Acta Biomed 2021; Vol. 92, Supplement 2: e2021502 DOI: 10.23750/abm.v92iS2.11506

The perceptions and experience of the diabetic person with an insulin pump: a review of the literature

Veronica Strini[1], Roberta Schiavolin[2], Ilaria de Barbieri[3], Angela Prendin[4]

[1]Clinical Research Unit; University-Hospital of Padua, Padua; [2]Continuity of care service; University-Hospital of Padua, Padua; [3]Woman's & Child's Health Department; University-Hospital of Padua, Padua; [4]Independent research; University-Hospital of Padua, Padua

Abstract. *Background and aim of the work:* diabetes mellitus is a chronic disease of the endocrine system, characterized by an increase in the concentration of glucose in the blood. For patients with diabetes, it is possible to cover the need for insulin through the use of an insulin pump, a subcutaneous implantable device, which aims to simulate the action of the Langherans islets. Therapy with an insulin pump allows patients who use it to have a greater flexibility in the long-term management of diabetes. The aim of this review is to investigate in the literature the perceptions and experiences of patients subjected to the use of the insulin pump. *Methods:* this review was carried out using the international databases Pubmed, CINAHL and COCHRANE. The mesh terms "Insulin infusion system, attitude to health, experiences, emotions, perceptions, activities of daily living" were used combined with the Boolean operator AND. Age limits and language were set and literature was investigated from 2008 to 2018, respecting specific inclusion and exclusion criteria. *Results:* 260 articles from the Pubmed database were analyzed, 26 articles from Cinhal, no articles by COCHRANE; of these 188 excluded based on the reading of the abstract and because they were duplicate articles, 7 because they did not meet the inclusion criteria. 15 articles were included in the review. *Discussion:* four main themes emerged regarding the personal experience of patients with insulin pumps: perceptions deriving from the use of the insulin pump, behaviour deriving from therapy, obstacles to adequate glycemic control and discrepancy between education received and reality. *Conclusions:* different moods and behaviors have been reported in people who use the insulin pump: one above all the fear of hypoglycemia. There are different expectations from patients and nurses. In addition to adequate training with respect to direct patient care, training is also required for nursing staff in emotional support and in technological development.

Keywords: insulin infusion system, attitude to health, experiences, emotions, perceptions.

Background

Diabetes mellitus is a chronic disease of the endocrine system, characterized by an increase in the concentration of glucose in the blood. Responsible for this phenomenon is an absolute or relative defect of insulin, due to its inadequate production by the pancreas. Two types of diabetes mellitus can be distinguished: Type I and Type II; type I, or "insulin-dependent" diabetes mellitus, is characterized by the almost total absence of insulin, so it is necessary to take insulin from an external source from the onset of the disease; it occurs before the age of 20 and is therefore also called "juvenile diabetes". Non-insulin-dependent type II diabetes mellitus is characterized by a progressive reduction of insulin but not as markedly as in type I diabetes mellitus, so in most cases, it is not necessary to take insulin: it is also called "adulthood diabetes"(1) For patients with diabetes, both type I and type II, it is possible to cover the need for insulin through injections or with

the insulin pump(2). The insulin pump is a subcutaneous implantable device, introduced in 1970, with the aim of simulating the action of the Langherans islets of the pancreas(3). It is a small electromechanical pump powered by batteries, which supports a prefilled syringe of insulin (reservoir); the reservoir communicates with the body via an infusion set, consisting of a catheter at the end of which there is a needle in a soft and hypoallergenic plastic material (Teflon, polyethylene), which is inserted into the abdominal subcutaneous tissue(4). The tank must be replaced at least every 6 days because the insulin crystallizes in contact with the heat of the body and could create precipitates and clog the catheter. The needle and its application site, on the other hand, must be replaced every 3 days to prevent inflammation or infections. This device delivers fast-acting insulin 24 hours a day. Administration can be interrupted for short intervals of time, up to an hour, to avoid the risk of hypoglycaemia(4). Insulin pump therapy allows patients who use it to vary the required insulin dose with simple gestures(4), ensuring greater flexibility and freedom of choice in the long-term management of diabetes(5). The technology of insulin pumps has evolved a lot, since 1970 now, and is constantly evolving(6). For this reason it is necessary to maintain continuous training on the use of this technology(7). The use of the pump requires commitment and understanding both by people who use it and by nurses: by patients because individual adaptation and a particular lifestyle is required, by nurses because they need to understand the point of view of patients towards these devices and any related difficulties(8). Hence, the study on the patient who uses the insulin pump in his usual context of life could help nurses to provide a more personalized education, e.g. regarding alcohol consumption and physical activity, which affect insulin absorption and expose to the risk of hyperglycaemia and hypoglycaemia(6).

Aim

The purpose of this review is to investigate in the literature the perceptions and experiences of patients subjected to the use of the insulin pump.

Methods

A literature review was carried out by consulting three databases: PUBMED on 08/02/2018, CINAHL on 08/09/2018 and COCHRANE on 08/12/2018. An update of the results was made on 17/09/2021 in the same databases

The PICO method was adopted.

POPULATION: Adult diabetic patients with age ≥ 18 years.

INTERVENTION: Daily use of insulin pump.

COMPARISON: Patients receiving daily insulin injections.

OUTCOMES: Evaluation of the perceptions and experiences of patients with insulin pumps.

In table 1 is presented the research strategy.

Results

328 total articles were analysed, divided as follows: PUBMED 302 results, CINAHL 26 results and COCHRANE 3 results. After evaluate the abstract and exclude duplicate results, 190 articles were kept. Subsequently a sample of 32 articles were selected before reading the Full Text. Reading the full text, 17 articles were included in the review (Figure 1, Table 2). The selected articles included qualitative studies (n = 16) and a literature review (n = 1). Online or paper

Table 1. Research strategy.

Database	PUBMED, CINAHL, COCHRANE Database
Keywords	Insulin infusion system, attitude to health, experiences, emotions, perceptions, activities of daily living
Inclusion Criteria	Articles that investigate the perceptions and experiences of patients regarding the use of the insulin pump. Period: studies published from 2008 to 2018. Study format: full text.
Exclusion Criteria	Articles that do not investigate the perceptions and experiences of patients but only the methods of using insulin, articles that deal only with the technical aspect of the insulin pump.
Total Records	328 articles: 302 PUBMED, 26 CINAHL, 3 COCHRANE

