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Alanna Chambers is a Registered Dietitian, Certified Diabetes Educator, and Certified Pump Trainer based in Kelowna, BC. With extensive experience in various diabetes settings across Canada, she now focuses on technology training and education for both individuals living with diabetes and healthcare professionals. In recent years, Alanna has been honoured to contribute to Diabetes Canada initiatives and guidelines focused on type 1 diabetes care. Her passion for diabetes education led her to launch Type One Journeys Inc., where she is dedicated to expanding educational initiatives in Canada's type 1 diabetes community. Having lived with type 1 diabetes for over 30 years, Alanna understands that effective daily management requires a balance of knowledge, tools, creativity, support, and self-compassion.

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doi.org/110.58931/cdet.2025.3345

Optimizing the Use of Automated Insulin Delivery (AID) Systems in Routine Clinical Care of People with Type 1 Diabetes

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Introduction

With the updated Diabetes Canada Clinical Practice Guidelines recognizing automated insulin delivery (AID) as the standard of care for people with type 1 diabetes (PwT1D),[1] clinicians play a vital role in supporting individuals to adopt and optimize use of this technology.

AID systems integrate insulin pump therapy (IPT) and real-time continuous glucose monitors (rtCGM) in conjunction with a control algorithm to automate various aspects of insulin delivery. The recommendation to adopt AID is supported by robust evidence from both randomized-controlled trials and real-world studies across diverse populations, including all ages, previous experience with technology, baseline glycemia, and self-management behaviours.[1] Glycemic benefits include consistent improvements in time in range (TIR) (often by >10%), and reductions in A1C, mean glucose levels, and hypoglycemia.[2-4] Additionally, AID use has shown important improvements in person-reported outcomes, including reduced diabetes distress, reduced fear of hypoglycemia, improved quality of life, and improved sleep.[5]

Although strong evidence supports the glycemic and non glycemic benefits of AID for PwT1D, uptake remains limited. US data from the type 1 diabetes (T1D) exchange showed that only 30% of participants were using AID in 2022, with lower levels of uptake among marginalized populations.[6] Clinical practice and current evidence across various AID systems has revealed that those struggling most with diabetes management often experience the greatest benefit from AID, with greater than 20% TIR improvements for those with baseline A1C levels >8.5%.[7] Even without refined carbohydrate counting or consistent bolus behaviours PwT1D do better with any form of automation compared to basal: bolus injections (BBI) or IPT.[8-10] Therefore, clinicians are encouraged to offer AID to all PwT1D who are willing to use the devices, and to actively support its effective, ongoing use.

As AID becomes integrated into routine care, clinicians must adapt their approach to self-management education and counselling. This includes considering key AID self-management themes **(Table 1)** and applying system-specific strategies to optimize outcomes and experiences

We will follow a series of common clinical scenarios, offering guidance on how to approach and optimize care using the available Canadian AID systems. For all clinical scenarios we suggest beginning assessments by reviewing key AID data **(Table 2)** to guide discussions and collaboratively develop a management plan to achieve the personal goals of the PwT1D.

Optimization Opportunity 1: Build Trust to Minimize Variability

Presentation:

The AID user reports ongoing self-management burden, describing frequent cycles of “chasing highs and lows.” Daily reports reveal a pattern where episodes of hypo- and hyper-glycemia precede one another. Glucose sensor data may show glycemic variability (coefficient of variation >36%), hypoglycemia >4%, and/or frequent preventative treatments for anticipated lows. These patterns may reflect limited trust in the AID system, leading to user-driven interventions that increase variability.)

Clinical Explorations:

· How is hypoglycemia treated (glucose level/trend and carbohydrate source)?
· How frequently do they treat in anticipation of hypoglycemia?
· How do they respond to continuous glucose monitoring (CGM) low and high alerts? What are their alert thresholds?
· Have settings been optimized?

