



THE JOANNA BRIGGS INSTITUTE

The effectiveness and appropriateness of educational components and strategies associated with insulin pump therapy (IPT):
A comprehensive systematic review



This review was commissioned by the Australian Diabetes Educators Association and funded through the National Diabetes Services Scheme (NDSS). The NDSS is an initiative of the Australian Government administered by Diabetes Australia.

July 2008

Promoting and Supporting
Best Practice

The effectiveness and appropriateness of educational components and strategies associated with insulin pump therapy (IPT): A comprehensive systematic review

Dr Rasika Jayasekara, RN, BA, BScN(Hons), PG Dip Edu, MNSc, PhD¹

Mr. Zachary Munn, BMR (NM)²,

Mr. Craig Lockwood, RN, BN, GDipClinNurs, MNSc³

^{1,2} Research Fellow, ³Associate Director Research and Innovation, Joanna Briggs Institute, Level 8, Royal Adelaide Hospital, North Terrace ADELAIDE SA 5000
Tel: +61 8 8303 7581

Reference Group Members:

Ms. Erica Wright (Chair)
Australian Diabetes Educators Association

Ms. Carmel Smart
Australian Diabetes Educators Association

Mr. Brad Marney
Australian Diabetes Educators Association

Dr. Jane Overland
Australian Diabetes Educators Association

Associate Professor Alicia Jenkins
Australian Diabetes Society

Dr. Kim Stanton
Australian Diabetes Society

Project Officer:
Mrs. Gunhild Cremer
Australian Diabetes Educators Association

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Foreword

As the leading Australian organisation for health professionals providing diabetes education and care, the Australian Diabetes Educators Association sets standards of practice in diabetes education.

The Australian Diabetes Educators Associations supports the implementation of the National Diabetes Services Scheme by undertaking a range of projects determined in its National Diabetes Services Scheme Services Plan with the view to improving the standard of care and education provided to people with diabetes. This report is the outcome of a systematic review undertaken by the Australian Diabetes Educators Association. The review was undertaken in recognition of the need to establish standards of practice in the growing area of insulin pump therapy as identified in the Australian Diabetes Educators Associations National Diabetes Services Scheme Services Plan.

Consumer uptake of insulin pump therapy has continued to increase in recent years. As of July 2006, 2,700 children, adolescents and adults were registered to purchase insulin pump consumables through the National Diabetes Services Scheme. In June 2008, 4,142 adults alone were receiving insulin pump consumables from the National Diabetes Services Scheme.

A variety of factors have contributed to the increased acceptability of insulin pump therapy among both consumers and diabetes health professionals. Evidence has demonstrated that glycaemic control as close to normal as possible may prevent or delay development of chronic diabetes complications. Advances in insulin pump technology such as improved safety and quality mechanisms have reduced the likelihood of acute diabetes complications arising from insulin pump therapy. Evidence now suggests that people with diabetes choosing insulin pump therapy can achieve near normal blood glucose levels without a significant increase in adverse events.

The individual economic burden from insulin pump therapy has been reduced. Insulin pump consumables have become available for eligible consumers through the National Diabetes Services Scheme. The purchase price of insulin pumps has remained relatively unchanged in recent years. There has been an increase in the uptake of private health insurance following the Commonwealth's introduction of 30% contribution rebate thus enabling more people to obtain a rebate for the

purchase of an insulin pump from their insurer.

Increasing consumer acceptance has led to increasing demand for insulin pump therapy initiation and ongoing care. However, consumers, health professionals and industry representatives have expressed concern regarding difficulties expressed by consumers wishing to access insulin pump services, particularly outside larger public hospital services provided in metropolitan areas.

Diabetes self management education in the initiation and ongoing care of people choosing insulin pump therapy has become an increasing part of the practice of Credentialed Diabetes Educators. Credentialed Diabetes Educators are now responsible for 87% of all authorisations for access to insulin pump consumables from the National Diabetes Services Scheme. Diabetes educators have reported that increasing consumer demand has resulted in work - intensification as they attempt to deal with waiting lists for insulin pump therapy initiation and accommodating ongoing insulin pump therapy care arrangements within existing appointment schedules. Diabetes educators have expressed concerns with respect to lack of equity of access to insulin pump therapy as well as inconsistency of practice in delivery of insulin pump education and support services.

The Australian Diabetes Educators Association recognises the importance of ensuring equity of access to effective care through consistent standards of practice. A search for existing best practice recommendations in insulin pump therapy yielded information with regards to various aspects of care, treatment and management. The search included a Cochrane review of multiple daily insulin injections versus insulin pump therapy in pregnancy, a Cochrane protocol comparing treatment with multiple daily insulin injections to insulin pump therapy and international consensus guidelines for insulin pump therapy in paediatric and adolescent diabetes care. However, no practice recommendations were found for the provision of diabetes self management education in initiation and ongoing care of adults with type 1 diabetes who use insulin pump therapy.

The Australian Diabetes Educators Association initiated a staged project aimed at developing best practice recommendations for the provision of diabetes self management education in initiation and ongoing care of adults with type 1 diabetes choosing insulin pump therapy as their modality of treatment. The Joanna Briggs Institute was commissioned to undertake a comprehensive systematic review of the effectiveness and appropriateness of educational components and strategies

associated with insulin pump therapy. A Reference Group with representatives from the multidisciplinary Australian Diabetes Educators Association membership and the Australian Diabetes Society was established to ensure the project's direction remained grounded in practice and to provide expert opinion to the Joanna Briggs Institute and the Australian Diabetes Educators Association project management team.

This report is the first stage in the development of best practice recommendations for the provision of diabetes self management education in the initiation and ongoing care in insulin pump therapy for adults with type 1 diabetes. The report will inform the development of practice recommendations and underpin the Australian Diabetes Educators Association approach during the project's second stage. The Australian Diabetes Educators Association would like to take this opportunity to acknowledge and thank the Joanna Briggs Institute and the Reference Group members for their contribution.

Jane Giles

President

Australian Diabetes Educators Association

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EXECUTIVE SUMMARY

Objectives

The objectives of this review were to establish the effectiveness and appropriateness of approaches to the provision of education for adults with type 1 diabetes using or initiating insulin pump therapy (IPT), and identify the best available evidence on the association between intervals and duration of follow up and the stated outcome criteria.

Inclusion criteria

This review considered all studies and papers that involved adults (aged 16 years or over) with type 1 diabetes using IPT as their form of therapy who participated in education or training, with no restrictions placed on gender or co-morbidities. All forms of education, including resources utilised during education were included in the review.

Search strategy

The search strategy sought to find both published and unpublished studies and papers written in the English language. An initial limited search of MEDLINE and CINAHL databases was undertaken to identify optimal search terms. A second search using all identified keywords and index terms was then undertaken based on key words specific to each database across all included databases from 1998 to February 2008. Thirdly, the reference lists of all identified reports and articles were searched for additional studies.

Methodological quality

Two independent reviewers assessed the methodological quality of retrieved papers using the corresponding checklist from the System for the Unified Management, Assessment and Review of Information (SUMARI) package.

Results

A total of 142 studies were identified as potentially relevant to the review question in the first and second steps of the literature search. Based on the title and abstract, 30

papers that were relevant to the review topic were retrieved for evaluation of methodological quality. Following this stage, 20 papers were excluded. Whilst searching the reference lists of the selected studies ($n=10$), one paper met the inclusion criteria. Therefore, a total of 11 papers were included in the review. Of these 11, five descriptive studies examined educational programs and their impact on a variety of outcomes. The included papers reported a variety of educational methods and different outcome measures. Due to the lack of qualitative research to inform the subjective perspectives related to experiences in IPT education, the appropriateness of educational components and strategies is described using six opinion papers including a position statement, a consensus statement and four expert opinions papers.

Conclusion

In general, it is difficult to draw a strong conclusion regarding the effectiveness of components and strategies associated with IPT due to a lack of high quality comparative studies, small sample sizes and a variability of reported methods in the included studies. However, included descriptive studies explored a range of issues related to the effectiveness of IPT therapy, and the educative requirements of patients. It is clear that type 1 diabetes patients initiating and utilising IPT need a comprehensive range of advice, education and training. The mixture of group and individual teaching, multidisciplinary teams as educators, educational materials, long-term training with multiple sessions and a variety of educational contents may all be effective for delivering IPT education and training. In terms of educational outcomes that meet the needs of patients, there was evidence to suggest educational programs should be structured, and the content delivered in such a way that individual patients' goals in relation to lifestyle and degree of glycaemic control be facilitated. However, educators also were seen as having a gate keeper role as not all patients may be appropriate for IPT, or have realistic expectations of what IPT would achieve for them in terms of social and glycaemic control.

Keywords

Insulin pump therapy, IPT, continuous subcutaneous insulin infusion, CSII, insulin pump, insulin infusion, education, training, systematic review

INTRODUCTION

The purpose of this systematic review was to identify evidence for the effectiveness and appropriateness of educational components and strategies associated with insulin pump therapy (IPT). The review located all forms of research and papers on the topic. The design and conduct of this review was in accordance with the methods established by The Joanna Briggs Institute (JBI). The JBI System for the Unified Management, Assessment and Review of Information (JBI SUMARI) was used to assist with the review.

BACKGROUND

The popularity of insulin pump therapy (IPT) or continuous subcutaneous insulin infusion (CSII) as a treatment option for diabetes mellitus has increased over the past decade.^{1,2} It is estimated that the insulin pump is used in everyday therapy by at least 130 000 people worldwide, with more than 80 000 in the USA alone.³ It is also suggested that nearly 8% of adults and approximately 6% of children with Type 1 diabetes use insulin pumps worldwide.³

The findings of the Diabetes Control and Complications Trial (DCCT) and the UK Prospective Diabetes Study (UKPDS) have highlighted the importance of intensive therapy in achieving tight metabolic control and improving long-term health.^{4,5} IPT has been demonstrated in numerous studies to be an effective method to achieve near normoglycemia and reduce the number of episodes of severe hypoglycaemia.^{6,7} The principle of IPT is to mimic the normal function of the pancreas, by providing continuous basal infusion of short acting insulin to reduce hepatic glucose production and normalise glucose in the fasting state. Prior to meals, the user infuses a predetermined bolus of insulin that is based on the carbohydrate content of the food to be eaten and the blood glucose concentration. In this way, IPT provides greater lifestyle flexibility and food choices.^{2,3,8}

The initiation of IPT requires the candidates to develop and apply a new spectrum of theoretical knowledge and practical skills. Although education and training is the key to successful initiation, IPT can be difficult to teach and also to learn. This is due to the myriad technical factors associated with the device⁹, the need for continuous

monitoring of blood glucose levels, education regarding how to live with the pump attached and the need for nutritional training such as carbohydrate counting, along with various lifestyle considerations. IPT candidates therefore should be motivated, have the technical and functional ability to operate the pump and the intellectual ability to be able to learn new skills.^{10, 11}

There is no consensus on the core requirements of an educational program or structure outlined in the published literature for IPT. There is an inconsistency in the literature regarding important aspects of the educational program, such as educational strategies, components of the program, teaching and learning materials, length of time of the education, follow up training and whom the educating team should consist of. However, there has been no attempt to systematically review the evidence on the effectiveness and appropriateness of IPT educational strategies and components. Such a systematic review will assist diabetes educators to develop appropriate educational programs for IPT.