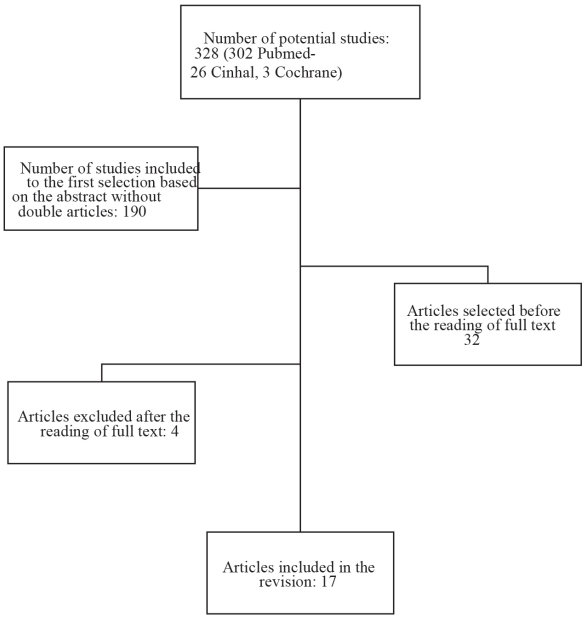

Figure 1. Flow chart of results

self-assessment questionnaires were used in 5 studies, interviews in 6, in one it was used a mixed methodology by administering both questionnaires and interviews, in 2 focus groups, in one a phone and e-mail survey, and in 2 data extracted from electronic sheets. Four themes emerged from the analysis of the data resulted from the studies: perceptions derived from the use of the insulin pump; behaviours derived from therapy; obstacles to adequate glycaemic control; discrepancy between education and reality. The review was conducted following the PRISMA (9) guidelines, the evaluation and selection of the articles was performed by two separate researchers.

Discussion

Perceptions arising from the use of the insulin pump

Diabetic patients may decide to rely on pump technology to manage their disease. From interviews to 11 patients in an endocrinology department of a Swedish hospital, the reasons behind the change in treatment were: to have a high HbAc1 value, high instability of glycaemic levels and fear of hypoglycaemia. The transition to insulin pump therapy entailed, after an initial training phase, a natural adaptation of patients, also facilitated by the support of health professionals. The purpose of the qualitative study of Saarinen et al. (10) was to describe the experience that patients had during the transition from injection therapy to the insulin pump. Study participants stated that: "Insulin pump therapy is perceived as liberating, but implies a greater 'visibility' of diabetes", since they feel satisfied with the treatment and would recommend it to other people. On the one hand, this type of administration was felt like a *liberation*; on the other hand, they felt that wearing the insulin pump made the diabetic's disease state more visible, especially for women. In the study of Alsairafi (11) patients are *annoyed* from wearing pump. Patients also felt a *sense of dependence* on technology, because they had to be connected continuously to a medical device and consequently risk technical failures (10, 11). In another Swedish qualitative study by Garmo et al. (12) is described the individual experience of 16 diabetic patients who had been using the insulin pump for 5 years. This type of therapy was intended as a *constraint*: they live this device as an instrument felt like an *obstacle* to daily life, especially on the beach, during swimming and sexual activities. They are afraid of not being prepared to manage the complications of the insulin pump (e.g. malfunction) and lack of trust in health professionals were common. Other feelings were: habit, understood as a series of obligatory actions that leave no space to person's freedom; *flexibility*, during meals and daily comfort due to the absence of injections; *sense of constriction*, due to carry the necessary for the functioning of the device (e.g. insulin reserves); *relief,* for the feeling of a simpler and safer life (e.g. less fear of hypoglycaemia); *fear of stigma,* to feel different from others (11, 12).

In another qualitative study by Joubert et al. (13), the aim was to assess the satisfaction and behaviour of other patients who have also been on insulin pump therapy for 5 years. Also in this study it is confirmed that the insulin pump makes people feel at ease during daily life, a little uncomfortable during sport and sexual activity due to the visibility of the device. In a Canadian qualitative study by Taleb et al. (6), an online survey with the aim of investigating perceptions related to the use of the insulin pump. It was observed that, using the insulin pump, 84% of patients did not perceive an increase in anxiety or

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Experiences of adults using continuous subcutaneous insulin infusion: a qualitative study. 2020 Qualitative study. Kuwait	The study aimed to determine the quality of life (qol) of kuwaiti adults with type 1 diabetes mellitus (t1dm) who used continuous subcutaneous insulin infusions (csiis) and to understand their perception of this treatment.	Clinic in kuwait to treat diabetes.	Eighteen individuals were required to achieve data saturation (8 males and10 females; mean age 31.4 ± 6.4 years; mean diabetes duration 17.7 ± 9.5 years; mean csii duration 3.6 ± 2.4 years.	Eighteen subjects were individually interviewed using a semi-structured interview topic guide with open-ended questions. Prompts were used to encourage the interviewees to express their experiences, thoughts, and feelings towards csii. All interviews were recorded digitally.	All 18 interviews were transcribed verbatim, before being translated from arabic to english. The translation was reviewed twice by 3 researchers to confirm that the original meaning was retained. Data analysis was performed using an inductive thematic approach. Data from transcripts were then categorized into codes or groups of expressions or phrases that were common across the transcripts. Similar codes were categorized into subthemes. Further analysis was performed to identify the main themes. Finally, the themes and codes were reviewed to verify the effectiveness of the transcript analysis and to reduce bias.	Six main themes were studied: health benefits, lifestyle flexibility, improvement of mood and emotion, practical problems, physical and personal effects, and self-confidence to manage diabetes. Csii positively affected the qol of particpants', most notably by enhancing lifestyle flexibility; however, important negative qualities were also reported.
A qualitative study exploring patients' experiences regarding insulin pump use. 2018 Qualitative study. Kuwait	To examine the views and experiences of adults with type 2 diabetes regarding the use of insulin pumps compared to their previous insulin delivery methods, in terms of glycaemic control, quality of life, preference, convenience and adherence to doses.	5 secondary-care hospitals in kuwait.	8 patients with type 2 diabetes.	Cross-sectional semi-structured interviews were conducted. The face-to-face interviews allowed exploration of patients' views and experiences of the use of insulin pumps and identification of their advantages and disadvantages compared to the patients' previous insulin delivery methods. In addition, the most recent clinical data-e.g. hba1c level, blood glucose level, body mass index (bmi)-were obtained from patients' medical notes by the researcher at the time of the interview.	Interview transcripts were typed using microsoft word. Files were saved with numbers, indicating the order in which the interviews were conducted. Maxqda-11 software was used to assist the management of the textual data. It allowed collecting, organising and analysing content from interviews in arabic in a flexible manner. Thematic analysis was conducted in three main stages: data management, data description and data interpretation.	Interviews with patients revealed that using an insulin pump improved patients' glycaemic control and quality of life as a consequence of improved satisfaction and adherence to doses. Themes emerged were: impact of using insulin pump on patient's health and behaviour, daily activities with insulin pump, impact of using insulin pump on family and social life.