Potential Solutions:

1. **Refine Hypoglycemia Treatment:** Because AID systems reduce or suspend insulin delivery to prevent hypoglycemia, less fast-acting carbohydrate (~5-10 grams) is usually sufficient if mild hypoglycemia does occur, compared with BBI or IPT.[1,11] Treatment should be prompt with fast-acting carbohydrate to avoid unnecessary subsequent treatments and rebound hyperglycemia. Encourage PwT1D to consider their glucose level, trend arrows, insulin-on-board/active insulin, activity levels, and duration of suspension.
2. **Follow the bolus calculator:** Discourage overriding bolus calculations or entering additional "phantom carbs" to influence the aggressiveness of insulin delivery. Over-interference with AID systems can negatively impact outcomes and experiences.[12]
3. **Evaluate CGM alert settings:** Ensure that high and low glucose alerts are set at actionable thresholds. Encourage patience and a "watch and wait" approach, allowing the system time to adjust to out-of-range glucose levels.
4. **Tailor system settings:** Fine-tune the adjustable settings based on the specific AID system **(Table 3)**. Among these, only certain settings—known as "automation levers"—directly influence how aggressively the system

1. Refine hypoglycemia treatment	• Treat mild hypoglycemia with less fast-acting carbohydrate (i.e., 5-10 grams) than with IPT or BBI[1,11] • Be patient and wait at least 15 minutes before re-treating • Consider CBG (finger poke) prior to retreating as sensor glucose values often lag • Consider adapting treatment based on glucose level, trend arrows, insulin-on-board, activity levels, and time spent suspended
2. Optimize bolus timing	• Deliver meal boluses 10-20 minutes before eating • If carbohydrate bolus delayed by > 1 hour, reduce the entered carbohydrates or use system advised corrections
3. Adapt strategies for exercise/ physical activity	• Activate exercise/activity feature 1-2 hours beforehand • Use small amounts of carbohydrates during activity based on sensor glucose trends
4. Teach DKA prevention and prompt treatment	• Be proactive with hyperglycemia. Teach practical points such as: ∘ For sensor accuracy concerns: "If symptoms do not match your sensor reading, check blood glucose with a meter" ∘ For pump/pod site failures: "When in doubt, change it out" • Educate on ketone monitoring with prolonged hyperglycemia, and treatment • Ensure that all AID users have back-up insulin pens and/or syringes and a clear plan for subcutaneous insulin injections
5. Follow system prompts to maximize time in automation	• To maximize outcomes, time spent in automation should be >80% • Maintain "manual mode" settings that are not used by the system in automation

Table 1. Key educational points applicable to all AID systems*; courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*

Abbreviations: AID: automated insulin delivery; **BBI:** basal:bolus injections; **CBG:** capillary blood glucose; **DKA:** diabetic ketoacidosis; **IPT:** insulin pump therapy

automates insulin delivery. These should be personalized according to the user's goals, comfort with automation, and individual circumstances.

5. **Explore other root causes of hypo- and/or hyper-glycemia:** Review bolus settings, mealtime behaviours, strategies for physical activity, and other concerns.

Optimization Opportunity 2: Reduce Postprandial Excursions

Presentation:

A PwD reports routine postprandial "spikes," negatively impacting TIR and causing frustration. Glucose data shows time above range is elevated (time above >10 mmol/L and >13.9 mmol/L are >25% and 5%, respectively). Daytime glycemic variability may be evident in the glucose profile. Alternatively, they may meet overall glycemic goals, but experience postprandial hyperglycemia with specific mealtimes or food choices.

Clinical Explorations:

- Has the insulin-to-carbohydrate ratio been optimized?
- How are meals quantified (carbohydrate counting, carbohydrate estimates, meal-size estimates)?
- Are boluses delivered before, during, or after eating?
- How often are boluses missed (while normalizing occasional missed boluses)?
- Does meal composition or glycemic index of food choices contribute to postprandial hyperglycemia?

Potential Solutions:

1. **Optimize the mealtime dose:** More insulin is likely required if the postprandial peak glucose level is consistently above target and daily reports reveal routine increases to insulin delivery over the postprandial period (e.g., increased basal delivery, reaching basal

