Usability, Participant Acceptance, and Safety of a Prefilled Insulin Injection Device in a 3-Month Observational Survey in Everyday Clinical Practice in Australia

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Abstract

Background:
SoloSTAR® (SOL; sanofi-aventis, Paris, France) is a prefilled insulin pen device for the injection of insulin glargine and insulin glulisine. This is the first Australian survey to determine its usability, participant acceptance, and safety in clinical practice.

Methods:
A 3-month, nonrandomized, noncomparative, observational survey in Australia was conducted in individuals with diabetes. Participants were given SOL pens containing glargine, the instruction leaflet, and a toll-free helpline number. Training was offered to all participants. Safety data, including product technical complaints (PTCs), were gathered from ongoing feedback given by the participant or health care professional (HCP) and by independent interviews conducted 6–10 weeks after study start.

Results:
Some 2674 people consented to take part across 93 sites (150 HCPs), and 2029 participated in interviews. Of these, 52.6% had type 1 diabetes, 16.3% had manual dexterity problems, and 15.5% had poor eyesight not corrected by glasses. At the time of interview, 96.8% of participants were still using SOL. None of the eight PTCs reported were due to technical defects; most were related to handling errors. Some 62 participants reported 77 adverse events; none were related to a PTC. The vast majority of participants (95.4%) were "very satisfied" or "satisfied" with using SOL, and 89.7% of the participants had no questions or concerns using SOL on a daily basis. Similar positive findings were reported by participants with manual or dexterity impairments.

Conclusions:
In this survey of everyday clinical practice, SOL had a good safety profile and was very well accepted by participants.

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Abbreviations: (AE) adverse event, (CI) confidence interval, (FP) FlexPen, (HCP) health care professional, (NGFP) Next Generation FlexPen, (PTC) product technical complaint, (SOL) SoloSTAR

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Insulin pens have had a significant impact on the treatment of diabetes. Compared with a vial and syringe, they offer substantial advantages in terms of compliance, social acceptability, and flexibility for patients using insulin and have been shown to be preferred by both people with diabetes and the health care professionals (HCPs) who treat them.[1–4] Since the first insulin pen was introduced in 1985, ongoing developments in technology have led to more advanced devices that offer larger maximum doses, smaller dose increments, and improved dose features, such as lower injection force and ease of identifying the insulin.[5–7]

SoloSTAR® (SOL) is a new prefilled insulin pen device developed for the administration of either insulin glargine (LANTUS®) or insulin glulisine (Apidra®; all sanofi-aventis, Paris, France). The SOL pen can be set in 1 U increments, similar to other devices, and is capable of delivering a maximum dose of 80 U, which is a larger dose volume compared with other commonly used disposable pen devices. SoloSTAR has a different pen body color for each insulin—gray for insulin glargine and blue for insulin glulisine. In addition, the insulin glulisine pen has a tactile differentiation of a raised ring on the dose button besides other differentiation features, including different colors in the labels and packaging.

The aim of this survey was to evaluate the safety, usability, and acceptance of SOL in a clinical setting and focuses on the administration of insulin glargine with SOL.

Participants and Methods

Objectives

The primary objective of this survey was to monitor SOL in actual everyday use in order to collect information on real use experience and detect any product technical complaints (PTCs), safety issues, or problems related to its use. This survey was designed to monitor the device and not the insulin. Secondary objectives included participant satisfaction with the use of the pen. This was a 3-month, prospective, observational survey based in Australia and was conducted between November 2006 and February 2007.

Participants

People with type 1 or type 2 diabetes with past or current use of injectable insulin or other prescribed antidiabetes agents or people considered by their health care provider to be candidates for initiation of injectable insulin therapy were invited to participate in the survey. Exclusion criteria included current addiction or current alcohol/drug abuse; diagnosis of dementia; severe visual or dexterity impairment; mental condition rendering the person unable to understand the nature, scope, and possible consequences of the survey; or any person deemed by the investigator as potentially uncooperative. Potential participants who met the inclusion criteria were identified by their HCP, and the program was explained to them at either the next routine clinic visit or by telephone. Participants were informed that they would be required to report and keep records of any apparently broken or not properly functioning devices and participate in a 10 min telephone interview. All potential participants were clearly informed that participation was entirely voluntary and that they would continue to receive the best standard of care available, even if they chose not to participate. Those who were interested were then asked to sign an information sheet, which further described the program. The survey was conducted in accordance with the Declaration of Helsinki. Health care professionals who participated in the survey were reimbursed for costs associated with administration of the survey.

