Treating psychological insulin resistance in type 2 diabetes

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Introduction

Diabetes, which is characterized by high blood glucose levels and microvascular complications, can result in damage to the cardiovascular system, eyes, kidneys, and lower limbs, resulting in high personal and societal costs [1]. Insulin therapy is a highly effective treatment for diabetes that reduces hyperglycemia and its associated medical complications [2]. The Diabetes Control and Complications Trial [3] and the United Kingdom Prospective Diabetes Trial (UKPDS) [2] have demonstrated the benefits of tight glycemic control in individuals with type 1 (T1DM) and type 2 diabetes (T2DM). For example, the UKPDS showed that a 1% decrease in HbA1c was associated with a 37% reduction in the risk of microvascular complications and a 14% reduction in the risk of macrovascular complications [4]. Although insulin therapy is highly effective in helping patients achieve tight glycemic control, this treatment benefit is often delayed in individuals with T2DM. This delay is frequently attributed to psychological insulin resistance (PIR), a term coined in 1994 to describe both provider- and patient-level barriers to initiating and maintaining insulin therapy [5]. Since then, aspects of PIR and its management have been well described in literature reviews [6,7].

Among the principal factors contributing to PIR, the foremost is patients’ lack of accurate knowledge and understanding about diabetes and insulin therapy [8,9]. For example, patients may believe that insulin is only appropriate for individuals with severe disease; thus, patients with PIR will interpret a new prescription for insulin therapy negatively as a sign that their diabetes is getting worse rather than a necessary next step in treatment to protect their health and quality of life [8,9]. Another component of PIR is a patient’s negative perception that a transition to insulin therapy is a personal failure as a result of inadequate disease self-management efforts, which is associated with guilt and remorse [9–13]. Other negative self-perceptions include feeling overwhelmed and unable to manage the complexity and daily self-management demands of insulin therapy [14], as well as fears that starting insulin therapy represents a loss of normalcy [15] and the risk of being viewed differently by others [13]. Using syringes in a public place may result in feeling socially embarrassed and rejected, leading to feeling that daily insulin injection routines...
must be hidden from others [16,17]. These perceptions can lead to omissions, delays, or early injections.

Individuals may also fear injecting insulin [9–13,18], including concerns about inability to self-administer injections [19], pain associated with injections [11,20], or general uneasiness or specific phobias about being injected [20,21]. Patients may also have concerns about the lifestyle changes imposed by insulin therapy, including concerns around its inconvenience [11,17], time-consuming aspects [22], complexity [17,23,24], and loss of personal freedom [25,26]. Additionally, patients may simply be unwilling to take on the new responsibilities associated with insulin therapy [24]. PIR may also result from potential physiological side effects of insulin [16], with the two most commonly cited problems being fear of hypoglycemia [17,27] and weight gain [28].

This accumulated body of clinical reports clearly shows that PIR can negatively affect a patient’s ability to successfully incorporate insulin therapy into daily life. However, few trials have described interventions used to treat PIR. To fill this gap in knowledge, this secondary analysis study explored how PIR was managed by certified diabetes educators (CDEs) in a large-scale behavioral intervention trial [29].

Materials and methods

For this secondary analysis study, we used empirical data from a behavioral intervention trial (N = 234) that included skills training for four CDEs in diabetes self-management education (DSME) [29]. The purpose of the trial was to determine whether glycemic control (HbA1c) is improved in Type 2 diabetes when DSME is used with Motivational Interviewing versus DSME alone. Trial participants were recruited from adult patients with T2DM and in the patient population of a large hospital medical center. Patients were included if they were 30–70 years old, had poorly controlled blood glucose (HbA1c > 7.5%), and were able to speak and write English. The full results of this trial are described elsewhere [29].

