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META-ANALYSIS

The Efficacy of Technology in Type 1 Diabetes: A Systematic Review, Network Meta-analysis, and Narrative Synthesis

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Abstract

Background: Existing technologies for type 1 diabetes have not been compared against the full range of alternative devices. Multiple metrics of glycemia and patient-reported outcomes for evaluating technologies also require consideration. We thus conducted a systematic review, network meta-analysis, and narrative synthesis to compare the relative efficacy of available technologies for the management of type 1 diabetes.
Methods: We searched MEDLINE, MEDLINE In-Process and other nonindexed citations, EMBASE, PubMed, All Evidence-Based Medicine Reviews, Web of Science, PsycINFO, CINAHL, and PROSPERO (inception—April 24, 2019). We included RCT ≥6 weeks duration comparing technologies for type 1 diabetes management among nonpregnant adults (>18 years of age). Data were extracted using a predefined tool. Primary outcomes were A1c (%), hypoglycemia rates, and quality of life (QoL). We estimated mean difference for A1c and nonsevere hypoglycemia, rate ratio for severe hypoglycemia, and standardized mean difference for QoL in network meta-analysis with random effects.
Results: We identified 16,772 publications, of which 52 eligible studies compared 12 diabetes management technologies comprising 3,975 participants in network meta-analysis. Integrated insulin pump and continuous glucose monitoring (CGM) systems with low-glucose suspend or hybrid closed-loop algorithms resulted in A1c levels 0.96% (predictive interval [95% PrI] 0.04–1.89) and 0.87% (95% PrI 0.12–1.63) lower than multiple daily injections with either flash glucose monitoring or capillary glucose testing, respectively. In addition, integrated systems had the best ranking for A1c reduction utilizing the surface under the cumulative ranking curve (SUCRA–96.4). While treatment effects were nonsignificant for many technology comparisons regarding severe hypoglycemia and QoL, simultaneous evaluation of outcomes in cluster analyses as well as narrative synthesis appeared to favor integrated insulin pump and continuous glucose monitors. Overall risk of bias was moderate–high. Certainty of evidence was very low.
Conclusions: Integrated insulin pump and CGM systems with low-glucose suspend or hybrid closed-loop capability appeared best for A1c reduction, composite ranking for A1c and severe hypoglycemia, and possibly QoL. Registration: PROSPERO, number CRD42017077221.

Keywords: Type 1 diabetes, Network meta-analysis, Insulin pumps, Continuous glucose monitoring, Flash glucose monitoring, Bolus advisors.

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Introduction

TYPE 1 DIABETES is an autoimmune condition primarily affecting pancreatic beta islet cells, leading to insulin deficiency and hyperglycemia.[1] The millions of people living with type 1 diabetes worldwide are dependent on insulin that must be titrated to food, physical activity, stress, and illness.[1,2] The potential consequences of suboptimal glycemic control are multisystemic, leading to substantial morbidity and markedly increased mortality.[1–3]

Technologies have been implemented since the 1970s in an effort to improve glycemic control and quality of life (QoL).[4,5] Furthermore, technologies for insulin delivery, glucose monitoring, and insulin advisors are increasingly being utilized by patients and carers.[6–9] The proposed benefits include finer control of insulin administration, the ability to provide more physiological rates of basal insulin, more accurate/appropriate insulin dose calculations, and the ability to make more frequent treatment adjustments. Integrated insulin pump and continuous glucose monitoring (CGM) systems with alarms, insulin delivery suspension for low-glucose levels, or hybrid closed-loop algorithms also aim to reduce the burden and complexity of optimally implementing these technologies through automating aspects of management. However, the efficacy of new technologies has not been compared with the full range of alternatives or even ranked against key outcomes. Furthermore, new technologies may be expensive and drive some patients and care providers to make choices based on cost or novelty rather than an integrated synthesis of high-quality evidence.[10–13]

Unlike standard meta-analyses and randomized controlled trials (RCTs), network meta-analyses utilize both direct and indirect evidence. The network approach facilitates comparison of devices within and between categories of insulin delivery, glucose monitoring, and insulin advisors or the comparison of devices when direct trial evidence is sparse.[14–16] Therefore, we aimed to systematically review the literature and perform network meta-analysis to inform clinical practice by comparing available technologies in the management of adults with type 1 diabetes. Narrative synthesis aimed to supplement results when data could not be part of network meta-analysis.

Methods

Data sources and searches

We searched Medline, Medline in-process and other non-indexed citations, EMBASE, PubMed, All Evidence-Based Medicine Reviews, Web of Science, PsycINFO, CINAHL, and PROSPERO (inception—April 24, 2019), limited to English language. Manual searches were also performed using the International Clinical Trials Registry Platform Search Portal (http://apps.who.int/trialsearch) and studies from the reference lists of review articles. We contacted study authors and technology companies for missing data where appropriate.