OBJECTIVES

The objectives of this review were to establish the effectiveness and appropriateness of approaches to the provision of education for adults with type 1 diabetes using or initiating IPT, and identify the best available evidence on the association between intervals and duration of follow up and the stated outcome criteria.

Specifically, the review addressed the question:

What are the most effective and appropriate strategies for delivering education for adults with type 1 diabetes either using or initiating IPT?

In the context of this review, the following definitions have been applied:

Effectiveness: the extent to which an intervention, when used appropriately, achieves the intended effect. Clinical effectiveness is about the relationship between an intervention and clinical or health outcomes.¹²

Appropriateness: the extent to which an intervention or activity fits with or is apt in a situation. Clinical appropriateness is about how an activity or intervention relates to the context in which care is given.¹²

REVIEW METHOD

Inclusion criteria

A-priori inclusion criteria were used to assess whether papers were relevant to the review topic. Papers that met the inclusion criteria were considered to be applicable to the review topic and retrieved for further assessment of quality. The inclusion criteria for this review were as follows.

Types of studies/papers

This review considered quantitative, qualitative and textual evidence. Quantitative evidence, particularly randomised and quasi (pseudo) randomised controlled trials (RCTs) were specifically searched for. In the absence of RCTs, other quantitative study designs, including cohort, longitudinal, case series and descriptive studies were considered. The review criteria also included qualitative evidence on the meaning and experience of participants who have received or delivered education programs, therefore, research designs such as phenomenology, grounded theory and ethnography were considered. Additionally, evidence in the form of text and opinion, conference proceedings, and program evaluations were searched. All studies were categorised according to the JBI Levels of Evidence (Appendix I)

Types of Participants

The review considered all studies and papers that involved adults (aged 16 years or over) with type 1 diabetes using IPT as their primary form of therapy who participated in education or training, with no restrictions placed on gender or co-morbidities. Additionally, the perspectives of those providing education and/or training were identified. Papers where the participants' age ranged below age 16 were retrieved and assessed to determine if sub group analysis could be conducted on those participants aged 16 or higher.

Types of Intervention(s)

The intervention of interest was education and/or training as defined in the individual papers retrieved. All forms of education, including resources utilised during

education were included in the review. These interventions were compared to either standard practice (education), which included any method or technique already in place at the facility, or no intervention.

Type of Outcomes

The outcomes of interest were:

Glycaemic control measured by glycated haemoglobin concentration (HbA1c-level) and/or fasting plasma glucose level;

Continuous blood glucose monitoring;

Body Mass Index and weight;

Episode of Diabetic ketoacidosis (DKA);

Frequency and severity of hypoglycaemia;

Frequency of admission/presentation/contact with healthcare professionals for blood glucose level problems;

Frequency of site complications (including infection);

Quality of life, well-being;

Patient satisfaction;

Experience (as described by those delivering and those receiving education and/or training in the qualitative literature);

Insulin pump knowledge;

Patient self-care behaviours (dietary habits, physical activity levels);

Self management skills (medication administration and/or adjustment, use of insulin pump);

Self-management skills in relation to adverse events such as hypoglycaemic events (patient managed or assisted), and hospital admissions for blood glucose level associated problems.

Additional outcome measures included timing of outcome assessment where available using the following schema:

Short term: until six months of the intervention;

Medium term: between six and twelve months of the intervention;

Long term: more than twelve months of intervention.

SEARCH STRATEGY

The search strategy aimed to find both published and unpublished studies and papers written in the English language. Studies conducted between 1998 and 2008 were targeted. A three-step search strategy approach was used. An initial limited search of MEDLINE and CINAHL was undertaken followed by analysis of the text words contained in the title and abstract, and of the index terms used to describe the article. A second search using all identified keywords and index terms was then undertaken based on key words specific to each database across all included databases from 1998 to February 2008. Thirdly, the reference lists of all identified reports and articles were searched for additional studies.

The databases searched included:

MEDLINE

CINAHL

Cochrane Library

EMBASE

Current Contents

PsycINFO

The search for unpublished studies included:

Digital Dissertations (Proquest)

For a complete list of search terms, see Appendix II

ASSESSMENT OF METHODOLOGICAL QUALITY

Identified papers that met the inclusion criteria were grouped into one of the following categories: experimental studies, descriptive studies, qualitative studies and text/opinion papers. The papers were then assessed by two independent reviewers for methodological quality before inclusion in the review using JBI SUMARI (Appendix III). Any disagreements that arose between the reviewers were resolved through discussion and if necessary with a third reviewer.

DATA COLLECTION

Following assessment of methodological quality, papers were grouped according to study methodology and other text. The quantitative data was extracted from papers included in the review using the standardised data extraction tool from the JBI Meta Analysis of Statistics: Assessment and Review Instrument (JBI-MAStARI). The qualitative data was extracted using the JBI Qualitative Assessment and Review Instrument (JBI-QARI). The opinion and other text data were collected utilising the JBI Narrative, Opinion and Text Assessment and Review Instrument (JBI-NOTARI) (Appendix IV). Where it was considered that papers did not adequately describe the educational interventions of interest, the authors were contacted to seek further information.

DATA SYNTHESIS

Quantitative data analysis

It was planned, where possible, for quantitative research study results to be pooled in statistical meta-analysis using JBI-MAStARI. All results were to be double entered. Odds ratio (for categorical data) and weighted mean differences (for continuous data) and their 95% confidence intervals were to be calculated for each analysis. Where possible, heterogeneity between comparable studies was to be assessed using the standard Chi-square analysis. However, statistical pooling was not possible because the study designs lacked randomisation or controls, and had a high degree of heterogeneity between study populations, interventions and outcome measures, hence the findings have been presented in a narrative form.

Qualitative data synthesis

It was planned, where possible, for qualitative research findings to be pooled using the Qualitative Assessment and Review Instrument (JBI-QARI). The process of meta-synthesis embodied in this program involves the aggregation or synthesis of findings/conclusions made in relation to the intervention, activity or phenomenon that is the subject of the review. The aim of the process is to generate a set of statements that represent aggregation through assembling the findings or conclusions rated according to their credibility (Appendix V), and categorising these

findings/conclusions on the basis of similarity in meaning. These categories are then subjected to a meta-synthesis in order to produce a single comprehensive set of synthesized findings that are used as a basis for evidence-based practice. However, in this review, only two qualitative papers were identified and these did not meet the inclusion criteria for the review, hence qualitative meta-synthesis was not possible.

Textual data synthesis

Conclusions from text and opinion based papers were subject to iterative thematic analysis using the Narrative, Opinion and Text Assessment and Review Instrument (JBI-NOTARI). This involved the aggregation or synthesis of conclusions to generate a set of statements that represent that aggregation, then assembling and categorising these conclusions on the basis of similarity in meaning. These categories were then subjected to a textual meta-synthesis in order to produce a single comprehensive set of synthesised findings that can be used as a basis for evidence-based practice. In this study a textual meta-synthesis is included in addition to a narrative summary of textual papers.

RESULTS

Description of studies

A total of 142 studies were identified as potentially relevant to the review question in the first and second steps of the literature search. Based on the title and abstract, 30 papers that were relevant to the review topic were retrieved for evaluation of methodological quality. Twenty papers were excluded due to incongruity with the review objectives and/or outcomes (Appendix VI). Whilst searching the reference lists of the selected studies ($n=10$), one paper met the inclusion criteria. Therefore, a total of 11 studies were included in the review. The design of the studies is as follows:

- Five descriptive studies
- Six text/opinion papers.

The identification, inclusion and exclusion results are illustrated in Figure 1. A table of the included studies and papers is in Appendix VII.

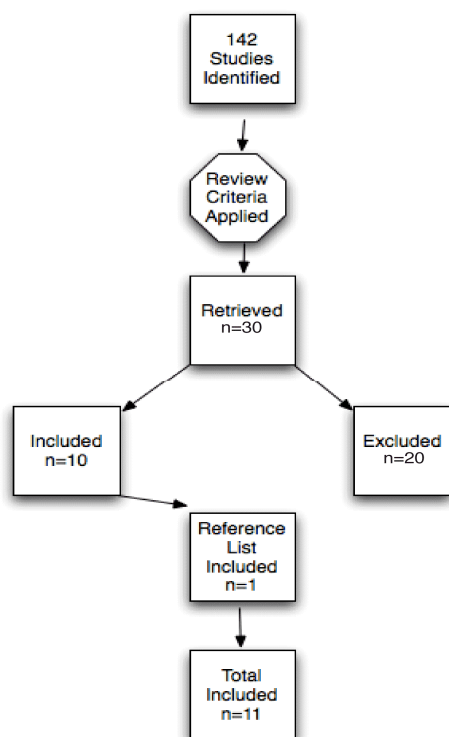


Figure 1: Numbers of papers identified, retrieved, included and excluded.

It should be noted that inadequate reporting of the descriptive studies made it difficult for the investigators to extract and analyse in detail the educational strategies utilised in some studies; where this was the case, the authors were contacted to obtain additional data. Only one author¹³ provided additional information and this information is reflected in the report.

Effectiveness of educational components and strategies

In this review, educational components are defined as the contents of the educational program, and educational strategies are defined as educational methods (e.g. individual teaching, group teaching etc.) and teaching and learning aids (e.g. information packages, video etc.). A total of five descriptive studies that included three pre and post-test designs evaluated educational programs and their impact on a variety of outcomes. The included papers reported a variety of educational methods and different outcome measures. Meta-analysis was not possible due to the different outcomes and interventions of the selected studies. This evidence is therefore

presented in a narrative summary.

A descriptive study from the Nationwide Quality Circle in Germany (ASD) in 1999-2000 included 250 IPT patients with type 1 diabetes mellitus (age 36.0 +/- 13.1 years; diabetes duration 16.1 +/- 9.9 years) from 21 ASD hospitals.¹⁴ All IPT patients had participated in a structured seven-day treatment and teaching program (TTP) that included technical instruction about the insulin pump, catheter and tape, adjustment of insulin dose, daily living instructions, prevention and management of ketoacidosis and severe hypoglycaemia, blood glucose self monitoring and documentation. Data were collected using four indicators: HbA1c, frequency of severe hypoglycaemia (defined as requiring intravenous glucose or glucagon administration), diabetes ketoacidosis (DKA) with hospital admission and hospitalisation days during 12 months before and after participation in the TTP. The study revealed that one year after participation in the TTP, the mean relative HbA1c (Relative HbA1c= HbA1c/Mean HbA1c of a normal control group) decreased from 1.51 (0.9-3.2) to 1.44 (0.9-3.6) afterwards ($p<0.0001$). Severe hypoglycaemia decreased from 0.46 to 0.12/patients/year ($p<0.001$), DKA from 0.08 to 0.05/patients/year ($p=0.003$) and hospitalisation from 5.2 to 3.1 days/patients/year ($p=0.002$).¹⁴ The study concluded that outcomes (HbA1c, incidents of hypoglycaemia, ketoacidosis, hospitalisation days) improved after participation in a TTP.