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Self-management behaviours in adults on insulin pump therapy: what are patients really doing? 2017 Qualitative study (data extraction from spreadsheets). Usa	Analyze the behaviors of people with type i diabetes mellitus (dmi), who use the insulin pump; make a comparison between the glycaemic levels achieved through these behaviours and the specific glycaemic goals of each patient.	Endocrinology clinic.	N. 19 participants. Adults. Both sexes, 63% women. Average duration of use of the pump: 11 years. Seven people used the continuous blood glucose monitoring (cgm) device; for the remainder, capillary glycaemia was measured. Mostly white (95%). Inclusion criteria: age 18-70 years. Average duration of dmi: 27 years. For at least a year followed by an endocrinology team. Absence of pregnant women. Spoken language: english only. Exclusion criteria: poor health, limited life expectancy, mental disorders, advanced vascular disease or microvascular complications, known history of severe hypoglycaemia or advanced atherosclerosis.	Extrapolation of data from spreadsheets, obtained within 30 days. The computer program was set up to highlight the frequency of the following behaviours: insulin bolus, blood glucose monitoring, carbohydrate intake and count, and other interactions with the pump.	Method of o'connell et al and driscoll et al: to define the minimum desirable behaviours for proper glycaemic management. Fisher's exact test: to monitor the glycaemic levels reached, given the behaviours implemented on certain days and correlating them with the expected glycaemic goal.	4249 interactions with the insulin pump were analyzed. The minimum desirable glycaemic management behaviours were: carbohydrate documentation three or more times per day (31.7%), glycaemic control four or more times per day (32.5%), and daily insulin boluses (5.7%). The delivery of boluses without consulting the pump calculator stood at a value of 16.9% of the total boluses delivered. The blood glucose checks performed by those who used the cgm were of a similar frequency to the checks performed by those who detected the capillary. When all three minimum expected self-management behaviours were adopted, there was a greater number of glycaemic levels close to the glycaemic target (3.0%) than when they were not assumed (3.2%). So it was found that frequently adopting the minimum desirable behaviours was a way to reach your glycaemic goal.
Insulin pump users require recurrent education for the management of pump failure. 2016 Qualitative study (self-assessment questionnaires). Uk	Evaluate people's knowledge of the insulin pump and the strategies implemented to control its possible malfunction. Develop educational resources to inform users and improve their knowledge and self-management skills.	Bournemouth center for endocrinology and diabetes.	N. 360 subjects invited to answer the questionnaires. Only 170 of these replied. Adults. Average duration of use of the pump: 5 years in 50% of participants, 10 years in 19%.	*Self-assessment questionnaires.* The duration of the therapy with the pump was ascertained and the participants were asked if the instructions received regarding the safety of the device and the actions to be taken in case of hyperglycaemia or failure, regarding the insulin reserves were still alive in their memory, emergency kit and appropriate insulin doses.	Not specified.	Despite detailed education and instructions provided by health professionals, some users remain at risk of hyperglycemia and diabetic ketoacidosis due to improper management of the system. For example, because they are wrong or unable to perform the ketone test, or to correct the insulin dose. Regular reviews of patient knowledge should be in place.

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Perceptions and experiences of adult patients with type 1 diabetes using continuous subcutaneous insulin infusion therapy: results of an online survey. 2018 Qualitative study (online questionnaires). Canada.	Considering the length of stay of the infusion sets and the practices implemented, the perceptions of those who use the insulin pump are investigated regarding metabolic control, device malfunction and individual reactions at the insertion site.	Clinical research institute of montreal.	115 participants residing in quebec. Adults, chronological age: ≥ 18 years. Both sexes, 72% women. Average duration of type i diabetes mellitus: 20.9 ± 12.2 years. Average duration of use of the pump: 6.2 ± 4.1 years and at least in the three months prior to the study. 59.1% of the participants had a university education level. Three different types of pumps were used with three different types of insulin.	*Online survey with 39 question* questionnaires including likert, multiple choice and open answer scales. Content of the questions: socio-demographic characteristics of the participants, type of pump used, length of stay of the catheter, frequency of medical visits; perceptions of metabolic control and quality of life with respect to treatment with injections; frequency and details of adverse events, advantages and disadvantages reported with the use of the pump compared to treatment with injections.	Spss software. Chi-square test. Anova. Logistic regression.	There was an improvement in glycemic control and a decrease in the number and severity of hypoglycemic episodes in 80% and 68/50% of the participants, respectively. Hba1c had decreased (≤ 7% in 42.6% of subjects). Participants felt confident in programming pump settings and managing insulin boluses. 94% of patients had two or more visits a year with health professionals. At least one adverse event occurred at the insertion site in numerous participants, such as pain (84%), non-adhesion (76%), irritation (69%), lipodystrophy (45%), and technical problems such as obstruction (52%), catheter curvature (50%), pump stop (55%), air bubbles (46%). The onset of adverse events did not depend on the length of stay in the catheter and despite their occurrence in all participants, only 37% of these reported them to health professionals.
Do perceptions of insulin pump usability impact attitudes toward insulin pump therapy? A pilot study of individuals with type 1 and insulin treated type 2 diabetes. 2015 Single-arm comparative pilot clinical study. Usa	Evaluate, in diabetic patients using daily injections, how convenient it would be for them to use the insulin pump.	San francisco research center.	N. 28 participants. Adults. Both sexes, for 64% women. Sixteen participants had type i diabetes mellitus, twelve had type ii diabetes. They were treated with multiple daily injections and the frequency of glycaemic monitoring was two or more times per day. They had never been treated with an insulin pump. They were randomized to evaluate two types of insulin pumps, type 1 followed by type 2; type 2 followed by type 1.	*Structured observational protocols,* to test the participants' ability to manage the insulin pump, without having first received instructions. *Questionnaires,* to evaluate the perceptions of those who use the insulin pump. *System usability scale (sus),* to evaluate the perceptions that participants have on the usefu*lness of the pump.* *Pump attitudes general,* questionnaire to assess what the participants' idea of the pump had before adopting it as a treatment. *Pump attitudes* specific, questionnaire to determine how convenient it would be for them to use the pump.	Anova analysis.	The sus scores showed that the type 2 pump was more practical than the type 1 pump. Participants had a generally more positive attitude towards the pump, after using type 2 than type 1. Participants preferred the type 2 pump for all its features: manual bolus (86%), bolus calculation (71%), basal insulin management (93%), alarm interpretation (96%), transferring settings (100%), change of insulin and infusion sets (93%).

