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Insulin delivery with FlexPen®: dose accuracy, patient preference and adherence

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The introduction of insulin pens has helped improve adherence in Type 1 or 2 diabetes, and reduce inaccurate dosing, fear of injection, and social embarrassment associated with vial and syringe. This report presents the published evidence base for the accuracy, patient preference and economic evaluation of one prefilled pen, FlexPen® (Novo Nordisk A/S, Bagsværd, Denmark) and discusses recent changes to the design of this pen. Primary research publications that included the study of FlexPen were identified from various sources. Several studies have shown that FlexPen delivers high, medium and low doses of insulin significantly more accurately than vial and syringe, SoloStar® (sanofi-aventis, Paris, France) or OptiClik® (sanofi-aventis, Paris, France). Patients have also found FlexPen easier to use than vial and syringe. A Next Generation FlexPen® has been developed, which maintains the demonstrated accuracy of FlexPen and is accompanied by a reduced injection force for simpler and more comfortable use, and clear colour scheme for insulin type to avoid medication errors.

Keywords: dose accuracy, FlexPen, insulin delivery, patient preference

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1. Introduction

In Type 1 and 2 diabetes, the primary goal of therapy is to achieve good glycaemic control and reduce the long-term complications of hyperglycaemia, and in particular microvascular complications [1,2]. All patients with Type 1 diabetes receive insulin therapy, and in patients with Type 2 diabetes, insulin is usually required when the efficacy of oral agents decreases and glycaemic control deteriorates. When intensive insulin therapy is initiated, multiple injected doses are given to try to mimic normal physiological plasma insulin profiles – injections of long/intermediate-acting and short-acting insulin formulations are used to recreate the natural basal levels of insulin and superimpose them with prandial peaks of insulin. This inevitably means that many patients have to self-inject several times a day and adhere to relatively complicated regimens.

Traditionally (for > 80 years), insulin has been administered by vial and syringe, which makes accurate dosing difficult and requires considerable motivation by the patient as it can be cumbersome, time-consuming, inconvenient and painful. This can be a particular issue for old or young patients who have difficulty handling the vials and syringes (and for parents or other relatives who have to administer insulin to children). Furthermore, the syringes and vials that have been used for insulin injection can produce needle anxiety, fear of injection pain, and social embarrassment [3-7]. Approximately 25% of patients have some form of anxiety about self-injecting [4,5] and even after 6 months of treatment, some patients still have extreme fear of self-injecting or testing [3]. There is evidence that such issues can affect treatment adherence in those taking insulin [8], and patients with

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Type 2 diabetes may be reluctant to initiate insulin therapy primarily due to beliefs and perceptions regarding diabetes and its treatment, and the nature and consequences of insulin therapy [9]. It has been shown that up to 65% of patients with diabetes are not fully confident in their ability to effectively self-manage their disease [10].

In general, the more complicated the dosing regimen for a chronic disease, the poorer the adherence by patients; diabetes is no exception to this general rule [11]. When discussing insulin use among patients with diabetes, adherence is usually defined as the number of missed injections (as reported by the patient) or is calculated from prescription refill patterns (which assumes that prescriptions collected by the patient are used by the patient). The complicating issues associated with self-injecting insulin may make the issue of adherence an even greater problem in diabetes than in other chronic diseases (as complicated regimens in other conditions may simply involve taking a combination of orally administered drugs). Although a link between poor treatment adherence and an increase in long-term microvascular complications has been established in patients with Type 1 diabetes, it has not been fully demonstrated for patients with Type 2 diabetes [12]. However, poor adherence may ultimately affect Type 2 diabetes care and glycaemic control [13].

To help tackle some of the issues with vial and syringe administration of insulin, a number of insulin pens have been introduced since the launch of NovoPen® (Novo Nordisk A/S, Bagsværd, Denmark) in 1985. Pens are either prefilled (disposable) or durable, and the use of prefilled pens appears to be increasing relative to durable pens [14]. Since 1985, pens have become increasingly sophisticated to meet patient needs, and offer a variety of features such as easy dose dialling and correction with audible clicks, large mechanical or digital displays, dose delivery confirmation, one and half unit increments, small, slim and light-weight designs, visual and tactile coding of pens with different insulins (long/intermediate- or short-acting, etc.), and easy to change cartridges. These pens simplify the dosing and administration of insulin in patients with diabetes and their convenience makes them an attractive alternative that has gained prominence, particularly in Europe, and increasingly, in the rest of the world. The USA is a notable exception to this, and syringe and vial remains the most widely used form of insulin administration.

