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A Qualitative Evidence Synthesis of Continuous Subcutaneous Insulin Infusion: Acceptability, Implementation, Equity

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ABSTRACT

This work provides a synthesis of the perceptions of people with type 1 diabetes mellitus (T1DM) and healthcare professionals about the acceptability, implementation, and equity of continuous subcutaneous insulin infusion (CSII). A qualitative evidence synthesis was carried out. Three online databases (Medline, Embase, and Web of Science) were searched. Qualitative articles which were available in Spanish or English were included. A descriptive thematic synthesis was conducted according to PRISMA and ENTREQ guidelines. Thirty-two references met the inclusion criteria of the study and were included out of an initial 345 identified references. Seven main themes were identified: (a) acceptability, (b) adaptation to the insulin pump, (c) facilitators for the adequate use of insulin pump, (d) variability of acceptability, (e) barriers for the use of insulin pump, (f) feasibility and implementation considerations, and (g) equity. CSII is well accepted by most people with T1DM, with some exceptions. CSII can relieve management burden, increase autonomy and flexibility and improve family relationships. There were multiple perceived barriers to its continued use. Future studies should continue to analyze inequalities in access and use of the CSII.

1 | Introduction

Type 1 diabetes mellitus (T1DM), or insulin-dependent, is a complex metabolic disorder characterized by an increase in blood glucose levels due to a deficiency in the production, a dysfunction of insulin, or the destruction of the beta cells of the pancreas, which can occur at any age, although it is more frequent in young people and children (American Diabetes Association 2022; Mobasseri et al. 2020). T1DM accounts for between 5% and 10% of diabetes cases in the world, with an incidence of 15 cases per 100 000 people. Among its most frequent symptoms are increased thirst, polyphagia, vision disorders, polyuria, and weight loss (Mobasseri et al. 2020).

Primary treatment of T1DM is based on the administration of insulin, which can be performed with needles (multiple daily insulin injections (MDII)) or an insulin pump (continuous subcutaneous insulin infusion (CSII)). Advances in technology seek to improve insulin delivery and ease diabetes management. CSII is the most technologically advanced mode of insulin delivery (Reidy et al. 2018). At present, continuous glucose monitoring systems provide patients, carers, and professionals

Summary

- Though several studies and reviews have addressed the experiences and perceptions of people using insulin pumps, there is no synthesis focusing on the acceptability, implementation, and equity of insulin pump use.
- Despite its general acceptability, perceived barriers to its continued use were related to wearability issues, lack of consideration of users' circumstances, preferences, and values, especially during the fitting process; lack of access to trained HCPs; and high cost.
- It is critical for policy-makers, healthcare professionals, and industry to understand the key factors influencing uptake of the devices and the key aspects for better implementation for the success of insulin pump therapy.

with real-time information on glucose values and trends (Phillip et al. 2012).

The use of insulin pumps alone or integrated into a system with continuous glucose monitoring systems improves the quality of life and metabolic goals in people with T1DM. Noteworthy benefits of CSII include improvements in glycosylated hemoglobin values (HbA1c), the time in range or the decrease in overall glycemic oscillations and therefore in hypoglycemic events and severe hypoglycemia (Pease et al. 2020; Pintaudi et al. 2022; Grose, O'Brien, and Castle 2017). In addition, it has been shown that glycemic control is better when the infusion is controlled by an algorithm based on the values of continuous monitoring through a sensor (Biester et al. 2022).

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The impact of insulin pumps on improving family dynamics (functioning, cohesion, and psychosocial aspects) is also known (Hirose and Beverly 2012), improving flexibility in daily life, independence, and freedom in meals (Barnard and Skinner 2007).

MDII is the main mode of insulin administration worldwide (Reidy et al. 2018), and the percentage of people using insulin pumps either alone or in combination with continuous glucose monitoring sensors administration is still low. Moreover, access to CSII varies between and within countries (Reidy et al. 2018; Renard 2010).