All DSME sessions were conducted by a CDE, and all patients received four DSME sessions within the 6-month intervention period. Participants were randomly assigned to four intervention conditions: DSME alone, DSME with motivational interviewing, DSME with a summary of participants’ barriers to diabetes self-management from the computerized Diabetes Self-Care Profile (DSCP) questionnaire, or DSME with motivational interviewing and the DSCP one-page clinical summary. The DSCP was found to improve patient-provider communication about diabetes-related lifestyle changes [29]. Participants not currently using insulin completed the 10-item Barriers to Insulin Therapy measure, which is part of the DSCP and includes 10 common barriers to initiating insulin therapy such as erroneous beliefs, negative self-perceptions, concerns about lifestyle adjustments, and fear of injections. The four CDE interventionists documented their approach to addressing participants’ barriers to taking insulin. Specifically, CDEs used a standard form we provided to record retrospectively their treatment recommendations (n = 1–3) used for each of the 10 barriers. Recommendations were collated and summarized.

Statistical analysis

Data were analyzed using descriptive statistics. Continuous variables (age, diabetes duration, body mass index, HbA1c, CDE visits) were described by means, standard deviations (SDs), and ranges. Categorical variables (gender, race/ethnicity, education level, marital status, use non-insulin diabetes medications, insulin use, barriers questions, and CDE recommendations) were described by number and percent.

Table 1

| Characteristic                  | Mean (SD) | Range    | n (%)  |
|--------------------------------|-----------|----------|--------|
| Age, years                     | 56.6 (10.6) | 31.0–80.0 |        |
| Female                         | 69 (58.0)  |          |        |
| Married                        | 71 (59.7)  |          |        |
| <High school graduate          | 48 (40.3)  |          |        |
| White race                     | 96 (80.1)  |          |        |
| Hispanic ethnicity             | 12 (10.1)  |          |        |
| Duration of diabetes, years    | 8.4 (7.4)  | 0.5–38.0 |        |
| Body mass index, kg/m²         | 34.5 (6.6) | 21.3–57.4 |        |
| Hemoglobin A1c, %              | 8.8 (1.1)  | 7.3–12.0 |        |
| Use non-insulin diabetes medication | 102 (85.7) |          |        |

Results

Of the 234 participants enrolled in the study, 119 were in the two intervention conditions whose CDEs received DSME skills training. Participants’ mean ± SD age was 56.6 ± 10.6 years, and 58% were women. Most participants were white (83.5%), 13% self-identified as Hispanic, and 41% had graduated from high school or had some high school education. They had been diagnosed with diabetes on average for 8.4 ± 7.4 years and their baseline HbA1c was 8.8 ± 1.1% (Table 1).

The majority of participants were not using insulin (59%), and only 10.4% reported being “OK with starting insulin.” A majority of participants also reported they “would be upset, but would start” insulin (61.2%), and 28.4% “would not start” insulin (Table 2).

Participants endorsed a mean (±SD) of 4.1 ± 2.1 insulin therapy barriers. The top three barriers to starting insulin therapy were “I would want to try all other options first” (89.6%), “I would mean my diabetes was getting worse (83.6%)” and “Reluctance to give myself insulin shots in public” (43.4%). Moderately endorsed barriers were “I would be scared of needle pain (38.8%), “I would be worried about gaining weight” (38.8%), and “I would be worried about getting low blood sugars” (35.8%). Less commonly endorsed barriers included “I am too busy to add another big demand to my life right now” (19.4%), “Health insurance/financial difficulties would make it hard to afford,” (16.4%), and “I have seen people develop serious complications after going on insulin” (11.9%) (Table 3).

The majority of CDEs’ 45 treatment recommendations to overcome/minimize insulin therapy barriers consisted of first exploring reasons why participants did not think they could take insulin, then teaching and explaining (Table 4). Education examples included teaching about progression of diabetes, causes of hypoglycemia, prevention of hypoglycemia, injection techniques in public places, the benefit of practicing, the benefits of insulin, and strategies to prevent weight gain. Other educational points are to teach that people may develop… serious complications when they start insulin because the insulin was started too late not because the insulin caused the complication and teaching about strategies to get insulin if they can’t afford it. Explanation examples included distinguishing between the natural progression of diabetes and complications due to high glycemic levels, and explaining insulin action times to prevent hypoglycemia.

