Supplementary Appendix

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Introduction to T1D China Registry Study

T1D China Registry Study is a large-scale population and hospital-based registry focusing on T1D patients across China since 2014. It is inspired by large-scale registries including DPV Scientific Initiative of Germany and Austria, Hvidore Study Group and T1D Exchange Registry Study.

The T1D China Registry consists of three components: (1) a network of comprehensive and pediatric hospitals that is prospectively recruiting and following up patients affected by T1D; (2) a mobile platform called Tangtangquan (TTQ) serving as (i) an online community to provide diabetes self-management education and support and (ii) an online platform to collect and store demographic and clinical data at recruitment and follow-ups; and (3) a biobank to store biological human samples for use in research. Demographic and clinical information of participants are collected at recruitment by HCPs in hospitals via the electronic medical record module in TTQ platform. QoL scales and food frequency questionnaire are performed in a proportion of patients to assess psychosocial status and food choice, respectively. Follow-ups are conducted via internet by HCPs every three months since recruitment, during which demographic and clinical information together with QoL scales and food frequency questionnaire data are collected. Clinical information includes diabetes history, treatment, and monitoring; general health; smoking/drinking status, diet, exercise; family history; socioeconomic factors; medications; acute and chronic diabetic complications; other medical conditions; and biological results.

The T1D China Registry Study is coordinated by the First Affiliated Hospital of University of Science and Technology of China, under the auspices of Chinese Medical Doctor Association. Participating hospitals were selected to provide a broad representation of pediatric and adult patients with T1D. As of January 20, 2020, 80

hospitals are participating, with a wide distribution throughout China, covering 22 provincial-level administrative divisions. Four primarily care for pediatric patients, and the other 76 are comprehensive hospitals caring for both adult and pediatric patients.

To be enrolled in the clinic registry, an individual must have a clinical diagnosis of T1D.[1] Specially, participants have to be insulin dependent, diagnosed with T1D by an endocrinologist from a secondary or tertiary hospital, and meet at least one of the following criteria: (i) obvious symptoms of a diabetes-related metabolic disorder; (ii) previous diabetic ketosis or ketoacidosis; (iii) tested positive for diabetes autoantibodies; and (iv) fasting and stimulated C-peptide levels <200 pmol/L.

The study protocol was approved by the Institutional Review Board of each participating hospital, and the study was conducted according to Good Clinical Practice guidelines and the Declaration of Helsinki. Written informed consent is obtained from adult participants and parents/guardians of minor participant. Minor participants provide written assent, according to Institutional Review Board requirements.

Diseases potentially interfering with the study

1. Clinically significant nephropathy (eGFR < 45ml/min) or renal failure on dialysis
2. Proliferative retinopathy
3. Liver function damage (aspartate aminotransferase 2.5 times higher than normal upper limit
4. Clinically significant cardiovascular disease, including myocardial infarction, arrhythmia, the ECG chart heart block (Type I second-degree AV block and above), unstable angina or decompensated heart failure (NYHA Graded III ~ IV)
5. Sickle cell disease, haemoglobinopathy or anemia
6. Uncontrolled coeliac disease
7. Eating disorder such as anorexia or bulimia
8. Cystic fibrosis, pancreatitis, pancreatic tumor, or any other pancreatic disease besides

type 1 diabetes

9. Adrenal disease or tumor

Survey on AndroidAPS during the first three-month's use

1. What continuous monitoring system did you use? Specify if you had switched (date, reason etc.).

2. What insulin pump did you use? Specify if you had switched (date, reason etc.).

3. Which version of AndroidAPS did you use? Specify if you had switched (date, reason etc.).

4. What glycemic target/range in AndroidAPS did you set? List them if the target/range was separated into different periods. Specify if you had switched (date, reason etc.).