Step 1: Glycemic Metrics	• Time in glucose ranges: hypoglycemia, time in range, time above range • Mean glucose • Glycemic variability (coefficient of variability) • Shape of the glucose profile
Step 2: Insulin Delivery and Settings	• Total daily dose (useful for checking settings using certain rules-see Table 3) • Basal: bolus distribution • Units of daily basal delivered vs. programmed basal settings • Bolus delivery data per day: number of user-initiated boluses, carbohydrate entries, overrides, and auto-corrections (varies by system) • Have adjustable settings been optimized? (see Table 3) • Frequency of infusion site or pod changes
Step 3: Automation	• Percent of time in automation • Use of temporary or activity modes (exercise, sleep, different profiles, adjustable targets—vary by system see Table 3)
Step 4: Review Daily Reports	• Hypoglycemia patterns • Overnight patterns: glucose trends, automated insulin adjustments • Daytime patterns: bolus behaviours, pre- and post-meal glucose patterns, responses to automated insulin delivery (basal modulations and auto-corrections if applicable) • Use of temporary or exercise modes/targets • Patterns of automation exits or loss of sensor data

Table 2. Approach to data review with automated insulin delivery*; courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*

delivery limits, and/or frequent auto-correction boluses).

To address this:

a. **Strengthen the insulin-to-carbohydrate ratio:** Consider reducing the ratio by 10–20% at a time for the affected meal(s).[11]

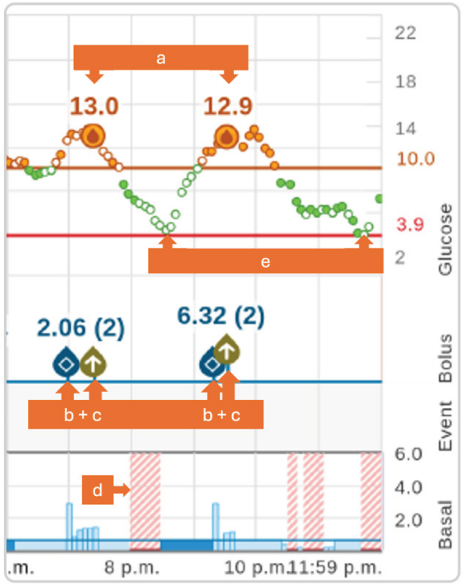
b. **Review the accuracy of carbohydrate estimation or meal entries:** Even simplified approaches to carbohydrate estimation with rounded values (ex: 25 grams, 50 grams, 75 grams) can yield effective results.[9,17] Continuing education on carbohydrate counting approaches or "carbohydrate awareness" may be helpful. For those using meal size entries, re-evaluate the parameters used.

2. **Prioritize meal-dose timing:** Bolus timing may be the issue if postprandial glucose levels are above target but resolve without significant automated increases to insulin delivery. For individuals who bolus after eating, increased sensor daily reports show rising glucose and increased insulin delivery is visible before the user-initiated boluses (**Figure 2**). This can lead to immediate postprandial hyperglycemia followed by late postprandial hypoglycemia if bolus doses are not adjusted to account for insulin delivered by the automation.

Encourage pre-meal bolusing (10-20 minutes before eating):[1,11] Work collaboratively on a specific and realistic action plan to help implement this behaviour. Consider further adjustments based on glucose trends, the glycemic load of the meal, and/or digestion-related concerns (e.g., gastroparesis).

Educate on adjustments for delayed or omitted bolus doses:

- If the bolus is delayed within 30-60 minutes of the meal start, reduce the dose by 50%[11]
- If >1 hour has passed after the meal start, consider system-specific correction strategies:
  - Minimed 780G & Tandem Control-IQ: rely on automatic correction boluses. (Manual correction boluses may be added but are typically not necessary).
  - mylife camAPS FX: rely on automated adjustments for correction. Avoid manual correction boluses (the system does not factor automated insulin into insulin-on-board calculations within the bolus calculator).
  - Omnipod 5: deliver a manual correction bolus to avoid reaching the system's automation delivery limits (the system accounts for increases to basal insulin delivery as insulin-on-board).



The individual responds to subsequent above-range glucose levels (a). The system had already delivered auto-correction boluses (b). Yet the user chose to override recommendations and deliver additional, overlapping correction insulin (c). As glucose dropped, the system responded by suspending insulin delivery (d). However treatment was required for impending hypoglycemia following both overrides (e). Overtreatment of the first impending hypoglycemia leads to the next glucose rise, contributing to significant variability and frustration for the PwD.