Survey Design

At the start of the observation period, participants were given SOL pens containing insulin glargine, the instruction leaflet, and a toll-free helpline number, which was operated by an independent agency. At this time, participants were also offered training by the HCPs on how to use SOL. Participants used SOL for 6–10 weeks and were asked to report any issues that they experienced during this time. At 6–10 weeks after initial use, participants were contacted to take part in a 10 min telephone survey (Appendix 1) to collect information on any problems experienced with SOL. Participants were also asked to rate their experience with SOL, including aspects of use. To maintain participant confidentiality, all telephone contact with participants was managed through an independent customer service group (International™ SOS) specializing in medical assistance.

Statistical Analysis

No comparisons were performed, and descriptive data are provided. Events are presented as number of

the Clopper–Pearson algorithm). All analyses were performed using SAS version 8.2 (SAS Inc., Cary, NC). An estimated sample size of 2000 participants was determined by taking into account potential device and handling problems, which were derived from already marketed insulin pen devices in terms of occurrence rate. In addition, the minimum sample size allowed the detection (with 95% confidence) of potential pen issues that occur at a rate of 0.005% or handling problems occurring at a rate of 0.0035%, based on an estimated 6 weeks of use, involving 10,000 pens and >105,000 injections.

Participant Characteristics and Disposition

A total of 2674 people agreed to participate in this observational survey of everyday clinical practice, which was conducted across 93 sites, involving 150 HCPs (Appendix 2). Health care professionals were a combination of primary care physicians, endocrinologists/diabetologists, and diabetes educators. Twenty participants withdrew consent prior to the survey; therefore, 2654 people used SOL. At 6–10 weeks after initial use of SOL, 2029 people provided feedback during solicited interviews. Participant characteristics and demographics are summarized in **Table 1.**

Table 1.
Characteristics and Demographics of the Participants, Collected from Spontaneous Interviews Conducted after 6–10 Weeks of SOL Use in the Overall Survey Population and in Specified Subgroups Of Participants, Including Diabetes Type, Prior Device Experience, Visual/Manual Impairments and Participant Age

	Overall population (*n* = 2029)	Diabetes type		Prior device experience		Self-reported impairments		Participant age	
		Type 1 (*n* = 1067)	Type 2 (*n* = 926)	Naïve (*n* = 194)	Experienced (*n* = 1834)	Visual (*n* = 170)	Manual (*n* = 130)	<18 years (*n* = 21)	≥70 years (*n* = 230)
Age (years) [a]	50.5 ± 16.1	42.6 ± 15.4	59.3 ± 11.6	55.8 ± 16.4	50.0 ± 16.0	60.4 ± 13.2	60.8 ± 12.9	14.9 ± 3.0	75.0 ± 4.4
Females/males (%)	49/51	49/51	48/52	46/54	49/51	57/43	58/42	43/57	48/52
Type 1/2 diabetes (%)	54/46	100	100	29/71	56/44	42/58	34/66	100/0	22/78
Never used an injection pen (%)	10	5	15	100	0	8	8	24	16
Satisfied with using SOL (%)									
Very satisfied	74	74	75	77	74	72	78	76	77
Satisfied	21	22	20	21	21	19	18	19	19
Neutral	3	3	3	1	3	5	2	5	3
Unsatisfied	<1	<1	<1	1	<1	<1	<1	0	<1
Very unsatisfied	1	<1	1	<1	1	2	2	0	<1
Participants without concerns/questions/ issues (%)	90	90	90	92	89	88	91	86	94
Questions raised during interviews (%)									
Needle attachment	<1	<1	<1	<1	<1	2	<1	5	<1
Dose dialing	3	3	3	3	3	5	2	5	2
Injecting	4	4	5	3	4	4	5	0	2
Reading anything on the pen	<1	1	<1	<1	<1	<1	1	0	0
Removing bubbles	<1	<1	<1	0	<1	0	0	5	0
Continuing to use SOL after the end of survey period (%)	97	97	97	96	97	98	95	100	97

[a] Mean ± standard deviation.