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
The process of incorporating insulin pumps into the everyday lives of people with type 1 diabetes: a critical interpretive synthesis. 2017 Review of the literature. Uk.	Analyze the existing literature on the factors that influence the incorporation, adaptation and use of the insulin pump in the life of diabetic people.	None.	4998 titles were identified, 274 abstracts examined, 39 full texts retrieved and 22 selected for analysis. Inclusion criteria: diabetic people who use the insulin pump daily or who are considering using it; research including the perspective of healthcare professionals/ guardians/relatives. Study design: research protocols, qualitative, observational, methodological, reviews, mixed methods. Studies published from 2008 onwards, in english. Exclusion criteria: non--daily use of the pump; lack of focus/data on life experiences with the insulin pump; purely biomedical focus; research focused on continuous blood glucose monitoring device. Purely quantitative study designs. Patents and editorials.	Review of the literature. The following electronic literature databases were used: cinahl; embase; medline; psycinfo; cochrane database; web of science.	Each article was analyzed in consideration of the identified themes and then compared with the other studies.	3 main themes emerged: 1) tensions between expectations and reality 2) negotiation of responsibilities and access support 3) reflection, active experimentation and feedback
Insulin pump patient characteristics and glucose control in the hospitalized setting. 2014 Qualitative study (retrospective review). Usa	Evaluate the blood glucose trend in patients who use the insulin pump in hospital.	Endocrinology clinic.	N. 50 participants. Adults, chronological age ≥ 18 years. Both sexes, 57% males. 86% had type i diabetes mellitus. Average duration of diabetes: 26 ± 14 years. Average duration of use of the pump: 8.7 ± 6 years. Average hba1c value: 7.6 ± 1.4%. Average length of hospital stay: 5.6 ± 4.6 days. Number of hospital admissions: 51. Exclusion criteria: patients with uncontrolled hyperglycemia and diabetic ketoacidosis related to device malfunction. Three groups were identified: group a, with patients who had not been trained to use the insulin pump during hospitalization; group b, with patients who had been educated to use the insulin pump during hospitalization; group c, with patients for whom the use of the insulin pump was not appropriate and injections were used.	*Retrospective review* of the 50 electronic records to obtain data on: demographics, medical history, characteristics of the pump, insulin dose, knowledge of device settings, blood glucose trends during hospitalization.	Anova test. Jmp software. Spearman's correlation. T test.	At least a quarter of patients did not know how to manage the essential functions of the pump and about half of them did not know how to set their basal insulin. Mean blood glucose and the frequency of hyperglycaemic and hypoglycaemic events were not statistically very different between the three groups. No one developed diabetic ketoacidosis while using the insulin pump. Furthermore, it was found that knowing how to correct hypoglycaemia was essential for optimal glycaemic control. Patients who had been trained to use the insulin pump during hospitalization acted in a similar way to those who had not been educated.

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Characterization of exercise and alcohol self-management behaviours of type 1 diabetes patients on insulin pump therapy. 2017 Qualitative study. Arizona	With regard to alcohol consumption and physical activity, distinguish between the reported behaviors and those that actually implement, patients being treated with the insulin pump.	Endocrinology clinic.	N. 19 participants. Adults, chronological age: 18-70 years. Both sexes, twelve were women, not pregnant. Average duration of type i diabetes mellitus: 27 years. Average duration of use of the pump: 11 years. Average value of hba1c: 7.3%. Spoken language: english. Ethnicity: eighteen were caucasians. Seven participants used the device for continuous glucose monitoring (cgm) and the remainder detected the capillary. Exclusion criteria: poor health, limited life expectancy, known history of mental disorders or severe hypoglycaemia, advanced vascular disease.	Interviews structured on: awareness of the fact that alcohol and physical activity could significantly alter their blood sugar and behaviors implemented in these cases; sources of information. Each participant also had to keep a daily diary with notes on the time, duration and intensity of physical activity and time, type and amount of alcohol consumed, for a period of four weeks. The data extracted from the pump was uploaded online to a website.	The data were summarized in tables. Those coming from patients, through paper sources, were electronically coded and analyzed to quantify the number of drinks and the frequency of physical activity. Those uploaded online, coming from the pump itself, were used to compare the real data with those reported by patients.	4000 interactions between patients and the insulin pump were analyzed. Patients reported that, as regards alcohol consumption, blood sugar is influenced by the type of drink and its quantity, while for physical activity, it is the type of exercise, its intensity and the time of day in which it is carried out that affect it. The analysis highlighted inconsistencies between the behaviors reported by patients and those verified and more attention is paid to blood sugar control in the case of physical activity rather than alcohol consumption.
Fear of hypoglycemia: influence on glycemic variability and self-management behavior in young adults with type i diabetes. 2017 Qualitative (exploratory) study. Chicago	Examine how the fear of hypoglycaemia affects the self-management behaviours of blood sugar.	None.	N. 35 participants. Adults, chronological age: 18-35 years. Both sexes, 63% women. Duration of type i diabetes mellitus: at least one year. They make use of the pump. Spoken language: english. Race / ethnicity: 88% white, 9% black, 3% multiracial and 6% latin. Marital status: 60% single, 20% married, 17% cohabiting. 89% of the subjects lived far from their parents; level of education: 86% diploma or higher; 60% work full time. Exclusion criteria: pregnancy, mental or physical disorders, recent hospitalization for metabolic decompensation.	*Perspective design of repeated measures. Self-assessment questionnaires, real-time checks, daily diaries, data downloads from insulin pumps, actigraphy and continuous blood glucose monitoring.*	Summary of data collected with descriptive statistics (spss 24). Pearson correlation coefficient.	The most frequent concerns of patients who fear hypoglycaemia are: nocturnal hypoglycemia (51%), interference with important activities (49%), embarrassment that can arouse in social situations (34%), lack of food available whenever it occurs (34%). The fear of hypoglycaemia becomes chronic and gives rise to a feeling of inevitable loss of control. During the day, the fear of hypoglycaemia is felt most in the morning (52%) and in the evening (45%). All but two subjects were able to identify the symptoms of hypoglycaemia. Fear of hypoglycaemia is identified as a stress factor that increases glycaemic variability; leads to a greater caloric intake and a reduction in heavy physical activity, preferring light activity.

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Influence of health locus of control and fear of hypoglycaemia on glycaemic control and treatment satisfaction in people with type 1 diabetes on insulin pump therapy. 2017 Multicenter cross-sectional study. Italy	Considering diabetic people on insulin pump therapy, evaluate the influence of the locus of control and the fear of hypoglycaemia on metabolic control and treatment satisfaction.	Clinical outpatient clinics of the university hospital of padua and verona.	N. 214 participants. Adults, average age: 43.4 ± 12.1. Both sexes, 64% women. Average duration of type i diabetes mellitus: 23.7 ± 11.0 years. Average duration of use of the pump: at least 1 year. Average hba1c value: 7.75 ± 0.78%. Frequency of blood glucose monitoring: 5.7 ± 2.0 times a day. Exclusion criteria: previous diagnosis of dementia or psychosis, pregnancy. They were divided into two groups: the first (n = 87) with "acceptable glycemic control" [hba1c ≤ 58 mmol / mol (7.5%)] and the second (n = 127) with "suboptimal glycemic control" [hba1c> 58 mmol / mol (7.5%)].	*Interviews* on: socio-economic characteristics of the participants, educational level and marital status. Three *questionnaires*: 1) multidimensional health locus of control (mhlc scale) to estimate the locus of control; 2) hypoglycaemia fear survey ii (hfs-ii) to estimate the fear of hypoglycaemia 3) diabetes treatment satisfaction questionnaire (dtsq), to estimate treatment satisfaction.	Kurtosis index. Kolmogorov – smirnoff test. Student's t-test. Mann – whitney test. Chi-squared test. Spearman rank correlation coefficient. Multivariable regression model. P value <0.05. Used sas 9.4 for windows.	In the group with suboptimal glycaemic control, the patients were mostly overweight, they reported less frequent blood glucose controls and compared to the group of patients with acceptable glycaemic control. Their internal mhlc and dtsq scores were lower than the group with acceptable glycaemic control. The hfs-ii scores were not significantly different in the two groups. The internal mhlc score was negatively associated with hba1c and positively associated with the number of episodes of moderate / severe hypoglycaemia and with the dtsq score. The obtained hfs-ii scores were negatively associated with the dtsq score. The hfs-ii total score correlated with severe hypoglycaemic episodes and the dtsq score correlated negatively with glycaemic control. The internal locus of control and the daily frequency of blood glucose monitoring have been identified as protective factors for hba1c; the internal locus of control and the hfs-ii score have been identified as risk factors for the onset of hypoglycaemia.

