BRIEF COMMUNICATIONS

Journal of the ASEAN Federation of Endocrine Societies

Utilization and Impact of Diabetes Technology among Type 1 Diabetes Patients at a Tertiary Hospital in Thailand

Jirawan Pongrujikorn,[1] Jutipond Jitchana,[2] Nitchakarn Laichuthai[1,2]

[1]*Division of Endocrinology and Metabolism, Department of Medicine, Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand*
[2]*Excellence Center in Diabetes, Hormone, and Metabolism, King Chulalongkorn Memorial Hospital, Thai Red Cross Society, Bangkok, Thailand*

Abstract

Background. While diabetes technologies such as insulin pumps, continuous glucose monitoring (CGM), and automated insulin delivery (AID) systems have demonstrated potential to improve glycemic control and reduce hypoglycemia, their utilization and effectiveness in Thailand remain underdocumented. This study aimed to assess the use and impact of diabetes technologies on glycemic outcomes at King Chulalongkorn Memorial Hospital (KCMH), a tertiary care center in Bangkok, Thailand.

Methodology. A cross-sectional study was conducted among T1D patients receiving care at the endocrinology clinic of KCMH between August 2023 and July 2024. Data were collected at each patient's most recent follow-up visit, and participants were classified into technology users and non-technology users. Data collection focused on demographics, diabetes technology use, and clinical parameters, including HbA1c, hypoglycemia events, and CGM metrics (Time in Range (TIR), Time Above Range (TAR), Time Below Range (TBR)).

Results. A total of 61 patients with T1D were included, of whom 49% were technology users (6% insulin pumps, 57% CGM, 37% AID). Technology users had a significantly higher mean HbA1c (8.1% ± 1.6) than non-technology users (7.2% ± 1.2, p = 0.011). AID users achieved a higher mean TIR (67.6% ± 16%) compared to CGM users (54.0% ± 23.8%), but the difference was not statistically significant. Both AID and CGM users maintained a low incidence of hypoglycemia (<54 mg/dL).

Conclusion. This study found a relatively high rate of diabetes technology adoption at our center compared to other Asian countries, highlighting its potential to reduce the risk of hypoglycemia and improve glycemic stability. However, technology users also had higher HbA1c levels, suggesting that diabetes technology is often prescribed to high-risk patients with poor glycemic control. Future research should focus on longitudinal studies to better understand and address barriers to optimal glycemic outcomes among diabetes technology users.

Key words: diabetes technology, type 1 diabetes, glycemic control

INTRODUCTION

Type 1 diabetes (T1D) requires intensive glucose management to prevent long-term complications.[1] Traditional methods, such as multiple daily insulin injections (MDI), are associated with an increased risk of hypoglycemia and may offer less lifestyle flexibility compared to advanced insulin delivery systems. Recent advancements, such as insulin pumps (CSII) and automated insulin delivery (AID) systems, have demonstrated potential in improving therapy optimization by enabling more precise, real-time adjustments to insulin delivery.[2] Similarly, self-monitoring of blood glucose (SMBG) provides only single-point measurements, potentially leading to unrecognized episodes of hyperglycemia or hypoglycemia. Recent advancements, such as insulin pumps, continuous glucose monitoring (CGM) and automated insulin delivery (AID) systems, have demonstrated potential to improve glycemic management by enabling better self-management and therapy optimization.[3] Meta-analyses have shown that CGM significantly reduces HbA1c levels by 0.24% compared to SMBG (95% CI: -0.34 to -0.13), while also lowering the risk of severe hypoglycemia.[4] Similarly, insulin pump therapy has been associated with a significant HbA1c reduction of 0.30% (95% CI: -0.58 to -0.02) compared to MDI, along with a decrease in severe hypoglycemic events.[5]

eISSN 2308-118x (Online)
Printed in the Philippines

Received: January 30, 2026. Accepted: March 18, 2026.
Published online first: August 7, 2026.
https://doi.org/10.15605/jafes.041.02.6355