This technology evaluation provides a comprehensive review of the prefilled FlexPen® (Novo Nordisk A/S, Bagsværd, Denmark); it is not intended to be a systematic review of insulin delivery devices. Literature on FlexPen has been identified by Medline searches using 'FlexPen', 'insulin pen' and 'insulin delivery device' as search terms (since 2000), from references cited in major reviews, and from the authors' meeting presentations or work that is currently in press. There are several other publications (that were outside the scope of this review) that cover the subject of insulin delivery via insulin pens. A brief introduction is provided on accuracy and patient preference of pens compared with syringe and vial, followed by a more detailed review of FlexPen and the effect of recent modifications to the design on accuracy, injection force and patient preference.

2. Advantages of insulin pens

There are many factors that can potentially affect glycaemic control in patients with diabetes. Physiological variability is probably a major barrier to consistent control of blood glucose, but when administering insulin, the accuracy of the doses delivered is crucial to avoid introducing further variability, and patient preference and adherence can ensure regimens are followed.

Many studies have demonstrated better dose accuracy with pens than with vial and syringe, particularly for the delivery of low doses of insulin (≤ 5 IU) [15-17], and some have gone as far as concluding that syringes are 'dangerously' inaccurate at low doses [16]. Dose accuracy is important *per se*, but if the patient has trust that their device is delivering insulin accurately, this may also improve adherence [18].

The stated advantages of pens over vial and syringe in a large number of studies include: ease of use and convenience, improved flexibility, social acceptability, perceived clinical efficacy and quality of life [19-24]. One study that assessed the effects of these advantages on preference found that improvements in convenience, flexibility, perceived clinical efficacy and quality of life all contributed to the preference for a pen versus a vial and syringe [23]. Such factors may also have a clinical relevance as they may contribute towards the improved adherence to insulin regimens with pens versus vials and syringes [25]. Furthermore, improved medical adherence was associated with improved endpoints including the incidence of hypoglycaemia and the number of hypoglycaemia-associated hospital and physician visits [25].

3. Clinical evidence with FlexPen

A number of prefilled and durable pens are available for delivery of insulin, and one of the most commonly used of these is the prefilled FlexPen. This pen is used by more than 3 million patients worldwide for delivery of insulin [26] and is a simple and safe device [27-33]. This article discusses the clinical evidence for the use of this pen and ongoing improvements to the design of the pen.

3.1 Dosing accuracy

Vial and syringe administration of insulin has been shown to be error prone in the majority of patients [34,35], and there can be a > 25% difference between the delivered dose and the intended dose in many patients [36]. Pens have been shown to be more accurate, especially in the elderly or for delivering low doses of insulin [16,17,34].

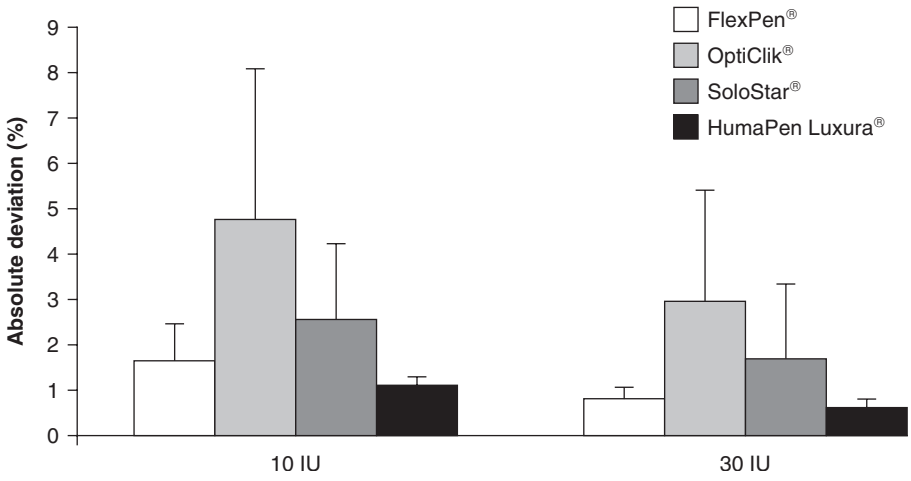

Figure 1. Dose accuracy of four insulin pens.
Reproduced with permission from the Journal of Diabetes Science and Technology [29].