In a prospective study, 70 patients with type 1 diabetes and no significant comorbidity were recruited to intensified conventional therapy (ICT) that included a skills training program.¹⁵ The total duration of the skills program was not described. The major aim of this program was to empower patients to self-manage their diabetes. The training program was conducted in three phases. In the first phase, patients and partners were involved in 45 minutes training on carbohydrate counting that included reading and analysing of food labels and portion size. In this program, visual aids (e.g. bespoke displays, commercially available guides) were also used as teaching and learning materials. After successful completion of this phase, the next step was one-on-one instruction on insulin dosage, carbohydrate portions and the use of correction boluses for glycaemic excursions. The third phase involved a short term follow up program in a multidisciplinary clinic for analysing patients' dairies that incorporated food records, blood glucose records, and insulin dosages to ensure

appropriate use of insulin dosage and adjustments. Following the conversion of 70 patients to ICT, 12 of these converted to IPT during some period following ICT. In these 12 patients a significant improvement in HbA1c was seen following ICT (pre-ICT HbA1c $9.6\pm 1.5\%$, post-ICT HbA1c $8.3\pm 1.4\%$, $t = 2.9$, $p < 0.02$), but no further improvement was seen after a further year of IPT (HbA1c $8.4\pm 0.8\%$, $n = 9$).¹⁵ Furthermore, the study revealed that two-thirds of those opting to continue with ICT showed a sustained improvement in glycaemic control over one year. The study also found that patient satisfaction with both ICT and IPT was very high according to a questionnaire. The study concluded that IPT did not appear to offer significant glycaemic control advantages over ICT in this program. The authors recommend that ICT including a training program can be used to initiate IPT successfully.

In an observational retrospective study, five older adults with type 1 diabetes (mean age 66.4 years) who changed to IPT were investigated to describe the impact of IPT on clinical outcomes.¹³ These patients had suboptimal glycemic control (HbA1c $> 8.0\%$), microvascular complications, and frequent hypoglycaemia (frequency was not quantified). Before initiation of IPT all patients had participated in a total eight hours outpatient intensive insulin pump training and attended training on carbohydrate counting at the American Diabetes Association recognised diabetes care program of University Hospital, Augusta, Georgia. The teaching method was conducted in groups, and included both lecture format and interactive sessions. Follow-up training programs were conducted by a diabetes nurse educator and a registered dietician at biweekly visits (one hour) during the following period of two to four months. Components covered in this program included self-monitoring of plasma glucose by finger-stick analysis, carbohydrate counting for determining premeal insulin boluses, calculation of insulin requirements and practical aspects of insulin pump use (e.g. insulin replacement, care of needle insertion sites, and pump malfunction). Teaching aids utilised were a blackboard, books, printed materials, pictures and models of foods and food portions. HbA1c levels were measured before intensive training was initiated, at the start of IPT and during IPT to investigate whether the training or IPT improved glycaemic control. The study found that individual and mean HbA1c values showed no significant improvement after intensive training but decreased considerably only after initiation of IPT (HbA1c pre IPT 9.16% , post IPT 7.6% $p < 0.0025$).¹³ The study concluded that initiation of IPT

was the major factor contributing to the observed favourable outcomes.

An Australian survey was conducted to evaluate the incorporation of a nutritional information session at an insulin pump clinic on improving knowledge and food choices, and to assess patient satisfaction with the session.¹⁶ A diabetes educator conducted one and a half day training for patients commencing IPT. The program provided information and training to operate the pump and to set the initial basal rates and pre-meal boluses. The nutrition session was held at the end of the second half-day and lasted for 45-60 minutes. In addition, written nutritional information on carbohydrate exchanges and glycaemic index and several other learning aids (e.g. “Facts on fat”, “Sugar update”) were used as teaching materials. An eight-part self-administered questionnaire was sent to 25 adult patients who had attended the insulin pump training and 16 responded. As the sample size was small, the results were presented as a narrative summary. The study suggested that the most useful information provided (as rated by four patients) was the information on carbohydrate counting and glycemic index. Of the 11 participants who answered this specific question, eight participants were able to recall a message from the session consistent with the information provided and five participants actively made dietary changes following the session. The study concluded that participants were generally positive about the nutrition information session. While these were subjective outcomes, and it is not clear whether there was any impact on objective clinical outcomes, it is clear this study group felt the information was useful to them. It is reasonable to conclude that patients using IPT benefit from a range of information, not just technical information related to IPT usage.

A descriptive study was conducted to explore the use of a group approach for the initiation and training for IPT.¹ A group of diabetes experts in the Royal Liverpool University Hospital, United Kingdom were the investigators in this study. The education and training program included two group sessions and follow-up. During the first session, basic pump programming and operation skills were taught. The participants were allowed to take the pump home as this enabled them to become more familiar with the pump. In the second session, participants commenced IPT and the participant programmed in the basal rate, primed the pump and inserted the cannula under supervision. The study reported that the patients had lunch with the

dietitian, which provided an excellent opportunity for the practical application of calculating insulin doses for various food choices. In addition, this training included a discussion about dietary, life style and pump management issues. The day after initiation of IPT the group met again for information on adjusting the basal rate and also to discuss knowledge gaps and problems. Subsequent follow-up was arranged according to specific needs until glycaemic control was optimised. The training program was subjectively evaluated using a questionnaire and interview. Although the sample size was not reported, the study found that all participants were very positive about the group program. Furthermore, the study found that group participation saved approximately 10-27 hours of professional time compared to individual training.¹ The study concluded that the group approach for IPT training allows the development of peer support, strengthens the learning process and avoids isolation.

Appropriateness of educational components and strategies

Following the literature search, two qualitative studies were retrieved based on title and abstract; however, these studies were excluded due to incongruity with the review objectives. Due to the lack of qualitative research to inform the subjective perspectives related to experiences in IPT education, the appropriateness of educational components and strategies is described using six opinion papers including a position statement, a consensus statement and four expert opinions papers.

A position statement published by the American Association of Diabetes Educators (AADE) was designed to provide direction for the educational requirements related to IPT.¹⁰ This included the major components required for an adequate educational program along with selection criteria for patients to begin IPT. The position statement highlights that IPT may be initiated in either the inpatient or outpatient setting. In these settings, adequate education and training should be provided regarding insulin dose adjustment and technical management of the pump.

The position paper further recommended that components of an education program should include blood glucose monitoring (e.g. frequency), diet (e.g. carbohydrate

counting, nutrition assessment), exercise (e.g. adjustment of food and/or insulin in anticipation of physical activity), technical aspects (e.g. operating procedure), sick day management (e.g. adjusting the insulin infusion), hypoglycaemia management (e.g. blood glucose monitoring), hyperglycaemia management and prevention of DKA (e.g. checking urine ketones), and infection (e.g. changing the infusion site every 48-72 hours).¹⁰ It was recommended that patients should be well trained to identify problems associated with IPT and educated on how to solve these issues. It was also suggested that a qualified professional, with expert knowledge regarding IPT should be accessible 24 hours a day in order to assist the new user of IPT. In addition, IPT education should include knowledge of how to manage their pump during activities such as showering, sexual intercourse, strenuous exercise, and sleeping. The paper concluded that even among motivated patients, a range of technical skills and self-management capabilities are required for successful implementation of IPT.

One paper included in this review summarised the findings of a series of studies involving more than 800 patients in the United States, and included consensus and expert opinion on IPT.⁸ The authors of this paper included a medical director for a diabetes resource centre in Atlanta, a professor of paediatrics, Yale University School of Medicine and a practicing endocrinologist in Atlanta. The paper outlines the history of IPT development, its advantages, impact on physiological outcomes and diabetes management. Based on experiences in the clinical setting, the authors suggested that insulin pump training may be undertaken in two 60-90 minute outpatient sessions, with no need to admit patients to the hospital. The paper recommended that IPT education should focus on adjustments of premeal bolus doses to accommodate variations in pre-prandial glucose levels (using correction boluses) and meal size (using carbohydrate counting), prevention of ketoacidosis and hypoglycaemia, and algorithms for sports and exercise, care of injection sites, and use of advanced pump features. The paper outlined appropriate insulin dose levels (basal dose, bolus, total daily insulin levels) when initiating pump therapy. The paper suggested that patients should be encouraged to call their healthcare professional if they have a problem. Through analysis of patients during routine follow-up visits, the authors identified several factors that are key to successful treatment with insulin pumps. The most important is frequency of blood glucose monitoring (patients who

monitor blood glucose levels three or more times a day have a lower average HbA1c level than patients who monitor levels once or twice daily (7.2% versus 8%; $P < 0.001$).⁸ Other important factors affecting glycaemic control were recording of insulin doses and blood glucose values in a logbook (HbA1c value, 7.4% in adults who record versus 7.8% in adults who do not record, and a $>1\%$ reduction in adolescents who record) and counting carbohydrates (HbA1c value, 7.2% in those who count carbohydrates versus 8% for an undefined diet; $P < 0.001$).⁸ Furthermore, authors highlighted that most of patients' families felt that the improvements in metabolic control and quality of life made such an investment worthwhile. The authors concluded that patient education, careful adjustment of basal/bolus doses and close follow-up (including education) are crucial to the success of IPT.

A review paper by Boland et al. discussed insulin pump therapy in adolescents and utilise case studies to emphasize points they make in the paper.¹⁷ This paper is largely based on expert opinion and is set in the United States, with some reference to relevant literature, and provides several recommendations on IPT initial training and follow-up. The authors suggested that the diabetes nurse should meet with the patient and family and should provide initial education and training at the beginning of the therapy. Patients and family members should be encouraged to write down all their questions and bring these into the educational sessions. The authors believed that this helped to identify potential risks of IPT.

In addition, educational materials, literature and videos should be provided to the family and patients beginning IPT for the necessary basic information.¹⁷ The paper recommended that the patient should be able to contact the diabetes nurse with any questions during initiation of treatment. The focus of educational preparation was based on the understanding that people need time, reinforcement and often the "safety net" of available advice and expertise as they start out with IPT. The diabetes nurse educator was seen as being ideally placed to provide this additional coverage. Actual implementation of 24-hour coverage by a diabetes nurse educator has significant resource implications; and this opinion paper did not provide evidence to support this recommendation. While the opinion sought to best represent the needs of patients commencing IPT, it may not be appropriate in the Australian health care context. In conclusion, the paper suggested that continued education is vital due to

new circumstances arising in the adolescent's life. Therefore it is important that IPT education is tailored to the developmental stage of the IPT patient.

A paper on IPT education presents expert opinion from a diabetes specialist nurse with extensive experience in a community clinic in The Netherlands.¹⁸ This expert opinion paper is based on literature and clinical experience. The paper recommended that IPT education be performed in a group setting and then individually, with the content and timing of individual education provided on an as required basis. In the group setting, interaction between patients and sharing of their experiences is beneficial, as the patients then motivate each other through the sharing of experiences and ideas. Individual education was described as a continuing process of evaluating and practising skills. The paper also suggested that a multidisciplinary team that consists of doctors, dieticians and nurses be involved in the provision of education. The authors own community clinic offered individual IPT education. In the first week, patients attended daily half an hour educational sessions. After that they attended education sessions weekly and then monthly. The paper does not provide details of program evaluation. The paper concluded that patients should not have access to IPT until they have been well educated about IPT as they should be able to take responsibility for their decisions concerning their illness.

The focus of this paper was on cultural appropriateness from the perspective of new to IPT patients needing to take in important information without feeling overwhelmed or threatened. The author suggests providing education in a format, which would not overload patients with information by beginning with half hour sessions, and gradually extending the time between sessions. This was seen as more appropriate to persons planning to start IPT as it would decrease the risk of information overload, and readily enable patients to follow up with questions, or return to prior learning experiences at their own pace rather than feeling pressured to conform to a set program with a limited time frame.