Corresponding author: Nitchakarn Laichuthai, MD, MSc
Division of Endocrinology and Metabolism
Department of Medicine, Faculty of Medicine,
Chulalongkorn University/King Chulalongkorn Memorial Hospital,
1873 Rama IV Road, Pathum Wan, Bangkok 10330, Thailand
E-mail: nitchakarn.l@chula.ac.th
Tel. No.: +6689-789-7340
ORCiD: https://orcid.org/0000-0002-4801-9697

Despite the benefits of diabetes technology, its utilization and effectiveness in Thailand remain underdocumented. This study aims to assess the use and impact of diabetes technologies on glycemic outcomes at King Chulalongkorn Memorial Hospital (KCMH), a tertiary care center in Bangkok, Thailand.

METHODOLOGY

This is a cross-sectional study conducted among T1D patients receiving care at the diabetes clinic of KCMH between August 2023 and July 2024. Patients aged 18 years or older with at least two follow-up visits were included, while those who were pregnant or lost to follow-up were excluded. We utilized a complete-case analysis approach, including only participants with complete clinical data for the outcomes in the final assessment. Individuals lost to follow-up were excluded. Baseline demographic data, micro- and macrovascular complications and treatment outcomes were collected from each patient's most recent follow-up visit. Participants were classified into two primary groups: technology users and non-technology users. Technology users were further categorized by their device type: Standalone CGM, Standalone insulin pumps (CSII) and Automated Insulin Delivery (AID) systems.

The data collection focused on the patient demographics, diabetes technology use and clinical parameters. For each participant, clinical data, including the most recent HbA1c reading, severe hypoglycemia events (hypoglycemia requiring assistance, emergency room visit or hospitalization) and CGM metrics collected from only technology users such as Time in Range (TIR 70-180 mg/dL), Time Above Range (TAR 181-250 mg/dL and >250 mg/dL), Time Below Range (TBR 54-69 mg/dL and <54 mg/dL) and glucose variability (% coefficient of variation), were collected from their latest follow-up visit within the study window.

Qualitative data were presented as frequencies and percentages. Prior to the analysis, the distribution of all continuous variables was assessed for normality using visual inspection of histograms and formal statistical testing (e.g., the Shapiro-Wilk test). Quantitative data with a normal distribution were expressed as mean ± SD and analyzed using the Student's t-test. Meanwhile, non-normally distributed data were expressed as median (IQR) and analyzed using the Wilcoxon rank-sum test. Categorical data were analyzed using the chi-square test or Fisher's exact test, as appropriate. A p-value of <0.05 was considered statistically significant.

This study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand [IRB no.0459/68].

RESULTS

A total of 61 patients with T1D were included, with females comprising 67.2% of the participants, a median age of 35 years and a mean diabetes duration of 15 years. The mean body mass index (BMI) was 23.2 kg/m². Most participants held at least a bachelor's degree (77%) and were employed (72.1%). Regarding healthcare coverage, 56% of diabetes technology users were under the Universal Coverage Scheme, with fewer participants in the self-pay group. Comorbidities included dyslipidemia (39.3%), hypertension (8.2%) and thyroid disorders, including hypo-, hyperthyroidism, thyroid nodules and autoimmune thyroid diseases (16.4%). The prevalence of microvascular complications was 14.8% for diabetic retinopathy, 16.4% for diabetic nephropathy and 9.8% for diabetic neuropathy. Macrovascular complications were rare (Table 1).

Among the participants, 49% were technology users, while 51% were non-technology users. Among technology users, 6% used insulin pumps, 57% used CGM and 37% used AID systems. The median duration of technology use was 7.4 months. Technology users had a significantly higher mean HbA1c (8.1% ± 1.6) than non-technology users (7.2% ± 1.2, p = 0.011). Severe hypoglycemia occurred in 13.3% of technology users and 16.1% of non-technology users. Hyperglycemic crises (diabetic ketoacidosis or hyperglycemic hyperosmolar state) in the past year were rare, with only one patient affected in each group (Table 2).