The effectiveness and safety with the use of CSII systems in people with T1DM have been supported in clinical trials (Haidar et al. 2015) and meta-analyses (Misso et al. 2020; Pickup 2008). In addition, one study describes the influence of psychosocial factors on adherence to the insulin pump, such as realistic expectations of pump use, active participation in self-care or emotional recall of diabetes diagnosis (Ritholz et al. 2007). Moreover, an iterative review analyzes the psychosocial impact of insulin pumps on people with T1DM showing that this technology affects diabetes self-management, self-identity or the disease's emotional burden (Grose, O'Brien, and Castle 2017), but little is known about the perceptions of patients and health care providers (HCP) regarding the use of these systems for the administration of insulin or about the psychosocial aspects that influence the success of this therapy despite the importance of knowing users' attitudes and expectations to predict the adoption of health-related technologies (Venkatesh 2000). Furthermore, to the best of the authors' knowledge, no study has synthesized the available qualitative evidence on the perceptions of people with T1DM about the acceptability, implementation, and equity of the use of insulin pumps. Information that the authors believe is key for HCPs and policy-makers to develop and implement evidence-based guidelines for the success of insulin pump therapy.

Therefore, this qualitative evidence synthesis (QES) review was conducted to understand and synthesize the perceptions of people with T1DM and HCPs about the acceptability, implementation, and equity of insulin pumps. The review answered the following research questions:

Are insulin pumps acceptable to people with T1DM and their HCP?

What considerations need to be taken into account when implementing care with insulin pumps for people with T1DM?

How the use of insulin pumps by people with T1DM can impact equity?

2 | Methods

A descriptive QES was conducted following the proposals of the Cochrane Qualitative and Implementation Methods Group (Noyes et al. 2018). The starting point of the analysis were the categories of acceptability, feasibility, and equity from the Evidence To Decision framework from Grading of Recommendations Assessment, Development and Evaluation (Group GW n.d.). Research questions that guided the comprehension of acceptability, feasibility, and equity can be found in Table 1.

2.1 | Data Sources and Search Strategy

Three databases were searched—Medline, Embase, and Web of Science (WoS)- to retrieve studies in English and Spanish. The search was limited to the ten years between 2011 and 2021. The search was limited to ten years because of the rapid evolution of CSII over the past decade. Earlier studies may not adequately reflect adaptability due to the characteristics of obsolete equipment. However, references of the included studies were screened to find potential additions. These references included studies published before 2011 because of their relevance. For the search strategies see File S1.

TABLE 1 | Research questions related to acceptability, feasibility, and equity.

Acceptability: Is the intervention acceptable to key actors?	• Are there key stakeholders that would not accept the distribution of the benefits, harms and costs? • Are there key stakeholders that would not accept the costs or undesirable effects in the short term for desirable effects (benefits) in the future? • Are there key stakeholders that would not agree with the values attached to the desirable or undesirable effects (because of how they might be affected personally or because of their perceptions of the relative importance of the effects for others)? • Would the intervention adversely affect people's autonomy? • Are there key stakeholders that would disapprove of the intervention morally, for reasons other than its effects on people's autonomy (e.g., in relation to ethical principles such as no maleficence, beneficence or justice)?
Feasibility: Is the intervention feasible to implement?	• Is the intervention or option sustainable? • Are there important barriers that are likely to limit the feasibility of implementing the intervention (option) or require consideration when implementing it?
Equity: What would be the impact on equity?	• Are there groups or settings that might be disadvantaged in relation to the problem or options that are considered? • Are there plausible reasons for anticipating differences in the relative effectiveness of the option for disadvantaged groups or settings? • Are there different baseline conditions across groups or settings that affect the absolute effectiveness of the intervention or the importance of the problem for disadvantaged groups or settings? • Are there important considerations that should be made when implementing the intervention in order to ensure that inequities are reduced, if possible, and that they are not increased?

Note: Adapted from Moberg 2018 (Moberg et al. 2018).

2.2 | Inclusion Criteria

The inclusion and exclusion criteria for this QES are described in Table 2. Two independent researchers reviewed the retrieved titles and abstracts to assess their eligibility. Those selected were then reviewed in the full text, also independently, by two researchers. If needed, a third reviewer resolved any disagreement.