A review paper based on expert opinion and the relevant literature focused on the technical problems associated with IPT and its impact on metabolic complications; highlighting the need of an adequate education program to prevent these risks.⁹ The authors are situated in Brittany, France, and have had clinical experience with

patients utilising pumps in this region. The paper provides an overview of technical problems associated with IPT, such as infusion set failure, infection/inflammation at the insertion site, insulin precipitation or aggregation, pump malfunctions, metabolic complications due to technical defects, and prevention and treatment of technical and metabolic complications of IPT. The paper suggested that appropriate education should be given to each patient prior to IPT commencement to prevent complications. The education program should be planned to address technical failure of IPT (e.g. obstruction and leakage from the infusion site, cannula dislodgement, battery failure, empty syringe) and possible solutions (e.g. frequent switching of injection sites, additional taping of the cannula, awareness of corresponding alarms, spare batteries and insulin). In addition, the paper recommended that the IPT education should also focus on blood glucose monitoring, prevention of cutaneous complications (e.g. body hygiene, hand washing before insertion of needles, sterile covering of the needle), management of hypoglycaemia due to programming error (e.g. checking basal infusion rates and bolus doses previously administered), and prevention of DKA (e.g. checking urine ketones). The paper concluded that a professional 24-hour on call service and frequent outpatients visits for technical reassessment are required to prevent technical complications of IPT.

A consensus statement from the European Society for Paediatric Endocrinology, the Lawson Wilkins Pediatric Endocrine Society, and the International Society for Pediatric and Adolescent Diabetes, which has been endorsed by the American Diabetes Association and the European Association for the Study of Diabetes provides recommendations related to IPT in paediatric and adolescent patients with type I diabetes.² In relation to IPT education, the consensus statement suggested that patients (children and adolescents) and their caregivers receive initial and ongoing education regarding warning symptoms and strategies for prevention of DKA and problem-solving strategies for pump problems. It was also advised that initial and ongoing education should include pump functions, proper infusion set insertion, nutrition therapy (carbohydrate counting/estimation), basal-bolus therapy principles, insulin kinetics, hypoglycaemia/hyperglycaemia management, activity and exercise and its effect on blood glucose, and sick day management. Furthermore, the consensus statement recommended that information on handling the pump in intimate situations should be provided to adolescents and young adults using IPT.

Textual meta-synthesis

The above narrative summary provides a textual overview of the evidence related to appropriateness in relation to education and training for IPT. While narrative summary provides a useful overview of the literature, it does not readily highlight the key themes that emerge from thematic analysis, and tends to be overly descriptive.

Meta synthesis of textual data is an analytic process of working with non-research papers to summarise and bring together the views and opinions of the authors. Textual data is not the same as research findings, however it is a useful source of novel evidence, which often precedes research. The textual data reported here has been critically appraised following selection only of papers that met the inclusion criteria for this systematic review.

The process of meta-synthesis used in this review is consistent with the methods of meta-synthesis recommended by the Joanna Briggs Institute. It involves the identification of the authors' opinions and statements – or conclusions. All conclusions are identified and documented. The reviewers then read and re read all identified conclusions to find which express similar intention or meaning. This reading and re reading assists in the creation of categories which reflect the meaning of two or more conclusions and is known as categorisation. The third level of analysis is to read and reread the categories to create one or more synthesised findings. Hence a number of text and opinion based papers can be brought together and concisely reported.

The primary role of text and opinion in this systematic review is to inform the reader of current practice in areas where there is inadequate clinical research to review. The conclusions reported in this section of the review report are the opinions of individual authors and are not the final conclusions, or recommendations arising from this review (these are reported at the end of the document). Some authors in this section focused on particular sub groups, such as young adults, or adolescents. Their opinions have been transcribed verbatim, however this review report in its entirety is not focused on young people in particular.

Synthesised finding 1

Education is a specialist function of appropriately educated and prepared multidisciplinary teams

Category	Conclusion
<p>Appropriate education delivery requires a range of specialists knowledge and methods of presentation</p>	<p>Careful selection of candidates should include multidisciplinary input when considering young adults for IPT</p> <p>Drawing on adolescent interest in technology can motivate young adults to learn and use IPT more effectively</p> <p>Effective IPT requires specialist education, selective patient allocation, and a reliable follow up program</p>
<p>Education involves supporting IPT patients through a series of life choices and changes</p>	<p>Appropriate education will account for any need to transition care to the young adult from other family members</p> <p>Continuing education with a diabetes nurse should include home visits and incorporate the young adults family</p> <p>Young adults may fear being permanently attached to a "device", education and training should equip them to appropriately connect and disconnect their pump while maintaining glycaemic control</p> <p>Younger adults may be attracted to technology, but require that technology make life less risky, and have minimal impact on their lifestyle</p>

The synthesised finding that “Education is a specialist function of appropriately educated and prepared multidisciplinary teams” was drawn from two categories which summarised that the provision of appropriate education requires not only specialists from diverse fields of practice to ensure patients commencing IPT have access to necessary knowledge and skills; but that those involved in delivering education also need to be appropriately prepared to provide education, adapt teaching methods to meet the changing needs of individuals making a wide range of lifestyle choices that may impact their glycaemic control. Not only is appropriate education titrated to the glycaemic needs of patients, it must be delivered in consideration of an individuals level of motivation, and be able to “demystify” or myth bust potentially unreal expectations which would otherwise impact the success of education and

training; as well as avoid potential treatment failures through appropriate candidate selection for IPT.

Synthesised finding 2

Education that incorporates group and individual dynamics facilitates experiential learning

Category	Conclusion
<p>Autonomy as an objective of education and training can improve outcomes, relationships and self image</p>	<p>A non hierarchical approach to education and training assists persons commencing IPT to freely engage with the diabetes team and ask questions</p> <p>Education and training which addresses basic pump care needs and potential complications can assist individuals to decrease or prevent cutaneous complications</p> <p>Encouraging experimentation within appropriate guidelines assists young adults to take responsibility for integrating IPT with their needs, expectations and lifestyle.</p> <p>Patient selection for IPT should include consideration of whether they currently practice self management or not</p> <p>Technology can be used to promote a greater sense of normality when selected appropriately</p> <p>Technology which decreases young adults needs to recall information, or document information are more congruent with their lifestyle</p> <p>The need for technical supervision can strain family relationships, training and education can facilitate a reduction in this stress</p> <p>The use of audio visual resources is congruent with young adults patterns of learning, and may facilitate better engagement between the diabetes team and the patient</p>

<p>Structured, group education facilitates appropriate, shared learning opportunities</p>	<p>Expertise and specialisation should characterise providers of education and training related to IPT</p> <p>Fixed duration education and training programs may not adequately meet the needs of individuals due to variability in motivation and expectations of IPT</p> <p>Group education creates a dynamic that assists individuals to internalise knowledge</p> <p>Group education forms a useful and complementary approach to individual education or training sessions</p> <p>Group education which includes multi disciplinary input gives patients a wider perspective on their diabetes and IPT management</p> <p>Progressive, contextual education offers individuals greater freedom to learn and adapt to new technology</p> <p>The setting for education and training should be chosen based on access to resources and expertise</p>
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The synthesised finding that “Education that incorporates group and individual dynamics facilitates experiential learning” was drawn from two categories. Engendering patients with the knowledge and skills to achieve autonomy requires not only individuals with the capacity to achieve autonomy. It also requires educators to draw on their experiences to create an environment conducive to learning complex technical information, as well as redefine lifestyle and psychosocial expectations.

To achieve autonomy, the evidence suggests patients must first be engaged and drawn in to a group dynamic, becoming part of a group identity through the sharing of stories and experiences. The expert educator will be aware of this, and encourage and participate in the “learning from sharing” process rather than be tied to a timeframe or curricula. Once a group identity is established, patients will draw on that dynamic and relate it to their individual lives, thus moving in toward autonomy in a supported fashion. While technology can promote autonomy, it can also intimidate. Patients tend to focus their learning needs on technical knowledge to overcome concerns regarding the use of IPT, and this focus can detract from wider

learning about glycaemic control, lifestyle and nutritional knowledge. Hence the benefits of shared experiences, and the importance of ongoing follow up by appropriate members of the diabetes team.

Synthesised finding 3

Psychosocially appropriate education is based on principles of engagement

Category	Conclusion
<p>Broader engagement of the significant others as well as the person commencing IPT decreases stress and increases receptivity and social supports</p>	<p>Education and training inclusive of family adds to the safety of home IPT care</p> <p>Educators require knowledge of individuals social activities, enabling teaching using specific case examples related to glycaemic control</p> <p>Emphasising lifestyle during education and training can promote long term compliance with IPT</p> <p>Family engagement in education and training can decrease stress and enable sharing of coping strategies</p> <p>Group education which includes partners is better received by patients</p> <p>Targeting education and training to young adults developmental status is more appropriate than a "one size fits all" approach</p>

<p>Individual knowledge needs to inform decisions regarding patient follow up</p>	<p>Appropriate education and training will be complemented by the availability of one to one follow up</p> <p>Group education raises individuals baseline knowledge and motivation, an effect which continues once the group format has been discontinued</p> <p>Individual patients have specific needs for flexible management of IPT, hence life skills and knowledge are appropriate components of education and training</p> <p>The diabetes nurse can assist to link family, diabetes clinic and educational facilities to ensure young adults are supported in IPT</p> <p>The level of self care required with IPT may act to deter some young adults</p>
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<p>Psychosocial needs can facilitate or obstruct education and training</p>	<p>Awareness of the young adults mental and emotional maturity should be established before education and training are offered</p> <p>Fear of hypoglycaemia is common and may act as a barrier to improving glycaemic control</p> <p>Frustration or discouragement can block patients from achieving good glycaemic control education and training can assist in identifying blocks, and can motivate IPT users to overcome their frustrations</p> <p>Motivation for IPT is enhanced through story telling by educators, patients and their families</p> <p>Younger adults may be hesitant to take up IPT due to body image concerns</p>
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The synthesised finding that “Psychosocially appropriate education is based on principals of engagement” was extracted from 3 categories. While education may focus on the learning needs of the patient commencing IPT, the meta-synthesis illustrates that the transition to IPT impacts family, friends, school or university teachers and others in the patient’s social circle. The inclusion of persons of significance in the education process has been reported to decrease stress experienced by patients, their partners and/or family and friends. Thus motivation to learn and capacity to adapt to the technology, then adapt the technology to ones life is enhanced when education engages those in the patients circle of influence. That the group dynamic and impact of social circles has a clear influence on the experiences and perceptions of patients was reinforced by the finding that consideration of the individual’s psychosocial needs facilitates learning from education and training. However, there was also a link between individualisation and follow up, with the notion that one to one follow up provides opportunities for individuals to be guided in the integration of technical and educational knowledge with their personal needs and perspectives.

DISCUSSION

The topic of IPT education and training continues to be an area that has received minimal research using high-quality research methods. All studies included in this review were descriptive studies that do not establish the existence of a relationship between variables. However, included descriptive studies explored a range of issues related to the effectiveness of IPT therapy, and the educative requirements of patients, particularly those new to the therapy. Due to the lack of qualitative research, the findings on appropriateness are based on expert opinion. The opinion papers included in the review provide synthesis evidence towards the appropriateness of certain cultural and experiential perspectives associated with IPT education and training.