CGM reports indicated that AID users achieved a higher mean TIR (67.6% ± 16%) compared to CGM users (54.0% ± 23.8%), although this difference was not statistically significant (p = 0.125). AID users also spent less time in hyperglycemia, with a lower time above range 181-250 mg/dL (23% ± 9.3%) and time above 250 mg/dL (10.6% ± 11%) compared to CGM users (27.9% ± 19.7% and 15.4% ± 16.1%, respectively). Furthermore, AID users had lower average glucose levels than CGM-only users (164.2 ± 28.2 versus 173.6 ± 46.3 mg/dL, respectively), whereas glucose variability was similar between the groups (35.8% ± 6.1% versus 35.6% ± 7.0%, respectively). Both AID and CGM users maintained low rates of hypoglycemia: time spent between 54–69 mg/dL was 1.5%–2.0% in both groups, while time spent below 54 mg/dL was 0% for all technology users (Table 3).

DISCUSSION

Our study identified a diabetes technology adoption rate of 49%. This figure is notably higher than reported data from other Asian regions, such as Singapore, China and Korea, where utilization of diabetes technology in T1D remains relatively low.[6-8] While our findings are comparable to adoption levels observed in Europe (>50%), they remain lower than those in high-income countries like the United States, where adoption rates reach up to 80%. Meanwhile, in countries like Japan, higher adoption rates (23% for insulin pumps and 41% for CGM) are driven by established reimbursement programs.[6-10] Our center's uptake likely reflects the impact of Thailand's Universal Coverage Scheme. Notably, while this scheme covered 56% of our technology users, the remaining 44% were self-

Table 1. Baseline characteristics of the T1D patients

Baseline characteristics	All (n = 61)	Technology users (n = 30)	Non-technology users (n = 31)
Female, n (%)	41 (67.2)	21 (70)	20 (64.5)
Age: median (IQR)	35 (26, 41)	32.5 (23.5, 37)	37 (29.5, 43.5)
Body weight(kg): mean ± SD	62.1 ± 12.1	63.9 ± 12.8	60.4 ± 11.4
Body mass index (kg/m²): mean ± SD	23.2 ± 3.6	23.8 ± 3.9	22.7 ± 3.3
Education level: n (%)			
High school	12 (19.7)	8 (26.7)	4 (12.9)
Bachelor's degree	47 (77)	21 (70)	26 (83.9)
Master's degree	2 (3.3)	1 (3.3)	1 (3.2)
Employment status: n (%)			
Yes	44 (72.1)	19 (63.3)	25 (80.6)
No	17 (27.9)	11 (36.7)	6 (19.4)
Healthcare entitlements: n (%)			
Universal coverage scheme	31 (50.8)	17 (56.7)	14 (45.2)
Social security scheme	24 (39.3)	10 (33.3)	14 (45.2)
Civil servants' direct payment entitlement	4 (6.6)	1 (3.3)	3 (9.7)
Self-pay	2 (3.3)	2 (6.7)	0 (0)
Comorbidities: n (%)			
Hypertension	5 (8.2)	3 (10)	2 (6.5)
Dyslipidemia	24 (39.3)	10 (33.3)	14 (45.2)
Graves' disease	4 (6.6)	2 (6.7)	2 (6.5)
Hashimoto's thyroiditis	6 (9.8)	2 (6.7)	4 (12.9)
Obstructive sleep apnea	1 (1.6)	1 (3.3)	0 (0)
MAFLD	3 (4.9)	2 (6.7)	1 (3.2)
PCOS	2 (3.3)	1 (3.3)	1 (3.2)
Depression	5 (8.2)	5 (16.7)	0 (0)
Coronary heart disease	2 (3.3)	1 (3.3)	1 (3.2)
Duration of T1DM - years: median (IQR)	15.5 (9.8)	15.1 (9.6)	15.8 (10.1)
HbA1C - %: mean ± SD	7.6 ± 1.4	8.1 ± 1.6	7.2 ± 1.2
Macrovascular complication: n (%)			
Myocardial infarction	2 (3.3)	1 (3.3)	1 (3.2)
Cerebrovascular disease	0 (0)	0 (0)	0 (0)
Peripheral arterial disease	0 (0)	0 (0)	0 (0)
Microvascular complication: n (%)			
Retinopathy	9 (14.8)	4 (13.3)	5 (16.1)
Nephropathy	10 (16.4)	2 (6.7)	8 (25.8)
Neuropathy	6 (9.8)	1 (3.3)	5 (16.1)
Diabetic technology: n (%)			
Continuous glucose monitoring alone	17 (27.9)	17 (57.3)	0 (0)
Insulin pump alone	2 (3.3)	2 (6)	0 (0)
Automated insulin delivery	11 (18.0)	11 (36.7)	0 (0)

