Dose Accuracy Comparison Between SoloSTAR and FlexPen at Three Different Dose Levels

Alfred Penfornis, M.D., Ph.D.[1] and Kristian Horvat

Abstract

Background: The convenience and accuracy of insulin pens have led to their extensive use in patients with diabetes. Although all insulin pens go through extensive testing as part of the regulatory process, it is important that both the patient and clinician can be assured of the accuracy of the dose delivered. This study compared the dosing accuracy of two commonly available insulin pens, the SoloSTAR® (sanofi-aventis Deutschland GmbH, Frankfurt, Germany) and FlexPen® (Novo Nordisk A/S, Bagsvaerd, Denmark) devices.

Methods: Doses of 5, 10, and 30 units of insulin were investigated for SoloSTAR and FlexPen, and specific units of accuracy were based on International Organization of Standards for insulin injection pens (±1 unit for the 5 and 10-unit doses, ±5% for the 30-unit dose). A total of 30 pens were tested for both the SoloSTAR and FlexPen, and a total of 2,280 measurement values were taken for each pen type (5 units, 1,260; 10 units, 750; and 30 units, 270 doses).

Results: Both devices were shown to be accurate at all three doses, and all doses were delivered within the limits proposed by the International Standard of Organization, which is used as part of the regulatory approval process when introducing an insulin injection device to the market.

Conclusion: Our study shows that the SoloSTAR and FlexPen devices have comparable accuracy.

Introduction

SINCE THE LAUNCH of the first insulin pen in 1985, there are now numerous reusable or disposable pen devices officially approved for administering insulin; insulin pens currently account for just over 50% of insulin use worldwide.[1] With this widespread use, it is important that both the patient and clinician are confident regarding the accuracy of an insulin injection device, as the key to treatment management of diabetes is the consistent delivery of an accurate insulin dose. To this regard, it is important to note that all insulin pens undergo extensive evaluation as part of the regulatory process, which includes the demonstration of accuracy.

The SoloSTAR® disposable pen (sanofi-aventis, Deutschland GmbH) has been approved and is available on the market to deliver insulin (either insulin glargine [Lantus®] or insulin glulisine [Apidra®]; both sanofi-aventis, Paris, France). Dose delivery by SoloSTAR has been shown to be accurate in a previously published laboratory-based study,[2] in addition to studies performed in a clinical setting.[3,4]

The aim of this study was to compare the dosing accuracy of two commonly used insulin injection pen devices, the SoloSTAR and FlexPen® (Novo Nordisk A/S Bagsvaerd, Denmark).

Materials and Methods

The method for generating the dose accuracy data is detailed in the article of Asakura et al.[5] Two batches of each of the SoloSTAR and the FlexPen were tested: SoloSTAR insulin glargine pens (batch numbers U200 and U208) using Micro-Fine® needles (31 gauge, 0.25 × 5 mm; Becton, Dickinson and Co., Franklin Lakes, NJ) and FlexPen insulin detemir (Levemir®; Novo Nordisk A/S) pens (batch numbers VH70046 and VH70047) with Novo-Fine® needles (32 gauge, 6 mm; Novo Nordisk A/S).

The study sample size was based on the International Organization of Standards (ISO) 2000 regulation for insulin injection pens (ISO 11608-1), which requires a minimum of 15 pen devices to be tested in a laboratory setting repeatedly across three specified doses, for 60 single doses at each dose level.[6] Therefore, a total of 15 pens from each batch (30 pens in total) were used to test doses of 5, 10, and 30 units, and each pen was tested 42, 25, and nine times, respectively. Dur-

[1]Service d'Endocrinologie Metabolisme et Diabetologie Nutrition, Hôpital Jean Minjoz, Besancon, France.
[2]sanofi-aventis Deutschland GmbH, Frankfurt am Main, Germany.

needles were preconditioned for at least 4 h (standard atmosphere at 18–28°C with relative humidity of 25–75%) and underwent testing in these conditions. Before use, the pens were prepared for injection as stated in the instructional leaflet. Prior to each measurement, a new prescribed needle was mounted to the device. A safety shot (priming) as quoted in the instruction manuals was performed, and the subsequent units were dialled and dispensed. The mass of the insulin delivered was weighed and recorded; measured mass was calculated to the subsequent volume by using the density of the relevant insulin (SoloSTAR insulin glargine, 1.004 g/mL; FlexPen insulin detemir, 1.008 g/mL). After the dose was dispensed, the SoloSTAR and FlexPen devices were held in place for 10 and 6 s, respectively, in accordance with the instruction manuals.