Study selection

We included RCTs of parallel and crossover study design that were ≥6 weeks duration overall (or each phase of a crossover study) and included nonpregnant community dwelling adults (≥18 years of age) with type 1 diabetes. We considered studies that compared technologies for insulin delivery, glucose monitoring, insulin dosing advice, or multiple daily injections (MDI) and self-monitoring of blood glucose (SMBG) via capillary testing. MDI was defined as three or more insulin bolus injections and at least one basal insulin injection per day. The combination of CGM and continuous subcutaneous insulin infusion (CSII) that facilitated low-glucose suspend, glucose threshold alarms, or any automated adjustment of insulin delivery was defined as an integrated system. Smart device applications for insulin dose calculation were merged with the freestanding bolus-calculator node for analysis of participants receiving MDI therapy. Unless otherwise reported by authors, it was assumed that bolus-calculator functionality was activated on insulin pumps with that capability. Implanted devices or systems that required telemedicine were the only excluded interventions. Studies that included adult and pediatric participants or a variety of diabetes types were also excluded unless stratified results were available. As at least one method for insulin delivery and glucose monitoring is required for managing type 1 diabetes, we considered 12 intervention pairs based on the results of our searches. The primary outcomes comprised efficacy for reducing A1c and hypoglycemia incidence. Severe hypoglycemia was defined as hypoglycemic events requiring third-party assistance,[17,18] whereas nonsevere hypoglycemia was defined by any study-reported hypoglycemic threshold <3.9 mmol/L (70 mg/dL). Where multiple thresholds were reported, we used the highest threshold <3.9 mmol/L (70 mg/dL). The presence of hypoglycemic symptoms was not required for our definitions because such information was often not available. The main secondary outcome was QoL determined by validated tools with published mean overall scores. Where multiple tools were reported, we chose the broadest assessment of QoL and tools where an overall score was reported. Other important secondary outcomes included time within, above, or below target (3.9–10.0 mmol/L, 70–180 mg/dL), frequency of diabetic ketoacidosis, as well as patient engagement with and acceptability of technology. The protocol for this network meta-analysis, including a complete list of outcomes, has been published (protocol link).[19]

Data extraction and quality assessment

Two investigators (A.P. and C.L.) independently selected articles, and two investigators (A.P. and V.K.) independently reviewed the main reports and supplementary materials, assessed the risk of bias, and extracted relevant summary estimates using a predefined tool. Any discrepancies were resolved by consensus or deferral to a third reviewer (S.Z.). Studies were excluded if mean (standard deviation [SD]) treatment effects were not published or there was inadequate information to calculate missing data.[20] We assessed risk of bias following the Cochrane Handbook for Systematic Reviews of Interventions and the quality of evidence for the network meta-analysis with the Grading of Recommendations Assessment, Development, and Evaluation (GRADE) framework.[21–23]

Data synthesis and analysis

We estimated the mean difference (SD) for A1c at the completion of relevant studies. Due to the small number of events, their skewed distribution, and studies of varying

length, we estimated the rate ratio of participants with at least one severe hypoglycemic episode per person-year. For nonsevere hypoglycemia, the number of participants experiencing at least one episode as well as the number of episodes they experienced was expected to follow a skewed distribution. Categorization of nonsevere hypoglycemia rates was not possible and therefore we utilized the mean (SD) number of episodes per patient/week, having assumed that rates followed a Poisson distribution. For QoL, we estimated the standardized mean difference (SMD) after correcting for the direction of tool scoring systems (i.e., higher scores indicating higher assessment of QoL) as outlined in the Cochrane Handbook for Systematic Reviews of Interventions.[24] In network meta-analysis, we utilized group-level data and followed a frequentist approach. The effect sizes were synthesized using a random-effects model. Interval plots were generated with confidence intervals (95% CI) as well as 95% predictive intervals (PrI) that estimate treatment effects of future studies incorporating direct and indirect evidence. Potential effect modifiers, including age, diabetes duration, and A1c, were considered to assure transitivity. To quantify inconsistency and heterogeneity, we considered the network τ^2 and I^2 (95% CI) as well as loop-specific inconsistency and side splitting.[25–29] If authors were not able to provide missing results in individual studies, we followed the Cochrane Handbook for Systematic Reviews of Interventions recommendation for calculation, and we cite the rate of severe hypoglycemia for one study from a previously published meta-analysis comparing CSII to MDI.[15,30] Due to the reporting of results for crossover studies, data were extracted as though they were parallel if carryover effect was absent. Where insufficient information was provided on period effect, carryover, or intraperson variation, we imputed the variance of effect size according to different correlation coefficients (0.1, 0.5, and 0.9).[15] We reported the results for our article with the conservative correlation coefficient of 0.5, and present other results in the Supplementary Appendix. We ranked the treatments for A1c, severe hypoglycemia, nonsevere hypoglycemia, and QoL with the surface under the cumulative ranking curve (SUCRA). We investigated the ranking for outcome-pairs with clustered ranking plots from SUCRA values for A1c and severe hypoglycemia as well as for A1c and QoL. If at least three studies for an outcome included participants using different modalities of insulin delivery for studies investigating glucose measurement technology, a second network was generated. Subgroup analyses could not be performed due to inconsistent reporting across some studies. We used comparison-adjusted funnel plots to determine how results of studies differed by their precision. Statistical analysis was performed in Stata (version 14.0) and R (version 3.4.4).

Results

We identified 16,772 publications, of which 153 potentially eligible publications were retrieved in full text (Fig. 1). Of these, 52 parallel or crossover RCTs met our inclusion criteria, involving 3,975 participants eligible for analysis. Respectively, there were 43, 40, 19, and 14 studies included in network meta-analysis for the outcomes of A1c, severe hypoglycemia, nonsevere hypoglycemia, and QoL. Characteristics of included studies were summarized in the Supplementary Appendix (p15–120). Incomplete trials were not included, and correspondence with authors did not yield additional data for analysis.

Overall, the mean sample size of included studies was 78 (±79), the mean duration of intervention was 8 (±7) months, and 78% received industry funding or material support. Europe was the study location for 30 (59%), 12 (24%) had study sites in the United States of America, 5 (10%) were based in Canada, 6 (12%) in the United Kingdom, and 1 (2%) in Australia. The mean age of participants was 40.2 (±6.2) years, mean baseline A1c was 8.4% (±0.8), and mean duration of diabetes was 19.5 (±9.7) years.