Data are presented as n (%), median (IQR) and mean ± SD as described. MASLD = Metabolic-dysfunction associated steatotic liver disease, PCOS = polycystic ovarian syndrome

Table 2. Clinical outcomes and diabetic technology use

	Technology users (n = 30)	Non-technology users (n = 31)	*P*-value
HbA1c: Mean ± SD	8.1 ± 1.6	7.2 ± 1.2	
≤7%	4 (13.8)	13 (41.9)	0.011
>7%	25 (86.2)	18 (58.1)	0.033
Severe Hypoglycemia, n (%)			1.000
Yes	4 (13.3)	5 (16.1)	
No	25 (83.3)	25 (80.6)	
Hyperglycemic crisis, events per patient year			0.935
0	27 (90)	26 (83.8)	
1	1 (3.3)	1 (3.2)	
N/A	2 (6.7)	4 (13)	

payers, suggesting that individual affordability remains a significant factor in access to technology in our setting.

Interestingly, our study found that technology users had a significantly higher average HbA1c compared to non-technology users. While we acknowledge that technology users represent three distinct clinical groups — CGM, CSII and AID — the small size of our individual subgroups (specifically the standalone pump users at 6%) necessitated analyzing these participants as a single cohort to maintain sufficient statistical power. This disparity in HbA1c likely reflects several factors. First, advanced technology is often prioritized for high-risk patients with a history of poor glycemic control or clinically significant hypoglycemia, indicating a clinical selection bias. Second, the duration of technology use may play a role; since the median duration of technology use was approximately 7 months, new users face a steep learning curve in interpreting glucose trends and adjusting insulin, which can lead to suboptimal short-term results. Because our cross-sectional analysis focused

Table 3. Summary of CGM metrics of the technology-user T1D patients

Factor	CGM-only (n = 17)	AID (n = 11)	*P*-value
HbA1C: Median (IQR)	7.9 (7.0, 8.8)	7.6 (7.2, 8.0)	0.429
TIR (70 – 180 mg/dL) (%)	54.0 ± 23.8	67.6 ± 16.0	0.125
TAR (181-250 mg/dL) (%):	27.9 ± 19.7	23.0 ± 9.3	0.478
TAR (>250 mg/dL) (%)	15.4 ± 16.1	10.6 ± 11.0	0.417
TBR (54-69 mg/dL) (%): Median (IQR)	2.0 (1.0, 4.0)	1.5 (0.0, 2.8)	0.355
TBR (<54 mg/dL) (%) Median (IQR)	0.0 (0.0, 1.0)	0.0 (0.0, 0.0)	0.065
Average glucose, mg/dL	173.6 ± 46.3	164.2 ± 28.2	0.576
GMI, %	7.5 ± 1.2	7.2 ± 0.8	0.555
Glucose variability (%CV)	35.6 ± 7.0	35.8 ± 6.1	0.940

Data are presented as mean ± SD unless stated otherwise.
TIR = Time in range, TAR = Time above range, TBR = Time below range, GMI = Glucose management indicator

on the most recent clinical parameters, these findings might capture a population with more complex management needs that require ongoing, intensive support.