The dose accuracy limits followed throughout this examination were based on the ISO regulation for insulin injection pens (ISO 11608-1).[6] Specified accuracy ranges were 5 ± 1 units (4.0–6.0 units), 10 ± 1 units (9.0–11.0 units), and 30 ± 5% (28.5–31.5 units).

Results

All 2,280 measurement values (1,260 for 5 units, 750 for 10 units, and 270 for 30 units) were within the accuracy limits for both SoloSTAR and FlexPen.

Table 1 summarizes the combined mean delivered doses of 5, 10, and 30 units of insulin with the SoloSTAR and FlexPen for all batches tested.

The overall variance of SoloSTAR for the 5-unit dose was lower compared with FlexPen; the variance for the 10- and 30-unit doses was higher for SoloSTAR compared with FlexPen.

When comparing the ordinal view to the aberration from the target value, SoloSTAR had the majority of values closer to the target (at all dosing steps). A total of 47.9% of all 1,260 detected dose accuracy values at the 5-unit dosing step of the SoloSTAR were within an area of 0.1 unit from target compared with 37.1% of FlexPen values, and only 0.5% of all dose accuracy values of the SoloSTAR had an aberration of more than 0.5 unit from the target compared with 2.5% for FlexPen. For the 10-unit dose setting, 33.3% of all 750 detected dose accuracy values for the SoloSTAR were within an area of 0.1 unit from target compared with 28.3% of FlexPen values. No SoloSTAR dose accuracy values had an aberration of more than 0.5 unit from the target compared with 3.6% for FlexPen. At 30-unit testing, 28.5% of all 270 detected dose accuracy values with the SoloSTAR were within an area of 0.2 unit from target compared with 8.1% of FlexPen values. A total of 9.3% of all SoloSTAR dose accuracy values had a deviation of more than 0.8 unit from the target compared with 13.3% for FlexPen.