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Impact of the omnipod insulin management system on quality of life: a survey of current users. 2016 Randomized cross-over crossover study. Usa	Explore the effects the omnipod pump has on quality of life.	None.	N. 1269 participants. Adults, av ± 13.3 years. Both sexes, 64.1% women. 65.7% had type i diabetes mellitus, with an average duration of more than 15 years. Average duration of use of the omnipod insulin pump: 6-24 months. Average level of hba1c: 7.4% ± 1.0%. Spoken and written language: english. Ethnicity: 84.9% caucasian. Level of education: 59% had completed college. 56% of users used the continuous blood glucose monitoring (cgm) device.	*Online questionnaires* divided into three sections; one focused on the demographic and clinical characteristics of patients, including their experience with the insulin pump and their trust in the omnipod; the second on the impact that omnipod has had on glycemic control and on the frequency of cases of hypoglycemia; the third on the impact of the omipod on the quality of life. Scales were used: world health organization-5 scale (who-5), to assess the change in general well-being; diabetes distress type i diabetes (t1-dds) scales for assessing change in diabetes stress, which included seven subscales: impotence, hypoglycemic stress, stress management, negative social perceptions, physical stress, stress with family and friends and food stress; diabetes technology impact measure (dt1m) to examine how users perceive the change in diabetes control, on the perception of safety from hypoglycemia; big-five inventory scale, to investigate the skill that each user has in using an insulin pump.	Statistical analysis with spss 23.0 software. Cronbach'alpa, factor analysis with promax rotation. Regression analysis.	The use of omnipod has brought several benefits: in general well-being (53.5%), in the perception of diabetes control (72.5%), in the perception of safety from hypoglycemia (50.6%) and in diabetes stress (69.6%).); 64.2% reported improvements in blood glucose, while 35.2% reported a drop in severe hypoglycemic episodes. Worsening in these areas was rare. Confidence in one's omnipod, improved glycemic control, and reductions in severe hypoglycemia were factors that helped improve quality of life.
Cross-sectional survey and retrospective analysis of a large cohort of adults with type 1 diabetes with long-term continuous subcutaneous insulin infusion treatment. 2014 Analytical observational qualitative study. France	Evaluate the satisfaction produced by the long-term use of the insulin pump, the behaviors assumed by users as a result, verify the safety and effectiveness of the device.	Endocrinology department of a university hospital.	N. 295 participants. Adults. Type i diabetes mellitus. Average duration of use of the pump: at least one year. Followed by a diabetes center. Exclusion criteria: absence of hba1c at the start of treatment with the pump, temporary use of the device, unclear diagnosis of type i diabetes mellitus.	*Cross-sectional survey,* carried out by telephone or e-mail. Collected data: recent hba1c level, body weight, daily insulin dose such as boluses and basal, perceived satisfaction and comfort (e.g. in work, leisure, sexual activity, rest). The level of education received on: use of the pump and frequency of blood glucose monitoring has been investigated.	Statistical analysis with sas software. T student test, logistic regression, poisson regression. Pearson correlation coefficient. P value <.05.	After an average duration of 5 years of using the insulin pump, the general satisfaction of the participants was 90%. Discomfort was low during work, leisure, rest; moderate on the other hand during sport and sexual activity. Despite a high level of education, only one third of patients made use of the advanced properties of the device. In terms of safety, the device has proven to be reliable. The hospitalization rate (for hypoglycemia or ketoacidosis) of the patients was low (0.18 patients / year) and catheter infections were low (2.0% had 2-8 episodes of infection). The hba1c level dropped to around 0.5% regardless of the duration of use of the pump.

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Insulin pump therapy is perceived as liberating, but to many it can imply a sense of the diabetes made visible. 2014 Qualitative study based on focus group interviews. Sweden	Describe the sensations of change in the transition from treatment with insulin injections to the use of an insulin pump, in patients with type i diabetes mellitus.	Endocrinology department of a university hospital of karolinska.	N. 11 participants. Adults, chronological age: 25-75 years. Both sexes, 6 men and 5 women. Average duration of diabetes: 4-46 years. Mean hba1c value: range 43–84 mmol / mol. Four users had retinopathy, while in the rest there was no nephropathy. Inclusion criteria: adults with type i diabetes mellitus who have been on an insulin pump for 1 year or 2.5 years. Exclusion criteria: presence of type ii diabetes mellitus, no knowledge of the swedish language.	*Interviews,* recorded on tape, lasting 90 minutes each. Subdivision of the participants into two discussion groups. Investigated: motivation for the change of treatment and experience lived during the transition from one to the other system, impact of the insulin pump in life, practicality of the device, support received from health professionals, reactions from relatives, friends and acquaintances and possible recommendations from use to other people.	Qualitative analysis according to graneheim & lundman. Sub-categories and then categories were formed from the codes.	The reasons for the passage of treatment, from insulin injections to the insulin pump, were mainly a high hbac1 value, high glycemic variability and hypoglycemia. Participants were satisfied with the treatment and would recommend it to other people. The meaning of the participants' experiences could be summarized by saying: "therapy with the insulin pump is perceived as liberating but also implies the acceptance of making one's diabetic state visible" Three main themes: 1) life and health 2) involvement of others 3) technological dependence
'the pump was a saviour for me'. Patients' experiences of insulin pump therapy. 2013 Qualitative study (interviews). Sweden	Describe the experience with the insulin pump by adults with type i diabetes mellitus.	Falun hospital medical clinic.	N. 16 participants. Adults, chronological age: 29-65 years. Both sexes, 10 women, 6 men. Average duration of diabetes: 8-45 years. Average duration of use of the pump: 5-9.5 years. Average hba1c value: 5.8–9.3%. Three participants had nephropathy, thirteen had retinopathy.	*Descriptive, cross-sectional interviews.* Collected data on: effects of the pump in daily life. 40-50 minutes long, recorded on tape, and then transcribed verbatim. Participants were required to give a detailed description of a typical day and talk about the advantages and disadvantages of the treatment, along with the actions taken to correct their blood sugar.	Qualitative content analysis, according to graneheim & lundman.	Main themes: insulin pump therapy perceived as a constriction or as a lifeline 6 sub-themes: 1) submission vs domination. 2) dependence vs autonomy. 3) vulnerability vs sense of strength. 4) habit vs flexibility. 5) weight vs relief. 6) stigma vs normality.
A hermeneutic phenomenological study of why adults with type 1 diabetes choose to discontinue csii. 2011 Qualitative phenomenological study. Uk	Examine why people with type i diabetes mellitus decide to discontinue pump therapy.	A branch in southern england.	N. 5 participants. Adults. Both sexes. Suffering from type i diabetes mellitus. The decision had been made to discontinue pump therapy. Nationality: british, white-skinned	*Review of the literature* using the search engine "my athens" and the keywords "continuous subcutaneous insulin infusion", "csii", "insulin pumps". *Qualitative research in the form of hermeneutic phenomenology.* The researcher is a nurse specializing in diabetes and has kept a personal diary where he reported the example of himself, a diabetic person in therapy with an insulin pump. The semi-structured interviews addressed to the study participants were also transcribed.	Analysis by themes.	3 main themes: 1) challenge to wear your pump 2) lack of control over the pump, over the body, over health 3) expectations vs reality 9 sub-themes: - challenge to wear your pump - lack of control over your pump, your body, your health - expectations vs reality

