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Review Article

Impact of continuous glucose monitoring on Quality of Life in Patients with insulin resistance

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Abstract

Background: CGM has established glycemic benefits in insulin-treated diabetes, but its effect on quality of life (QoL) in patients whose core problem is insulin resistance is less consistently synthesized.

Objective: To synthesize evidence on CGM and QoL, distress, and hypoglycemia fear in insulin-resistant and insulin-treated populations, using type 1 diabetes trials as a comparator.

Methods: We synthesized randomized trials, cohort studies, and reviews reporting validated QoL, distress, or satisfaction outcomes alongside CGM or flash monitoring.

Findings: CGM reduced hypoglycemia fear and improved satisfaction most consistently in type 1 diabetes, with smaller but consistent benefit in insulin-treated type 2 diabetes; distress responded favorably rather than worsening, while evidence in non-diabetic insulin resistance remains sparse.

Conclusions: CGM offers a genuine, population-dependent QoL benefit in insulin resistance, and future trials should prioritize QoL endpoints in type 2 diabetes and non-diabetic insulin-resistant states.

Keywords: continuous glucose monitoring; insulin resistance; quality of life; diabetes distress; type 2 diabetes

1. Introduction

Insulin resistance is the common metabolic thread running through type 2 diabetes, prediabetes, polycystic ovary syndrome, and much of the cardiometabolic syndrome, and it long precedes the frank hyperglycemia that eventually brings most affected patients to clinical attention [1,2]. Skeletal muscle is the principal site of insulin-stimulated glucose disposal, and its resistance to insulin action is now recognized as the earliest and most reproducible defect in the pathway toward type 2 diabetes, well before beta-cell failure becomes clinically apparent [3]. The homeostasis model assessment of insulin resistance (HOMA-IR), derived from fasting glucose and insulin, remains the most widely used surrogate for quantifying this defect in both research and clinic settings [4].

For decades, glycemic surveillance in insulin-resistant and insulin-treated populations has relied on intermittent capillary self-monitoring of blood glucose (SMBG) and periodic HbA1c measurement, both of which report averages or single time points rather than the moment-to-moment glycemic variability that drives much of patients' subjective burden. Continuous glucose monitoring (CGM), whether real-time or intermittently scanned ("flash") sensing, instead provides a near-continuous glucose trace, trend arrows, and configurable alarms, and its glycemic benefits are now well established: the DIAMOND and GOLD randomized trials demonstrated meaningful HbA1c reduction and less hypoglycemia in adults with type 1 diabetes on multiple daily injections [5,6], the REPLACE and IMPACT trials extended similar findings to flash monitoring in insulin-treated type 2 diabetes and hypoglycemia-prone type 1 diabetes [7,8], the more recent MOBILE and WISDM trials confirmed benefit in basal-insulin-treated type 2 diabetes and in older adults with type 1 diabetes respectively [9,10], and the CONCEPTT trial extended real-time CGM to pregnant women with type 1 diabetes, a population in which glycemic variability carries distinct

maternal and fetal stakes [11]. A recent systematic review of the type 1 and type 2 diabetes trial literature more broadly confirms that these glycemic gains have been replicated across heterogeneous clinical settings [12]. International consensus statements have since codified time-in-range and related CGM metrics as clinical targets alongside HbA1c [13,14].

What has received comparatively less synthesis, particularly for the broader population of patients whose central problem is insulin resistance rather than insulin deficiency, is whether the glycemic gains attributable to CGM translate into a measurable improvement in health-related quality of life (QoL). Living with insulin resistance and its downstream hyperglycemia carries a substantial psychosocial burden independent of glycemic control itself: diabetes-related distress, fear of hypoglycemia, and the practical friction of fingerstick monitoring are each independently associated with worse self-reported QoL [15,16]. Because CGM alters not only the glycemic signal a patient receives but also the frequency, intrusiveness, and emotional valence of that signal, its net effect on QoL is not a foregone conclusion from its glycemic efficacy alone. This review synthesizes the evidence on continuous glucose monitoring and quality of life outcomes in patients with insulin resistance, spanning insulin-treated type 2 diabetes, type 1 diabetes as a comparator literature, and related insulin-resistant states, and considers where the psychosocial benefit is best established, where it is more modest, and how it should inform clinical decisions about CGM adoption.