Figure 2 shows the network of eligible technology comparisons for the outcomes of A1c, hypoglycemia, and QoL. The Supplementary Appendix provides detailed results of both direct and indirect pairwise comparisons of diabetes management interventions in the network meta-analyses.

Figure 3 shows network meta-analysis results as interval plots. In terms of A1c (38 RCTs comprising the same within-study cointerventions and 3,330 randomized participants), only integrated systems comprising low-glucose suspend or hybrid closed-loop therapy were clearly superior to other diabetes management interventions. The mean difference of A1c values favored integrated systems when compared to MDI combined with either flash glucose monitoring (FGM) (0.96; 95% PrI 0.04–1.89) or SMBG (0.87; 95% PrI 0.12–1.63). Among integrated systems, sensitivity analyses found that hybrid closed-loop therapy was the primary driver for significant A1c reductions (data not shown). When considering the 95% CIs of the mean difference in A1c, integrated systems also had lower values than MDI with insulin advisors (0.69; 95% CI 0.10–1.29) and CSII with SMBG (0.67; 95% CI 0.09–1.25). CSII with standalone CGM systems appeared better than MDI combined with either insulin advisors (0.34; 95% CI 0.01–0.66), FGM (0.61; 95% CI 0.03–1.19), or SMBG (0.52; 95% CI 0.26–0.78). The combination of MDI with SMBG had higher A1c values than CSII with SMBG (0.20; 95% CI 0.03–0.38) and MDI with CGM (0.45; 95% CI 0.22–0.68). These differences were not significant for the 95% PrI.

Ranking technologies by A1c values favored integrated systems (SUCRA–96.4), CSII with standalone CGM (SUCRA–80.0), MDI with CGM (SUCRA–72.5), and CSII with bolus calculators (SUCRA–52.6) (Supplementary Appendix p129–130).

For the outcome of A1c, a second network consisted of 542 participants and 5 RCTs investigating glucose sensing technology, in which the insulin delivery modality was not the same for all participants within each study. No diabetes management intervention was clearly better than any other for the mean difference in A1c, although SMBG tended to perform slightly worse than CGM (0.19 95% CI −0.41 to 0.79), insulin advisors (0.21 95% CI −0.30 to 0.72), and FGM (0.01 95% CI −0.65 to 0.67) (Supplementary Appendix p137).

Regarding rate ratios for severe hypoglycemia (36 RCTs comprising the same within-study cointerventions, and 2,844 person years), CSII with SMBG was significantly better than MDI with bolus advisors (2.21 95% PrI 1.03–4.74) (Fig. 3). Rate ratios for severe hypoglycemia were otherwise nonsignificant and lead to similar ranking values for MDI with FGM or CGM (SUCRA—80.0 and 78.2, respectively), CSII with SMBG (SUCRA—67.4), as well as integrated CSII and