2.3 | Data Extraction and Data Synthesis

A descriptive thematic synthesis adapted from the first phases of Thomas & Harden (Thomas and Harden 2008) was conducted for the analysis. An initial codebook was developed using the previously mentioned framework for acceptability, feasibility, and equity. A small sample of studies were reviewed to create a set of codes that were then discussed by the team. Studies were then independently reviewed and coded by two researchers and a data extraction form was used to report findings and quotations for each category. The reporting of the results was structured from the most general to more specific findings.

A table was prepared to extract the characteristics of each study, which includes first author, year of publication, aim of the study, qualitative study design, sample, setting and methodological limitations of the study.

2.4 | Research Team and Reflexivity

In relation to reflexivity, the authors are experienced qualitative researchers and they also have experiential knowledge that has helped to analyze the retrieved findings from an interprofessional perspective. The team includes two registered nurses (BR-M and JD), an anthropologist (AT-C), and a bioethicist (JD). In addition, one of the authors has been diagnosed with T1DM which has helped with doubts and the contextualization of findings. The research team has previous experience in Health Technology Assessment of other devices and services developed for patients with T1DM.

2.5 | Quality Assessment

The CASP checklist was used to critically appraise the methodological quality of the studies (CASP n.d.).

Both the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page et al. 2021) and the Enhancing transparency in reporting the synthesis of qualitative research checklist (ENTREQ) (Tong et al. 2012) were used to improve the reporting of this QES (Files S2 and S3).

3 | Results

The searches retrieved 345 references, 102 duplicates. The authors reviewed 289 titles and abstracts of which 233 were excluded and 55 full texts were assessed for eligibility. Finally, 30 studies fulfilled the inclusion criteria, with these studies being reported in 32 articles (File S4).

3.1 | Description of Included Studies

The characteristics of the included studies can be found in File S5. Ten studies took place in the UK, seven in the USA, three in Sweden and Australia, two were conducted both in the UK and USA, and one in Denmark, Germany, Ireland, Kuwait, and Canada. One study did not disclose the setting. All studies used interviews, focus groups or both as data collection techniques

TABLE 2 | Inclusion and exclusion criteria for the selection of the studies.

	Population	Intervention	Findings	Design
Inclusion	Persons with a T1DM[a] diagnosis of any age.	Administration and/or dosage of insulin by any route and anatomical area, continuously (insulin pump), or intermittently (disposable syringe, pre-filled, or refillable pen).	Experiences or trajectory of care. Acceptability, feasibility, equity, or considerations for implementation of interventions.	Qualitative studies or mixed studies reporting results separately
Exclusion	Other populations (persons with type 2 diabetes mellitus, etc.).	Continuous glucose monitoring or intermittent glucose monitoring.	Any other findings.	Randomized clinical trials, non-randomized clinical trials, quasi-experimental studies, narrative reviews, editorials, letters to the editor, and abstracts.

[a]T1DM: Type 1 diabetes mellitus.

(21, 5, and 4 respectively). Participants in the studies consisted of one or multiples of the following populations: T1DM adults (13 studies), pregnant women (1), young adults (2), children and teenagers (15), their parents (13), and HCPs (4) including pediatric practitioners (2), nurses (1), and dieticians (1).