The other treatment recommendations included demonstrations and sharing examples of insulin therapy success, return demonstrations (e.g. participants’ successful demonstration of taking an insulin injection as taught by the CDE), addressing participants’ feelings about insulin therapy and positively managing their expectations. Examples of demonstrations or sharing experiences of insulin therapy success (n = 8) included showing how easy it is to give an insulin injection, talking about how many people give themselves injections at dinner tables or in bathroom stalls, discussing different ways to give injections in these places, and
showing how quickly insulin can be injected. Return demonstration examples included having participants inject themselves with insulin syringes or insulin pens provided, having participants handle the syringe and vial, and practicing injecting into an injection pillow (n = 4). Lastly, examples of addressing negative feelings and positively managing expectations included asking participants who doubted their ability to take insulin to think about accomplishments and challenges overcome in their life; ask why they think they cannot learn to inject insulin; agree that some people do gain weight on insulin, but CDEs can help them to control their weight through meal planning and exercise (n = 3).

### Discussion

This is the first study to describe effective patient management strategies for PIR from experienced certified diabetes educators who were asked to systematically provide feedback on management strategies they used in routine clinical care that could inform other clinicians working in this challenging area of patient education and behavior change in T2DM. Our finding that 28.4% of participants’ not currently taking insulin had strong PIR is consistent with previous reports. In the UKPDS landmark trial, 27% of patients with T2DM randomized to insulin therapy initially refused insulin treatment [30]. Similarly, of 708 community-dwelling patients with T2DM not taking insulin, 28.2% reported that they would not take insulin even if it were prescribed by their physician [12,22].

Our findings on barriers to using insulin and CDEs’ interventions for treating PIR are similar to those from a systematic review of 16 papers on PIR in adults with T2DM [7]. In this study, we found that PIR could be explained by five themes about people with T2DM: Some patients do not see the necessity for insulin and actively seek ways to control blood sugars without insulin, patients have a holistic view of the consequences of insulin, people with T2DM see insulin therapy as less feasible, some patients see insulin as a source of fear/anxiety (about injection, hypoglycemia, and addiction), and some patients perceive the necessity to start insulin therapy as strongly negative and it is associated with distressing emotions. These individuals did not believe their illness was serious nor that it was temporary and did not therefore did not see benefit in starting insulin or did not believe they required insulin therapy. Some patients were also more likely than insulin users to have a negative attitude towards the physical and psychological benefits of insulin and to fear the social consequences of taking insulin, influencing their perception of insulin therapy as inaccessible, impractical and unacceptable [7]. Two differences between this review and our study were that 16.4% of our participants reported health insurance/financial difficulties as a barrier to starting insulin therapy, and the review comprised mostly non-US studies.

The CDEs in our study followed evidence-based procedures [31] for counseling participants with PIR. For example, they assessed participants’ health literacy as part of their initial visit and tailored the education to each participant’s health literacy level and preferred learning style (e.g., verbal, written, demonstration). Part of CDEs’ insulin self-management education included the benefits and risks associated with insulin (Table 4). Since our participants were insulin naïve, we did not assess who had provided previous insulin education, as recommended [31]. The barriers to insulin therapy identified in our study are similar to those of another systematic review of 60 studies on PIR [6]. This review found that PIR was due to patients’ emotional states (e.g., anxiety, fear), cognitive status (lack of knowledge), social stigma, and interactions with health providers [6]. In our study we did not examine the health provider’s role in PIR. This review also found that PIR can be worsened by 1) a previous threat by a physician to initiate insulin as a punishment for low adherence, 2) perceiving the physician as inexperienced, 3) believing that insulin is an incorrect medical decision for oneself, 4) lack of knowledge and treatment guidelines, 5) fear of hypoglycemia in elderly patients with T2DM and serious comorbidities, 6) reduced life expectancy, and 7) lack of time and/or personnel to teach insulin initiation [6]. It is important that future studies consider the additional PIR barriers of health literacy, the health provider’s role, and who is providing the insulin education.