Consistent with established literature, our findings suggest that diabetes technology is effective in mitigating hypoglycemia risk.[11] In our cohort, severe hypoglycemia events—defined as episodes requiring external assistance—occurred less frequently among technology users (13.3%) compared to non-technology users (16.1%). This difference did not reach statistical significance. Furthermore, CGM data indicated that both AID and CGM users maintained a low incidence of time spent in the clinically significant hypoglycemic range (<54 mg/dL), supporting the role of these technologies in improving glycemic stability and preventing dangerous low blood sugar events.

Additionally, in our cohort, 56% of technology users were covered under Thailand's Universal Coverage Scheme, underscoring the expanding role of the National Health Security Office (NHSO) in improving access to advanced diabetes care. However, the remaining 44% of technology users relied on out-of-pocket payments or private insurance, suggesting that socioeconomic factors and individual affordability still play a major role in technology adoption in Thailand. This disparity highlights a potential selection bias whereby more affluent patients may be more likely to utilize these devices. Future policy efforts should focus on broader reimbursement to ensure that clinical need, rather than financial status, is the primary driver of technology use.[12]

The strengths of this study include a detailed exploration of demographic characteristics and CGM metrics among diabetes technology users. However, the limitations include a small sample size and the cross-sectional study design, which limit the ability to determine long-term glycemic improvements. In this study, a formal sample size calculation was not performed. Instead, a convenience sampling method was employed, including all 61 eligible patients with Type 1 Diabetes who attended the Diabetes clinic during the study period. We acknowledge this small sample size as a limitation that may impact the study's statistical power and the generalizability of the results. Moreover, the small sample size precluded the use of multivariable regression to adjust for potential confounders, such as duration of diabetes or baseline disease severity. Consequently, the observed associations remain unadjusted and should be interpreted with caution. Also, the cross-sectional design and use of convenience sampling may introduce selection bias, as patients with more complex management needs were more likely to be technology users. Specifically, the small number of standalone insulin pump users (6%) precluded a robust three-way subgroup analysis between CGM, CSII, and AID users. While these technologies are distinct, lumping them allowed for a broader assessment of the impact of technology adoption versus traditional management within our clinical context.

The study revealed that patients with more complex glycemic management needs primarily used advanced diabetes technologies as reflected by their higher HbA1c levels. AID systems demonstrated superior glycemic stability and a reduced risk of hypoglycemia, supporting their targeted use in high-risk patients. However, effective use of diabetes technology requires adequate training, continuous patient support and comprehensive education. Future research should focus on longitudinal studies to better understand and address barriers to optimal glycemic outcomes among diabetes technology users.

CONCLUSION

This study found a high rate of diabetes technology adoption at our center, highlighting its potential to reduce the risk of hypoglycemia and improve glycemic stability.

Acknowledgments
The authors would like to express their gratitude to all the patients who participated in this study and to the healthcare staff at the Advanced Diabetes Clinic, King Chulalongkorn Memorial Hospital, for their invaluable support. They also extend their appreciation to the Division of Endocrinology and Metabolism, Faculty of Medicine, Chulalongkorn University, for their continuous guidance and encouragement.

Statement of Authorship
All authors certified fulfillment of ICMJE authorship criteria.

CRediT Author Statement

JP: Conceptualization, Methodology, Formal analysis, Investigation, Data Curation, Writing – original draft preparation, Visualization**; JJ:** Formal analysis, Investigation, Resources, Data curation, Project administration; **NL:** Conceptualization, Methodology, Formal analysis, Writing – review and editing, Supervision.

Data Availability Statement

Datasets generated and analyzed are included in the published article.

Author Disclosure

The authors declared no conflict of interest.

Funding Source

None.

