

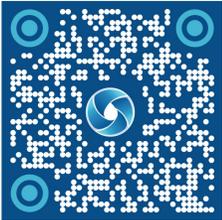
Insulin Pump Infusion Set Failure (IPISF) Management: T1D Exchange Survey



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BACKGROUND

- Insulin Pump Infusion Set Failure (IPISF): a partial or total mis delivery of insulin from an insulin pump (CSII) into a patient's subcutaneous tissue.
- Caused by catheter kinking, insulin leakage, blockage, improper insertion, set detachment from body, and/or site inflammation which can lead to hyperglycemia, diabetic ketoacidosis (DKA), and death.^{1,2}
- Pump/tubing defects (e.g., IPISFs) are the highest contributor to DKA development and are the main cause for DKA hospitalization in CSII patients.³⁻⁵
- Failure detection by the insulin pump can take up to 24 hours.⁶

STUDY AIMS

- To identify IPISF occurrence and troubleshooting methods by CSII patients.
- Determine habits and perceptions of diabetes technology use in CSII patients who experience IPISF.
- Assess the history of IPISF education in CSII patients.

METHODS

- SurveyMonkey Platform® Online Survey distributed to the T1D Exchange online community (09/2020 - 11/2020).
- 57 items including multiple choice, Likert scale, and open-ended questions.
- 3 groups surveyed (N=715):
 - Adult patients with diabetes who uses an insulin pump (N=639)
 - Caregiver answering for a dependent person with diabetes who uses an insulin pump (N=72)
 - Caregiver with diabetes answering for a dependent person with diabetes who uses an insulin pump (N=4)
- 8 duplicates identified through email confirmation; 2 groups sorted (N=707):
 - Adult PwD (N=631)
 - Dependent PwD (N=76)

Table 1. Demographics of survey respondents

	Adult PwD (N=631)	Dependent PwD (N=76)		Adult PwD (N=631)	Dependent PwD (N=76)
Age (Mean ± SD Years)	51.6 ± 15.1	15.2 ± 11.2	Pump Brand (%)		
Gender Identity (%)			DIY Closed Loop System	4.9	6.6
Male	31.4	14.5	Medtronic Paradigm Series	4.0	0.0
Female	67.5	82.9	Medtronic 630G	8.1	2.6
Genderqueer	0.6	0.0	Medtronic 670G	16.0	3.9
Transgender	0.2	0.0	Medtronic 670G Hybrid Closed Loop System	8.9	1.3
Prefer not to answer	0.3	2.6	OmniPod Dash System	6.3	22.4
Ethnicity (%)			Omnipod System	11.4	21.1
American Indian or Alaska Native	0.0	1.3	Tandem t:flex	0.2	0.0
Asian or Asian American	0.3	1.3	Tandem t:slim X2	3.6	0.0
Black or African American	0.8	2.6	Tandem t:slim X2 with Basal IQ	5.2	9.2
Hispanic or Latino	1.4	1.3	Tandem t:slim X2 with Control IQ	30.9	32.9
Middle Eastern or North African	0.2	0.0	Roche Accu-Chek Spirit	0.3	0.0
Mixed/Bi Racial	2.9	2.6	Ypsomed YpsoPump	0.2	0.0
White or Caucasian	93.0	88.2	Infusion Set Wear Time (Mean ± SD Days)	33 ± 0.95	29 ± 0.77
Prefer not to answer	1.4	2.6	Wear Time >3 days (%)	29.2	6.6
Income Bracket (%)			Infusion Set (%)		
\$0-\$24,999	6.3	3.9	Medtronic Minimed Mio	6.7	6.6
\$25,000-\$49,999	12.2	7.9	Medtronic Minimed Mio Advance	0.5	0.0
\$50,000-\$74,999	16.0	14.5	Medtronic Minimed Quick-set	22.2	0.0
\$75,000-\$99,999	16.6	11.8	Medtronic Minimed Silhouette	6.8	0.0
\$100,000-\$124,999	16.3	9.2	Medtronic Minimed Sure-T	2.5	6.6
\$125,000-\$149,999	8.7	10.5	Tandem Diabetes Care AutoSoft 30	5.1	2.6
\$150,000-\$174,999	6.5	9.2	Tandem Diabetes Care AutoSoft 90	13.0	10.5
\$175,000-\$199,999	5.7	6.6	Tandem Diabetes Care AutoSoft XC	10.8	15.8
\$200,000 and up	11.6	26.3	Tandem Diabetes Care TruSteel	6.8	9.2
Type 1 Diabetes (%)	99.5	100	Tandem Diabetes Care VariSoft	3.3	0.0
HbA1c (Mean ± SD %)	6.7 ± 0.9	7.3 ± 1.2	Other	22.3	48.7
Time in Range (Mean ± SD %)	73.3 ± 15.3	63.0 ± 19.8	Cannula/Needle Length (%)		
Time in Range <70% (%)	27.7	51.3	6mm	33.9	39.5
TDD (Mean ± SD Units)	42.8 ± 24.0	46.0 ± 26.2	8mm	4.4	1.3
Percent of TDD as Bolus (Mean ± SD %)	48.5 ± 15.7	52.7 ± 16.2	9mm	21.7	3.9
Time on Pump (Mean ± SD Years)	15.2 ± 8.3	5.3 ± 4.5	10mm	1.3	0.0
Time on Closed Loop (Mean ± SD Years)	1.7 ± 2.5	1.0 ± 1.0	13mm	7.4	0.0
CGM Use (%)	95.1	96.1	17mm	3.0	1.3
			Other	28.2	53.9