Effectiveness

A seven day teaching and training program combined both technical and life skills information.¹⁴ The study found a highly significant impact on HbA1c over a 12-month period post TTP compared with pre TTP. Although descriptive studies rarely provide clear evidence of effectiveness, this study suggests teaching and training can have a beneficial impact on HbA1c in addition to the benefits associated with IPT. Patients with similar characteristics to the study group may benefit if at risk of, or experiencing poor HbA1c results, episodes of severe hypoglycaemia, DKA, or hospitalization. Further studies testing this program against “routine care” (where routine care is clearly described and within ethical parameters) would be useful. Separating the teaching and training from the actual implementation of IPT means it remains unclear as to the degree of influence of teaching and training on glycaemic control.

One study utilized a progressive, stage based approach to the transfer of patients from conventional therapy, to intensified conventional therapy, then to IPT.¹⁵ The accompanying education program was not described (although it included group and individual formats) and appeared to be staged also. Participants may have remained within a particular educational focus until they had learned from it before progressing to the next focus, and before progressing from conventional to intensive conventional insulin therapy. The study found that intensified conventional therapy ICT improved outcomes for patients who were moved from conventional therapy,

but that transitioning to IPT from ICT was no more effective than ICT alone. The design of this study was unclear in that how patients were selected for IPT. The lack of statistical difference in ICT compared with IPT may be an indication of a true lack of difference in outcomes between these two forms of therapy, or that the educational program was particularly effective, or that the participants were the type of people with a high internal locus of control and hence likely to do well (presuming they had the right information) on which ever form of therapy they were allocated to. This final possibility is a reasonable suggestion given the participants was prospectively chosen and had no significant co morbidities. Interestingly, the primary aim of this program was not optimisation of glycaemic control, but rather empowerment of the enrolled individuals so they could achieve better self-management. This philosophical perspective does not appear in other studies included in this systematic review.

A very small observational study found education and training had no impact on glycaemic control, but that IPT was itself independently associated with improved glycaemic control.¹³ The study was too small to demonstrate any effect, and its results should be considered preliminary only. A small-scale survey in Australia asked patients whether they found receiving nutritional education and information helpful.¹⁶ The one and a half day program combined interactive and didactic methods, and utilised handouts and self-learning aids. Participants generally favoured the program and materials they had been given, suggesting similar programs or techniques might be well received more widely. Although the impact on clinical outcomes was not considered, additional dietary information was well received in this group, suggesting a role for interactive teaching and self help methods in the delivery of dietary specific advice and information.

While some studies used combinations of group and individual education, one study specifically utilized a group format.¹ The formal group training program was complemented by an informal group follow up process that enabled the participants to direct the follow up, and bring their own experiences, learnings and lifestyle issues back to the group (which included health professionals). This style of group format resulted in high satisfaction ratings, suggesting people appreciate hearing and

learning from each other, in addition to hearing and learning from health professionals.

Key findings

Overall, it is difficult to draw a strong conclusion regarding the effectiveness of components and strategies associated with IPT due to a lack of high quality comparative studies, small sample sizes and due to variability of reported methods in the included studies. In addition, the studies revealed a number of variations in teaching methods, the implementation of an education program and evaluated an array of differing outcomes. However, the included descriptive studies explored a range of issues related to the effectiveness of IPT therapy and the educative requirements of patients.

In terms of the outcomes of interest aforementioned, the data from this review further supports the view that IPT is an effective method to achieve improved HbA1c, decreased episodes of hypoglycaemia, hyperglycaemia and hospitalisation for diabetes related complications (Level III). Further to this, it was clear that persons using IPT needed a range of advice, education and training; the evidence suggests:

- Education and training is important for successful initiation of IPT (Level III).
- Multidisciplinary teams that comprised of doctors, nurses, dieticians, and diabetes educators may be an effective team for delivering IPT education and training (Level III).
- There is no one educational method that appears significantly more effective than any other method. However, the mixture of group and individual teaching may be effective for delivering IPT education and training (Level III).
- The provision of materials for use in education and training and for patients to take home (e.g. training pump) may be considered useful and valued by patients (Level III).
- Blood glucose monitoring, carbohydrate counting, adjustment of insulin dose (initial basal rates and pre-meal boluses), practical aspect of insulin pump including identification of malfunctions, prevention and management of

acute complications (e.g. DKA), and life style changes are the major components of IPT education and training programs (Level III).

- Longer-term training with multiple sessions may be more effective than short session training (Level III).
- The duration and frequency of follow-up for optimal self-management of IPT may be adapted to individual needs (Level III).

Appropriateness

Although two qualitative research papers were identified, they did not match the criteria for this review, hence the findings on appropriateness are based on expert opinion. Appropriateness in relation to qualitative evidence relates not to the financial viewpoint, but to cultural and experiential perspectives of patients and providers. It should be noted that the literature on patient perspectives is scant; further research should be conducted to enable current understandings to be more fully developed. The evidence available to date focuses on the experiences and perspectives of patients; hence this section is unable to provide detailed comment on appropriateness from the perspective of health care providers.

A position statement published by the AADE was designed to provide direction for the educational requirements related to IPT.¹⁰ Appropriate educational content was outlined, with an emphasis on comprehensiveness across technical and life management knowledge and skills that users of IPT would require. This included consideration of the individual patients needs in terms of flexibility and degree of glycaemic control being sought. Further to this, educational providers were encouraged to consider each individuals level of motivation, and their expectations of IPT, and provide education targeted at developing technical capacity, as well as subjective decision making such as when to seek advice from health care professionals. The AADE note that education is progressive, contextual and should be a partnership between the patient and the multi disciplinary diabetes team. With this approach, the AADE advocate for IPT as being appropriate for the needs of motivated and autonomous individuals. It should be noted that this position paper focused on adults, not including those with physical or mental disabilities. This should not be construed as evidence that IPT does not apply to wider groups; rather that among independent adults, education which is appropriately targeted to

matching the technology to the individual's expectations, is likely to result in glycaemic control being better maintained.

One paper included in this review outlined the history and development of IPT, its advantages, and its impact on physiological outcomes and diabetes management.⁸ The paper highlighted that appropriate education includes individualised teaching of titration of pre-meal boluses. The authors also suggested that diabetes educators needed to be aware of patient's social activities, and where these included sports or other forms of exercise, that those patients education be focused on teaching appropriate insulin algorithms that can be tailored to the individuals needs. The authors concluded that education that fits with the lifestyle related needs of patients commencing IPT would lead to better self-management, be more motivating and promote optimal glycaemic control.

Boland et al. discussed insulin pump therapy in adolescents.¹⁷ This paper identified that among adolescents, appropriate educational resources include use of printed materials, videos and other materials, which the adolescent patient can relate to as age appropriate mediums for absorbing information. The diabetes nurse was seen as the primary point of contact and supply of resources through this initial training. The need for education individualised to the developmental status of the adolescent rather than being prescriptive, or program bound was emphasised as appropriate for adolescents as learning was seen as a facilitated process which occurs over time and requires reinforcement. This approach was advocated as congruent with the teenage approach to learning. Again, the diabetes nurse educator was advocated as being the ideal contact should adolescents require additional support, although the authors did not state a rationale.

The role of motivation, and methods to build and sustain motivation for adults on IPT was the focus of a discussion paper.¹⁸ Of particular interest to this review was the author's emphasis on the role of group education formats as a forum in which adults on IPT share their experiences and stories, thus providing new insights, shared perspectives and a group identity, leading to increased individual motivation and locus of control. The group education process was used to establish a psychological baseline of positive experience and expectation leading to a "can do" attitude which

was built upon during the ongoing individual's education. With a group dynamic to support them, the authors felt patients were better able to assimilate the information provided by the multidisciplinary team. The implications of this paper are that group and individual formats of education have potentially congruent, or mutually enhancing contributions to the educational experiences and subsequent knowledge gains for patients commencing IPT.

A review paper based focused on highlighting the need of an adequate education program to prevent these risks.⁹ The authors suggested that appropriate education should be given to each patient prior to IPT commencement to prevent complications of therapy. While the primary focus of this paper was on the technical requirements, this was also one of the few papers to highlight the basic care needs that would be informed by an education program. Whilst a comprehensive education program based on potential problems, and the solution or preventative strategies related to the problem were detailed in the paper, the authors, as with other papers included in this review highlighted the benefits of a 24 hour phone line for patients on IPT.

A consensus statement from the European Society for Paediatric Endocrinology, the Lawson Wilkins Pediatric Endocrine Society, and the International Society for Pediatric and Adolescent Diabetes, which has also been endorsed by the American Diabetes Association and the European Association for the Study of Diabetes provides recommendations related to IPT in paediatric and adolescent patients with type I diabetes.² Of specific interest to identifying appropriate strategies for education of adolescents were a series of recommendations based on adolescent culture and lifestyle. These included seeking to engage individuals interests in technology and matching them to IPT with features of this risks in to opportunities to normalise lifestyle, play sports, and minimise the adolescents need to focus on their pump, or on monitoring and documentation.

Key findings

The literature on appropriateness focuses on the patient perspective in relation to how education is perceived, rather than the diabetes educator. As such the following conclusions relate to appropriateness from the patient perspective:

- While the duration and structure of education may vary considerably, patients need a degree of flexibility and individualisation that allows them to learn at their own pace, and return to prior learning experiences to refresh their knowledge (Level IV);
- Educational programs which do not involve story telling and sharing of experiences by both educators and patients are valued less and are seen as less motivating by patients learning about IPT (Level IV);
- Lifestyle rather than technology was the focus for many patients in IPT education programs, hence education that is geared toward management of dietary and insulin needs related to lifestyle choices was valued by patients (Level IV);
- Educational resources that have been designed for the adolescent age-group are more likely to facilitate their learning experience and subsequently their knowledge uptake (Level IV);
- Group education formats can be used to create a positive dynamic which exerts a positive influence on individuals learning experience and level of motivation to succeed with IPT even once the group format has finished (Level IV);
- Education programs created and delivered by multi disciplinary teams appear to be better received from group educational formats than individual formats (Level IV);
- Patients commencing IPT may focus more on technical information related to pump care and management, however, they value the role of education and training on basic life skills and health care as much as the technical data (Level IV);
- Among adolescents and young adults, youth culture and lifestyle are significant forces which impact the individuals beliefs and behaviours, education programs which consider and integrate youth culture are seen as more congruent with the expectations and needs of young adults commencing IPT (Level IV);
- The technology focus evidence in young adults can be positively used to engender interest and proactive self-management of IPT (Level IV);

- Addressing specific fears or concerns, and repeating/re-enforcing the positive messages can assist young adults to overcome fears related to tight glycaemic control (Level IV);
- Family are central to individuals experiences and expectations, and positive engagement of family members can facilitate young adults learning experiences (Level IV);
- Normality as perceived by the individual adolescent may include concepts such as freedom and flexibility – these should be viewed as positive attributes and the role of IPT at enhancing lifestyle explored and articulated through appropriate educational strategies (Level IV).
- Many IPT programs advocate 24 hour support for people on IPT (Level IV)

CONCLUSIONS

Effectiveness

In general, it is difficult to draw a strong conclusion regarding the effectiveness of components and strategies associated with IPT due to a lack of high quality comparative studies, small sample sizes and a variability of reported methods in the included studies. However, included descriptive studies explored a range of issues related to the effectiveness of IPT therapy, and the educative requirements of patients. The results of this systematic review further support the notion that IPT is an effective method to achieve improved HbA1c, and decrease episodes of hypoglycaemia, hyperglycaemia and hospitalisation for diabetes related complications. In relation to IPT education and training, it is clear that type 1 diabetes patients initiating and utilising IPT need a comprehensive range of advice, education and training. The mixture of group and individual teaching, multidisciplinary teams as educators, educational materials, long-term training with multiple sessions and a variety of educational contents may all be effective for delivering IPT education and training.