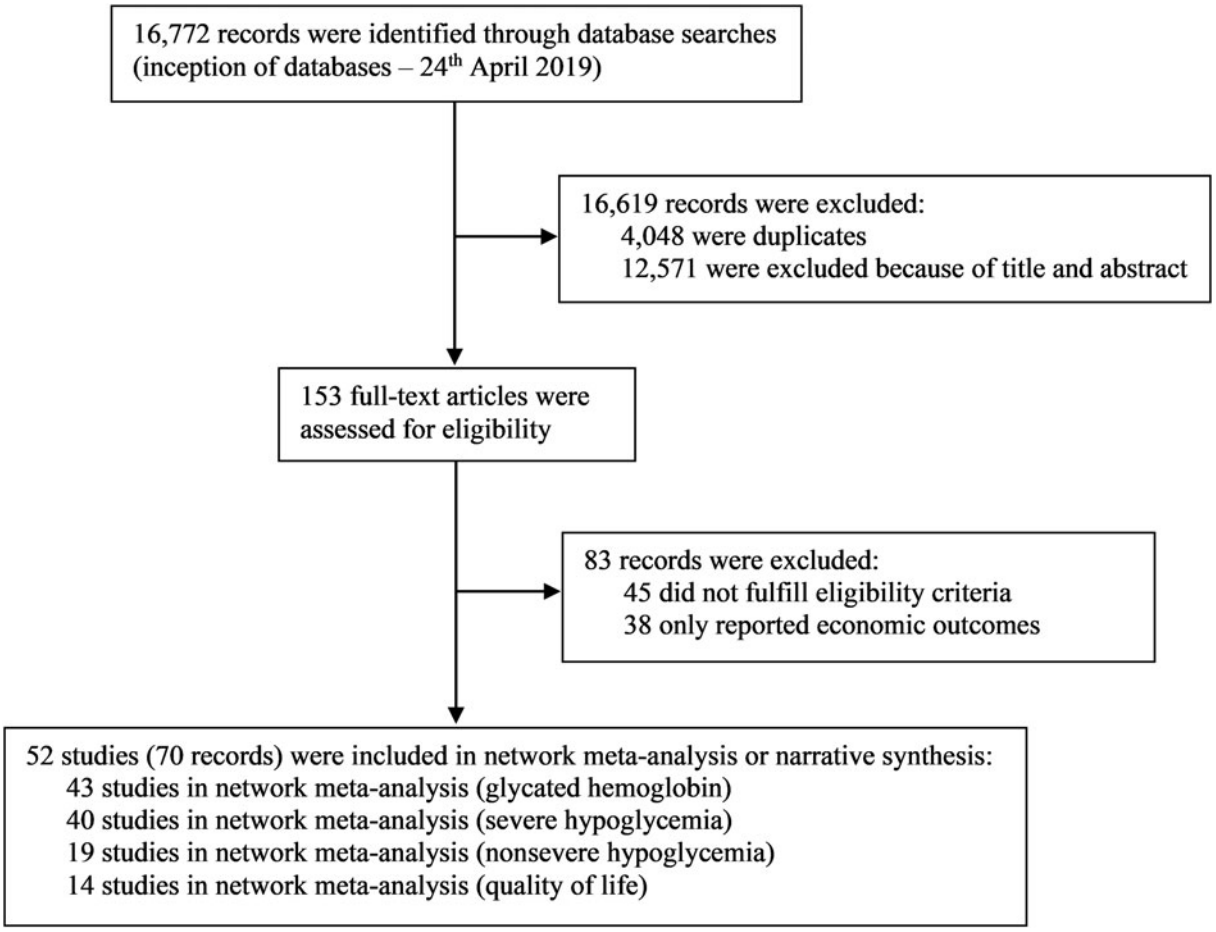


FIG. 1. Study selection.

CGM systems (SUCRA—53.7) (Supplementary Appendix p148–150). A second network for severe hypoglycemia comprised 263 person years and four RCTs investigating glucose sensing technology, in which the insulin delivery modality was not the same for all participants within each study. Effect size was not significantly different between treatments, however, ranking favored CGM (SUCRA—70.2) or FGM (SUCRA—68.5) over SMBG or bolus calculators regardless of insulin delivery modality (Supplementary Appendix p155–157).

In terms of the mean difference of nonsevere hypoglycemic events per patient/week (19 RCTs comprising 2,080 participants in Fig. 3), MDI with CGM event rates were 1.65 (95% PrI 0.24–3.06) and 1.18 (95% PrI 0.05–2.32) lower than CSII with insulin advisors or SMBG, respectively. When considering only the 95% CIs, MDI with CGM also had 1.14 (95% CI 0.32–1.97) and 0.96 (95% CI 0.30–1.63) fewer events than MDI with either insulin advisors or SMBG, respectively. These differences were not significant for the 95% PrI. Ranking technologies by nonsevere hypoglycemia rates alone favored MDI with CGM (SUCRA—94.6), MDI with FGM (SUCRA—67.6), and integrated systems comprising low-glucose suspend or hybrid closed-loop therapy (SUCRA—64.1) (Supplementary Appendix p165–167).

In terms of the SMD for QoL (14 RCTs comprising 1,499 participants), no intervention was clearly superior. When considering 95% CIs of the SMD for QoL, MDI with CGM appeared superior to MDI with SMBG (0.70; 95% CI 0.25–1.15). This difference was not significant for the 95% PrI. Ranking technologies by SMD for QoL favored MDI with CGM (SUCRA—88.9), MDI with FGM (SUCRA—66.3), CSII with insulin advisors (SUCRA—55.8), as well as CSII with standalone CGM (SUCRA—49.7) (Supplementary Appendix p175–177).

When simultaneously considering A1c and severe hypoglycemia, integrated systems comprising low-glucose suspend or hybrid closed-loop therapy, as well as MDI with CGM, appeared to provide the highest composite ranking in cluster analysis of SUCRA values (Supplementary Appendix p151). When simultaneously considering A1c and QoL, CGM with either CSII or MDI appeared to provide the highest composite ranking in cluster analysis of SUCRA values (Supplementary Appendix p178).

The distribution of potential effect modifiers, including age, diabetes duration, and A1c, satisfied the assumption of transitivity (Supplementary Appendix p181–183). The certainty of evidence for the treatment effects was very low (Supplementary Appendix p185–192). Network heterogeneity was considerable for the A1c network comprising the same within study cointerventions ($\tau^2 = 0.06$, I^2 [95% CI] = 86% [80–94]) as well as the A1c network comprising different within study cointerventions ($\tau^2 = 0.10$, I^2 [95%