Although treatments have been suggested for PIR, no empirically tested PIR intervention studies have been published to date. However, 45 patients’ and 21 health professionals’ experiences of starting insulin treatment were explored in the Treating To Target in T2DM trial [32]. The majority of participants were receptive to starting insulin despite being upset, disappointed, shocked and anxious. The health professionals were highly experienced at initiating insulin and used insulin pens with high associated patient acceptance and quality of life [33,34]. Other interventions to overcome PIR included encouraging engagement with self-monitored blood glucose results, prescribing a low starting dose of insulin, supervising initial injections, and having patients inject themselves [32]. The study authors concluded that the problem of PIR may have been previously overstated, with factors and treatment experiences possibly promoting insulin receptiveness ignored among patients with T2DM [32]. However, this study was limited by not using an objective measure of insulin barriers. Moreover, the study may have downplayed PIR among their participants, who reported emotional distress at the prospect of having to start insulin. PIR may be considered as occurring at different levels of resistance such as a moderate degree of PIR when a patient may be upset but willing to try insulin. If PIR emotions are not addressed, participants/patients may quickly change their mind and refuse to start insulin.

Our study was limited by not including real-time documentation of CDEs’ interventions to treat PIR. Instead, CDEs were interviewed after the end of the trial to obtain PIR treatment information. Second, our study did not use a longitudinal randomized controlled intervention design to determine the effectiveness

### Table 2

Insulin use status and attitudes towards starting insulin.

| Attitude towards starting insulin | n (%) |
|----------------------------------|-------|
| Not currently using insulin      | 67 (56.3) |
| Would be OK starting insulin     | 7 (10.4) |
| Would be upset, but would start  | 41 (61.2) |
| Would not start                  | 19 (28.4) |

### Table 3

Barriers to starting insulin therapy (n = 67).

| Barrier                                                                 | Participants Endorsing Barrier, % |
|------------------------------------------------------------------------|----------------------------------|
| It would mean diabetes getting worse                                   | 83.6                             |
| I would be scared of needle pain                                       | 38.8                             |
| I would be worried about getting low blood sugars                      | 35.8                             |
| I would be worried about gaining weight                                | 38.8                             |
| I don’t think I could learn to take insulin shots                      | 22.4                             |
| Reluctant to give myself insulin shots in public                       | 43.4                             |
| I am too busy to add another big demand to my life right now           | 20.7                             |
| I would want to try all other options first                            | 89.6                             |
| I have seen people develop serious complications                        | 11.9                             |
| after going on insulin                                                 |                                  |
| Health insurance/financial difficulties would make it hard to afford    | 16.4                             |