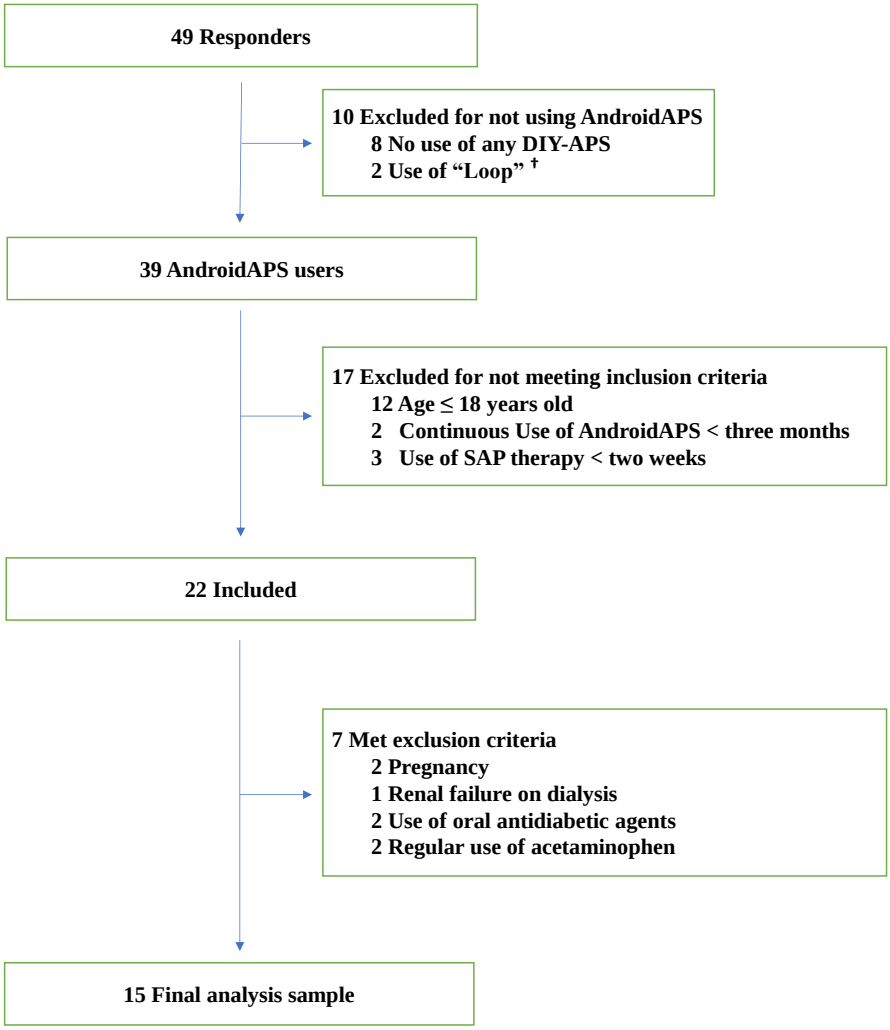
5. Did you enable super micro bolus feature? Specify if you had switch (date, reason etc.).

6. Did you enable un-announced meal feature? Specify if you had switched (date, reason etc.).

7. Did you use remote monitoring feature (i.e. sharing data of AndroidAPS via Nightscout platform)? Specify if you had switched (date, reason etc.).

8. If the answer for Q7 was yes, how many reminders did you receive from your relatives when Nightscout alarms were activated every month? (Total, due to hypoglycemia and due to hyperglycemia)

Supplementary Figure S1. Flow Diagram for Identification of Eligible Patients



† One of the DIYAPSs that uses a different algorithm than AndroidAPS

Abbreviation: DIYAPS: do-it-yourself artificial pancreas system; TID: type 1 diabetes