3.2 | Quality Assessment

A summary of the results of the critical appraisal is presented in File S5, together with the characteristics of the included studies. The design and use of qualitative methodology were adequate in 21 of the 30 included studies (Ritholz et al. 2007; Mesbah et al. 2020; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Ferrari, McIlwain, and Ambler 2018; Collard et al. 2020; Gajewska et al. 2021; Berg, Simonsen, and Svensson 2018; Gildersleeve et al. 2017; Alsaleh et al. 2014; Sullivan-Bolyai et al. 2004; Garza et al. 2018; Hood and Duke 2015; Rashotte et al. 2014; Low et al. 2005; Garmo, Hörnsten, and Leksell 2013; Todres, Keen, and Kerr 2010; Wysocki et al. 2016; Hayes et al. 2011; Lindholm Olinder, Ternulf Nyhlin, and Smide 2011; Saarinen et al. 2014; Rankin et al. 2015). However, the data analysis was not described in depth in 10 of them (Mesbah et al. 2020; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Collard et al. 2020; Berg, Simonsen, and Svensson 2018; Gildersleeve et al. 2017; Sullivan-Bolyai et al. 2004; Garza et al. 2018; Hood and Duke 2015; Hayes et al. 2011; Saarinen et al. 2014). The results were only partially applicable in 13 of the studies due to opportunistic recruitment in a single hospital, recruitment of participants within another randomized controlled trial or recruitment from another study, or lack of ethnic and cultural diversity (Barnard and Skinner 2007; Ritholz et al. 2007; Lawton et al. 2016; Grose et al. 2018; Farrington et al. 2017; Hendrieckx et al. 2017; Iturralde et al. 2017; Sullivan-Bolyai et al. 2004; Rashotte et al. 2014; Garmo, Hörnsten, and Leksell 2013; Barnard et al. 2015; Lindholm Olinder, Ternulf Nyhlin, and Smide 2011; Barnard et al. 2017). Only eight studies included a description of the relationship between researchers and participants or reflexivity about the research team's relationship with the theme (Lawton et al. 2016; Ferrari, McIlwain, and Ambler 2018; Hendrieckx et al. 2017; Berg, Simonsen, and Svensson 2018; Gildersleeve et al. 2017; Garmo, Hörnsten, and Leksell 2013; Hayes et al. 2011; Lindholm Olinder, Ternulf Nyhlin, and Smide 2011). Three studies did not mention any ethical considerations (Garza et al. 2018; Wysocki et al. 2016; Rankin et al. 2015). Available on request are the full results of the quality assessment.

3.3 | General Acceptability

Examples of relevant quotations for each theme can be found in Table 3. CSII were generally well accepted by users (Ritholz et al. 2007; Mesbah et al. 2020; Lawton et al. 2016; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Ferrari, McIlwain, and Ambler 2018; Alsaleh et al. 2014; Sullivan-Bolyai et al. 2004). and HCPs (Lawton et al. 2016). However, some people with T1DM refused or discontinued the use of CSII for a variety of reasons: size, visibility, amount of time needed, alarms, skin problems, lack of confidence, difficulties in the adaptation process, and so forth.

TABLE 3 | Examples of relevant quotations by theme.