Table 2. Variables Correlated to IPISF Incidence Rate

Variable	P-value	Odds Ratio
Infusion Set/Pod Type	0.5116	0.8894
Catheter Material	0.3761	0.8008
Angle of Catheter	0.2279	0.8264
Length of Catheter	0.5357	--
Length of Tubing	0.2447	--
Last Time Receiving Education	0.0018	--
Wear Time	0.5661	0.9054
Feeling of Good Diabetes Control	0.0202	0.6870
Time On Pump	0.5604	--
Considering Leaving Pump Therapy	0.0002	2.2332
Hemoglobin A1c	0.3186	0.8525
Time in Range	0.4478	1.1360
Knowing Reason for Unexpected Hyperglycemia	<0.0001	0.4985
Feeling Burned Out	0.0016	1.6343

*Pearson's chi-squared test performed using SAS for patients reporting <1 IPISF/month and ≥1 IPISF/month
 **(-) Odds Ratio not reported for single variable due to multiple levels

RESULTS

- 97% reported having experienced an IPISF event with 41% having ≥1 IPISF/month and 59% having <1 IPISF/month.
- 66% are first alerted of IPISF by Hyperglycemia and Symptoms versus a Pump Alarm (25%), Smell/see/feel leaking insulin (5%), or No Alarm (3%).
- Following IPISF, 46% administer a correction bolus without replacing the infusion set/pod while 43% immediately replace the infusion set/pod and give a correction bolus.
- 36% last received IPISF education >4 years ago and 19% have never received IPISF education.
- Primary reported resource for IPISF education was Diabetes Online Forums (28%).
- Average infusion set wear time decreased for patients with higher rates of IPISF.

DISCUSSION & CONCLUSION

- Almost all patients had IPISF, with a majority having not been recently educated about IPISF.
- Patients are primarily alerted of IPISF by Hyperglycemia and Symptoms, rather than by their insulin pump occlusion alarm.
- Higher rates of IPISF influence patients to switch off CSII therapy and lower rates of IPISF are associated with better control of diabetes.
- IPISF can still occur during longer infusion set wear times (>3 days) and detection of IPISF remains poor. In order to achieve 100% closed loop insulin delivery, IPISF must be addressed. There is a need for advanced technology that prevents and better notifies patients of the occurrence of IPISF events. This is critically important as extended wear infusion sets and AID systems become increasing automated in the subcutaneous delivery of insulin.

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Patients with ≥1 IPISF/month more likely to:

- Feel burned out by their diabetes technology
- Want to end CSII for a different diabetes therapy

Patients with <1 IPISF/month more likely to:

- Report having good diabetes control
- Know reason for their unexpected hyperglycemia