*a* Mean number of barriers endorsed: 4.1 (SD = 2.1, range = 0–9).
| Treatment Recommendation                                                                 | Information Source |
|------------------------------------------------------------------------------------------|-------------------|
| It would mean my diabetes was getting worse (n = 56, 83.8%)                               | Teaching/Explanation |
| We would discuss the natural progression of diabetes and give facts such as 80% of people w/type 2 diabetes will require insulin. (KZ) | Teaching/Explanation |
| Explain that diabetes is a naturally progressive disease where the pancreas produces less insulin over time. Insulin injections are a replacement of what the body would produce naturally. (BB) | Teaching/Explanation |
| If there are changeable lifestyle measures such as weight loss and exercise, explain that insulin might be a temporary treatment until these measures decrease insulin resistance. (BB) | Teaching/Explanation |
| Explain that controlling blood sugar levels through insulin administration can prevent diabetes complications which can worsen health. (BB) | Teaching/Explanation |
| Explain that diabetes is not getting worse, it is “progressive” and requires treatment with insulin to replace what their body no longer can produce. (MC) | Teaching/Explanation |
| Explain diabetes is a progressive disease, current therapy (diet, exercise, medications) may not continue to keep blood glucose in goal ranges. Their body requires insulin shots because the pancreas may not be producing enough anymore (MOH) | Teaching/Explanation |
| I would be scared of needle pain (n = 26, 38.8%)                                          | Return demonstration |
| I always have the patient do a self-stick with an insulin syringe and generally find 95% of people are amazed that it doesn’t hurt. | Teaching/Explanation |
| Show how small the needles actually are now and that we can select an appropriate needle size to the patient’s body. (BB) | Teaching/Explanation |
| Remind them that we are only trying to deliver a small amount of fluid into the tissue. We are not drawing blood, like for a lab test, blood glucose monitoring, or intravenous therapy. (BB) | Teaching/Explanation |
| Have them self-inject a clean needle. (BB) | Teaching/Explanation |
| Validate that most people are afraid of the needle stick until they actually do it and see how relatively pain-free it actually is. (BB) | Teaching/Explanation |
| I show them how thin and short the needle is and how to help them perform a dry demo stick to get over the anxiety and see that it is not painful. (MC) | Teaching/Explanation |
| Show the needles are smaller and thinner than the lancets they are using and smaller/thinner than the needles used to draw blood at lab (MOH). | Teaching/Explanation |
| I would be worried about getting low blood sugars (n = 24, 35.8%)                        | Teaching/Explanation |
| We would talk about prevention of low sugars and especially convey that people w/ type 2 diabetes are not likely to lose consciousness but would have warning symptoms. (KZ) | Teaching/Explanation |
| Explain that we would start on a low dose that would reduce the risk of hypoglycemia and then adjust the dose as necessary to control the blood sugar. (BB) | Teaching/Explanation |
| Instruct that prevention of hypoglycemia is key, through balancing activity, food, and exercise, which we would teach them how to do. Instruct them how to prevent hypoglycemia. (BB) | Teaching/Explanation |
| Explain that there is always a reason for hypoglycemia—either lack of food, increased activity levels, or excess medication. (BB) | Teaching/Explanation |
| Teach them how to appropriately be prepared to treat hypoglycemia and to wear a medical ID. (BB) | Teaching/Explanation |
| I teach them low blood sugar prevention and proper treatment. Explaining insulin action and proper timing to meals is essential in minimizing risk of low BS. (MC) | Teaching/Explanation |
| So patients feel more in control, educate how to avoid low blood sugars by proper meal planning, exercise, and correct insulin dosing. Teach how to recognize symptoms of low blood sugar test and the correct way to treat a low blood sugar (MOH) | Teaching/Explanation |
| I would be worried about gaining weight (n = 26, 38.8%)                                  | Teaching/Explanation |
| We discuss the fact that a slight weight gain may happen as they are no longer voiding out their calories and then discuss how to begin to modify their diet. (KZ) | Teaching/Explanation |
| Agree that some people do gain weight, but that we would help them to control their weight through meal planning and exercise. (BB) | Teaching/Explanation |
| I explain that weight gain in not from insulin, but from consuming excess calories and then talk about healthier choices and meal planning. (MC) | Teaching/Explanation |
| Acknowledge weight gain can happen due to the body more efficiently using food calories with the addition of insulin injections. Explain that with healthful food choices, along with the right meal plan and exercise, weight can be controlled (MOH) | Teaching/Explanation |
| I don’t think I could learn to take insulin shots (n = 15, 22.4%)                         | Demonstration/Examples |
| Have patients handle syringe and vial vs. insulin pens and practice injections on injection pillows. (KZ) | Demonstration/Examples |
| Have them think about all the things that they have accomplished in their lives that they were able to overcome (BB) | Demonstration/Examples |
| Demonstrate how easy it is if insurance covers insulin pens, teach pen use, which is easier than bottle and syringe. (BB) | Teaching/Explanation |
| Ask them why they think they cannot learn to take the shots. (BB) | Teaching/Explanation |
| I demonstrate how easy insulin injections are, and if their insurance covers insulin pen devices, I teach the pen vs. vial and syringe. (MC) | Teaching/Explanation |
| Find out why they doubt their ability to learn (i.e., literacy or sight issues, lack self-confidence, depression, etc.). Describe and show insulin pen, if an option (MOH) | Teaching/Explanation |
| Reluctant to give myself insulin shots in public (n = 29, 43.4%)                          | Demonstration/Examples |
| Reluctant to give myself insulin shots in public (n = 29, 43.4%)                          | Demonstration/Examples |
| Insulin pens could be more discreet if [allowed? reimbursed?] by insurance (BB)           | Teaching/Explanation |
| I show the patient ways they can get around public injections, depending upon the type of insulin that is prescribed. Some insulin is once daily and can be taken at home. Meal time insulin in a pen, can be discretely taken at the table or bathroom right before the meal. (MC) | Teaching/Explanation |
| Explain how many people with diabetes take insulin discreetly, in public places such as bathrooms, offices, restaurants; with planning and experience, it can be done quickly (MOH). | Teaching/Explanation |
| I am too busy to add another big demand to my life right now (n = 14, 19.4%)             | Teaching/Explanation |
| Try to find out what is happening in their lives and brainstorm as to when they do have time on their side. Discuss being proactive will take less time than getting sick and possibly hospitalized. (KZ) | Teaching/Explanation |
| If they have symptoms of hyperglycemia such as fatigue, frequent urination, blurred vision etc., then explain that improved blood sugar would increase their energy level and improve vision so they can accomplish more. (BB) | Teaching/Explanation |
of specific treatment interventions we describe for PIR but were embedded within a broader DSME intervention. Future studies on effective treatment strategies specifically for PIR are needed and should use a longitudinal randomized controlled design with independent evaluations of the actual DSME content of scheduled PIR sessions rather than using CDE self-report as in this study.