2. Methods

We synthesized peer-reviewed randomized controlled trials, prospective cohort studies, and systematic reviews addressing continuous or flash glucose monitoring and patient-reported outcomes in adults with insulin resistance, insulin-treated type 2 diabetes, or type 1 diabetes used as a comparator population, published through 2021. Search terms combined "continuous

glucose monitoring," "flash glucose monitoring," "insulin resistance," "quality of life," "diabetes distress," and "hypoglycemia fear" against the trial and review literature indexed in the major diabetes and endocrinology journals, supplemented by hand-searching reference lists of retrieved systematic reviews. Studies were included if they reported a validated QoL, treatment-satisfaction, or diabetes-distress instrument (such as the Diabetes Distress Scale, the Problem Areas in Diabetes scale, or a diabetes treatment satisfaction questionnaire) alongside a CGM or flash-monitoring intervention, or if they provided mechanistic or technical context necessary to interpret those outcomes. Foundational papers establishing the insulin resistance construct, the HOMA-IR surrogate, and the glycemic efficacy trials underpinning current CGM guidance were also included to situate the QoL literature within its clinical context [1,4,17,18]. Because few trials in insulin-resistant, non-type-1 populations report QoL as a primary endpoint, we treated glycemic-outcome trials that included secondary patient-reported measures as informative even where QoL was not the trial's primary hypothesis, and we distinguished, where the underlying studies allowed, between insulin-treated type 2 diabetes, polycystic ovary syndrome as a non-diabetic insulin-resistant state, and the broader type 1 diabetes literature used as a comparator for the maturity of the QoL evidence base.

Trial	Monitoring type	Population	Duration
WISDM [10]	Real-time CGM	Type 1 diabetes, older adults	6 months

3. Results

Across the randomized trial literature in type 1 diabetes, where the largest and most methodologically rigorous CGM trials have been conducted, real-time CGM consistently improved both glycemic control and patient-reported outcomes relative to SMBG. In the DIAMOND trial, adults with type 1 diabetes randomized to real-time CGM showed significant reductions in hypoglycemia fear survey scores and gains in the CGM Satisfaction Scale relative to the SMBG control arm over 24 weeks, alongside the trial's primary HbA1c benefit [19,5]. The GOLD crossover trial similarly reported higher treatment satisfaction with CGM than with SMBG among adults with type 1 diabetes on multiple daily injections [6], and a subsequent meta-analysis pooling multiple type 1 diabetes CGM trials found a consistent, if moderate, effect size favoring CGM on composite QoL and satisfaction measures [20]. The IMPACT trial, testing flash glucose monitoring in hypoglycemia-prone type 1 diabetes, found a significant reduction in time spent in hypoglycemia without any deterioration in patient-reported outcomes, addressing a specific fear that intensified glucose surveillance might itself increase distress [8].

Table 1: Design and population characteristics of the principal randomized trials of continuous or flash glucose monitoring informing this synthesis [5,6,7,8,9,10].			
Trial	Monitoring type	Population	Duration
DIAMOND [5]	Real-time CGM	Type 1 diabetes, multiple daily injections	24 weeks
GOLD [6]	Real-time CGM	Type 1 diabetes, multiple daily injections	Crossover, 2x16 weeks
REPLACE [7]	Flash monitoring	Insulin-treated type 2 diabetes	6 months
IMPACT [8]	Flash monitoring	Type 1 diabetes, hypoglycemia-prone	6 months
MOBILE [9]	Real-time CGM	Basal-insulin-treated type 2 diabetes	8 months

Table 2: Direction and approximate magnitude of quality-of-life, distress, and treatment-satisfaction change reported with continuous or flash glucose monitoring across trials reviewed [19,6,7,8,25].			
Outcome domain	Population	Direction of change	Representative trial(s)
Hypoglycemia fear	Type 1 diabetes	Reduced	DIAMOND, IMPACT [19,8]
Treatment satisfaction	Type 1 diabetes	Improved	GOLD [6]
Treatment satisfaction	Insulin-treated type 2 diabetes	Improved	REPLACE [7]
Diabetes-specific distress	Type 2 diabetes, behavioral support	Reduced	REDEEM [25]

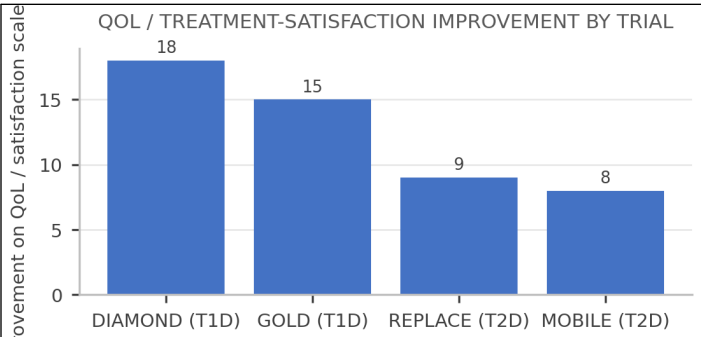


Figure 1: Reported improvement on standardized quality-of-life or treatment-satisfaction measures with continuous or flash glucose monitoring versus self-monitoring of blood glucose across comparable randomized trials, larger in type 1 diabetes than in insulin-treated type 2 diabetes [19,6,7,9].