When patients' attitudes to FlexPen were assessed by questionnaire, confidence in the dose of insulin being delivered was high [37,38]. Although patient confidence in the dosing of insulin delivery devices is important, direct measurements of device accuracy are essential (to confirm patient perceptions and to maintain confidence). Recently, several studies have demonstrated the dose accuracy of FlexPen, as described below.

Both healthcare professionals and healthy volunteers were capable of delivering accurate doses from FlexPen in one study [33], and two recent studies (one based in Japan, the other in Germany) demonstrated the accuracy of FlexPen compared with another prefilled pen, SoloStar® (sanofi-aventis, Paris, France) [29,30]. Both studies assessed dose accuracy of FlexPen and SoloStar by delivering insulin doses onto a precision balance. When delivering doses of 10 IU and 30 IU, FlexPen delivered 192 doses and 72 doses, respectively, within pre-defined acceptable dose ranges (based on ISO limits; 9 – 11 IU when set to deliver 10 IU, and 28.5 – 31.5 IU when set to deliver 30 IU) [29]. The deviation from the set dose was only 1.64 and 0.83%, respectively (**Figure 1**). In contrast, SoloStar under-dosed 1/192 (0.5%) and 3/72 (4.1%) of the 10 and 30 IU doses, respectively, and the deviation in doses was 2.61 and 1.70% ($p < 0.05$ versus FlexPen), respectively [29]. Neither pen over-dosed at 10 or 30 IU. In the same study, the durable device OptiClik® (sanofi-aventis, Paris, France) delivered 6.8% of 10 IU doses and 13.9% of 30 IU doses outside the pre-specified limits, and FlexPen was as accurate at delivering these two doses of insulin as the durable pen HumaPen Luxura® (Eli Lilly & Co, IN, USA) [29]. A second study demonstrated similar accuracy, with 227/228 doses delivered by FlexPen within pre-specified limits, and showed that FlexPen delivered low 5 IU doses of insulin accurately (126/126 doses delivered within the pre-specified range). Conversely, SoloStar under-dosed in 2/126 (1.6%) 5 IU doses and 22/75 (29.3%) and 9/27 (33.3%) 10 and 30 IU doses, respectively [30]. The calculated dosing error was significantly greater with SoloStar than with FlexPen ($p < 0.001$) (**Figure 2**). These studies followed the manufacturers' instructions for use of the pens, which included changing the needle between each delivered dose.

The accuracy of FlexPen has been demonstrated in another comparative trial of similar design [31]. When used to deliver insulin doses of 10 or 30 IU, FlexPen delivered all 240 doses of 10 IU and all 45 doses of 30 IU within pre-specified acceptable ranges. However, the durable pen, OptiClik, under-dosed 17.1% of the 10 IU doses and 28.9% of the 30 IU doses (**Figure 3**) [31].

The clinical significance of differences in accuracy between FlexPen and other prefilled and durable pens has not been demonstrated. However, the poorer accuracy of some pens is not predictable – they also have poor precision, with large standard deviations around a mean delivered dose (e.g., at 5, 10 and 30 IU the standard deviation of the mean dose delivered by FlexPen were 0.19, 0.27 and 0.34, respectively, and were 0.30, 0.52 and 0.47 for SoloStar, respectively) [30]. This means patients cannot simply adjust the set dose to ensure delivery of the correct amount of insulin. Instead, patients may be injecting higher doses one day and lower doses the next day, and this could potentially lead to frequent hyperglycaemia and/or hypoglycaemia, both of which are associated with risks in the long term. Regardless of the true clinical significance of accuracy and precision, FlexPen clearly minimises any possible problems by accurately and precisely delivering the dose of insulin.