The phenomenon of PIR has been well documented for two decades, but interventions to treat PIR have not been well described and randomized controlled trials testing the efficacy of PIR interventions are needed. The personal barriers to starting insulin reported by our patient sample were similar to those described elsewhere [8,9,11,14,17,28,35]. Our study describes specific interventions taken by CDEs to treat PIR. This level of specificity has been lacking in the literature on PIR. These intervention strategies to treat PIR included 1) teaching and providing explanations, 2) demonstrations and sharing success examples, 3) return demonstration, and 4) addressing negative feelings and positively managing expectations. The next logical step is for a well-designed randomized controlled trial testing the efficacy of PIR interventions.

References

[1] Center for Disease Control and Prevention. National Diabetes Statistics Report, 2014.

[2] UKPDS Study Group. U.K. prospective diabetes study 16. Overview of 6 years’ therapy of type II diabetes: a progressive disease. U.K. Prospective Diabetes Study Group. Diabetes 1995;44:1249–56.

[3] DCCT Study Group. The effect of intensive treatment of diabetes on the development and progression of long-term complications in insulin-dependent diabetes mellitus. N Engl J Med 1993;329:977–86.

[4] UK Prospective Diabetes Study Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). Lancet 1998;352:837–53.

[5] Leslie CA. Psychological insulin resistance: a missed diagnosis? Diabetes Spect 1994;7:52–7.

[6] Gherman A, Veresiu I, Sasso R, Schnur J, Scheckner B, Montgomery G. Psychological insulin resistance: a critical review of the literature. Pract Diabetes Int 2011;28:125d–6d.

[7] Wang HF, Yeh MC. Psychological resistance to insulin therapy in adults with type 2 diabetes: mixed-method systematic review. J Adv Nurs 2012;68:743–57.

[8] Funnell MM. Overcoming barriers to the initiation of insulin therapy. Clin Diabetes 2007;25:36–8.

[9] Polonsky WH, Hajes TR, Dain MP, Snoek FJ. Are patients with type 2 diabetes reluctant to start insulin therapy? An examination of the scope and underpinnings of psychological insulin resistance in a large, international population. Curr Med Res Opin 2011;27:1169–74.

[10] Bogatean MP, Hancu M. People with type 2 diabetes facing the reality of starting insulin therapy: factors involved in psychological insulin resistance. Pract Diabetes Int 2004;21:247–52.

[11] Larkin ME, Capasso VA, Chen CL, Mahoney EK, Hazard B, Cagliero E, et al. Measuring psychological insulin resistance: barriers to insulin use. Diabetes Educ 2008;34:511–7.

[12] Peyrot M, Rubin RR, Lauritzen T, Skovlund SE, Snoek FJ, Matthews DR, et al. Resistance to insulin therapy among patients and providers: results of the cross-national Diabetes Attitudes, Wishes, and Needs (DAWN) study. Diabetes Care 2005;28:2673–9.

[13] Rubin RR, Peyrot M. Psychological issues and treatments for people with diabetes. J Clin Psychol 2001;57:457–78.

[14] Funnell MM, Kruger DF, Spencer M. Self-management support for insulin therapy in type 2 diabetes. Diabetes Educ 2004;30:274–80.