Acceptability
"All participants were contented since using CSII, with the reduced frequency of injections and better glycemic control cited as common reasons" (Mesbah et al. 2020) "Participants in the low A1C groups stated that the pump helped them feel more accepting of their diabetes, less ashamed of it, and able to speak about it to others for the first time." One person said that the pump helped "lift the stigma" of diabetes, whereas another described the pump as making the "psychological burden of diabetes lighter somehow." A female mathematics teacher described how she incorporated her insulin-to-carbohydrate ratio when teaching mathematics concepts: ... "so I teach them and hopefully I'm changing the world" (Ritholz et al. 2007) "I think we can maximize most people and it's wonderful... We've had a lot of improvements and reductions in hypos" (Lawton et al. 2016)
Adaptation to the insulin pump
"'Parent:' It's quite different at the beginning, it's a massive multi-stress burden to use the sensor" (Bomba, Müller-Godeffroy, and von Sengbusch 2018) "The time needed to adapt to SAP differed from family to family: some parents reported that their children got used to the new technology very rapidly:" "in no time he had made friends with the sensor." In other families, according to the parents, it had been "a long and winding road" (Bomba, Müller-Godeffroy, and von Sengbusch 2018) "When commencing CSII therapy some participants described the need to be emotionally prepared in order to cope with the change in self-management. Additionally, participants struggled during the transition phase from parental care to independence with self-management. '[You] definitely have to be mentally ready to wear something 24 h a day and have a constant reminder of your diabetes.'" (Grose et al. 2018) "Optimal use of CSII required more skill and effort than MDI: It's a lot harder to use a pump and, although they've got the potential to make those really fine adjustments to basal rates, in practice, whether people are able to do [so] is another matter" (Lawton et al. 2016)
Facilitators for proper insulin pump use
"'It just makes me think [diabetes is] manageable, it's not as hard as it used to be... it can only get better, it can only get easier" (Farrington et al. 2017) "There are no injections and I only need to take 1 needle every 3 days instead of like 5 needles a day" (Ferrari, McIlwain, and Ambler 2018) "Children had a notion that an automated insulin delivery system would allow them to improve sports performance. 'It's keeping your numbers up during the match, so you don't have to like at half-time, test and that. You can keep on routines and focus more on the actual game" (Collard et al. 2020)
Variability of acceptability
"Although some perceived the alarms as annoying, others reported that there were fewer alarms than with their usual care, because their glucose levels were more often within target range" (Hendrieckx et al. 2017) "Some parents found the new technology easy to understand; "Anyone who can operate a smart phone can work with a pump plus sensor." However, others reported that they found it difficult. According to the statements of the families, a certain affinity to technology makes handling SAP easier, being "something of a tech-savvy"" (Bomba, Müller-Godeffroy, and von Sengbusch 2018) "Required tasks perceived as burdensome included responding to alarms, entering in meal information, confirming boluses, providing corrective insulin doses, calibrating CGM, and taking meter readings, sometimes in excess of what would happen in usual care" (Iturralde et al. 2017) "HCPs' attitude was the most significant and widely discussed barrier to or facilitator of access to CSII. According to participants, HCPs (mainly endocrinologists) "are the gatekeepers." If they don't see the need for pump therapy, then it is going to be very challenging for you to get your hands on a pump. So, they are a key barrier or facilitator" (Gajewska et al. 2021) "According to the participants, skin problems had a great influence on the everyday life. For the patients, frequently described themes were pain, irritation, and itching, influencing sleep, distraction, and disturbed concentration. Some even suspected fluctuations in insulin usage when having skin problems or needed to use antiallergic medicine to reduce the skin problems and help sleeping. The comments and questions from others because of the visible skin problems were described as another consequence" (Berg, Simonsen, and Svensson 2018)
Feasibility and implementation considerations
"This learning process involved engagement with a variety of resources including diabetes educators, doctors and dietitians, as well as workshops, diabetic support groups and pump manufacturers" (Grose et al. 2018) "Participants unanimously supported simple, written, and pictorial instructions accompanying alarms to help children and other care providers with treatment decisions and alleviate alarm-induced anxiety among school staff" (Gildersleeve et al. 2017)
Equity
"There was general agreement among participants that the uptake of CSII is low in Ireland, and that the "postcode lottery," understood as an unequal provision of services, exists" (Gajewska et al. 2021) "Barriers to accessing pump therapy including cost, private health insurance bureaucracy and living in rural areas" (Grose et al. 2018)

Abbreviations: CSII: continuous subcutaneous insulin infusion; CGM: continuous glucose monitoring; HCPs: healthcare professionals; MDI: multiple daily injections; SAP: sensor-augmented pump.

3.4 | Adaptation to the Insulin Pump

The adaptation period required to accepting CSII therapy varied. In some cases, the adaptation process was overwhelming and stressful due learning about the changes involved in T1DM self-management as well as the handling of the device (alarms, change of infusion equipment...). Frustration could also occur when the expectations people had before using the device were not fulfilled. In the case of adolescents and young adults, the increasing responsibility of diabetes self-management was an additional burden that affected the adaptation to CSII (Garza et al. 2018; Hood and Duke 2015; Rashotte et al. 2014).

The adaptation period lasted between a few days and three months and culminated either with the acceptance or the abandonment of the device (Grose, O'Brien, and Castle 2017; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Grose et al. 2018; Farrington et al. 2017; Alsaleh et al. 2014; Sullivan-Bolyai et al. 2004; Rashotte et al. 2014; Low et al. 2005). If possible, an appropriate time should be set to facilitate the adaptation (Rashotte et al. 2014; Grose, O'Brien, and Castle 2017).

Once adapted to the CSII, people with T1DM normalized its use perceiving that this technology replaced their own body sensations to detect variations in glycemia. This normalization increased their perception of safety since the insulin infusion was able to act on possible hypoglycaemias, but also it contributed to increasing their sense of dependence on the device (Grose, O'Brien, and Castle 2017; Farrington et al. 2017; Ferrari, McIlwain, and Ambler 2018; Farrington et al. 2018).

For a correct use of the pump, it was necessary to establish routines and allocate some time every day to the care required (changing catheters and sensors, being aware of alarms, taking care of the insertion point, avoiding accidental disconnections...) (Lawton et al. 2016; Grose et al. 2018; Garmo, Hörnsten, and Leksell 2013).