Recommendations to prevent variability for this case:

- encourage user to follow system recommendations and be patient with insulin action
- if hyperglycemia is not adequately corrected with auto-correction boluses, consider strengthening the correction factor and assess other settings
- treat hypoglycemia with ~5-10 grams of carbohydrate to prevent rebound hyperglycemia

Figure 1. Glycemic variability due to over-interference with the system: Tandem Control-IQ daily snap-shot; *courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*

	Minimed 780G	mylife CamAPS FX	Omnipod 5	Tandem Control-IQ
Adjustable Settings Important for overall insulin delivery and glycemic management optimization	✓ Insulin-to-carbohydrate ratio ✓ Insulin action time ✓ Target	✓ Insulin-to-carbohydrate ratio ✓ Correction Factor ✓ Insulin action time ✓ Target	✓ Insulin-to-carbohydrate ratio ✓ Correction factor ✓ Insulin action time ✓ Target	✓ Insulin-to-carbohydrate ratio ✓ Basal rates ✓ Correction factor
"Automation Levers" Adjustable settings that influence the strength of automation	✓ **Insulin action time:** 2-8 hours ✓ **Target:** 5.5, 6.1, or 6.7 mmol/L	✓ **Target:** value within 4.4-11.0 mmol/L (adjustable by time of day	✓ **Target:** 6.1, 6.7, 7.2, 7.8, or 8.3 mmol/L (adjustable by time of day)	✓ **Basal rates** ✓ **Correction Factor: adjustable by time of day**
Specific Settings Considerations	For optimal glycemic outcomes consider[13] • IAT: 2 hours • Target: 5.5 mmol/L • Bolus increment of 0.025 If frequent hypoglycemia consider loosening Carbohydrate ratios to ensure basal: bolus ratio is closer to 50/50. If hypoglycemia persists, raise target and increase IAT	Adjust target within 5.8-7.0 mmol/L for most individuals[14] considering hypoglycemia risk and personal goals Consider adjusting target by time of day to meet specific needs	For optimal glycemic outcomes consider target of 6.1 mmol/L[15] An accurate total daily insulin dose influences accuracy of the system calculated "adaptive basal" rate.[15] Bolus settings should be refined to ensure adequate bolus delivery	Strengthen the correction factor for more aggressive insulin delivery, especially for those who routinely omit boluses. Consider using a '90 rule' (90/TDD) or stronger for calculations[16] Compare delivered vs. programmed basal rates: • to increase TIR: ensure the programmed rate is higher than delivered • to reduce hypoglycemia: ensure the programmed basal rate is set lower than delivered Consider setting alternate profiles with weaker and/or stronger settings.

Table 3. Adjustable settings and considerations for AID systems currently available in Canada*; courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*

Abbreviations: IAT: insulin action time; **TDD:** total daily dose; **TIR:** time in range

3. **Refine Meal Composition:** Encourage balanced meals and lower glycemic index options to minimize postprandial variability. Discussions around food choices should remain nonjudgmental, respect individual dietary preferences, and consider food security challenges. When high–glycemic index foods are chosen, insulin dose timing may require further refinement.
4. **Incorporate Postprandial Activity:** For level 1 hyperglycemia (10.0–13.9 mmol/L) 10–30 minutes of moderate-intensity physical activity in the postprandial time period effectively lowers glucose levels without causing hypoglycemia.[19] This strategy can reduce time spent in hyperglycemia and minimize reliance on additional corrective insulin. Prolonged exercise will likely require further management strategies.

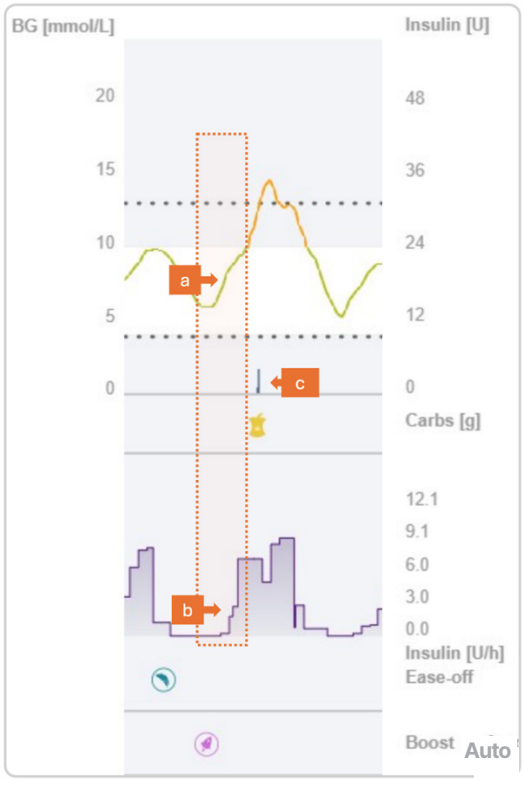
Optimization Opportunity 3: Reframe Exercise Management Strategies