Table 2. Synthesis of the results

Title, date, type of study	Objective	Context	Characteristics of the participant	Method of data collection, posture of the researcher	Data analysis method	Results: themes and concepts and emerged concepts
Barriers to improving glycaemic control in csii. 2010 Qualitative study. Uk	Determine the barriers to achieve the gold standard of hba1c <7.5%.	Bournemouth center for endocrinology and diabetes.	17 participants. Adults, chronological age: 44 ± 13.3. Type i diabetes mellitus. Average duration of use of the pump: 3 ± 2.5 years. Average level of hba1c:> 8%.	Group discussions lasting one hour with semi-structured interviews.	Qualitative survey.	The barriers encountered in achieving good glycemic control are: fear of hypoglycemia (in fact, an hba1c value of 7% arouses anxiety and fear of an increase in hypoglycemic episodes in them); difficulties and great efforts to reach a good level of hba1c; possible restrictions and less freedom in lifestyle. These barriers have resulted in higher blood glucose levels than health professionals expected. Therefore, despite the gold standard value of hba1c being <7.5%, most remained at 8%, but still eager to continue learning how to get the most out of their insulin pumps. They agreed that their knowledge of the system was based in particular on their own experience, that of others, from online information and from education.

concern compared to the previous therapy. Patients felt confident in setting pump and managing insulin boluses and there were improvements in blood glucose control (80%), fewer hypoglycaemic episodes (68%), and less severe intensity (50%). Among the disadvantages, emerged: the fact of constantly having the device on you (37.4%), the costs (18.3%), sudden stops of the insulin pump (9.5%). Among the advantages, instead, the better perception of glycaemic control (30.4%), freedom and better quality of life (27%), flexibility given by meals (23.5%), physical activity (15.6%), corrections of insulin doses (12.1%). These feelings are in line with those mentioned by Mesbah (14) in the theme "practical trouble fear": the participants are dependent by the machine and they are concerned with the interruption of insulin delivery.

Chamberlain et al. (8) observed that, after using a less complex device, patients felt more oriented to adopt that type of therapy, thanks to the perceptions of simplicity, usefulness and potential benefits that its use had. An example was found in the qualitative study of Polonsky et al. (15): it was seen that, compared to the use of the basic type insulin pump, the use of Omnipod has brought further benefits: general well-being (53.5%), perception of diabetes control (72.5%), perception of safety from hypoglycaemia (50.6%) and from diabetes stress (69.6%); 64.2% of respondents reported improvements in blood glucose, while 35.2% reported a drop in severe hypoglycaemic episodes. In the literature review of Reidy et al. (5) there were discrepancies between patients' expectations and their experiences at the time of adopting the device, as for some it was seen as an universal remedy for glycaemic

management, for others it was seen only as an object that had improved diabetes management, so much so that they had discontinued its use(16). To motivate their transition from injection to insulin pump therapy, patients stated that they wished to have a more flexible lifestyle and easier glycaemic control (10, 11, 14, 17, 18), that could motivate to acquire new skills for the use of the device (20, 21).

It was fundamental to understand how these subjects incorporate the use of the device into their lives and what influence the support they can receive from the outside, such as from friends, caregivers or nurses has; knowing how to manage the device, makes it easier for people with diabetes to manage the pump (19, 22). The impact of the insulin pump on life at the beginning of treatment was examined, as well as the challenges that patients had to face in integrating the device into their daily life. After a first moment of experimentation with the use of the insulin pump, it was generally perceived the possibility to extend their control over diabetes (23, 24, 25, 26).

Behaviours resulting from therapy

Not all the patients have the same experience. Despite the decrease of the number and severity of hypoglycaemic episodes in the participants of six studies (2, 11, 12, 19, 27, 28) thanks to the use of the insulin pump, the fear of hypoglycaemia persisted among patients. An example is given by the study by Martyn-Nemetha et al. (28) in which it was noted that it is precisely the fear of getting hypoglycaemia that induces behavioural changes, such as a greater caloric intake and a reduction in heavy physical activity, preferring light physical activity. This was achieved by carrying out real-time checks, downloading data from insulin pumps, reading daily diaries and administering self-assessment questionnaires to 35 subjects, who used a device for continuous glucose monitoring. Participants were afraid being in hypoglycaemia at night, during important activities or socializing, with the fear of not having suitable means to deal with the emergency. This fear can become chronic and cause a feeling of loss of control. In the qualitative study by Indelicato et al. (29) the topic of the "locus of control" was examined, with the aim of understanding how it, together with the fear of hypoglycaemia, influenced metabolic control and satisfaction with the pump. The "locus of control" is the approach that each person has towards the events of his life, that is, one can think that success or failure are produced by their own efforts or behaviours (internal locus of control) or that they are determined by luck, by chance or by other people (external locus of control). In this study, we considered a sample of 214 participants who were administered questionnaires (MHLC scale to study the "locus of control"; HFS-II for the fear of hypoglycaemia; DTSQ scale for the satisfaction of the treatment). The results showed differences can also be observed between the two groups: patients in the group with suboptimal glycaemic control had a lower internal locus of control level and were less satisfied of the treatment than those with acceptable glycaemic control were.