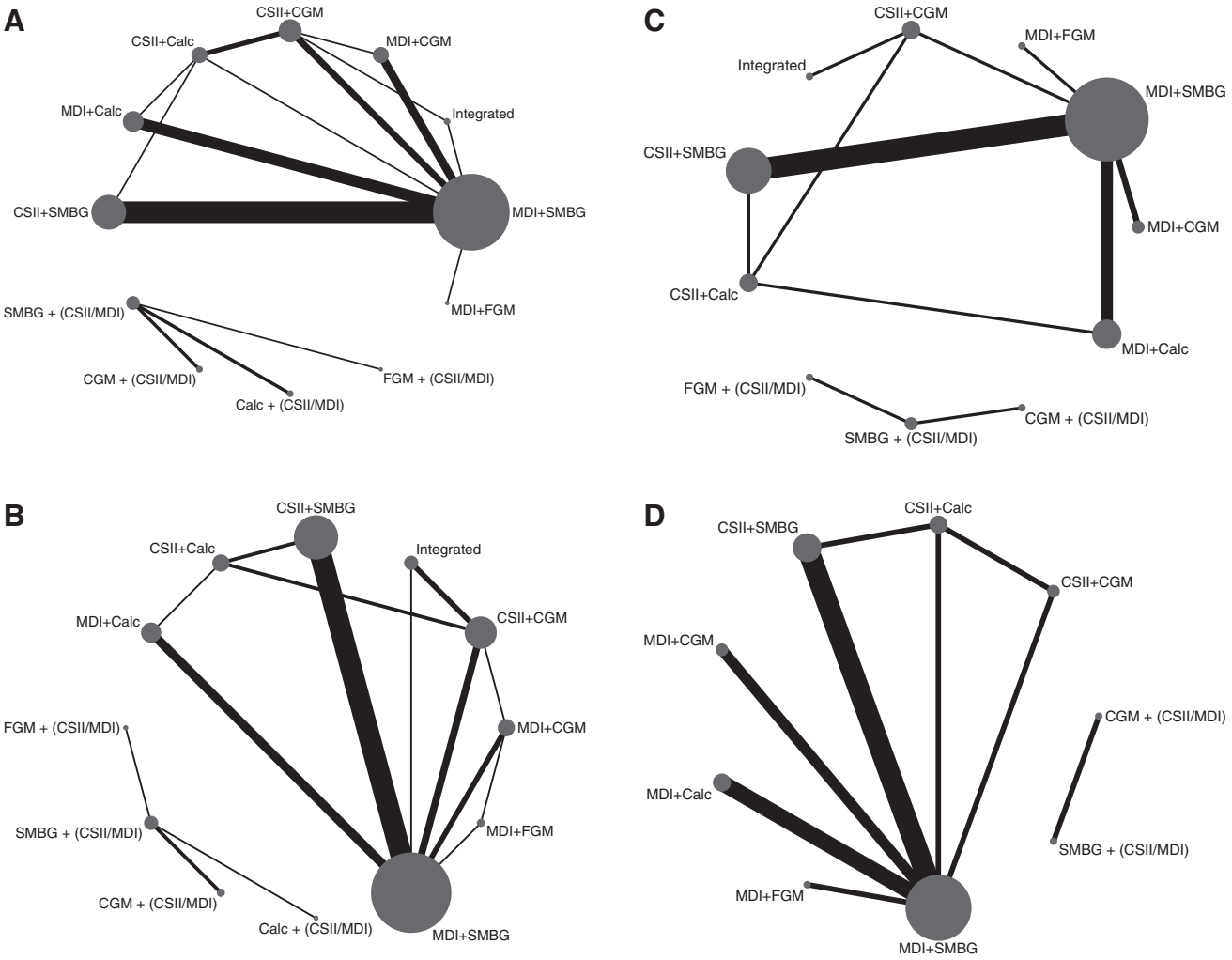


FIG. 2. Network map of direct diabetes management comparisons for the outcome of HbA1c **(A)**, severe hypoglycemia **(B)**, nonsevere hypoglycemia **(C)**, and quality of life **(D)**. The size of each circle and the width of each line is proportional to the number of participants randomized to each intervention and the number of trials comparing each pair of treatments, respectively. CGM, continuous glucose monitoring; CSII, continuous subcutaneous insulin infusion; FGM, flash glucose monitoring; MDI, multiple daily injections; SMBG, self-monitoring of blood glucose.

CI] = 83% [0–99]). Network heterogeneity was low for the severe hypoglycemia networks comprising the same within study cointerventions ($\tau^2 < 0.01$, I^2 [95% CI] = 0% [0–6]) and low to moderate for the network comprising different within study cointerventions ($\tau^2 < 0.01$, I^2 [95% CI] = 0% [0–63]). Network heterogeneity was considerable for nonsevere hypoglycemia ($\tau^2 = 0.14$, I^2 [95% CI] = 90% [74–97]), and moderate to substantial for QoL ($\tau^2 = 0.08$, I^2 [95% CI] = 54% [27–80]). Statistical consistency between direct and indirect evidence was present in all but one quadratic loop for nonsevere hypoglycemia comprising CSII with CGM, CSII with insulin advisors, MDI with SMBG, and MDI with insulin advisors ($p = 0.032$).

Narrative synthesis was performed for additional outcomes from studies over 6 weeks duration that could not be pooled for network meta-analysis, including time-in-range and patient engagement with technology (Supplementary Appendix p193–376). Time-in-range (3.9–10.0 mmol/L [70–180 mg/dL]) was inconsistently reported, but favored interventions that included CGM or FGM over respective controls.[31–37] The only study that directly compared CGM to FGM reported that participants using CGM spent significantly more time-in-range and less time in hypoglycemia.[38] Furthermore, integrated CSII and CGM systems with low-glucose suspend or hybrid closed-loop algorithms were superior for time-in-range when compared to CSII with freestanding CGM systems.[39,40] Patient health literacy, engagement with and utilization of technologies were reported inconsistently; however, some studies concluded that glycemic improvements were associated with participants utilizing CGM or integrated systems >40%–70% of the trial periods. Technical difficulties were broadly cited by participants as a reason not to use devices as often as suggested by trial protocols. Reasons for not engaging with health technologies were not routinely reported.