References

1. Fullerton B, Jeitler K, Seitz M, Horvath K, Berghold A, Siebenhofer A. Intensive glucose control versus conventional glucose control for type 1 diabetes mellitus. Cochrane Database Syst Rev. 2014;2014(2):CD009122. PMID: 24526393 PMCID: PMC6486147 DOI: 10.1002/14651858.CD009122.pub2
2. Roos T, Hermanns N, Gross C, Kulzer B, Haak T, Ehrmann D. Effect of automated insulin delivery systems on person-reported outcomes in people with diabetes: A systematic review and meta-analysis. EClinicalMedicine. 2024;76:102852. PMID: 39364272 PMCID: PMC11447321 DOI: 10.1016/j.eclinm.2024.102852
3. American Diabetes Association Professional Practice Committee for Diabetes. 7. Diabetes technology: Standards of care in diabetes-2026. Diabetes Care. 2026;49(Suppl 1):S150-65. PMID: 41358889 PMCID: PMC12690173 DOI: 10.2337/dc26-S007
4. Dicembrini I, Cosentino C, Monami M, Mannucci E, Pala L. Effects of real-time continuous glucose monitoring in type 1 diabetes: A meta-analysis of randomized controlled trials. Acta Diabetol. 2021;58(4):401-10. PMID: 32789691 DOI: 10.1007/s00592-020-01589-3
5. Yeh HC, Brown TT, Maruthur N, et al. Comparative effectiveness and safety of methods of insulin delivery and glucose monitoring for diabetes mellitus: A systematic review and meta-analysis. Ann Intern Med. 2012;157(5):336-47. PMID: 22777524 DOI: 10.7326/0003-4819-157-5-201209040-00508
6. Chen L, Liu X, Lin Q, Dai H, Zhao Y, Shi Z, et al. Status of continuous glucose monitoring use and management in tertiary hospitals of China: A cross-sectional study. BMJ Open. 2023;13(2):e066801.
7. Chandran SR, Ho C, Yeoh E, Gardner D. Type 1 diabetes in Singapore: Self-care challenges, diabetes technology awareness, current use, and satisfaction, an online survey. Indian J Endocrinol Metab. 2024;28(2):167-76. PMID: 38911114 PMCID: PMC11189278 DOI: 10.4103/ijem.ijem_369_22
8. Kim JY, Kim S, Kim JH. Current Status of continuous glucose monitoring use in South Korean type 1 diabetes mellitus population-pronounced age-related disparities: Nationwide Cohort Study. Diabetes Metab J. 2025;49(5):1040-50. PMID: 40289448 PMCID: PMC12436030 DOI: 10.4093/dmj.2024.0804
9. Sato J, Nakajima K, Mita T, et al. Protocol of a prospective observational study on lifestyle and quality of life in adults with type 1 diabetes in Japan. Diabetes Ther. 2024;15(4):883-92. PMID: 38363542 PMCID: PMC10951137 DOI: 10.1007/s13300-024-01539-0
10. Foster NC, Beck RW, Miller KM, et al. State of type 1 diabetes management and outcomes from the T1D exchange in 2016-2018. Diabetes Technol Ther. 2019;21(2):66-72. PMID: 30657336 PMCID: PMC7061293 DOI: 10.1089/dia.2018.0384
11. Beck RW, Riddlesworth T, Ruedy K, et al. Effect of continuous glucose monitoring on glycemic control in adults with type 1 diabetes using insulin injections: The DIAMOND randomized clinical trial. JAMA. 2017;317(4):371-8. PMID: 28118453 DOI: 10.1001/jama.2016.19975
12. Yordsudueam N, Numsriskulrat N, Lerdrassameethad W, et al. Preliminary clinical outcomes and adoption of continuous glucose monitoring following reimbursement implementation in patients with type 1 diabetes in Thailand. Ann Pediatr Endocrinol Metab. 2026;31(1):66-75. PMID: 41354744 PMCID: PMC12963732 DOI: 10.6065/apem.2550096.048a