Appropriateness

In terms of educational outcomes that meet the needs of patients, there was evidence to suggest educational programs should be structured, and the content delivered in such a way that individual patient goals in relation to lifestyle and degree of

glycaemic control be facilitated. However, educators also were seen as having a gate keeper role as not all patients may be appropriate for IPT, or have realistic expectations of what IPT would achieve for them in terms of social and glycaemic control.

Implication for practice

From the overall results of the review, a number of recommendations can be made for practice. Grades of recommendations have been assigned (see Appendix VIII)

- Education and training is important for successful initiation of IPT. (Grade B)
- Multidisciplinary teams comprised of doctors, nurses, dieticians, and diabetes specialist educators form the most effective team for delivering IPT education and training. (Grade B)
- The mixture of group and individual teaching can be effective for delivering IPT education and training. (Grade B)
- Group education formats can be used to create a positive dynamic which exerts a positive influence on individuals learning experience and level of motivation to succeed with IPT. (Grade B);
- The use of teaching and learning materials and the provision of materials for patients to take home (e.g. training pump) may be useful for delivering IPT education and training. (Grade B)
- Educational resources that have been designed for the adolescent age group are more likely to facilitate their learning experience and subsequently their knowledge uptake. (Grade B)
- Blood glucose monitoring, carbohydrate counting, adjustment of insulin dose (initial basal rates and pre-meal boluses), practical aspects of insulin pump management, including identification of malfunctions, prevention and management of acute complications (e.g. DKA), and life style changes form the core components of IPT education and training programs. (Grade B)
- Education that is geared toward management of dietary and insulin needs should be related to lifestyle choices of individual patients. (Grade B)
- Education programs which consider the needs of youth culture are seen as more congruent with the expectations and needs of young adults commencing IPT. (Grade B)

- For young adults, a technology focus can be positively used to engender interest and proactive self-management of IPT. (Grade B)
- Addressing specific fears or concerns, and repeating/re-enforcing the positive messages can assist young adults to overcome fears related to tight glycaemic control. (Grade B)
- Normality as perceived by the individual adolescent may include concepts such as freedom and flexibility – these should be viewed as positive attributes and the role of IPT in enhancing lifestyle highlighted through appropriate educational strategies. (Grade B).
- Longer-duration training with multiple sessions may be more effective than short, sessional training. Patients offered flexibility and individualisation learn at their own pace, and return to prior learning experiences to refresh their knowledge. (Grade B)
- The duration and frequency of follow-up for optimal self-management of IPT should be adapted to individual needs. (Grade B)
- The ability to integrate positive engagement of family members in IPT education can facilitate young adults learning experiences. (Grade B)
- Professional 24 hour support for people on IPT should be considered. (Grade B)

Implication for research

Investigating the relationship between IPT education and its influence on effective use of therapy presents numerous design challenges to researchers. This may be the reason for a lack of high-quality evidence on effectiveness of IPT education and training. Further quantitative research is needed to investigate the potential relationships between education and clinical outcomes. Ideally, cluster RCTs, and program evaluation designs should be used, however, given the variability in educational programs evident from this review, program evaluation may prove a more realistic approach. Where program evaluation is used, objective scales or outcome measures should be used to increase the strength of the findings. Such research, if concentrated on identifying the optimal duration of education and the ideal intensity of education would provide a significant contribution to knowledge and the capacity to optimise IPT education.

Further research gaps made evident through this review include the need for prospective, comparative studies where brief, targeted educational interventions are compared with comprehensive, longer duration programs. The impact of these different models of education on clinical outcomes is currently unclear. While the duration and intensity of education is unknown, it is clear a range of methods, resources and strategies are implemented with no clear evidence of effectiveness. Routine follow up is a feature of most of the included studies in this review, however, the effectiveness of routine follow up in terms of glycaemic control has not been established, nor is it clear how long such follow up should continue.

In addition to quantitative research, it would be very useful to examine questions regarding patient behaviours, beliefs and the meanings they attach to the educational experience. As such, Participatory Action Research methods are recommended to facilitate a better understanding of patient characteristics that lead to successful IPT education and training. Further to this, qualitative research, particularly in the form of phenomenology would assist in illuminating the meaning of IPT to patients, thus providing valuable insight in to how to target educational strategies more effectively. The experiences and expectations of the diabetes education team have not been well researched, and qualitative research could make a valuable contribution to our understandings of what it means to be involved in education and training as individuals, or as part of a multi disciplinary team.

Acknowledgements

This review was commissioned by the Australian Diabetes Educators Association and funded through the National Diabetes Services Scheme (NDSS). The NDSS is an initiative of the Australian Government administered by Diabetes Australia. The review team would like to express sincere thank to the chair and the reference group members for their guidance and suggestions.

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Appendix I

JBI Level of Evidence

Level of Evidence	Feasibility, Appropriateness, Meaningfulness	Effectiveness	Economic Analysis
I	Meta-synthesis of research with unequivocal synthesised findings	Meta-analysis (with homogeneity) of experimental studies (e.g. RCT with concealed randomisation)	SR (with homogeneity) of Level 1 economic studies
II	Meta-synthesis of research with credible synthesised findings	One or more RCT, retrospective cohort studies or untreated control groups in RCTS. Retrospective cohort study or follow-up of untreated control patients in an RCT	SR (with homogeneity) of Level 2 economic studies Analysis comparing a limited number of alternative outcomes against appropriate cost measurement, and including a sensitivity analysis incorporating clinically sensible variations in important variables
III	a. Meta-synthesis of text/opinion with credible synthesised findings b. One or more single research studies of high quality	Case-series (and poor quality prognostic cohort studies)	Analysis without accurate cost measurement but including a sensitivity analysis incorporating clinically sensible variations in important variables
IV	Expert opinion	Expert opinion, or physiology bench research, or consensus	Expert opinion, or based on economic theory

Appendix II

Comprehensive search terms

Limiters: 1998-2008; English language; adult >16

MEDLINE (OVID)

Database: Ovid MEDLINE(R) <1996 to February Week 2 2008>

Search Strategy:

-
- 1 exp Diabetes Mellitus, Type 1/ or type 1 diabetes.mp. (23818)
 - 2 type I diabetes.mp. (1685)
 - 3 insulin pump.mp. or exp Insulin Infusion Systems/ (876)
 - 4 insulin pump therapy.mp. (143)
 - 5 insulin dependent diabetes.mp. (7500)
 - 6 exp Blood Glucose/ or continuous subcutaneous insulin infusion.mp. or exp Diabetic Ketoacidosis/ (36905)
 - 7 exp adolescent/ or exp adult/ (1932465)
 - 8 exp Patient Education as Topic/ or diabetes education.mp. (30381)
 - 9 diabetes educators.mp. (179)
 - 10 1 or 2 or 5 (28466)
 - 11 3 or 4 or 6 (37263)
 - 12 8 or 9 (30431)
 - 13 10 and 11 (5348)
 - 14 12 and 13 (199)
 - 15 7 and 14 (118)
 - 16 limit 15 to (english language and humans and yr="1998 - 2008") (89)
 - 17 from 16 keep 1-89 (89)
 - 18 from 16 keep 1-89 (89)
 - 19 from 16 keep 1-89 (89)
 - 20 from 16 keep 1-89 (89)
 - 21 from 20 keep 1-89 (89)

CINAHL (EBSCOHOST)

- S1 (type 1 diabetes) or (MH "Diabetes Mellitus, Insulin-Dependent")
- S2 insulin dependent diabetes
- S3 type I diabetes
- S4 S3 or S2 or S1
- S5 (adult) or (MH "Adult")
- S6 S5 and S4
- S7 (education) or (MH "Education") or (MH "Outcomes of Education") or (MH "Adult Education")
- S8 (diabetes education) or (MH "Diabetes Education") or (MH "Diabetes Educators")
- S9 training or blood glucose monitoring
- S10 diabetes training
- S11 S10 or S9 or S8 or S7
- S12 (insulin pump therapy) or (MH "Insulin Infusion Systems")
- S13 (continuous subcutaneous insulin infusion) or (MH "Insulin Infusion Systems")
- S14 S13 or S12

Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED

Database: All EBM Reviews - Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED

Search Strategy:

-
- 1 type 1 diabetes.mp. [mp=ti, ot, ab, tx, kw, ct, sh, hw] (975)
 - 2 type I diabetes.mp. [mp=ti, ot, ab, tx, kw, ct, sh, hw] (251)
 - 3 insulin dependent diabetes.mp. [mp=ti, ot, ab, tx, kw, ct, sh, hw] (2199)
 - 4 diabetes mellitus.mp. [mp=ti, ot, ab, tx, kw, ct, sh, hw] (11324)
 - 5 insulin pump therapy.mp. [mp=ti, ot, ab, tx, kw, ct, sh, hw] (32)
 - 6 education.mp. [mp=ti, ot, ab, tx, kw, ct, sh, hw] (16610)
 - 7 1 or 2 or 3 or 4 (11465)
 - 8 5 and 7 (28)
 - 9 limit 8 to english language [Limit not valid in: CDSR,ACP Journal Club,DARE,CCTR,CLCMR; records were retained] (27)
 - 10 limit 9 to humans [Limit not valid in: CDSR,ACP Journal

Club,DARE,CCTR,CLCMR; records were retained] (26)

11 limit 10 to yr="1998 - 2008" [Limit not valid in: DARE; records were retained] (18)

12 from 11 keep 1-18 (18)

EMBASE

Database: EMBASE <1980 to 2008 Week 07>

Search Strategy:

-
- 1 exp Insulin Dependent Diabetes Mellitus/ or type 1 diabetes.mp. (36812)
 - 2 type I diabetes.mp. (3597)
 - 3 insulin pump.mp. or exp Insulin Pump/ (1324)
 - 4 exp Insulin Treatment/ or insulin pump therapy.mp. (8892)
 - 5 Adult/ (2041241)
 - 6 Adolescent/ (410551)
 - 7 education.mp. or exp EDUCATION/ (292416)
 - 8 diabetes education.mp. or exp Health Education/ or exp Diabetes Education/ or exp Patient Education/ or exp Education/ (260386)
 - 9 diabetes educators.mp. or exp Diabetes Educator/ (104)
 - 10 self management.mp. or exp Self Care or blood glucose monitoring/ (14671)
 - 11 exp EXPERIENCE/ or exp PERSONAL EXPERIENCE/ or experience.mp. (224029)
 - 12 1 or 2 (37684)
 - 13 exp Subcutaneous Drug Administration/ or continuous subcutaneous insulin infusion.mp. (72498)
 - 14 3 or 4 or 13 (80772)
 - 15 5 or 6 (2206908)
 - 16 7 or 8 or 9 (292440)
 - 17 10 or 11 (237788)
 - 18 12 and 14 (4631)
 - 19 15 and 16 and 17 and 18 (27)
 - 20 limit 19 to (human and english language and yr="1998 - 2008") (17)
 - 21 from 20 keep 1-17 (17)
 - 22 from 20 keep 1-17 (17)