Discussion

This large systematic review and network meta-analysis was based on 52 RCTs, including 3,975 participants, randomly

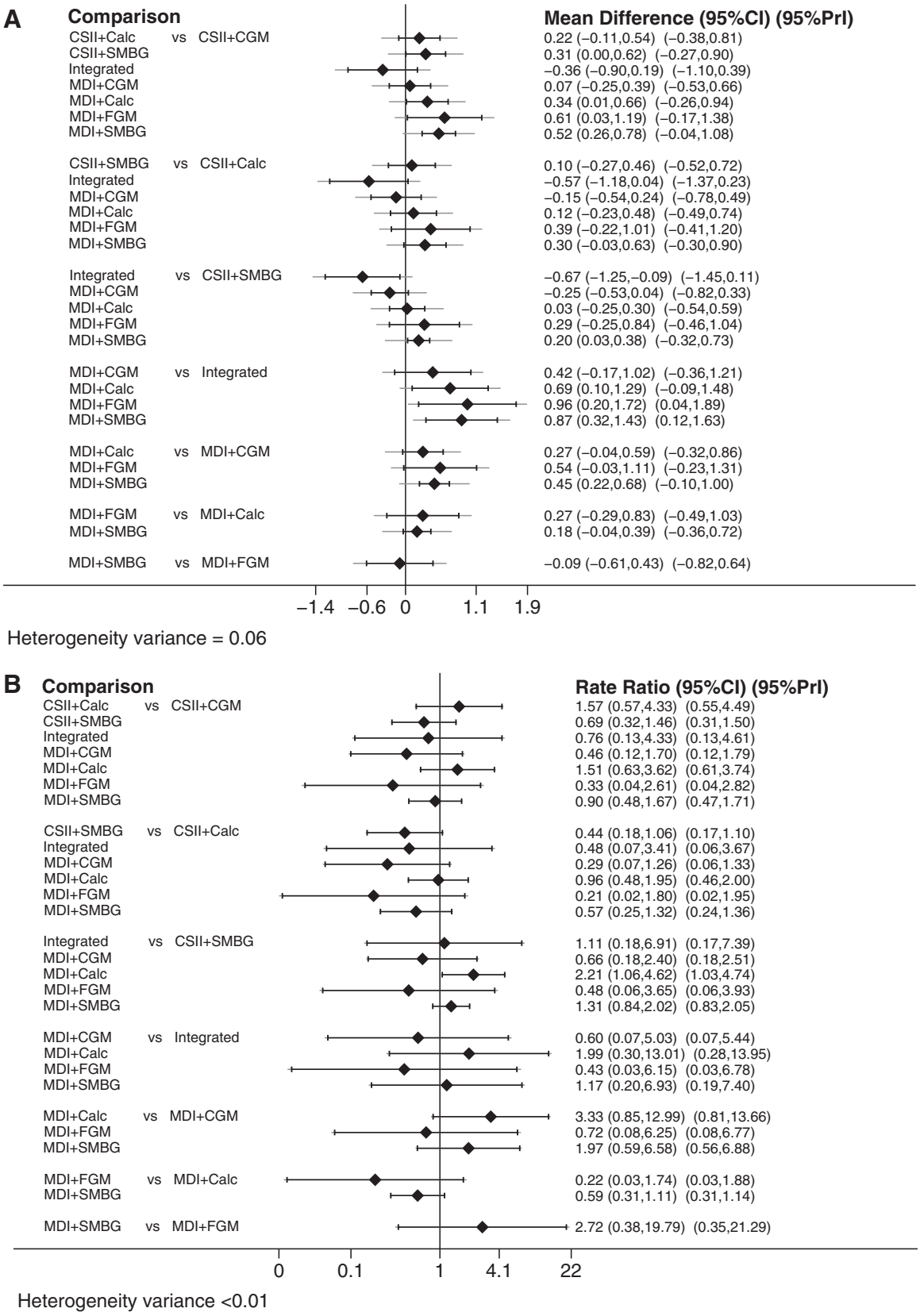
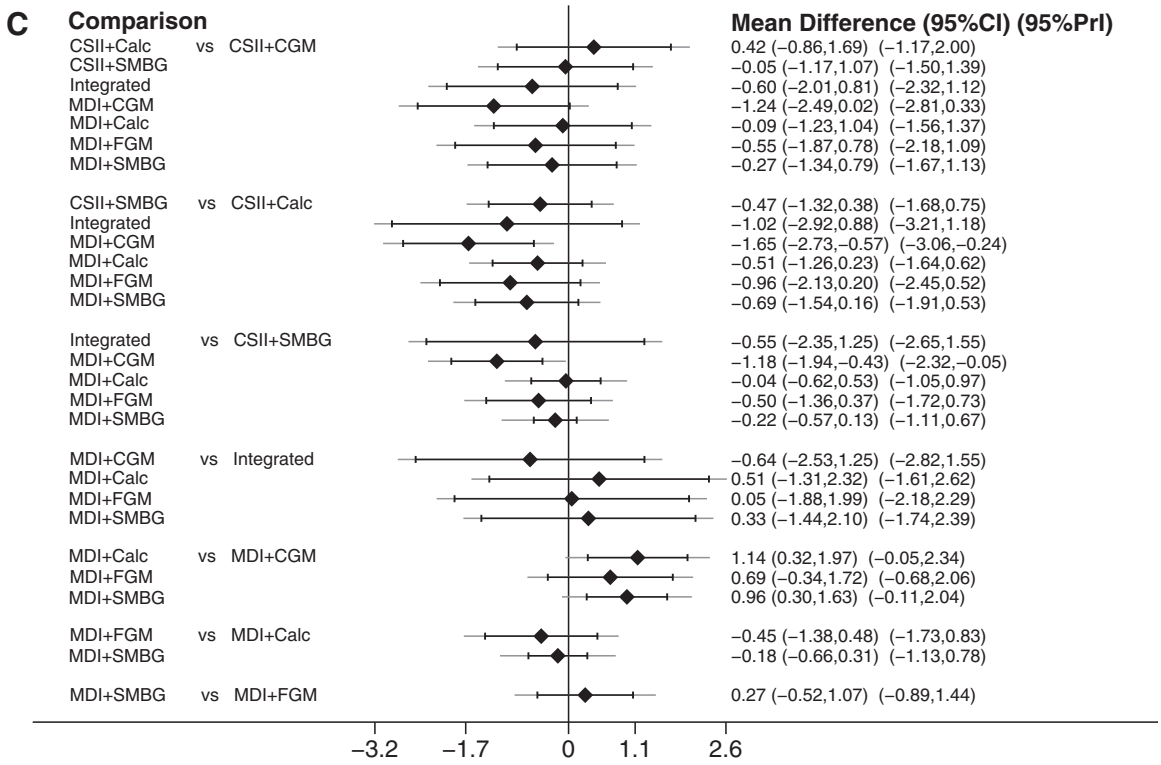