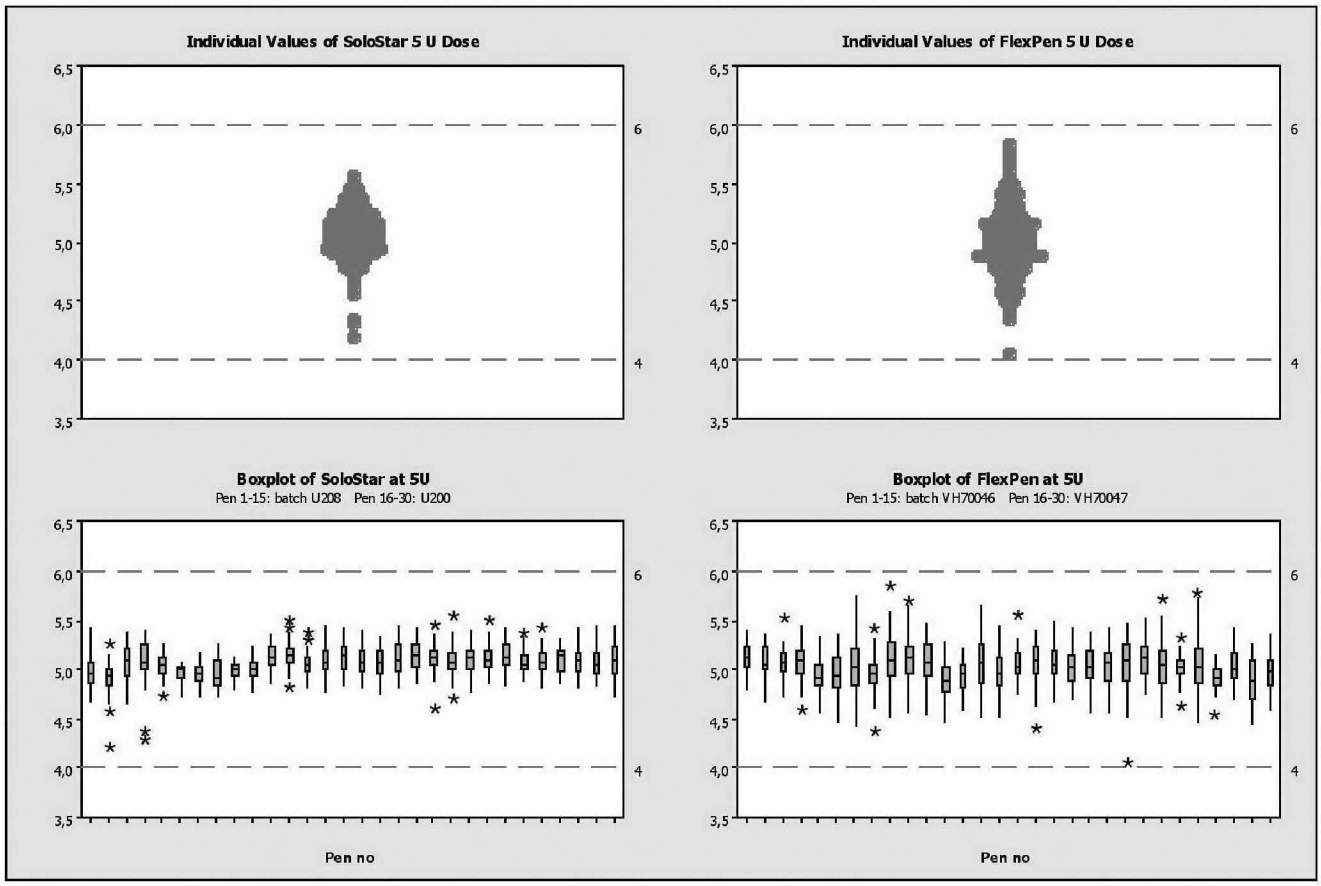

FIG. 1. Comparison of SoloSTAR and FlexPen at 5-unit dose. *Values outside the pen specific distribution, but still within the study limits.