3.2 Ease of use and patient preference

Many of the features of FlexPen are designed for ease of use, such as single-unit dosing increments, large dose selector, a

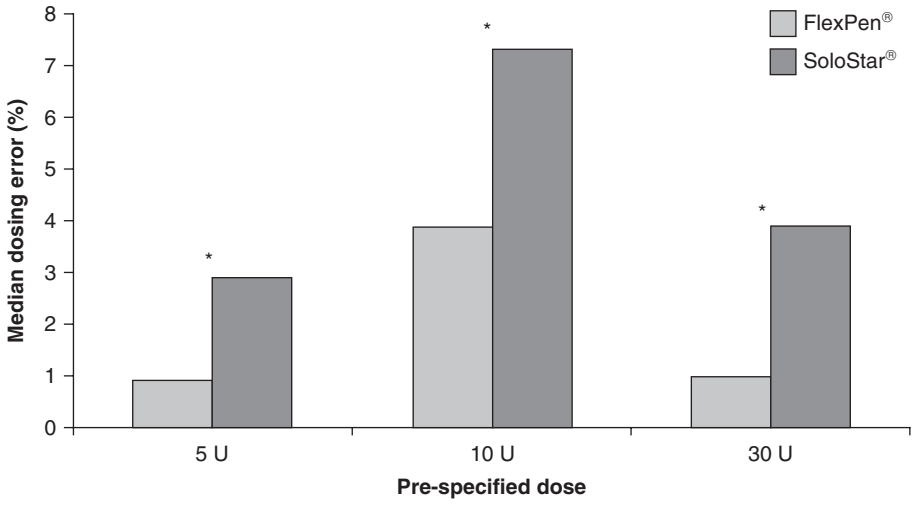

Figure 2. Difference between delivered dose and pre-specified dose with FlexPen® and SoloStar® pre-filled pens.
*$p < 0.001$.
Reproduced with permission from Asakura *et al.*, 2008 [30].

clear dose display to show the selected dose, dose correction by dialling back, and dial blockade when there is insufficient insulin in the cartridge to deliver the selected dose. The efficiency of such features has been assessed in clinical trials. However, because the main clinical investigation of FlexPen dates back to the early part of this decade, the comparators in most studies are vial and syringe or older pens that have since been updated or replaced. There are limited data confirming patient preference for FlexPen versus other recently introduced pens.

In a randomised trial, comparing FlexPen with a syringe for delivering insulin, 74% of patients preferred FlexPen to vial and syringe, while only 20% preferred vial and syringe [37]. FlexPen was considered more discreet for use in public by 85%, 74% considered it easier to use, and 85% found the dose scale easier to read with the pen compared with the vial and syringe [37]. Therefore, as with many other pens, most patients prefer FlexPen to vial and syringe. Reasons for patient preference for FlexPen include convenience, flexibility, confidence in the dose accuracy, perceived clinical efficacy and improved quality of life [23].

In addition, several studies have shown that patients find FlexPen easier to use than other insulin pens [27,38,39]. In one study, for example, compared with Humalog Pen® (Eli Lilly & Co, IN, USA), FlexPen was preferred by 82.8% of patients with diabetes [39]. FlexPen was rated as significantly easier for setting the dose, easier to press the push-button, simpler to use, more legible for dose setting, more stable during injection, and better for injection confirmation (**Figure 4**) [39]. Similarly, in another randomised trial, 74.6% of patients preferred FlexPen to Humalog Pen [27].

Preference for FlexPen over other pens has been expressed by healthcare professionals as well as the patients using the pens; ease of use was similarly cited as a major factor in having this preference and FlexPen was preferred for use in public to other insulin pens [40].

One of the few comparisons of FlexPen with more recently introduced pens with limited clinician and patient experience, including SoloStar, showed that the usability (measured by the completion of all steps for use) was very similar for SoloStar and FlexPen [41]. Similar proportions of patients also preferred many design/aesthetic features of FlexPen as preferred SoloStar, but factors mainly relating to injection force, were preferred in SoloStar by more patients [41]. However, changes to the design of FlexPen in Next Generation FlexPen® have significantly reduced injection force [42,43], and improved patient perception [42,44]. The Haak et al study [41] should, therefore, be interpreted with caution and with this perspective in mind, as it is not a relevant comparison in relation to Next Generation FlexPen.

3.3 Adherence and clinical benefits

The accuracy of FlexPen and the features of the pen that make it preferred by many patients should improve adherence, and this has been demonstrated in recent analyses discussed in this section. To date, adherence studies have only compared FlexPen with vial and syringe, and it remains unknown if there are clinically meaningful differences in medication adherence when using different insulin pens.