Supplementary Table S1. Settings of AndroidAPS Among Patients Enrolled

No.	CGM	Pump	Version of AndroidAPS	Glycemic Target in AndroidAPS (mmol/L)	Use of SMB?	Use of UAM?	Use of Remote Monitoring?
1	Dexcom G5	Dana R	2.0	5.6† (23:00-07:00: 6.0)	Yes	Yes	Yes (
2	Dexcom G5	Dana R	2.0	6.0	Yes	Yes	Yes
3	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes
4	Dexcom G5	Dana R	2.0	5.5	Yes	Yes	Yes
5	Dexcom G5	Dana R	2.0	5.6 (00:00-07:00: 6.5)	Yes‡	Yes	Yes
6	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes
7	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes
8	Dexcom G5	Dana R	2.0	6.0 (07:00-10:00: 5.5)	Yes	Yes	Yes
9	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes
10	Dexcom G5	Dana R	2.0	6.0 (00:00-07:00: 6.2)	Yes	Yes	Yes
11	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes
12	Dexcom G5	Dana R	2.0	5.6 (00:00-04:30: 6.0; 17:00-23:00: 6.1)	Yes	Yes	Yes
13	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes
14	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes
15	Dexcom G5	Dana R	2.0	5.6	Yes	Yes	Yes

† Glycemic target is 6.0 during 23:00-07:00, and 5.6 for the rest of the day. Similarly, hereinafter. ‡SMB feature was disabled around two months after initiation of AndroidAPS for fear of hypoglycemia

Abbreviations: CGM: continuous glucose monitoring; SMB: super micro bolus; UAM: un-announced meal

Supplementary Table S2. Frequency of Reminders Patients Received from Relatives When Nightscout Alarms Were Activated

No.	Frequency of reminders, total (per month)	Frequency of reminders, hypoglycemia (per month)	Frequency of reminders, hyperglycemia (per month)
1	20	12	8
2	10	9	1
3	0	0	0
4	4	4	0
5	0	0	0
6	0	0	0
7	0	0	0
8	4	1	3
9	0	0	0
10	16	12	4
11	0	0	0
12	1	1	0
13	12	1	11
14	70	35	35
15	12	1	11

Supplementary Table S3. Changes in Glycemic Control and Variability Before and After Three-Month of AndroidAPS Use Among Participants with Suboptimally Controlled Type 1 Diabetes

	Before use of AndroidAPS	After use of AndroidAPS	Difference	P value
HbA1c (%) †	8.20 (7.90, 8.90)	6.90 (6.20, 7.30)	-1.50 (-1.90, -1.30)	0.027
Mean Glucose Value (mmol/L) †	8.35 (7.98, 8.43)	7.29 (7.03, 7.80)	-1.16 (-1.24, 0)	0.063
TIT (3.9-7.8 mmol/L) (%)	45.87±9.97	62.44±10.73	16.57±10.81	0.007
TIR (3.9-10.0 mmol/L) (%)	72.11±12.78	84.29±8.93	12.18±8.45	0.009
% CGM Time < 3.0 mmol/L	0.69±0.64	0.28±0.33	-0.41±0.43	0.043
% CGM Time < 3.9 mmol/L	3.22±2.24	1.45±1.04	-1.77±1.52	0.021
% CGM Time > 10.0 mmol/L	24.67±10.98	14.27±8.14	-10.41±8.30	0.016
% CGM Time > 13.9 mmol/L	4.62±2.68	2.35±2.47	-2.27±2.47	0.051
SD (mmol/L)	2.84±0.63	2.33±0.55	-0.51±0.47	0.029
CV (%)	34.42±6.48	30.94±5.29	-3.48±5.53	0.147
MAGE (mmol/L)	7.49±1.69	6.10±1.40	-1.40±1.39	0.037

† Variables are presented as median (interquartile), other variables are presented as mean±SD

Abbreviations: CGM: continuous glucose monitoring; CV: coefficient of variation; HbA1c: hemoglobin A1c; MAGE: mean amplitude of glycemic excursion; SD: standard deviation; TIR: time in range; TIT: time in target

Supplementary Table S4. Changes in Glycemic Control and Variability Before and After Three-Month of AndroidAPS Use Among Participants with Well Controlled Type 1 Diabetes