3.5 | Facilitators for the Adequate Use of Insulin Pump

CSII therapy provided a perception of control and empowerment for most users. People with T1DM considered it a great help for decision making which increased their knowledge, autonomy, freedom and flexibility in their daily lives The positive impact on improving family relationships also influenced its acceptance (Grose, O'Brien, and Castle 2017; Barnard and Skinner 2007; Sullivan-Bolyai et al. 2004; Garza et al. 2018; Low et al. 2005; Garmo, Hörnsten, and Leksell 2013; Barnard et al. 2015; Todres, Keen, and Kerr 2010; Wysocki et al. 2016; Ritholz et al. 2007; Mesbah et al. 2020; Lawton et al. 2016; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Grose et al. 2018; Farrington et al. 2017; Ferrari, McIlwain, and Ambler 2018; Iturralde et al. 2017). The reduction in the number of punctures and the consequent pain relief were highly valued (Mesbah et al. 2020; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Ferrari, McIlwain, and Ambler 2018).

CSII relieved burden and fatigue and made it easier to manage diabetes on a daily basis for adults, children and their parents. CSII also improved sports performance, school life, travel, social relationships, sex, and emotional state (Lawton et al. 2016; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Grose et al. 2018; Farrington et al. 2017; Ferrari, McIlwain, and Ambler 2018; Collard et al. 2020; Garza et al. 2018; Farrington et al. 2018; Barnard et al. 2015). Moreover, support from peers and family members also facilitated the use of CSII (Grose et al. 2018; Sullivan-Bolyai et al. 2004; Hood and Duke 2015; Rashotte et al. 2014; Wysocki et al. 2016).

3.6 | Variability of Acceptability

The following aspects could act as a barrier or as a facilitator depending on individual preferences: the presence of alarms (especially if they are very abundant or made noise at night), positive or negative attitudes towards technology or the perception of dependency on technology (Bomba, Müller-Godeffroy, and von Sengbusch 2018; Grose et al. 2018; Farrington et al. 2017; Hendrieckx et al. 2017; Low et al. 2005; Barnard et al. 2015).

The main barriers to the use of CSII therapy were the personal effort and time needed to learn about its management, the amount of information that needs to be introduced, the need for calibration, the emotional burden or not having well-trained professionals to advise them or who have an open attitude to the use of pumps. Some users said the device was not very accurate for the management of hypo/hyperglycemia, which translated into fear or distrust (Grose, O'Brien, and Castle 2017; Ritholz et al. 2007; Hood and Duke 2015; Garmo, Hörnsten, and Leksell 2013; Hayes et al. 2011; Lawton et al. 2016; Bomba, Müller-Godeffroy, and von Sengbusch 2018; Grose et al. 2018; Farrington et al. 2017; Hendrieckx et al. 2017; Iturralde et al. 2017; Gajewska et al. 2021; Alsaleh et al. 2014).

Adults and adolescents may encounter difficulties (e.g., impaired body image, difficulty in sociability) because they consider that the device increased the visibility of T1DM, causing embarrassment or lack of social support. These difficulties could be a barrier to adherence to CSII therapy or to the practice of activities such as sports, sex, going to the beach or even sleeping (Grose, O'Brien, and Castle 2017; Barnard and Skinner 2007; Lawton et al. 2016; Grose et al. 2018; Hendrieckx et al. 2017; Berg, Simonsen, and Svensson 2018; Alsaleh et al. 2014; Sullivan-Bolyai et al. 2004; Hood and Duke 2015; Low et al. 2005; Barnard et al. 2015; Todres, Keen, and Kerr 2010).

Technical, usability or connectivity problems could also become barriers to the use of these devices (Mesbah et al. 2020; Farrington et al. 2017; Hendrieckx et al. 2017; Alsaleh et al. 2014; Sullivan-Bolyai et al. 2004; Barnard et al. 2015; Hayes et al. 2011). Skin problems caused by adhesives in the CSII can lead to the abandonment of CSII therapy in some cases (Berg, Simonsen, and Svensson 2018; Hayes et al. 2011).