Switching from a vial and syringe to FlexPen resulted in an increase in the proportion of Type 2 diabetes patients considered adherent from 36.1 to 54.6%; this improved adherence reduced the risk of a hypoglycaemic event by 50% in the total study population and was associated

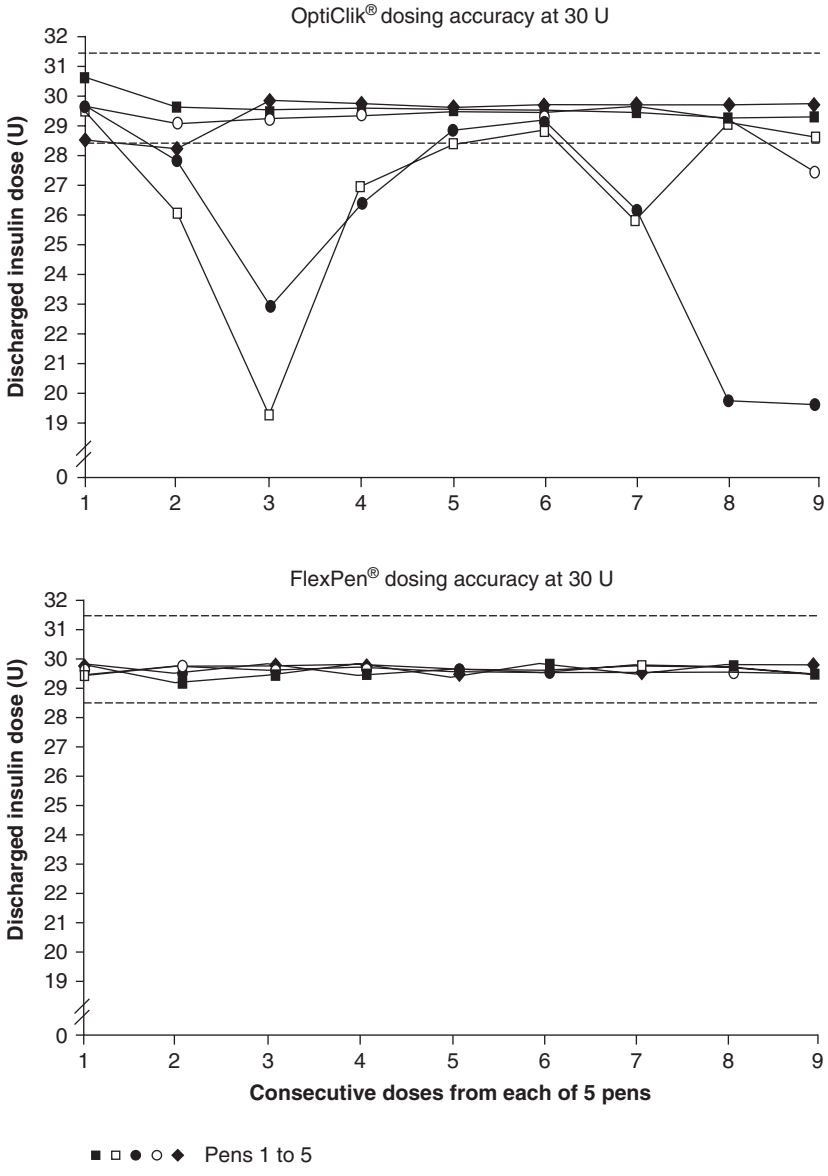

Figure 3. Dose accuracy of FlexPen® and OptiClik® for delivering 30 IU of insulin.
Reproduced with permission from Asakura T. Comparison of the dosing accuracy of two insulin injection devices. J Clin Res. 2005;8:33-40 [31].

with cost benefits [25]. This was confirmed in another comparison, in which overall medication adherence was significantly higher for Type 2 diabetes patients who switched from vial and syringe to FlexPen and/or NovoPen [45]. The same study also analysed adherence in patients with Type 2 diabetes, who were initiating insulin therapy. Adherence to FlexPen and/or NovoPen was similar to adherence to vial and syringe – overall medication possession ratio (MPR) was 94% with both delivery methods (possibly explained by patients being more motivated to adhere to their medication when first switching from oral medications to insulin injections). However, initiating therapy with FlexPen was associated with other benefits (see below) [45].