	Before use of AndroidAPS	After use of AndroidAPS	Difference	P value
HbA1c (%)	6.84±0.37	6.42±0.59	-0.42±0.41	0.025
Mean Glucose Value (mmol/L)	7.86±0.60	7.39±0.57	-0.47±0.39	0.011
TIT (3.9-7.8 mmol/L) (%)	51.61±7.37	62.10±9.03	10.50±6.47	0.003
TIR (3.9-10.0 mmol/L) (%)	77.55±7.03	84.27±5.23	6.72±3.61	0.001
% CGM Time < 3.0 mmol/L†	0.27 (0.11, 0.64)	0.18 (0.11, 0.42)	-0.06 (-0.28, 0.08)	0.401
% CGM Time < 3.9 mmol/L	2.49±1.78	1.96±0.91	-0.53±1.23	0.265
% CGM Time > 10.0 mmol/L	19.97±8.32	13.77±5.84	-6.20±4.47	0.006
% CGM Time > 13.9 mmol/L	2.28±1.83	1.89±1.27	-0.40±1.11	0.344
SD (mmol/L)	2.51±0.30	2.35±0.22	-0.16±0.16	0.029
CV (%)	31.89±3.00	31.77±1.48	-0.11±2.26	0.892
MAGE (mmol/L)	6.30±0.66	5.80±0.68	-0.50±0.28	0.001

† Variables are presented as median (interquartile), other variables are presented as mean±SD

Abbreviations: CGM: continuous glucose monitoring; CV: coefficient of variation; HbA1c: hemoglobin A1c; MAGE: mean amplitude of glycemic excursion; SD: standard deviation; TIR: time in range; TIT: time in target

Supplementary Table S5. Changes in Glycemic Control and Glycemic Variability Between Baseline and After Three-Month of AndroidAPS Use Among Patients Stratified by Baseline HbA1c

	Well Controlled (N=8)	Suboptimally Controlled (N=7)	P value
HbA1c (%)	-0.48 (-0.67, -0.05)	-1.50 (-1.90, -1.30)	0.020
Mean Glucose Value (mmol/L)	-0.60 (-0.82, -0.06)	-1.16 (-1.24, 0)	0.355
TIR (3.9-10.0 mmol/L) (%)	6.72±3.61	12.18±8.45	0.152
% CGM Time < 3.9 mmol/L	-0.53±1.23	-1.77±1.52	0.103
% CGM Time > 10.0 mmol/L	-6.20±4.47	-10.41±8.30	0.235
SD (mmol/L) †	-0.16±0.16	-0.51±0.47	0.100
CV (%) †	-0.11±2.26	-3.47±5.53	0.138
MAGE (mmol/L) †	-0.50±0.28	-1.40±1.39	0.140

† Variable is presented as median (interquartile), other variables are presented as mean ± standard deviation

Abbreviations: CGM: continuous glucose monitoring; CV: coefficient of variation; HbA1c: hemoglobin A1c; MAGE: mean amplitude of glycemic excursion; SD: standard deviation; TIR: time in range

Supplementary Table S6. Changes in Glycemic Control and Glycemic Variability Among Participants Before and After Three-Month of AndroidAPS Use During Daytime and Nighttime Periods