Presentation:

A PwD may feel confident with day-to day management, but encounter challenges adapting hypoglycemia prevention strategies for physical activity and exercise (**Figure 3**). Pre-AID behaviours such as "carbohydrate loading" or "running high" can lead to hypoglycemia due to increased automated insulin delivery. Some individuals may choose to disable automation for exercise, while for others, the fear of hypoglycemia may be a barrier to exercise altogether.

Clinical Explorations:

- What are the individual's typical physical activity patterns (type, timing, planning, duration)?
- What is their current strategy for glycemic management during activity?
- What are their glucose patterns before, during, and after physical activity?



Notice the rising sensor glucose (a) and corresponding automated increase to insulin delivery (b), *before* the carbohydrates and meal bolus are entered (c). This indicates that the meal dose was delivered after eating. In this situation the user reduced the bolus by ~50%, and prevented hypoglycemia.

Figure 2. Identifying delayed meal bolus entries: CamAPS FX daily report snap-shot; *courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*

Potential Strategies:

1. **Use system-specific exercise modes or targets:** Activate 1–2 hours before activity to allow time for the effects of reduced insulin delivery **(Table 4**).
2. **Encourage in-range exercise**: Avoid excessive carbohydrate intake prior to exercise which results in hyperglycemia and increased insulin delivery. When needed, use small amounts of supplementary fast-acting carbohydrate immediately before and/or during exercise, based on real-time glucose trends.[18] If feasible, exercising in a fasted state with minimal insulin-on-board may help reduce the risk of hypoglycemia and minimize supplementary carbohydrate needs.[18]
3. **Reduce pre-exercise meal bolus:** If planned exercise is scheduled within 2 hours of a meal, reduce the mealtime insulin dose by 25–33%, with the exercise mode/target already activated.[19] Carefully balance dose reduction decisions with the risk of hyperglycemia and subsequent increases to insulin delivery.
4. **Provide individualized guidance:** Tailor strategies to the specific AID system being used and individual glucose responses. Refer to specific guidance in the recent position statement: "The use of AID around physical activity and exercise in type 1 diabetes: a position statement of the European Association for the Study of Diabetes (EASD) and the International Society for Pediatric and Adolescent Diabetes (ISPAD)"[19]
5. **Reinforce and revisit strategies:** Provide ongoing support to continue building and maintaining confidence. Reinforce the importance of routine physical activity for glycemic, mental, and additional health benefits.

Optimization Opportunity 4: Pursuing Tighter Glycemic Management

Presentation:

A PwT1D who meets guideline-based targets may aim for even tighter glucose management. This decision may reflect specific needs, such as preparing for pregnancy, or a personal desire to optimize outcomes. Their autonomy should be respected while balancing potential risks such as hypoglycemia, psychosocial burden, and impact on lifestyle flexibility. When appropriate and achievable, targeted strategies can help support these efforts.

Clinical Explorations:

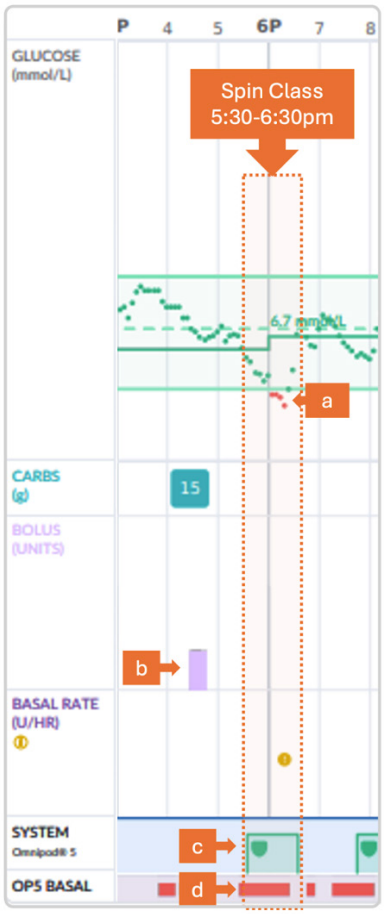
- What are their goals and expectations of AID?
- What is motivating tighter glycemic management?
- What are their risks of hypoglycemia and hypoglycemia unawareness?
- Were these goals achievable before using AID, and what strategies were used (e.g., adjunctive therapy, dietary strategies, exercise strategies, insulin dose timing)?

Potential Strategies:

1. **Strengthen system-specific settings:** Gradually strengthen system-specific adjustable settings **(Table 2)** to improve TIR and mean glucose levels. Monitor closely for increases in hypoglycemia (ensure time below range remains <4%). If hypoglycemia increases, discontinue adjustments and revert to previous settings.
2. **Refine bolus behaviours and meal-dose bolus timing:** Review meal-dose strategies and consider further optimization of meal-dose timing based on glucose patterns, trends, and meal composition.

	Minimed 780G	mylife CamAPS FX	Omnipod 5	Tandem Control-IQ
Flexible Modes for Exercise/ Activity	✓ Temp Target	✓ Ease Off Additional option: customize glucose target	✓ Activity Feature	✓ Exercise Activity Additional option: create alternate personal profile with less aggressive basal rate, correction factor, and carbohydrate ratio

Table 4. System-Specific Features for Exercise and Activity; *courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*



Contributing factors to this hypoglycemia episode (a) during a "spin class" were:

- 100% bolus delivery (b) for a carbohydrate snack ~1 hour before exercise started
- activated OP5 "Activity" feature at start of exercise (c)

The resulting insulin delivery suspension (d) was not sufficient to prevent hypoglycemia.

Recommendations to improve effectiveness of exercise management:

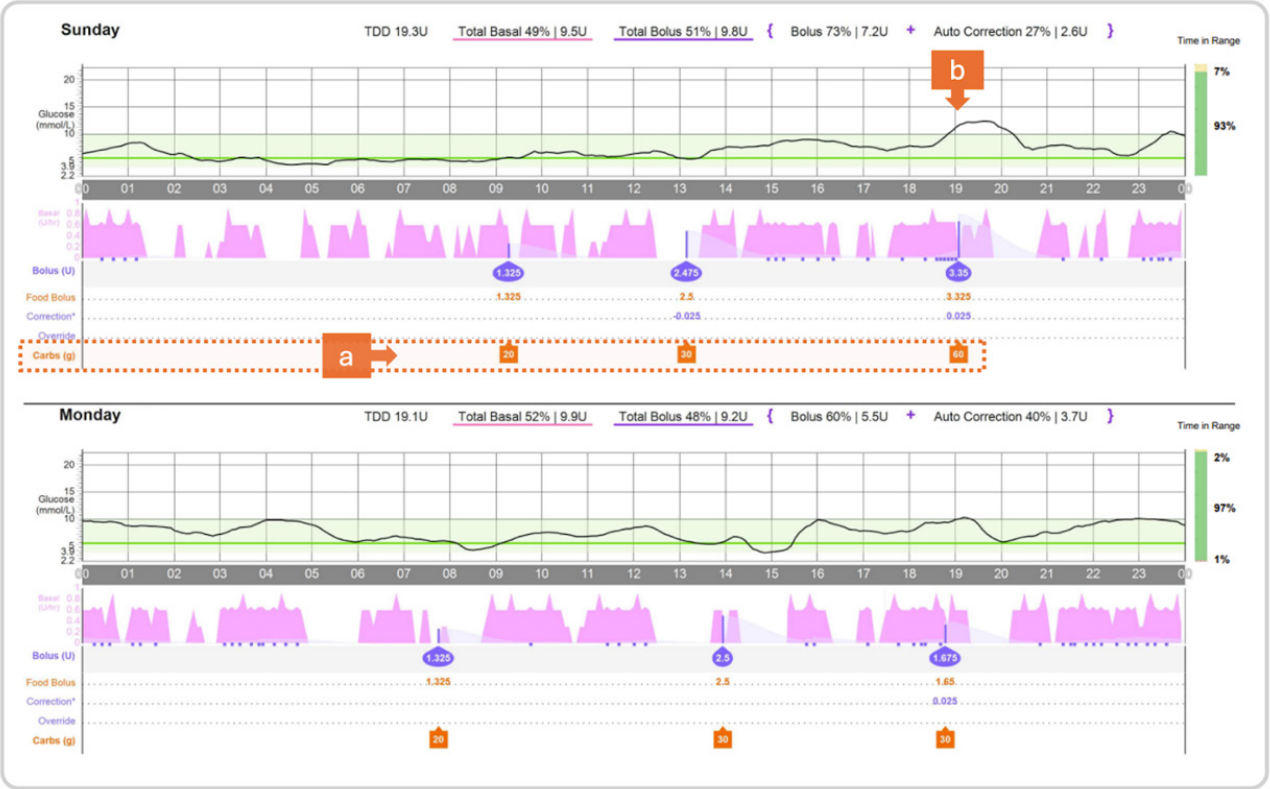
- if possible/desirable, avoid carbohydrate intake 1-3 hours before exercise to minimize insulin-on-board, or reduce bolus if carbohydrate is consumed
- monitor glucose and consume small amounts of fast-acting carbohydrate as needed throughout the exercise session
- activate the "Activity" feature 1-2 hours before the start of exercise to pro-actively reduce insulin delivery