[15] Morris JE, Povey RC, Street CG. Experiences of people with type 2 diabetes who have changed from oral medication to self-administered insulin injections. Pract Diabetes Int 2005;22:339–43.

[16] Brod M, Kongoj J, Lesiard S, Christensen TL. Psychological insulin resistance: patient beliefs and implications for diabetes management. Qual Life Res 2009;18:23–32.
Hayes RP, Bowman L, Monahan PO, Marrero DG, McHorney CA. Understanding diabetes medications from the perspective of patients with type 2 diabetes: prerequisite to medication concordance. Diabetes Educ 2006;32:404–14.

Polonsky WH, Fisher L, Schikman CH, Hinnen DA, Parkin CC, Jelovinsky Z, et al. Structured self-monitoring of blood glucose significantly reduces A1C levels in poorly controlled, noninsulin-treated type 2 diabetes: results from the Structured Testing Program study. Diabetes Care 2011;34:262–7.

Ho EY, James J. Cultural barriers to initiating insulin therapy in Chinese people with type 2 diabetes living in Canada. CanDiabetes 2006;30:390–6.

Polonsky WH, Jackson RA. What’s so tough about taking insulin? Addressing the problem of psychological insulin resistance in type 2 diabetes. Clin Diabetes 2004;22:147–50.

Zambanini A, Newson RB, Maisey M, Feher MD. Injection related anxiety in insulin-treated diabetes. Diabetes Res Clin Pract 1999;46:239–46.

Polonsky WH, Fisher L, Guzman S, Villa-Caballero L, Edelman SV. Psychological insulin resistance in patients with type 2 diabetes: the scope of the problem. Diabetes Care 2005;28:2543–5.

Kruger DF. Tying it all together: matching insulin regimens to individual patient needs. Diabetes Educ 2007;33(Suppl. 4):91S–5S.

Woudenberg YJC, Lucas C, Latour C, Scholte WJM. Acceptance of insulin therapy: a long shot? Psychological insulin resistance in primary care. Diabetes Med 2011;29(6):796–802. doi: http://dx.doi.org/10.1111/j.1464-5491.2011.03552.x.

Machinani S, Bazargan-Hejazi S, Hsia SH. Psychological insulin resistance among low-income, U.S. racial minority patients with type 2 diabetes. Prim Care Diabetes 2013;7:51–5.

Peragallo-Dittko V. Removing barriers to insulin therapy. Diabetes Educ 2007;33(Suppl. 3):605–5S.

Saleh M, Grunberger G. Hypoglycemia: an excuse for poor glycemic control? Clin Diabetes 2001;19:161–7.

Stotland NL. Overcoming psychological barriers in insulin therapy. Insulin 2006;1:38–45.

Welch G, Zagarins SE, Feinberg RG, Garb JL. Motivational interviewing delivered by diabetes educators: does it improve blood glucose control among poorly controlled type 2 diabetes patients? Diabetes Res Clin Pract 2011;91:54–60.

UK Prospective Diabetes Study. (UKPDS) Group. Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with type 2 diabetes (UKPDS 33). UK Prospective Diabetes Study (UKPDS) Group. Lancet 1998;352:837–53.

Karter AJ, Subramanian U, Saha C, Crosson JC, Parker MM, Swain BE, et al. Barriers to insulin initiation: the translating research into action for diabetes insulin starts project. Diabetes Care 2010;33:733–5.

Jenkins N, Hallowell N, Farmer AJ, Holman RR, Lawton J. Initiating insulin as part of the Treating To Target in Type 2 Diabetes (4-T) trial: an interview study of patients’ and health professionals’ experiences. Diabetes Care 2010;33:2178–80.

Hanas R, de Beaufort C, Hoey H, Anderson B. Insulin delivery by injection in children and adolescents with diabetes. Pediatr Diabetes 2011;12:518–26.

Magwire ML. Addressing barriers to insulin therapy: the role of insulin pens. Am J Ther 2011;18:392–402.

Brod M, Kongsjo JH, Lessard S, Christensen TL. Psychological insulin resistance: patient beliefs and implications for diabetes management. Qual Life Res 2009;18:23–32.