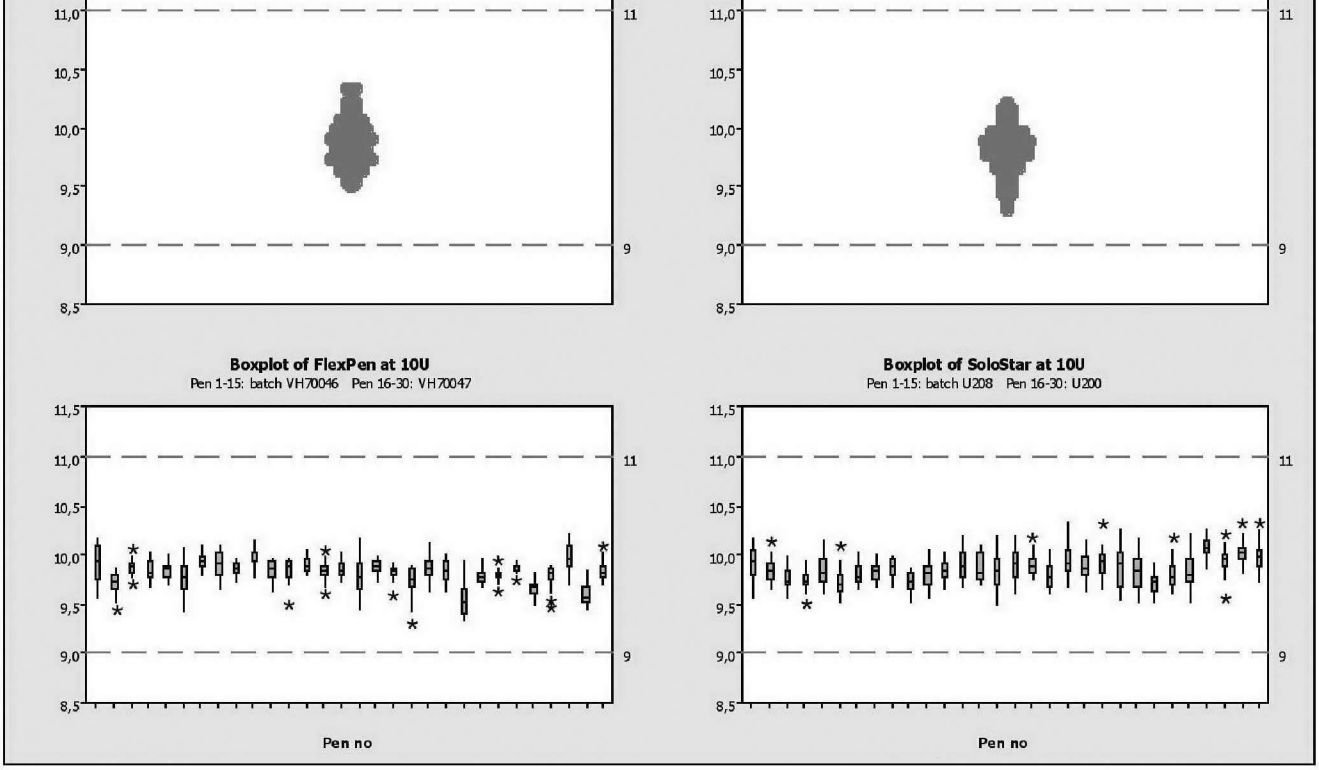

FIG. 2. Comparison of SoloSTAR and FlexPen at 10-unit dose. *Values outside the pen specific distribution, but still within the study limits.