had used a pen device in the past, and 9.6% of the participants (n = 194/2029) reported no prior experience of using insulin devices. Training was offered to all participants, and 87% (n = 1770/2029) were trained. Training by one-to-one demonstration was carried out in 74% (n = 1501) of participants, 12.5% (n = 253) of participants were trained using a group demonstration, 36.1% (n = 732) received both demonstration and a user guide booklet, 32.1% (n = 651) were trained with the user

Table 2.
Adverse Events Reported

AE	Nonserious	Serious	Total
Injection-site reaction	33	1	34
Hypoglycemia	7	1	8
Dizziness	3	—	3
Swelling	2	1	3
Abdominal pain	2	—	2
Pain	2	—	2
Headache	2	—	2
Hyperglycemia	3	—	3
Nausea	2	—	2
Rhinorrhea	2	—	2
Drug exposure during pregnancy	2	—	2
Back pain	1	—	1
Cystitis	—	1	1
Death[a]	—	1	1
Diarrhea	1	—	1
Drug ineffective	1	—	1
Emotional disorder	1	—	1
Hunger	1	—	1
Hypotension	—	1	1
Kidney infection	—	1	1
Loss of consciousness	—	1	1
Edema peripheral	—	1	1
Renal dysfunction	—	1	1
Respiratory disorder	1	—	1
Visual acuity reduced	1	—	1
Total	**67**	**10**	**77**

[a] This participant had long-standing medical history of renal and heart failure. Death was considered due to these conditions and not related to the use of SOL.

(multiple answers were allowed). The median age was 42 years for participants with type 1 diabetes and 60 years for participants with type 2 diabetes. Overall, 16.3% (n = 329/2024) of participants had manual dexterity problems, 15.5% (n = 314/2023) had poor eyesight not corrected by glasses, and 12.1% (n = 245/2022) had other disabilities considered unrelated to the ability to use SOL.

At the time of interview, 96.8% (n = 1962/2027) of participants were still using SOL. Of the participants who discontinued use of SOL, 17 (0.8%) ceased use SOL 1–6 days prior to interview, 19 (0.9%) 2–4 weeks previously, 16 (0.8%) 3–4 weeks previously, and 13 (0.6%) 5–6 weeks previously; reasons for discontinuation were not recorded. In total, 21.2% (n = 430/2028) were using insulin glargine as the only insulin, and 78.8% (n = 1598/2028) reported that they were using insulin glargine plus one or more other insulin product. The mean duration of SOL use prior to the interviews was 60.5 ± 15.7 days.

Product Technical Complaints

A total of eight problems were considered to be PTCs, of which seven were reported during the solicited interviews. In three instances, the pens jammed; in two instances, the pens leaked; in two instances, the pens were hard to push; and in one instance, the pen or plunger was reported as "faulty." Investigations were performed according to standard methods, and results were logged into the PTC database. None of the PTCs were due to a technical defect, and five PTCs were considered to be related to handling errors by the participants. The eight participants who reported a PTC rated their satisfaction with SOL to be either "very satisfied" (n = 6) or "satisfied" (n = 2).

Safety

A total of 77 adverse events (AEs) were reported by 62 people, none of which were related to a PTC. The most commonly reported AEs were injection-site reactions, hypoglycemia, dizziness, and hyperglycemia (**Table 2**). The reported rate of occurrence for injection-site reactions was 1.7% based on the number of enrolled participants. Injection site reactions are expected and are a listed event for insulin glargine. No AE was considered to be related to the SOL pen. There were four cases of serious AEs, none of which were related to a PTC. The majority of these events were most likely related to the participants' underlying diabetes or other confounding factors.