In the qualitative study of Groat et al.(2) the behaviours of 19 diabetic subjects using insulin pumps were analysed. From the results it was observed that the choice of the bolus not suggested by the calculator was made occasionally or regularly by 15 participants, rarely or never by 4; 9 patients referred regularly or excessively to the bolus calculator with omitting the glucose reading, 9 rarely or never, 1 occasionally. 8 participants did not consult the bolus calculator for delivery regularly or excessively, 10 rarely or never, 1 occasionally. 13 participants changed settings to modulate the bolus never or rarely. In the qualitative study by Grande et al.(9), the behaviours implemented by 19 patients to compensate the need for insulin were observed. Some participants (n = 7) reported that blood glucose is affected by physical activity based on the type of exercise, intensity and time of day it is performed, others (n = 7) reported that it is affected regardless of these factors (n = 5). Findings from the study of Alsaifar suggest that exercising with the insulin pump is safe. No participant reported serious complications due to practising sport with the pump (11).According to the guidelines of the Current American Diabetes Associations (ADA), patients are recommended to check their blood sugar before exercise, to change the dose of insulin and / or carbohydrates to avoid hypoglycaemia, to do at least 150 minutes of activity moderate physical activity three times a week and with an alcohol in-

take of no more than one drink per day for women, two for men. These recommendations have not always been followed by patients and that there are inconsistencies between the behaviours they have declared to have implemented (e.g. carbohydrate intake, bolus administration, glycaemic control) and those actually encountered by reading the insulin pump data collected online(9). It has also been observed that related to regulation of blood sugar, diabetic people have more attention to the management of physical activity (eg monitor blood sugar several times a day, perform carbohydrate counting, set the correct insulin dose) rather than alcohol intake (11,14).

Obstacles to adequate glycaemic control

Nine studies (2, 6, 8, 12, 13, 15, 19, 27, 28) emphasize the improvement in blood sugar thanks to the insulin pump. Diabetes management has improved, because patients feel greater self-responsibility, with more effective self-care (13, 14). Nonetheless, obstacles have been identified to achieve adequate blood sugar. In the qualitative study by Everett (19) was found that despite the recommended value of HbA1c was <7.5%, the subjects remained on values of 8%, justifying this fact with the fear of the onset of hypoglycaemia. What was reported was in contrast with the predictions of the nurses, who expected lower HbA1c values. A further obstacle is that the study participants believe that meeting their expectations (more flexible lifestyle, reduced hypoglycaemic episodes, improved HbA1c level, more stable blood sugar level) took a long time and commitment. In another qualitative study, by Hayes et al. (16) it was found that the use of the insulin pump was above all a challenge, due to the commitment to understand its functioning. As per its visibility (inability to hide it under clothing, especially in the female sex), for its management in particular environments, for discomfort and skin irritations and for issues related to intimacy (11, 16). Secondly, the patients felt a lack of control over the insulin pump, over the body, over health due to its technical failures, to the disconnection without alarm and consequent lack of insulin absorption and the anxiety it entailed. Among 39 questions addressed to 115 participants in a Canadian study (6), one concerned the frequency and details of adverse events: the responses showed that these had arisen at the insertion site, such as pain (84%), non-adhesion (76%), irritation (69%), lipodystrophy (45%) or were of a technical nature, such as obstruction (52 %), catheter curvature (50%), pump stop (55%), air bubbles (46%). It was also noted that their onset did not depend on the length of stay in the catheter. Despite the occurrence of adverse events in all participants, only 37% of these reported them to healthcare professionals.

Discrepancy between theoretical education and reality

According to what was reported by the participants of the study of Everett et al. (19), it is clear that in order to better manage the insulin pump, the theoretical sources of information are mainly: individual experiences and those reported by other diabetic patients; the possibilities offered by technology to analyse personal data (e.g. telemedicine: allows you to download data from the insulin pump, wirelessly and in graphic form; sensors for continuous glucose monitoring with which you can check blood glucose values in real time; downloading of data from the device at home or during clinical visits); the education provided by health professionals.

The qualitative study of Joubert et al. (13) showed that, despite the prevalence of satisfaction in 90% of the participants, only a minority of them used the advanced properties of the device, despite an extensive education received (12, 14). Further considerations regarding the ineffective education were made in the study by Kannan et al.(7) a retrospective review of the electronic records of a sample of 50 patients who used the insulin pump in hospital was performed, with the aim of evaluating the trend of blood glucose in that context. . The results of the study showed that patients who had been educated to use the insulin pump during hospitalization acted in a similar way to those who had not been educated and that a quarter of them did not know how to manage the main functions of the insulin pump. Jenkins et al.(27) also drew similar results in the qualitative study; self-assessment questionnaires were administered with the aim of verifying the knowledge that patients had about the insulin pump and the strategies to be adopted for its possible malfunction. The

sample included 170 participants of whom 50% had been using the insulin pump for 5 years, 19% for 10 years. From the responses to the questionnaires, it was found that some users misused it, despite having received detailed education from health professionals.

Conclusion

This review suggests a reflection on the everyday life of a diabetic person who uses an insulin pump. It can be noted that in these patients there is the need to feel "healthy" rather than sick, facing reality that places them to interact with other subjects who are often free from disease and therefore unrelated to their experience of illness. In general, in some cases patients feel satisfied with the treatment, autonomous and self-confident in managing the pump, in others they fell distressed or insecure, with a sense of dependence by the device and health professionals. It appears necessary to further investigating how to customize interventions aimed at increase the autonomy of those patients who experience feelings of addiction. There is also the need to investigate, preferably through qualitative surveys (for example questionnaires or focus groups), what are the expectations of patients to what they will have to face daily through the use of the insulin pump, what is their perception of the experience and how much the fear of hypoglycaemia has influenced with this method of administering alternative therapy. This could also lead to collecting information for the organization of training events aimed to patient and to caregiver. Having a feeling of control over one's health is essential and the nurse should pay attention to cases where this feeling is lacking. A limitation of this review appears to be the small number of studies presented in literature regarding this issue and the limitated number of participants in some studies (2, 9, 10, 16, 19) with the consequent impossibility of generalizing the results. Given the difficulties in using the insulin pump by some patients, periodic reviews of their knowledge and skills should be implemented, with individual or group meetings, chaired by a doctor and a nurse. In addition, a medical device should be proposed in line with the patient's abilities and cognitive capacity regarding its use. Listening groups could be organized, to give the opportunity to discuss, share their experiences and feel less alone facing the disease.

Author contributions: All authors contributed to the same and review of the work.

Conflict of interest: Each author declares that she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Acknowledgments: We thank Giosuè Bacchin for his precious assistance for document translation.