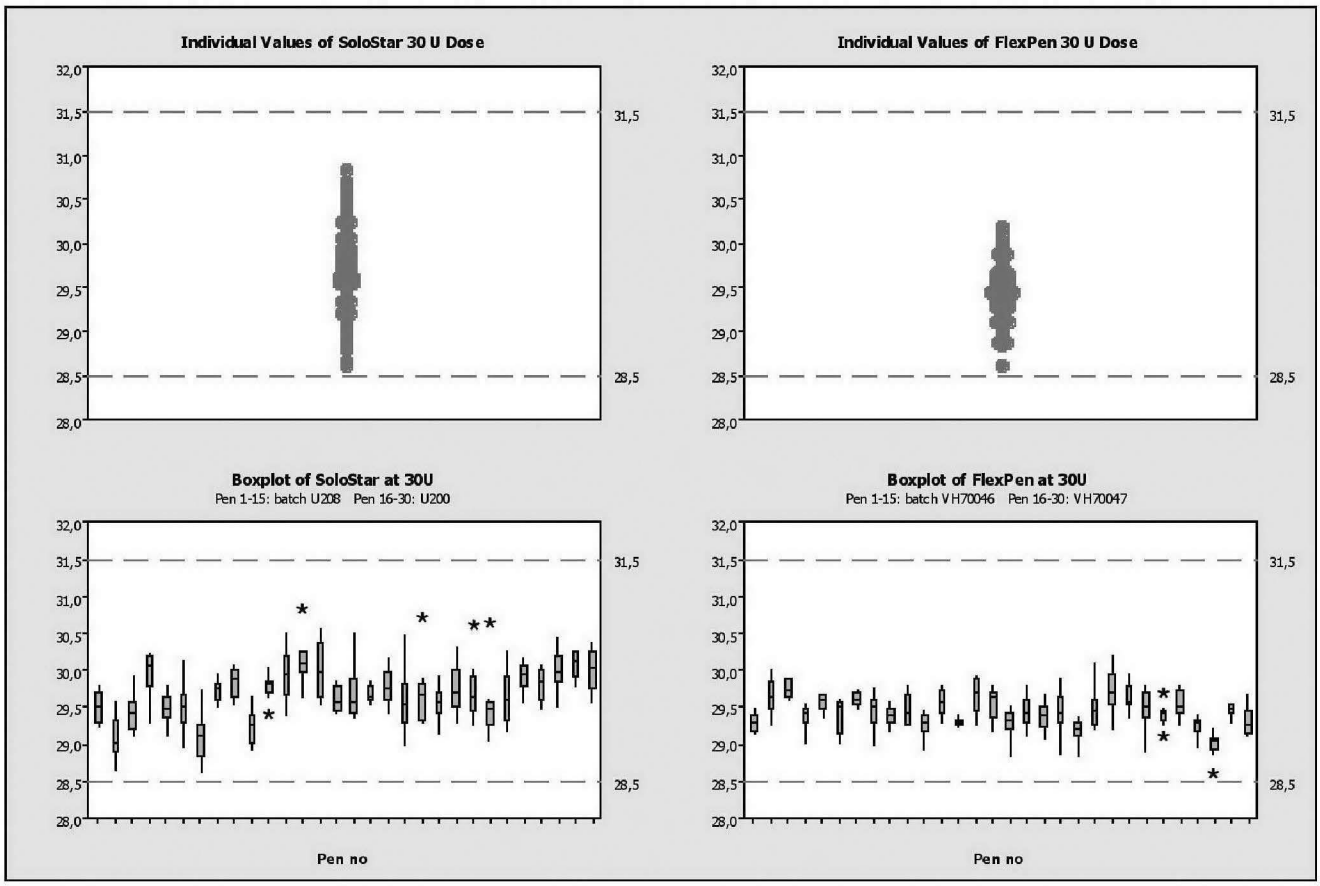

FIG. 3. Comparison of SoloSTAR and FlexPen at 30-unit dose. *Values outside the pen specific distribution, but still within the study limits.

Intended dose (units)	n	Mean delivered dose (SD) ± 95% CI	
		SoloSTAR	FlexPen
5	1,260	5.07 (0.15) ± 0.001	5.03 (0.21) ± 0.01
10	750	9.87 (0.16) ± 0.01	9.83 (0.14) ± 0.01
30	270	29.70 (0.38) ± 0.05	29.45 (0.25) ± 0.03

Data include the combined totals for the two batches of SoloSTAR (batches U200 and U208) and two batches of FlexPen (batches VH70046 and VH70047). SD, standard deviation; CI, confidence interval.

Discussion

Overall, the SoloSTAR and FlexPen devices had comparable accuracy over the standard doses of 5, 10, and 30 units. Data from this study are in line with previous published studies, which demonstrate the accuracy of the SoloSTAR in laboratory- and clinical-based settings.[2–4]

However, the findings from this study are different from those reported in a recently published study by Asakura et al.,[5] which suggested that FlexPen was more accurate compared with SoloSTAR at all doses tested. The methodology applied in our study was the same as that used in the study by these previous investigators. However, our findings are more robust compared to those in their study; 30 pens were tested compared with three pens in the previous study, and data from 2,280 doses versus 228 in the study by Asakura et al.[5] were investigated for each pen type (5 units, 1,260 vs. 126 doses; 10 units, 750 vs. 75 doses; and 30 units, 270 vs. 27 doses, respectively).

It should be noted that ISO 11608-1 describes the approach for determining the accuracy of dose delivery for injection devices.[6] However, the methodology of Asakura et al.[5] did not follow the exact ISO methods; the minimum, medium, and maximum dose settings for each pen device were not tested, and there was no randomization in the order of dose settings (only one dose setting was tested for each pen). SoloSTAR accuracy evaluation studies are ongoing, which closely follow ISO testing; minimum, medium, and maximum dose settings for each pen device will be tested across a wider range of doses. Moreover, these studies are also designed in such a way that will allow a robust statistical analysis for the comparison of the accuracy of SoloSTAR with FlexPen. Finally, further studies are being conducted that compare the dose accuracy of SoloSTAR with other commonly available insulin pens, such as Humalog® (Elly Lilly and Co., Indianapolis, IN).

Conclusions

Our results show that the SoloSTAR has comparable accuracy to that of the FlexPen. Both pens are accurate in dispensing insulin, which was to be expected, considering regulatory review and acceptance. These data presented are of particular relevance for people with type 1 or type 2 diabetes who use SoloSTAR to inject insulin glargine or insulin glulisine and who are reliant on the accuracy of the insulin injection device they use.

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Author Disclosure Statement

A.P. has served as a consultant to Lilly and sanofi-aventis, has lectured at a sanofi-aventis-sponsored symposium, and has served on an advisory board for Novo Nordisk and sanofi-aventis. K.H. is an employee of sanofi-aventis.

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Address reprint requests to:
Prof. Alfred Penfornis
Service d'Endocrinologie Metabolisme et Diabetologie Nutrition
Hôpital Jean Minjoz
25030 Besancon Cedex, France

E-mail: Alfred.penfornis@univ-fcomte.fr