Overall, the large majority (n = 1934/2028; 95.4%) of participants reported that they were either "satisfied" or "very satisfied" with using SOL (**Figure 1**). When the participants were asked to report on the occurrence of any issue or question during the 6–10 weeks period of SOL use, the majority of participants (n = 1820/2029; 89.7%; 95% CI: 88.3, 91.0%) reported that they experienced none with using SOL on a daily basis. This was consistent between those participants who were device naïve (n = 179/194; 92.3%; 95% CI: 87.6, 95.6%) and those who had previously used a device (n = 1641/1834; 89.5%; 95% CI: 88.0, 90.8%) and between people with type 1 diabetes (n = 957/1067; 89.7%; 95% CI: 87.7, 91.5%) and type 2 diabetes (n = 830/926; 89.6%; 95% CI: 87.5, 91.5%; **Table 1**). Similar findings were also reported by participants with manual or dexterity impairments and by young and elderly participants (**Table 2**). A small proportion of participants suggested aspects that could be improved, including injection (n = 86/2029; 4.2%; 95% CI: 3.4, 5.2%), dialing a dose (n = 65/2029; 3.2%; 95% CI: 2.5, 4.1%), reading anything on the pen (n = 16/2029; 0.8%; 95% CI: 0.5, 1.3%), attaching a needle (n = 13/2029; 0.6%; 95% CI: 0.4, 1.1%), removing air bubbles (n = 7/2029; 0.3%; 95% CI: 0.1, 0.7%), or something else (n = 21/2029; 1.0%).

Of the 32 participants who reported that they were "unsatisfied" or "very unsatisfied," only seven subsequently provided further comments, of which four were related to injecting and one each of dialing a dose, attaching a needle, and reading anything on the pen.

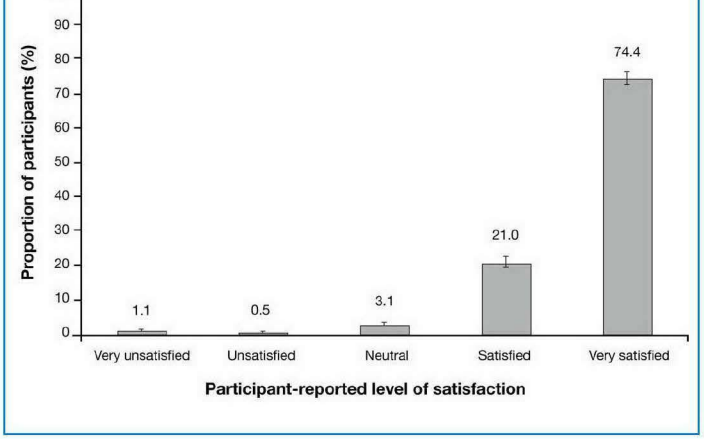

Figure 1. Participant satisfaction with SOL (percent ± 95% confidence bounds).

Discussion

In this survey of everyday clinical practice, SOL had a good safety profile and was very well accepted by participants with a low incidence of participant-reported questions or concerns during use, confirming its convenience in everyday practice. The results from this observational survey support the findings of Haak and colleagues that SOL demonstrates high patient usability and high patient preference in people with diabetes.[8]

Although patients with type 1 diabetes must accept the need for insulin from diagnosis, patients with type 2 diabetes are often resistant to the addition of insulin to their regimen of oral antidiabetes agents.[9,10] Delaying insulin therapy in type 2 diabetes may lead to deleterious effects on glycemic control and, as a result, increase the risk of diabetes-specific complications, such as retinopathy, nephropathy, and neuropathy.[11] Insulin pens have the potential to help patients overcome barriers to the initiation of insulin, such as fear of needles, social acceptability, and the inconvenience of a vial and syringe.[4]

The number of participants with type 1 versus type 2 diabetes who reported no concerns with using SOL on a daily basis and were either "satisfied" or "very satisfied" with the device were similar in this survey; a very small proportion of participants reported SOL as "acceptable," "poor," or "very poor." These positive experiences with SOL suggest that it may be a very convenient and useful tool in overcoming some of the barriers associated with the initiation of insulin in patients with type 2 diabetes and encouraging earlier use.

In the population of people included in this survey, only a small percentage were device naïve. Further studies in this group, and in insulin-naïve subjects, would help to strengthen this hypothesis. Nevertheless, results from this population of people, the majority of whom had type 2 diabetes, confirms the results given by Haak and colleagues[8] that SOL is rated positively by people with no experience of using insulin pen devices.

In addition, results of participants who were device naïve were similar to those in people who were experienced with devices. Of particular interest, the majority of people who had no experience of insulin devices had no problems using SOL and were either "satisfied" or "very satisfied" with the device. This ease of initiation with SOL could be expected to translate to benefits in everyday clinical practice for both people with diabetes and their HCPs. These findings were also consistent among the participants with manual or visual dexterity impairments and among the young and elderly participants.

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