3.7 | Feasibility and Implementation Considerations

The effective use of CSII therapy required prior training of both professionals and patients. Patients needed access to

trained professionals (Grose et al. 2018; Ferrari, McIlwain, and Ambler 2018; Collard et al. 2020; Garmo, Hörnsten, and Leksell 2013). Peer support and patient associations improved adequate device use and should be encouraged by HCPs (Grose et al. 2018; Ferrari, McIlwain, and Ambler 2018). Patients demanded improved relationships with professionals and received more support from them. Children also needed the accompaniment of parents and schools and information tailored to their needs (Grose et al. 2018; Farrington et al. 2017; Ferrari, McIlwain, and Ambler 2018; Gildersleeve et al. 2017; Grose, O'Brien, and Castle 2017).

Well-structured care pathways for the proper use of devices include the establishment of clinical criteria for device prescription, an informed decision on how to start treatment with it, structured education for people with T1DM, continuity of care between specialized services and care primary care, monitoring of patients, as well as the training of professionals (Ferrari, McIlwain, and Ambler 2018; Gildersleeve et al. 2017).

3.8 | Equity

Some existing inequalities in access to CSII were highlighted, with the main reasons being not having access to trained and motivated professionals, cost of the devices, and patient's clinical and personal characteristics that were a filter for the decision made by professionals about who was a candidate to use CSII (Lawton et al. 2016; Grose et al. 2018; Gajewska et al. 2021; Grose, O'Brien, and Castle 2017). Access to consultations and diabetological education was limited in rural areas or in those living far away from specialized T1DM centers (Gajewska et al. 2021).

4 | Discussion

CSII is perceived to relieve management burden, increase autonomy and flexibility, and improve family relationships for most of its users. A previous meta-analysis concluded that people with T1DM using the CSII were more satisfied with this mode of insulin administration than people with T1DM using multiple daily injections (Misso et al. 2020). In line with other studies (Hirose and Beverly 2012; Riddell 2009; Lenhard 2001) the results here show that the flexibility provided by CSII facilitates day-to-day living, sports performance, travel, socialization, family dynamics and emotional state for people with T1DM.

There are different barriers affecting the acceptability, implementation in healthcare settings and equitable use of CSII. Despite the safety of CSII in insulin dosing (Sherr et al. 2018), the results of this review point to a lack of confidence in the devices as one such obstacle. A few patients reject or discontinue its use due to factors related to the training required (alarm management, need to spend a lot of time on the devices, difficulties in use, problems in the adaptation process...). A systematic review (Dekker et al. 2023) showed that discontinuation rates varied among different studies ranging from 0% to 30% with a median of 7%. The most mentioned reason was related to the wearability of the devices. CSII therapy requires the user to have the device integrated into the body 24/7, which may affect appearance and body image (Reidy et al. 2018). The size and shape of the devices continue to be considered a barrier for certain participants because the device increases the visibility of diabetes (Saarinen et al. 2014). Furthermore, these devices can cause skin problems such as lipodystrophies, itching, eczema or injuries, especially in patients with atopic, dry or sensitive skin, increasing the burden of the disease and impacting their well-being and quality of life (Pickup et al. 2014; Ross et al. 2015).

The authors agree with previous studies on the importance of considering the expectations, attitudes, and perceptions of patients about health-related technologies (Venkatesh 2000) as well as the psychosocial impact of devices on people with T1DM (Barnard et al. 2015). For the aforementioned reason, the patients' experiences, values, and preferences should be included in clinical practice guidelines and in the design of devices for the treatment of T1DM. Continuation of insulin pump treatment depends on the guidance of HCP teams that are able to consider people with T1DM values and preferences (Munoz-Velandia et al. 2019). Special attention should be paid to new users, who need a period of adaptation to integrate the device into their daily life. Not having access to HCP support or additional resources hinders the adaptation to the device (Reidy et al. 2018).

One of the noteworthy results of the present review is the importance of training, both for HCPs and patients for the success of the CSII therapy (Barnard and Skinner 2007; Grose et al. 2018; Ferrari, McIlwain, and Ambler 2018; Garmo, Hörnsten, and Leksell 2013). Despite the fact that previous evidence shows that the use of CSII systems requires knowledge and monitoring from the medical team (Roze et al. 2015; Qin et al. 2018), the results of the review show that lack of training and motivation of HCPs continues to be a barrier to the use of CSII.