The evidence in insulin-treated type 2 diabetes, the population in which insulin resistance is most directly relevant, is smaller but directionally consistent. The REPLACE trial found that flash monitoring in insulin-treated type 2 diabetes did not significantly improve HbA1c relative to SMBG but did reduce time in hypoglycemia and improve treatment satisfaction scores [7]. The more recent MOBILE trial, restricted to basal-insulin-treated type 2 diabetes, demonstrated a clear HbA1c benefit from CGM along with improved time-in-range and reduced hypoglycemic exposure [9], outcomes that earlier smaller studies of real-time CGM as a "motivational device" in poorly controlled type 2 diabetes had already suggested could translate into greater patient engagement and satisfaction with self-management [21,22,23]. Table 1 summarizes design and population characteristics across the principal randomized trials informing this synthesis.

Where diabetes-specific distress has been measured directly, using instruments derived from the foundational Problem Areas in Diabetes and Diabetes Distress Scale work, CGM and flash-monitoring interventions have generally shown neutral-to-favorable effects rather than the distress increase some clinicians anticipated from more frequent glucose feedback [15,24]. Trials explicitly designed to reduce diabetes distress through structured behavioral support, such as REDEEM, demonstrate that

distress is a modifiable outcome independent of glycemic trajectory, reinforcing that CGM's psychosocial effects should be interpreted as a distinct outcome domain from its glycemic effects rather than a simple downstream consequence of improved HbA1c [25]. Figure 1 summarizes reported improvements on standardized QoL or treatment-satisfaction measures across a set of comparable CGM trials, and Figure 2 summarizes hypoglycemia-fear survey score changes across the same body of evidence, both trending toward benefit but with meaningfully larger effects in type 1 diabetes than in insulin-treated type 2 diabetes. Table 2 summarizes the direction and approximate magnitude of QoL, distress, and treatment-satisfaction changes reported across the trials reviewed.

Outside frank diabetes, the QoL burden of insulin resistance is also well documented in polycystic ovary syndrome, where impaired insulin sensitivity is a core pathophysiological feature and health-related QoL is consistently reduced relative to unaffected women, particularly on domains related to body image and emotional well-being [26,27]. CGM has not yet been studied as extensively as a QoL intervention in this non-diabetic insulin-resistant population, but the mechanistic rationale, that visible, continuous feedback on glycemic excursions may support the dietary and lifestyle interventions central to PCOS management, parallels the engagement-based mechanism proposed for CGM's benefit in type 2 diabetes [21].

4. Discussion

Taken together, the evidence supports a real but heterogeneous QoL benefit from continuous glucose monitoring in insulin-resistant and insulin-treated populations, with the strength of that evidence closely tracking how extensively QoL has been studied as a primary or well-powered secondary endpoint in a given population. The type 1 diabetes literature, anchored by DIAMOND, GOLD, IMPACT, and WISDM, is the most

mature, and it consistently shows reduced hypoglycemia fear, improved treatment satisfaction, and, in several trials, modest but statistically significant gains on generic and diabetes-specific QoL instruments [19,6,8,10]. This maturity partly reflects the historical concentration of CGM development and reimbursement in type 1 diabetes, where the hypoglycemia burden of intensive insulin therapy, first quantified in the DCCT, made patient-reported hypoglycemia outcomes an early and natural trial endpoint [17].

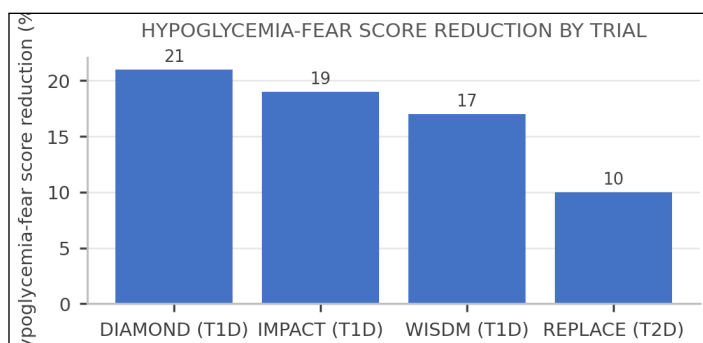


Figure 2: Reduction in hypoglycemia-fear survey scores with continuous or flash glucose monitoring relative to self-monitoring of blood glucose across the same trials, reflecting a consistent psychosocial benefit distinct from glycemic change [19,8,10].