As with dose accuracy, the possible clinical benefits of improved adherence with FlexPen have not been assessed directly. However in general, barriers to diabetes therapy adherence (such as unclear instructions on medication use) are associated with failure to meet glycaemic targets [46]. Specifically, a significant association between insulin use (adherence to prescribed regimens) and reduced HbA_{1c} levels has been demonstrated in adults with Type 2 diabetes [47] and adolescents with Type 1 diabetes [48]. For example, a recent study showed that Type 2 diabetes patients who took at least 80% of their prescribed insulin therapy had a mean HbA_{1c} level of 8.1%, but those who took < 80% of their prescribed insulin had a mean HbA_{1c} level of 8.7% ($p < 0.0001$) [49].

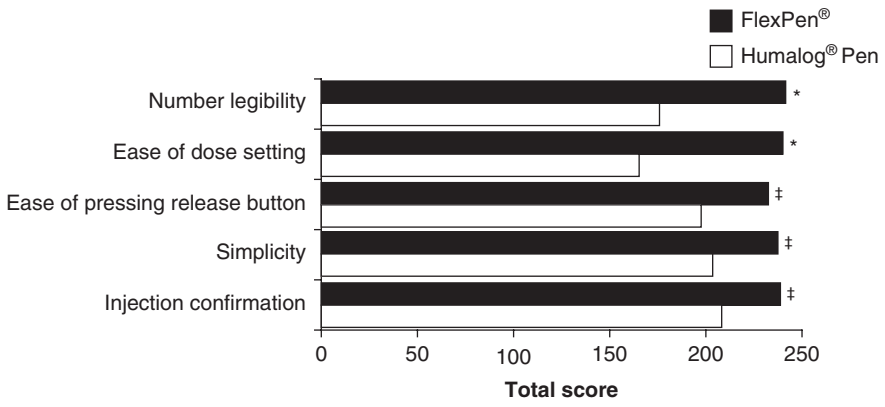

Figure 4. Comparison of usability scores of FlexPen® and Humalog® Pen.

*$p < 0.001$.

‡$p < 0.01$.

Reprinted from Clinical Therapeutics, 27 Suppl B, Korytkowski, Niskanen, Asakura, FlexPen: addressing issues of confidence and convenience in insulin delivery, S89-100, 2005, with permission from Excerpta Medica, Inc. [28,39].

3.4 Economic evaluations

The two studies discussed in Section 3.3 assessed the effect of adherence (to FlexPen) on the healthcare costs associated with diabetes management [25,45]. Both studies were US based and one focused on data that represented commercially insured individuals continuously enrolled in managed care settings [25], while the other focused on the low-income Medicaid population [45]. In the study by Lee *et al.*, total annual treatment costs, including the cost of the insulin delivery device and the insulin, were reduced by US$1590 per patient who switched from a vial and syringe to FlexPen – hypoglycaemia-attributable (such as hospital costs, physician-visit costs and emergency department costs) and diabetes-attributable healthcare costs were both reduced [25]. In the Medicaid population total annual healthcare costs with FlexPen use were ~ 50% of the costs of vial and syringe use ($p < 0.05$) in patients switching from oral medications, when all prescription costs were included, including the cost of the insulin delivery device and the insulin [45]. As in the earlier study, hospital costs, diabetes-related costs and outpatient costs were all reduced when patients used FlexPen rather than vial and syringe [45].

3.5 Other attributes of FlexPen

FlexPen comes prefilled with either the long-acting insulin Levemir® (Novo Nordisk A/S, Bagsværd, Denmark) (insulin detemir), NovoMix® 30 (Novo Nordisk A/S, Bagsværd, Denmark), NovoMix 50 or NovoMix 70, or the short-acting insulin NovoRapid® (Novo Nordisk A/S, Bagsværd, Denmark) (insulin aspart).