Current Contents

1. insulin pump
2. continuous subcutaneous insulin infusion
3. 1 OR 2
4. educat*
5. 3 AND 4

PsycINFO

Database: PsycINFO <1985 to February Week 2 2008>

Search Strategy:

- 1 diabetes/ or exp diabetes mellitus/ (4914)
- 2 type 1 diabetes.mp. (392)
- 3 type I diabetes.mp. (189)
- 4 insulin dependent diabetes.mp. (785)
- 5 exp Insulin/ or insulin pump.mp. (1141)
- 6 insulin pump therapy.mp. (7)
- 7 continuous subcutaneous insulin infusion.mp. (12)
- 8 1 or 2 or 3 or 4 (5024)
- 9 5 or 6 or 7 (1142)
- 10 8 and 9 (400)
- 11 limit 10 to (human and english language and yr="1998 - 2008") (192)
- 12 exp blood glucose/ or exp Health Education/ or exp Self Management/ or exp Self Care Skills/ or exp Client Education/ or exp Educational Programs/ (50232)
- 13 11 and 12 (23)
- 14 from 13 keep 1-23 (23)3 from 2 keep 1-7 (7)

Digital Dissertations (Proquest)

Basic search strategy: 1998-2008 'insulin pump therapy'

Appendix III

JBI-SUMARI Package Validity Checklist

Checklist for Assessing the Validity of Descriptive / Correlational Studies

Reviewer:	Date:		
Author:	Year:	Record No	
Observational Studies	Yes	No	Unclear
Is the study based on a random or pseudo random sample?			
Is the sample of adequate size and representative of the population?			
Are the criteria for inclusion in the sample clearly defined?			
Were hypotheses linked to explicit theoretical framework?			
Did measures have acceptable reliability and validity?			
If comparisons are being made, was there sufficient description of groups?			
Was an appropriate statistical analysis used?			
Were the findings statistically or clinically significant?			
Were findings linked to theoretical framework?			
Are the findings generalisable?			
TOTAL			

Reviewer's Comments:

From: The JBI-Meta Analysis of Statistics Assessment and Review Instrument (JBI-MAStARI)

Checklist for Assessing the Validity of Cohort Studies

Reviewer:

Date:

Author:

Year:

Record No

Criteria	Yes	No	Unclear
1) Is sample representative of patients in the population as a whole?			
2) Are the patients at a similar point in the course of their condition/illness			
3) Are outcomes assessed using objective criteria?			
4) Was followed up carried out over a sufficient time period?			
5) Were the outcomes of people who withdraw described and included in the analysis?			
6) Were outcomes measured in reliable way?			
7) Was appropriate statistical analysis used?			
TOTAL			

Reviewer's Comments:

From: The JBI-Meta Analysis of Statistics Assessment and Review Instrument (JBI-MASARI)

Interpretive and Critical Research Findings Critical Appraisal Instrument

Reviewer:

Date:

Author:

Year:

Record No

Criteria	Yes	No	Unclear
1) There is congruity between the stated philosophical perspective and the research methodology.			
2) There is congruity between the research methodology and the research question or objectives.			
3) There is congruity between the research methodology and the methods used to collect data.			
4) There is congruity between the research methodology and the representation and analysis of data.			
5) There is congruity between the research methodology and the interpretation of results.			
6) There is a statement locating the researcher culturally or theoretically.			
7) The influence of the researcher on the research, and vice-versa, is addressed.			
8) Participants, and their voices, are adequately represented.			
9) The research is ethical according to current criteria or, for recent studies, there is evidence of ethical approval by an appropriate body.			
10) Conclusions drawn in the research report do appear to flow from the analysis, or interpretation, of the data.			
TOTAL			

Reviewer's Comments:

From: The JBI-Qualitative Assessment and Review Instrument (JBI-QARI)

Narrative, Opinion and Textual Critical Information Instrument

Reviewer:

Date:

Author:

Year:

Record No

Criteria	Yes	No	Unclear
1) Is the source of the opinion clearly identified?			
2) Does the source of the opinion have standing in the field of expertise?			
3) Are the interests of patients the central focus of the opinion?			
4) Is the opinion's basis in logic/experience clearly argued?			
5) Is there reference to the extant literature/evidence and any incongruency with it logically defended?			
6) Is the opinion supported by peers?			
TOTAL			

Reviewer's Comments:

Appendix IV

Data Extraction Forms

Quantitative Data Extraction Form

Author _____ Record No _____

Journal _____

Year _____

Reviewer _____

Method _____

Setting _____

Participants

Number of Participants

Group A Group B Group C

Interventions

Group A _____

Control _____

Group B _____

Intervention 1 _____

Group C _____

Intervention 2 _____

Outcome Measures

Definition

Other Outcome Measures

Outcome Description

Scale/Measure

Results

Dichotomous Data

Outcome	Control Group number/total number	Treatment Group number/total number

Continuous Data

Outcome	Control Group mean & SD (number)	Treatment Group mean & SD (number)

Authors' Conclusions:

Comments:

Qualitative Data Extraction Form

Author _____ Record No _____

Journal _____

Year _____

Reviewer _____

Method
Methodology
Data Analysis

Setting & Context
Geographical Context
Cultural Context
Participants:
Number:
Description:

Intervention

Findings	Narrative Description	Quality of Evidence Rating 1,2,3

Authors' conclusion

Reviewer's conclusion

Appendix V

Degrees of Credibility

Unequivocal [E]: evidence beyond reasonable doubt, which may include findings that are matter of fact, directly reported/observed and not open to challenge;

Credible [C]: evidence that is, albeit an interpretation, plausible in light of the data and theoretical framework. The interpretations can be logically inferred from the data but, because the findings are essentially interpretive, they can be challenged;

Unsupported [S]: when none of the other level descriptors apply and when, most notably, findings are not supported by the data.

(These three levels of evidence are incorporated into the JBI-SUMARI (System for the Unified Management of the Assessment and Review of Information) software, The Joanna Briggs Institute, Adelaide, 2003.)

Appendix VI

Excluded studies

Benhamou PY, Melki V, Boizel R, Perreal F, Quesada JL, Bessieres-Lacombe S, et al. One-year efficacy and safety of Web-based follow-up using cellular phone in type 1 diabetic patients under insulin pump therapy: the PumpNet study. *Diabetes & metabolism*. 2007;33(3):220-6.

Reason for Exclusion: Does not meet inclusion criteria for this review (no education was included in SMS messages-intervention).

Bierschbach JL, Cooper L, Liedl JA. Insulin pumps: what every school nurse needs to know. *J Sch Nurs*. 2004 Apr;20(2):117-23.

Reason for Exclusion: Does not meet inclusion criteria for this review (no educational intervention on IPT)

Bin-Abbas BS, Sakati NA, Raef H, Al-Ashwal AA. Continuous subcutaneous insulin infusion in type 1 diabetic Saudi children. A comparison with conventional insulin therapy. *Saudi medical journal*. 2005;26(6):918-22.

Reason for Exclusion: Does not meet inclusion criteria for this review (comparison of conventional insulin therapy (CI) and CSII).

Bode BW, Sabbah HT, Gross TM, Fredrickson LP, Davidson PC. Diabetes management in the new millennium using insulin pump therapy. *Diabetes Metab Res Rev*. 2002 Jan-Feb;18 Suppl 1:S14-20.

Reason for Exclusion: Does not meet review objective (no educational components).

Boland EA, Grey M, Oesterle A, Fredrickson L, Tamborlane WV. Continuous subcutaneous insulin infusion: a new way to lower risk of severe hypoglycemia, improve metabolic control, and enhance coping in adolescents with type 1 diabetes. *Diabetes Care*. 1999;22(11):1779-84.

Reason for Exclusion: Does not meet inclusion criteria for this review (comparison of MDI and CSII).

Colquitt JL, Green C, Sidhu MK, Hartwell D, Waugh N. Clinical and cost-effectiveness of continuous subcutaneous insulin infusion for diabetes. *Health Technol Assess*. 2004 Oct;8(43):1-171.

Reason for Exclusion: Does not meet inclusion criteria for this review (outcomes)

Darby W. The experiences of school nurses caring for students receiving continuous subcutaneous insulin infusion therapy. *Journal of School Nursing*. 2006;22(6):336-44.

Reason for Exclusion: Does not meet inclusion criteria for this review (age group)

Davis J, Wilson V. NICE: the way forward with insulin pumps. *Diabetes Primary Care*. 2004;6(2):72.

Reason for Exclusion: Does not meet inclusion criteria for this review (no educational component)

DeVries JH, Snoek FJ, Heine RJ. Persistent poor glycaemic control in adult Type 1 diabetes. A closer look at the problem. *Diabet Med.* 2004 Dec;21(12):1263-8.

Reason for Exclusion: Does not meet review objective (focus on glycaemic control, not on IPT).

Everett J, Kerr D. Insulin pump therapy: a fresh start for the UK. *Journal of Diabetes Nursing.* 2000;4(2):44-7.

Reason for Exclusion: Does not meet inclusion criteria for this review (no educational intervention on IPT)

Fain JA. Photo guide. Delivering insulin 'round the clock. *Nursing.* 2002;32(8):54-6.

Reason for Exclusion: Does not meet inclusion criteria for this review (outcomes).

Muller UA, Femerling M, Reinauer KM, Risse A, Voss M, Jorgens V, et al. Intensified treatment and education of type 1 diabetes as clinical routine: a nationwide quality-circle experience in Germany. *Diabetes Care.* 1999;22:B29-34.

Reason for Exclusion: Does not meet inclusion criteria for this review (no educational intervention on IPT).

Rule AM, Drincic A, Galt KA. New technology, new errors: how to prime an upgrade of an insulin infusion pump. *Joint Commission Journal on Quality & Patient Safety.* 2007;33(3):155-62.

Reason for Exclusion: Does not meet inclusion criteria for this review (no educational component).

Shvide-Slavin C. Case study: a patient with type 1 diabetes who transitions to insulin pump therapy by working with an advanced practice dietitian. *Diabetes Spectrum.* 2003;16(1):37-40.

Reason for Exclusion: Does not meet inclusion criteria for this review (no details on education).

Sullivan-Bolyai S, Knafl K, Tamborlane W, Grey M. Parents' reflections on managing their children's diabetes with insulin pumps. *J Nurs Scholarsh.* 2004;36(4):316-23.

Reason for Exclusion: Does not meet inclusion criteria for this review (age group below 16).

Ulahannan TJ, Ross W, Davies FC. Carbohydrate counting in type 1 diabetes: time to REACCT. *Practical Diabetes International.* 2007;24(3):134-6.

Reason for Exclusion: Does not meet inclusion criteria for this review (no participants were on IPT as details obtained by the author).

Unger J, Marcus AO. Insulin pump therapy: what you need to know. *Emergency Medicine (00136654).* 2002;34(9):24.

Reason for Exclusion: Does not meet review objective (no educational components).

Viklund GE, Rudberg S, Wikblad KF. Teenagers with diabetes: self-management education and training on a big schooner. *International Journal of Nursing Practice*. 2007;13(6):385-92.