	Before use of AndroidAPS	After use of AndroidAPS	Difference	P value
Nighttime Period				
Mean Glucose Value (mmol/L)	8.14±0.79	7.03±0.74	-1.11±1.07	0.001
TIR (3.9-10.0 mmol/L) (%)	73.60±16.00	89.55±7.38	15.95±15.55	0.001
% CGM Time < 3.9 mmol/L	3.11±2.58	1.49±1.16	-1.62±2.25	0.014
% CGM Time > 10.0 mmol/L	23.29±14.87	8.96±7.45	-14.32±14.79	0.002
SD (mmol/L) †	2.38 (2.25, 3.14)	2.00 (1.48, 2.49)	-0.48 (-0.89, -0.19)	0.005
CV (%) †	31.40 (26.51, 35.93)	27.23 (23.7, 33.09)	-1.80 (-7.21, 1.22)	0.061
Daytime Period				
Mean Glucose Value (mmol/L)	7.99±0.61	7.56±0.55	-0.43±0.47	0.003
TIR (3.9-10.0 mmol/L) (%)	75.46±9.32	82.52±7.21	7.06±5.32	<0.001
% CGM Time < 3.9 mmol/L	2.75±2.02	1.80±1.05	-0.96±1.53	0.030
% CGM Time > 10.0 mmol/L	21.79±8.96	15.68±6.96	-6.11±5.41	0.001
SD (mmol/L)	2.65±0.49	2.41±0.40	-0.24±0.37	0.025
CV (%)	33.04±4.85	31.75±3.56	-1.28±4.25	0.262

† Variable is presented as median (interquartile), other variables are presented as mean ± standard deviation

Abbreviations: CGM: continuous glucose monitoring; CV: coefficient of variation; SD: standard deviation; TIR: time in range

Supplementary Table S7. Relationship Between Duration of Pump Use and Change in Glucose Metrics Among All Participants

	Change in HbA1c (%)	Change in mean glucose value (mmol/L)	Change in TIR% (%)	Change in TBR 3.9% (%)
Duration of pump use (year)	R=0.350 (NS)	R=-0.014 (NS)	R=-0.043 (NS)	R=0.025 (NS)
	Change in TAR 10.0% (%)	Change in SD (mmol/L)	Change in CV (%)	Change in MAGE (mmol/L)
Duration of pump use (year)	R=-0.018 (NS)	R=-0.086 (NS)	R=0.136 (NS)	R=-0.014 (NS)

All analyses were performed by using spearman correlation coefficient

NS: $P \geq 0.05$

Abbreviations: CV: coefficient of variation; HbA1c: hemoglobin A1c; MAGE: mean amplitude of glycemic excursion; SD: standard deviation; TBR 3.9%: percentage of time < 3.9 mmol/L; TIR: time in range

Supplementary Table S8. Glycemic Metrics for Participant No. 5 Before and After Discontinuation of SMB Feature

	AndroidAPS, SMB-abled (Months 1-2)	**AndroidAPS, SMB-disabled (Month 3)**
24 Hours		
Mean Glucose Value (mmol/L)	7.02	6.94
TIR (3.9-10.0 mmol/L) (%)	88.27	89.15
% CGM Time < 3.9 mmol/L	1.90	2.16
% CGM Time > 10.0 mmol/L	9.83	8.70
SD (mmol/L)	2.19	2.10
CV (%)	31.18	30.29
MAGE (mmol/L)	5.48	5.65
Nighttime		
Mean Glucose Value (mmol/L)	6.65	6.14
TIR (3.9-10.0 mmol/L) (%)	95.24	96.17
% CGM Time < 3.9 mmol/L	1.28	3.13
% CGM Time > 10.0 mmol/L	3.48	0.70
SD (mmol/L)	1.54	1.32
CV (%)	23.10	21.45
Daytime		
Mean Glucose Value (mmol/L)	7.14	7.21
TIR (3.9-10.0 mmol/L) (%)	86.05	86.72
% CGM Time < 3.9 mmol/L	2.09	1.82
% CGM Time > 10.0 mmol/L	11.86	11.47
SD (mmol/L)	2.35	2.25
CV (%)	32.89	31.15

Abbreviations: CGM: continuous glucose monitoring; CV: coefficient of variation; HbA1c: hemoglobin A1c; MAGE: mean amplitude of glycemic excursion; SD: standard deviation; TIR: time in range

References

1. Yang D, Deng H, Luo G, et al. Demographic and clinical characteristics of patients with type 1 diabetes mellitus: A multicenter registry study in Guangdong, China. *Journal of diabetes.* 2016;8(6):847-853.