Unlike some pens (e.g., OptiClik, SoloStar), FlexPen can be fitted with any currently available pen needle. The most commonly used needle with FlexPen is NovoFine® (Novo Nordisk A/S, Bagsværd, Denmark) 30G 6 mm needles. These needles are short and slim, and this reduces the pain or perception of pain compared with conventional syringe and vial [50,51]. For example, using these needles on NovoPen 3 significantly lowered injection pain compared with vial and syringe in 96 patients with Type 2 diabetes, and this reduction was particularly large in patients initially using vial and syringe who switched to the NovoPen [50]. NovoFine 30G 6 mm needles also have a wide bore to reduce the force required to deliver insulin doses. Other thinner needles such as NovoFine 31G and 32G needles (or any needle with the same attachment interface) can also be used with FlexPen.

These additional attributes tackle some of the key problems of traditional insulin injections (social embarrassment and fear of injection pain), and combined with the accuracy of FlexPen, and its ease of use, all help to improve treatment adherence in patients with diabetes and may contribute to more effective glycaemic control in the long run.

4. The future of FlexPen

There is good evidence that FlexPen is suitable for the delivery of insulin in a simple, safe and accurate manner, but occasional reports from patients suggest that some patients find it difficult to depress the push button because of the injection force of FlexPen. A Next Generation FlexPen is soon to be launched, which has some features designed to further improve the safety and simplicity of use.

Clearer colour-coding of the label, packaging and cartridge holder of Next Generation FlexPen should ensure the correct insulin cartridges are used and reduce the risk of patients administering the wrong insulin (**Figure 5**). Furthermore, the needle attachment interface of Next Generation FlexPen is designed to be compatible with all available needles on the market and to also fit the novel NovoTwist® (Novo Nordisk A/S, Bagsværd, Denmark) needle that is designed to make needle changing easier. The key change to the Next Generation FlexPen, however, is its reduced injection force compared with the conventional FlexPen. This has been reduced from

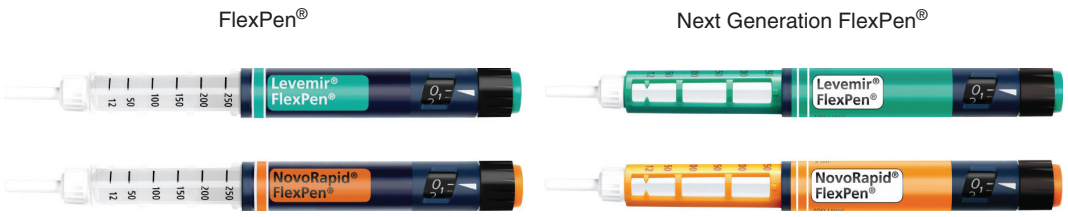

Figure 5. Next Generation FlexPen® clearer colour and labelling scheme (including coloured cartridge holder) used to help differentiate between insulin formulations to avoid medication errors.
Reprinted with permission from Sommavilla *et al.*, 2008 [44].

~ 18 N to ~ 12 N [42]. The injection force of conventional FlexPen is higher than some other pens (in particular SoloStar) and this has been cited as a factor that some patients prefer in some other pens [41], but a direct comparison of Next Generation FlexPen and SoloStar found that Next Generation FlexPen had a 18 – 45% lower injection force than SoloStar at three different injection speeds [43]. A lower injection force is preferred by users and makes injecting insulin easier, particularly in patients with impaired manual dexterity [52-54]. Importantly, the reduction in injection force in the Next Generation FlexPen may make a difference to patients – when tested by patients with Type 2 diabetes, 76% found the Next Generation FlexPen to be simpler and more comfortable to use than FlexPen and more patients rated the injection force of Next Generation FlexPen as 'good' or 'very good' than with FlexPen [42]. A second study of patient preference that included Type 1 and 2 diabetes patients, showed that identification of the type of insulin and usability when injecting insulin into an injection pillow were easier with Next Generation FlexPen than with FlexPen [44]. In addition, Next Generation FlexPen instilled more trust and confidence in the patient than FlexPen, nearly all patients preferred Next Generation FlexPen to FlexPen, and 77% of patients preferred using the new NovoTwist needle on Next Generation FlexPen than using the NovoFine needle [44]. The improvements made to the Next Generation FlexPen do not compromise any other aspects of the pen's performance, and the pen's accuracy is equivalent to or better than conventional FlexPen [42].