References

1. Alam U, Asghar O, Azmi S, Malik RA. General aspects of diabetes mellitus. Handb Clin Neurol 2014;126:211-22.
2. Groat D, Grando MA, Soni H, Thompson B, Boyle M, Bailey M , Cook CB. Self-Management Behaviours in Adults on Insulin Pump Therapy: What Are Patients Really Doing? JDST 2017;11:233–239.
3. Pickup J, Keen H. Continuous subcutaneous insulin infusion at 25 years: evidence base for the expanding use of insulin pump therapy in type 1 diabetes. Diabetes Care 2002;25(3):593–8.
4. Bruttomesso D, Filippi A, Scotton R, Costa S. L'uso del monitoraggio glicemico continuo e del microinfusore insulinico nella donna gravida con diabete: nuove opportunità di educazione terapeutica. Il Giornale di AMD 2011;14:7-15.
5. Reidy C, Bracher M, Foster C, Vassilev I, Rogers A. The process of incorporating insulin pumps into the everyday lives of people with Type 1 diabetes: a critical interpretive synthesis. Health Expect 2018;21:714–729.
6. Taleb N, Messier V, Ott-Braschi S, Ardilouze JL, Rabasa-Lhoret R. Perceptions and experiences of adult patients with type 1 diabetes using continuous subcutaneous insulin infusion therapy: Results of an online survey. Diabetes res clin pract 2018; 144:42–50.
7. Kannan S, Satra A, Calogeras E, Lock P, Lansang MC. Insulin Pump Patient Characteristics and Glucose Control in the Hospitalized Setting. JDST 2014;8: 473–478.
8. Chamberlain JJ, Gilgen E. Do Perceptions of Insulin Pump Usability Impact Attitudes Toward Insulin Pump Therapy? A Pilot Study of Individuals With Type 1 and Insulin-Treated Type 2 Diabetes. JDST 2015;9:105–110.
9. Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. Open Med 2009;3(3):123-130.
10. Saarinen T, Fernström L, Brorsson A-L, Olinder AL. Insulin pump therapy is perceived as liberating, but to many it can imply a sense of the diabetes made visible. Euro Diabetes Nurs 2014;11:38-42.
11. Alsairafi ZK, Smith FJ, Taylor K, Alsaleh F, Alattar AT.

A qualitative study exploring patients' experiences regarding insulin pump use. Saudi pharmaceutical journal: SPJ: the official publication of the Saudi Pharmaceutical Society, 2018;26(4):487–495. https://doi.org/10.1016/j.jsps.2018.02.010
12. Garmo A, Hörnsten Å, Leksell J. 'The pump was a saviour for me'. Patients' experiences of insulin pump therapy. Diabet Med 2013;30:717-723.
13. Joubert M, Morera J, Rod AVA, Parienti JJ, Reznik Y. Cross-sectional Survey and Retrospective Analysis of a Large Cohort of Adults With Type 1 Diabetes With Long-Term Continuous Subcutaneous Insulin Infusion Treatment. JDST 2014;8:1005–1010.
14. Mesbah NI, Taha NA, Rahme ZN, Sukkar FF, Omar DM. Experiences of Adults Using Continuous Subcutaneous Insulin Infusion: A Qualitative Study. Medical principles and practice : international journal of the Kuwait University, Health Science Centre 2020;29(3):255–261. https://doi.org/10.1159/000503705
15. Polonsky WH, Hessler D, Layne JE, Zisser H. Impact of the Omnipod Insulin Management System on Quality of Life: A Survey of Current Users. Diabetes technol ther 2016;18:10.
16. Hayes M, Frearson S, Keller C, Cartmale A, Lewis-Hayes S. A hermeneutic phenomenological study of why adults with type 1 diabetes choose to discontinue CSII. Euro Diabetes Nurs 2011;8:12-16.
17. Alsaleh FM, Smith FJ, Taylor KM. Experiences of children/young people and their parents, using insulin pump therapy for the man- agement of type 1 diabetes: qualitative review. J Clin Pharm Ther 2012;37:140-147.
18. Hood DG, Duke G. The nature and meaning of insulin pump use in emerging adults with type 1 diabetes. Diabetes Spectr 2015;28:75-81.
19. Everett J, Bowes A, Kerr D. Barriers to improving glycaemic control in CSII. J Diabetes Nurs 2010;14:176-181.
20. Rankin D, Harden J, Noyes K, Waugh N, Barnard K, Lawton J. Parents' experiences of managing their child's diabetes using an insulin pump: a qualitative study. Diabet Med 2015;32:627-634.
21. Barnard KD, Wysocki T, Thabit H, et al. Psychosocial aspects of closed- and open-loop insulin delivery: closing the loop in adults with Type 1 diabetes in the home setting. Diabet Med. 2015;32(5):601-8.
22. Todres L, Keen S, Kerr D. Continuous subcutaneous insulin infusion in Type 1 diabetes: patient experiences of 'living with a machine'. Diabet Med 2010;27:1201-1204.
23. O'Kane A, Rogers Y, Blandford A. Concealing or revealing mobile medical devices? Designing for onstage and offstage presentation. Proceedings of the 2015 Conference on Human Factors in Computing Systems (CHI-2015) 2015;18-23.
24. Hood DG, Duke G. The nature and meaning of insulin pump use in emerging adults with type 1 diabetes. Diabetes Spectr 2015;28:75-81.
25. Tullman AJ. A Phenomenological Study of the Psychosocial Effects of Insulin Pump Therapy on the Body Image and Self-esteem of Female, Adolescent, Insulin Dependent Diabetics. Chicago, IL: The Chicago School of Professional Psychology 2013.
26. Forsner M, Berggren J, Masaba J, Ekbladh A, Olinder AL. Parents' experiences of caring for a child younger than two years of age treated with continuous subcutaneous insulin infusion. Euro Diabetes Nurs 2014;11:7-12.
27. Jenkins EJE, Knott J, Brooks A. Insulin pump users require recurrent education for the management of pump failure. J Diabetes Nurs 2016;20:364–9.
28. Martyn-Nemeth P, Quinn L, Penckofer S, Park C, Hoferc V, Burke L. Fear of Hypoglycaemia: Influence on Glycaemic Variability and Self-Management Behaviour in Young Adults with Type 1 Diabetes. J Diabetes Complicat 2017;3:735–741.
29. Indelicato L, Mariano V, Galasso S, Boscari F, Cipponeri E, Negri C, et al., Bruttomesso D. Influence of health locus of control and fear of hypoglycaemia on glycaemic control and treatment satisfaction in people with Type 1 diabetes on insulin pump therapy. Diabet Med 2017; 34:691–697.
30. American Diabetes Association. Standards of medical care in diabetes: 2016. Diabetes Care 2016;39(1):1-120.

Correspondence:
Received: 13 August 2021
Accepted: 13 October 2021
Veronica Strini MSc, PBSc
Clinical Research Unit
University-Hospital of Padua,
via Giustiniani 2, Padua 35128 Italy
E-mail: veronicastrini@gmail.com
https://orcid.org/0000-0002-6863-1154