The results here point to inequities of accessibility to CSII based on socio-economic status and place of residence. Lack of access due to cost was mentioned as a barrier. Access to quality was diverse. Nevertheless, research is needed in relation to inequalities, the vast majority of the included studies came from high income countries and their results showed scarce findings in relation to inequality and did not cover most of its identified dimensions (Race/ethnicity/culture/language, occupation, gender/sex, religion, education, social capital and other characteristics such as sexual orientation, age and disability) (Kanbour et al. 2023; Everett et al. 2023; Auzanneau et al. 2023) such information could assist policy-makers in developing strategies aimed at reducing the disparities in technological device provision and guaranteeing equal access to them.

4.1 | Strengths and Limitations of This Review

We consider it a major strength of this study to have included a researcher who is both a CSII patient and a researcher. This dual perspective benefited the research process, especially in the development of the code tree and the analysis of the results. In addition, the participation of an interdisciplinary team consisting of nurses, anthropologists, and bioethicists allowed us to approach the topic from different angles. This balanced analysis considered both social and anthropological factors, such as

patient experience, and ethical concerns, such as equity. The results were triangulated among several researchers, significantly reducing the potential for bias.

Regarding the limitations of the study, the systematic search was restricted to studies published between 2011 and 2021 in Spanish and English. A few additional studies from prior dates were retrieved from the screening references of included studies. Nevertheless, the findings of this review are rich and coherent, supported by sufficient and coherent qualitative data. Other relevant works in other languages may shed some light on other contexts but resources for translation were not available. In addition, even if the individual included studies had certain methodological limitations the overall quality was adequate.

The results of the included studies do not allow a separate analysis of the insulin pump model, nor is it possible to know whether the results are due to CSII, continuous glucose monitoring, or a combination of both. Due to the rapid advances in therapies with CSII, more qualitative research in this field is needed to analyze the perceptions of users and to be able to make comparisons according to the type of device.

5 | Implications for Practice

The present study examining the acceptability, implementation, and equity of CSII may have several implications for practice. Firstly, understanding the acceptability of CSII among patients may inform healthcare providers of the need for better education and support programs aimed at improving patients' experiences with these devices. In addition, identifying barriers to CSII adoption may lead to the development of targeted strategies to overcome them. This may include addressing issues related to device affordability, accessibility of training programs, and patient preferences. Understanding the factors that influence CSII uptake can guide healthcare providers in offering personalized support services. This may include providing additional counseling or resources for patients who are reluctant to transition to CSII or who have difficulty using it. Finally, examining equity in CSII implementation can highlight disparities in access to this technology among different demographic groups. Healthcare providers can use this information to advocate for policies promoting equitable access to CSII, such as insurance coverage or subsidies for low-income individuals. Ongoing evaluation of the acceptability, implementation, and equity of CSII is critical to ensure that interventions remain effective and equitable over time. Further studies should evaluate patient feedback and outcome data to identify areas for improvement and address emerging challenges. In addition, there is a lack of studies focusing on HCP attitudes and opinions regarding these issues. These findings could provide valuable insights for healthcare providers to optimize the delivery of this technology and improve outcomes for patients with T1DM.

6 | Conclusions

Despite the general acceptability of CSII among its users, perceived barriers to its continued use were related to wearability issues, lack of regard for users' circumstances, preferences, and values, especially during the adaptation process, lack of access to trained HCPs and high costs. Implementation should take these barriers into account to improve health services and reduce disparities in rural areas. Future studies should continue to analyze inequalities in access and use of the CSII. This review may inform HCPs, policy-makers, and industry about gaps in the acceptability, implementation and equity related to the use of CSII in people with T1DM.

Author Contributions

Ana Toledo-Chavarri: conceptualization, investigation, writing – original draft, methodology, supervision, resources, project administration, writing – review and editing, formal analysis. **Janet Delgado:** investigation, writing – original draft, writing – review and editing, formal analysis. **María Padilla:** writing – review and editing, validation, supervision. **Beatriz Rodríguez-Martín:** investigation, writing – original draft, writing – review and editing, formal analysis.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors confirm that the data supporting the results of this study are available in the article and its Supporting Information. Additional data are available upon request.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.