5. Conclusion

Insulin pens have distinct advantages over syringe and vial in terms of accuracy, ease of use and reduced injection pain, and are now widely used, especially in Europe. FlexPen is a prefilled pen that is simple to use and has proven dosing accuracy – attributes that make it the most widely used insulin pen. Patient preference for FlexPen may increase adherence, and thus reduce hypoglycaemic episodes and cost (associated with hypoglycaemia). FlexPen not only demonstrates such advantages over vial and syringe, but has also been shown to be more accurate than other pens and to be preferred by most patients. Recent design changes to FlexPen have resulted in a pen that maintains all the qualities of the conventional FlexPen (simple to use, accurate and safe), but has reduced the injection force by 30% and as a result patients prefer the simplicity and comfort of Next Generation FlexPen over the conventional pen.

6. Expert opinion

With the growing epidemic of Type 2 diabetes, and demands from major organisations to treat diabetes aggressively and maintain lower blood glucose targets, so the demand for effective, safe and simple-to-use insulin delivery devices will continue. The advantages of insulin pens over the traditional vial and syringe are likely to increase the use of pens over the coming years, especially if the US market opens up to more widespread use of pens for insulin delivery. As more patients use pens, the demands for simple and effective devices will increase as will demands for specific features and improvements. Patients are individuals, and their personal preferences and lifestyles, as well as their specific treatment needs, will determine the preferred delivery device. For many, a prefilled insulin pen will be preferred (this may be especially true for elderly patients or other patients with reduced manual dexterity, as prefilled pens require no additional manipulation for changing cartridges, but many other patients will also prefer the simplicity of prefilled pens), and dose accuracy of the device must be the first consideration when choosing the appropriate prefilled pen. Although not demonstrated in long-term clinical studies, even small decreases in dose accuracy with a pen are likely to have an impact on the risk of hypoglycaemia or hyperglycaemia over time. Just as importantly, if reduced dose accuracy causes a loss of confidence in their device by patients, this may have consequences for medication adherence. Such effects of reduced dose accuracy could have serious long-term consequences.

This evaluation of insulin pens focuses on their advantages mainly from a patient perspective. However, it is briefly mentioned that studies have shown that healthcare professionals generally view pens as a better option for delivering insulin than vial and syringe [40,55]. Furthermore, there are other

Box 1. Alternative technologies box [57-59].

Insulin pumps (continuous subcutaneous insulin infusion): accurate and allow flexibility for otherwise complex injection regimens; can be cumbersome and expensive

Inhaled insulin: this is one of the most promising alternative technologies. Exubera® (Pfizer Inc, NY, USA) was the first product on the market, but was subsequently withdrawn. This technology is unproven (in terms of efficacy, safety or cost effectiveness) for use in the long term, in intensive insulin regimens, or in direct comparisons with insulin pens

Nasal insulins: lyophilised and gelified spray formulations have shown promise; local side effects may limit use

Oral (buccal or sublingual) insulin: limited data with a liquid formulation (Oral-Lyn®; Generex Biotechnology Corp, Toronto, Canada) and a spray formulation (RapidMist®; Generex Biotechnology Corp, Toronto, Canada), and variable pharmacokinetics

Oral (gastrointestinal) insulin: with permeation enhancers or in liposomes or emulsions; limited clinical data

Transdermal insulins: use chemical (liposomes, chemical enhancers) or physical (iontophoresis and sonophoresis) methods to enhance absorption; limited clinical data

practical issues that healthcare professionals have to deal with in the management of diabetes with insulin. For example, vials and syringes are associated with a high incidence of needlestick injury among nurses caring for patients with diabetes [56]. The anxiety and stress that such injuries can cause healthcare professionals could potentially be reduced with pen use.

The hope is that an accurate pen will have all the features that make it preferred by patients and healthcare professionals. As discussed in this review, FlexPen appears to have this advantage. In many studies, the superior accuracy of FlexPen has been demonstrated and patient preference often favours FlexPen. The reduced injection force of Next Generation FlexPen improves the pen's 'usability' by making it simpler and more comfortable for patients to use.

We anticipate continued changes to existing insulin delivery devices, and alternative technologies may in the longer-term be shown to be safe, effective and cost effective (**Box 1**). However, any new development or new technology will have to show at least equivalent accuracy and patient preference to FlexPen and Next Generation FlexPen if they are to succeed in the marketplace and offer improved insulin delivery to patients with diabetes.

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Declaration of interest

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