FIG. 3. Interval plot with 95% CIs and 95% PrIs for the HbA1c **(A)**, severe hypoglycemia **(B)**, nonsevere hypoglycemia **(C)**, and quality of life **(D)** networks comprising the same within-study cointerventions. CI, confidence interval; PrI, predictive interval.



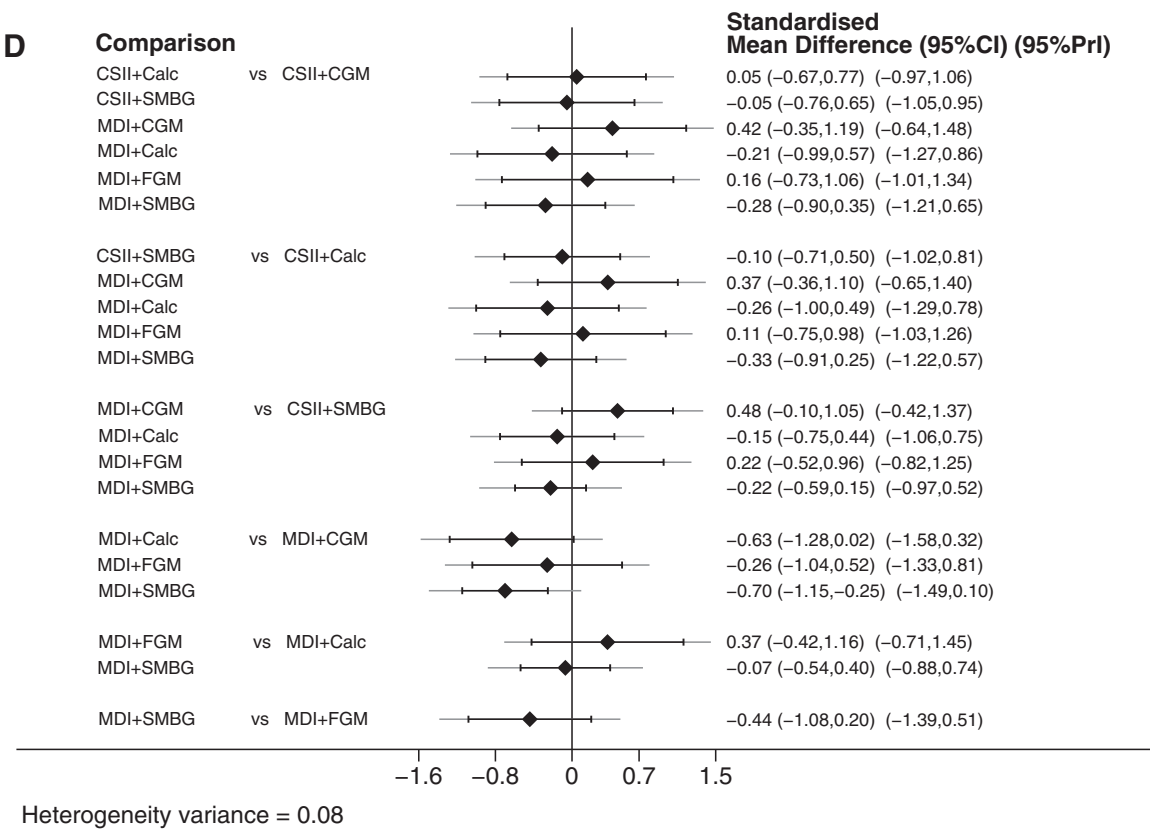


FIG. 3. (*Continued*).

assigned 12 diabetes management intervention-pairs. To our knowledge, this is the first network meta-analysis to integrate the comparison of technologies for insulin delivery, glucose monitoring, and insulin dose calculations in the management of type 1 diabetes. We performed detailed analysis for the key outcomes of A1c, severe hypoglycemia, nonsevere hypoglycemia, and QoL.

We found that integrated CSII and CGM systems comprising low-glucose suspend or hybrid closed loop algorithms appeared best for A1c reduction, composite ranking for A1c and severe hypoglycemia, and possibly QoL. Ranking of treatments for A1c favored integrated systems, CSII or MDI with standalone CGM systems, and CSII therapy with insulin advisors. Among integrated systems, additional sensitivity analyses suggested that hybrid closed-loop therapy was the primary driver for significant A1c reductions. This likely relates to low-glucose suspend systems not having the capability of hybrid closed-loop systems to increase insulin delivery in response to hyperglycemia. However, considering each outcome separately does not reflect clinical decisions where multiple factors must be integrated for optimal management. Exploratory cluster analysis of SUCRA data suggested that integrated systems as well as MDI with CGM may provide the best compromise of A1c reduction and severe hypoglycemia prevention. Additional cluster analysis suggested CSII with standalone CGM or MDI with CGM may provide the best compromise of A1c reduction and QoL. Integrated CSII and CGM systems comprising low-glucose suspend or hybrid closed-loop algorithms were not included in cluster analysis for A1c and QoL due to insufficient reported evidence for QoL. However, we suspect that integrated systems would rank higher than standalone CSII and CGM systems for QoL due to improved glycemic outcomes, more time-in-range, and reduced burden of management decisions for patients.[39–41]