Reason for Exclusion: Does not meet inclusion criteria for this review (not clear about participants were on IPT).

Weinzimer SA, Doyle EA, Tamborlane WV, Jr. Disease management in the young diabetic patient: glucose monitoring, coping skills, and treatment strategies. *Clinical Pediatrics*. 2005;44(5):393-403.

Reason for Exclusion: Does not meet review objective (no educational components)

Wilson VL. Insulin pump therapy: a postcode lottery? *Diabetes Primary Care*. 2004;6(1):49.

Reason for Exclusion: Does not meet review objective (no educational components)

Appendix VII

Included studies

Descriptive studies

Study	Design	Sample Size & setting	Interventions/ Education & Training	Outcomes	Author conclusion
[14]	Descriptive study	Included 250 IPT patients with type 1 diabetes mellitus (age 36.0 +/- 13.1 years; diabetes duration 16.1 +/- 9.9 years) from 21 ASD hospitals in Germany	Treatment and teaching program (TTP) <u>Methods:</u> Structured program, technical instruction Duration: 7 days <u>Contents:</u> insulin pump, catheter and tape, adjustment of insulin dose, daily living instructions, prevention and management of ketoacidosis and severe hypoglycaemia, blood glucose self monitoring and documentation. <u>Educators:</u> Not specified <u>T & L Aids:</u> Not specified	One year after participation in the TTP, the mean relative HbA _{1c} decreased from 1.51 (0.9-3.2) to 1.44 (0.9-3.6) ($p<0.0001$), severe hypoglycaemia from 0.46 to 0.12/patients/year ($p<0.001$), DKA from 0.08 to 0.05/patients/year ($p=0.003$) and hospitalisation from 5.2 to 3.1 days/patients/year ($p=0.002$)	Outcomes (HbA _{1c} , incidents of hypoglycaemia, ketoacidosis, hospitalisation days) improved after participation in a TTP.
[15]	Prospective study	Included 70 patients	Intensified conventional therapy (ICT) and IPT <u>Methods:</u> 3 step skills-based learning program 1 st : 45 minutes training on carbohydrate counting 2 nd : One-on-one instruction on insulin dosage to carbohydrate portions and the use of correction boluses for glycaemic excursions. 3 rd : Short term follow up program analysing patients' dairies that incorporated food records, blood glucose	Following the conversion of 70 patients to ICT, 12 of these converted to IPT during some period following ICT. In these 12 patients a significant improvement in HbA _{1c} was seen following ICT (pre-ICT HbA _{1c}	IPT did not appear to offer significant glycaemic control advantages over ICT in this program. The authors recommended that ICT including training

			records, and insulin dosages to ensure appropriate use of insulin dosage and adjustments <u>Duration:</u> 1 st session 45 min <u>Contents:</u> As above <u>Educators:</u> Multidisciplinary team <u>T & L Aids:</u> Bespoke displays, commercially available guides	9.6±1.5%, post-ICT HbA1c 8.3±1.4%, t = 2.9, p<0.02), but no further improvement was seen after a further year of IPT (HbA1c 8.4±0.8%, n = 9).	program can be used to initiate IPT successfully.
[13]	Observational retrospective study	Included five older adults with type 1 diabetes (mean age 66.4 years) who changed to IPT. These patients had suboptimal glycemic control (HbA1c >8.0%), microvascular complications, and unacceptably frequent hypoglycaemia	Outpatient intensive insulin pump training <u>Methods:</u> 1 st : Group teaching that included both lecture format and interactive sessions. 2 nd : Follow-up training program <u>Duration:</u> 1 st : 8 hours 2 nd : biweekly visits (1 hour) during a period of two to four months <u>Contents:</u> Self-monitoring of plasma glucose by finger-stick analysis, carbohydrate counting for determining premeal insulin boluses, calculation of insulin requirements and practical aspect of insulin pump (e.g. insulin replacement, care of needle insertion sites, and pump malfunction) <u>Educators:</u> Diabetes nurse educator and a registered dietician <u>T & L Aids:</u> blackboard, books, printed materials, pictures and models of foods and food portions	Individual and mean HbA1c values showed no significant improvement after intensive training but decreased considerably only after initiation of IPT (HbA1c pre IPT 9.16%, post IPT 7.6% p<0.0025)	Initiation of IPT was the major factor contributing to the observed favourable outcomes.
[16]	Survey (self-administered questionnaire)	An eight-part self-administered questionnaire was sent to 25 adult patients who had	Nutrition information session <u>Methods:</u> Information and training <u>Duration:</u> 45-60 min nutrition session in a 1 ½ day program <u>Contents:</u> Pump	Most useful information provided (as rated by four patients) was the information on carbohydrate	Participants provided a positive feedback about the nutrition

		attended insulin pump training and 16 responded.	management and setting the initial basal rates and pre-meal boluses <u>Educators:</u> A diabetes educator <u>T & L Aids:</u> Written nutritional information on carbohydrate exchanges and glycaemic index and several other learning aids (e.g. "Facts on fat" "Sugar update")	counting and glycemic index. Of the 11, eight participants were able to recall a message from the session consistent with the information provided and five participants actively made dietary changes following the session.	information session.
[1]	Descriptive study (questionnaire and interview)	Sample size: Not specified Study conducted in the Royal Liverpool University Hospital, UK	IPT Education & training <u>Methods:</u> Two group sessions and follow-up. 1 st : Basic pump programming and operation skills were trained. The participants were allowed to take the pump home that enabled them to more familiar with pump. 2 nd : Participants commenced IPT and the participant programmed in the basal rate, prime the pump and insert the cannula under supervision Follow-up: Adjusting basal rate and discussed knowledge gaps and problems <u>Duration:</u> Not specified <u>Contents:</u> In addition to above, discussion about dietary, life style and pump management issues included <u>Educators:</u> Not specified <u>T & L Aids:</u> Not specified	All participants were very positive about the group program. Group participation saved approximately 10-27 hours professional time with compared to individual training	The group approach for IPT training allows the development of peer support, strengthens the learning process and avoids isolation.

Text/ opinion papers

Paper	Opinion/Text and setting	Recommendations	Author conclusion
[10]	A position statement published by the American Association of Diabetes Educators	<p><u>Methods:</u> Education & training in either the inpatient or outpatient setting</p> <p><u>Duration:</u> Not specified</p> <p><u>Contents:</u> Blood glucose monitoring (e.g. frequency), diet (e.g. carbohydrate counting, nutrition assessment), exercise (e.g. adjustment of food and/or insulin in anticipation of physical activity), technical aspects (e.g. operating procedure), sick day management (e.g. adjusting the insulin infusion), hypoglycaemia management (e.g. blood glucose monitoring), hyperglycaemia management and prevention of DKA (e.g. checking urine ketones), and infection (e.g. changing the infusion site every 48-72 hours).</p> <p><u>Educators:</u> Not specified. Professional knowledgeable regarding IPT should be accessible 24 hours a day in order to assist the new user of IPT.</p> <p><u>T & L Aids:</u> Not specified</p>	Motivated patients with a range of technical skills and self-management capabilities are required for successful implementation of IPT.
[8]	A series of follow-up studies involving more than 800 patients in the United States, a paper presents a narrative summary of findings and clinical experience on IPT.	<p><u>Methods:</u> IPT training</p> <p><u>Duration:</u> Two 60-90 minute outpatient sessions.</p> <p><u>Contents:</u> Adjustments of premeal bolus doses to accommodate variations in preprandial glucose levels (using correction boluses) and meal size (using carbohydrate counting), prevention of ketoacidosis and hypoglycaemia, algorithms for sports and exercise, care of injection sites, and use of advanced pump features.</p> <p><u>Educators:</u> Not specified</p> <p>Patients are encouraged to call their healthcare professional if they have a problem</p> <p><u>T & L Aids:</u> Not specified</p>	Patient education, careful adjustment of basal/bolus doses and close follow-up (including education) are crucial to the success of IPT.

<p>[17]</p>	<p>This paper is largely based on expert opinion and is set in the United States, with some reference to relevant literature.</p>	<p><u>Methods:</u> Initial training and follow-up Initial education: Diabetes nurse should meet with the patient and family and should provide initial education and education at the beginning of the therapy. Participants are encouraged to write down all their questions and bring these into educational sessions. Practical training: A demonstration of loading and programming the pump and inserting the infusion set using a trainer pump. Troubleshooting and sick-day rules specific to IPT should be introduced <u>Duration:</u> Not specified <u>Contents:</u> As above <u>Educators:</u> Not specified Patient should be able to contact the diabetes nurse with any questions during treatment initially <u>T & L Aids:</u> Literature and videos</p>	<p>It is important that the IPT education should be tailored to the developmental stage of the IPT patient.</p>
<p>[18]</p>	<p>Expert opinion from a diabetes specialist nurse who has extensive experience in a community clinic in The Netherlands.</p>	<p><u>Methods:</u> Individual or group setting <u>Duration:</u> In the first week, patients attended daily half an hour educational sessions. After that they attended education sessions weekly or monthly <u>Contents:</u> Introduction to diabetes, treatment and medication including types of insulin and insulin pump management (e.g. adjusting insulin, complications). <u>Educators:</u> Multidisciplinary team (doctors, dieticians and nurses). <u>T & L Aids:</u> Not specified</p>	<p>Patients should not have access to IPT until they have been well educated about IPT as patients should be able to take responsibility for their decisions concerning their illness.</p>
<p>[9]</p>	<p>Expert opinion and the relevant literature focused on the technical problems associated with IPT. The authors are situated in Brittany, France, and have had clinical experience with patients utilising pumps in</p>	<p><u>Methods:</u> Technical education on pump <u>Duration:</u> Not specified <u>Contents:</u> Technical failure of IPT and solutions, blood glucose monitoring, prevention of cutaneous complications (e.g. body hygiene, hand washing before insertion of needles, sterile covering of the needle), management of hypoglycaemia due to programming error (e.g. checking basal infusion rates and bolus doses previously),</p>	<p>Technical risk of IPT should not be underestimated.</p>

	this region.	and prevention of DKA (e.g. checking urine ketones). <u>Educators:</u> Not specified Professional 24-hour on call service and frequent outpatients visits. <u>T & L Aids:</u> Not specified	
[2]	A consensus statement from the European Society for Paediatric Endocrinology, the Lawson Wilkins Pediatric Endocrine Society, and the International Society for Pediatric and Adolescent Diabetes, which has been endorsed by the American Diabetes Association and the European Association for the Study of Diabetes	<u>Methods:</u> Initial and ongoing education <u>Duration:</u> Not specified <u>Contents:</u> Prevention of DKA, pump functions and problem-solving strategies, infusion set insertion, nutrition therapy (carbohydrate counting/estimation), basal-bolus therapy principles, insulin kinetics, hypoglycaemia/hyperglycaemia management, activity and exercise and its effect on blood glucose, and sick day management. <u>Educators:</u> Not specified <u>T & L Aids:</u> Not specified	Proper education, frequent blood glucose monitoring, attention to diet and exercise and the communicating with diabetes team are vital for minimising IPT risk.

Appendix VIII

Grades of recommendations

In 2007 these grades of recommendation were adopted for evidence of Feasibility, Appropriateness, Meaningfulness and Effectiveness (FAME).

Grade of Recommendation

A Strong support that merits application

B Moderate support that warrants consideration of application

C Not supported