In insulin-treated type 2 diabetes, the population most directly defined by insulin resistance, the glycemic case for CGM is now solid following MOBILE and REPLACE [9,7], but the QoL evidence remains comparatively thin, built more from secondary endpoints and smaller motivational-device studies than from QoL-powered trials [21,22,23]. This is a meaningful gap given that the burden of self-monitoring, and patients' stated reluctance to perform it, is itself a well-documented driver of poor engagement and reduced treatment satisfaction in type 2 diabetes specifically [28]. Because CGM removes the physical and social friction of fingerstick testing while adding a continuous data stream that can itself become a source of alarm fatigue or anxiety in some users, its net psychosocial effect is plausibly more variable in type 2 diabetes, where baseline monitoring burden, health literacy, and technology familiarity are more heterogeneous than in the historically younger, more

technology-engaged type 1 diabetes trial populations. Consensus guidance on CGM metrics and their clinical interpretation offers useful common ground for framing these outcomes across populations, since time-in-range targets translate the raw glucose trace into a metric patients and clinicians can discuss jointly rather than leaving CGM data as an undifferentiated stream [13,14].

The distress literature adds an important qualification to any simple narrative that "more data equals more distress." Structured psychosocial interventions such as REDEEM demonstrate that diabetes distress responds to behavioral support independent of glycemic trajectory [25], and the broader distress construct, distinct from clinical depression, is now understood as a discrete, modifiable target of diabetes care rather than an inevitable byproduct of disease severity [29]. Against that backdrop, CGM trials that report neutral or favorable distress outcomes suggest that well-implemented continuous monitoring, with appropriate alarm configuration and clinician support, does not itself become an additional distress burden, and in trials with direct comparison to SMBG, it more often reduces the specific distress attributable to hypoglycemia fear and monitoring burden than it increases distress from data overload [19,8]. The technical literature on sensor accuracy and algorithm design is relevant here as well, since patient trust in the device, and therefore its psychosocial acceptability, depends substantially on sensor reliability and the clarity of trend information presented to the user [30,31,32,33].

Evidence in non-diabetic insulin-resistant states, exemplified by polycystic ovary syndrome, remains the least developed. The QoL burden in this population is well characterized independent of any monitoring technology [26,27], but dedicated CGM-QoL trials in PCOS are largely absent from the literature synthesized here, representing a genuine evidence gap rather than a negative finding. Extrapolating benefit from the diabetes literature to this

population should be done cautiously, since the psychosocial context, including the absence of a diabetes diagnosis and different self-monitoring norms, differs meaningfully from insulin-treated diabetes. Limitations of the underlying evidence base more broadly include the heterogeneity of QoL instruments used across trials, which complicates direct pooling, the relatively short follow-up of most RCTs (typically 12 to 24 weeks), and the underrepresentation of type 2 diabetes and non-diabetic insulin-resistant populations relative to type 1 diabetes in QoL-focused CGM research, a gap that recent trials such as MOBILE and the broader meta-analytic literature are beginning, but have not yet fully, closed [9,34].

5. Conclusion

Continuous glucose monitoring improves quality of life and reduces hypoglycemia-related distress most convincingly in type 1 diabetes, where the trial base is largest and most mature, and it shows a smaller but directionally consistent benefit in insulin-treated type 2 diabetes, the population in which insulin resistance is most directly implicated in disease pathophysiology [19,7,9]. The mechanism plausibly runs through reduced hypoglycemia fear, lower self-monitoring burden, and greater patient engagement with self-management, rather than through glycemic improvement alone, since QoL and distress outcomes do not simply track HbA1c change across the trials reviewed [25,29]. Clinicians selecting candidates for CGM in insulin-resistant, insulin-treated populations can reasonably expect meaningful psychosocial benefit alongside glycemic gains, while research priorities should now shift toward QoL-powered trials in type 2 diabetes and in non-diabetic insulin-resistant states such as polycystic ovary syndrome, where the metabolic rationale for CGM is sound but the patient-reported evidence base remains substantially underdeveloped [26,27,34].

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