Our study was unique in the breadth of interventions considered as well as the inclusion of indirect and direct evidence. Previous standard meta-analyses have typically favored CSII over MDI therapy,[42–48] as well as CGM over SMBG for A1c reduction and prevention of hypoglycemia.[49–52] Such comparisons are critical, but considering only two technologies does not reflect the range of alternatives that patients and clinicians have to choose from, or the statistical and clinical impact of cointerventions. The only other network meta-analysis for diabetes management technologies compared CSII and CGM systems with four other technologies and suggested that the MiniMed® Paradigm Veo™ reduced hypoglycemia more than other technologies without significant differences in A1c reduction or other outcomes.[53] However, their results may not be directly comparable to ours because they excluded crossover studies, considered fewer technologies, and combined studies with adult and pediatric populations.[53]

An important clinical application of our network meta-analyses and narrative synthesis may be illustrated by an approach to device selection. For patients using MDI and SMBG, integrated CSII and CGM with low-glucose suspend or hybrid closed-loop algorithms may be the best overall option for the majority of outcomes, with evidence strongest for A1c improvement. If only one technology is desired or practical, then CGM appears most favorable from composite ranking of A1c, hypoglycemia, and QoL. While nonsignificant differences were noted for other treatment comparisons, this may reflect limitations in the evidence base or that access to devices per se is only one part of holistic diabetes management. Indeed, glycemic improvements are correlated with increasing time spent using devices. Therefore, appropriate selection of technologies requires consideration of patient engagement and understanding of device use for optimal implementation. Our finding that integrated CSII and CGM systems with some form of automation appeared to perform better than alternatives that carry a greater burden of self-management suggests that this may be the case.

Our review also has some limitations. According to the GRADE framework, the certainty of the comparisons was very low. This was partly due to the nature of trials comparing diabetes management technologies. Every study was considered at high risk of performance bias due to the impracticality of blinding participants and trial clinicians to the devices being compared. Consequently, outcomes with a subjective component such as QoL and patient report of hypoglycemia were also deemed to carry a high or unclear risk of detection bias. In the absence of patient level data, network meta-regression was also not possible. While the potential effect modifiers of age, diabetes duration, and A1c appeared similar for included studies, important aspects such as patient preference for technology types and implementation strategies could not be assessed. This also led to the default downgrading of evidence certainty. Ranking of treatments and cluster analysis should therefore be interpreted cautiously. The exclusion of studies comprising children and adolescents from our review also limits generalizability. This important demographic could not be pooled with studies of adults since potential differences in body size, insulin sensitivity, developmental stages,[54] as well as differences in who managed the technology could undermine the central statistical assumption of transitivity. Furthermore, definitions of nonsevere hypoglycemia were inconsistent and severe hypoglycemia was variably reported as a safety outcome rather than trials being of adequate duration or power to detect significant differences. This may contribute to the wide confidence/PrIs and mostly nonsignificant rate ratios for severe hypoglycemia. There is also no consensus on the most accurate or representative tool to assess QoL despite the vital impact this has on the patient experience as well as economic modeling. The use of SMD for only validated tools controlled for this limitation in our analysis. We were also unable to meta-analyze time-in-range due to inconsistent reporting, skewed data, and many studies over 6 weeks duration not reporting this outcome. Finally, crossover studies often did not report results for each phase, did not report the correlation coefficient, or did not adequately report on the carryover effect. However, the consistency of results from our imputed correlation analysis suggested that this did not significantly impact our results.

Conclusions

Integrated systems comprising low-glucose suspend or hybrid closed-loop algorithms appeared best for A1c reduction, composite ranking for A1c and severe hypoglycemia, and possibly QoL, while interstitial glucose sensors ranked highly for preventing hypoglycemia or improving QoL independent of other outcomes.

Our network meta-analysis provides the most comprehensive and contemporary available evidence to guide choices between diabetes management technologies despite the limitations of the evidence base. While it may not be feasible for every technology to be directly compared to every available system, we believe that uniformity of reporting outcomes, including hypoglycemia and QoL, would greatly assist in making direct and indirect treatment comparisons. Furthermore, the rapid pace of technology development means that reviews struggle to remain current. Indeed, stratifying results by dates of publication was unable to resolve potential changes in technology efficacy over time due to the complexity of weighting for indirect treatment comparisons. We therefore advocate for more contemporary studies comparing available technologies to further define the efficacy of currently available technologies and the adoption of living systematic reviews to assist with timely incorporation of evidence into clinical practice guidelines. It is also important to recognize technology as one aspect of holistic and multifaceted care and that patient engagement with technology may be just as important as the choice between devices.

Authors' Contributions

A.P. and S.Z. conceived the study. A.P., A.E., D.L., and S.Z. designed the study. A.P. and C.L. selected the articles. A.P. and V.K. appraised articles and extracted data for the clinical review. A.P. analyzed the data under the supervision of A.E. and S.Z. A.P. wrote the first draft of the article. A.P., A.E., C.L., D.L., S.Z., and V.K. interpreted the data and contributed to the writing of the final version of the article. All authors agreed with the results and conclusions of this article. S.Z. is the guarantor and affirms that the article is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned have been explained.

Author Disclosure Statement

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Supplementary Material

Supplementary Appendix

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