Figure 3. Hypoglycemia with exercise: Omnipod 5 daily snap-shot; *courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*

3. **Utilize exercise strategically:** Explore using exercise to minimize postprandial excursions and to correct for rising or above range glucose levels.[20,21] Routine structured physical activity has been shown to improve TIR, but it may also increase time below range.[20,22] Apply hypoglycemia prevention strategies as discussed in the previous section.
4. **Consider adjunctive therapy:** Adjunctive agents (metformin, GLP-1 receptor agonists, or SGLT2 inhibitors) may be considered in adults with T1D to support individualized treatment goals (**Figure 4**).[1] Emerging evidence suggests that semaglutide may improve TIR and promote weight loss in PwT1D and obesity using AID.[23] Use shared decision-making and risk mitigation strategies to guide strategies for safety, efficacy, and tolerability.

Proactive Safety Considerations:

While AID offers many benefits, PwT1D should be regularly counselled on troubleshooting technology-related issues, including failures of infusion sets or pods and glucose sensors. Clinicians should review manual pump settings annually to ensure they meet current insulin needs. Provide written instructions on managing hyperglycemia, temporarily transitioning to BBI therapy, increasing the insulin dose during ketosis, and using confirmatory blood glucose monitoring (e.g., before repeat hypoglycemia treatment or large correction doses). Provide PwT1D with updated prescriptions for long-acting insulin, ketone testing supplies, intranasal glucagon, and blood glucose test strips.



This individual began using semaglutide 6 months ago while already using 780G. She has experienced significant improvements to time in range, less postprandial variability, and a reduction to total daily insulin requirements. She effectively estimates carbohydrates by 10-gram increments (a) and aims to bolus 20 minutes before most meals. She prioritizes low glycemic index and lower carb food choices. Even with a 60-gram carbohydrate meal delivered after eating (b), time above range is minimal and short-lived.

Figure 4. Aiming for tighter management with adjunctive therapy and self-management strategies: Minimed 780G daily snap-shot*; courtesy of Alanna Chambers, RD, CDE, Ilana Halperin, MD, MSc, FRCPC*

Conclusion:

AID is now considered the standard of care for individuals with T1D and should be offered to all eligible individuals. Clinicians play a key role in supporting its adoption, optimization, and sustained use. This paper provides a structured approach to common clinical scenarios across various AID systems, emphasizing the importance of building on foundational knowledge. By applying evolving best practices, tailoring strategies, and maintaining a person-centred approach, healthcare professionals can improve meaningful outcomes. Ongoing education and proactive support are essential to maximizing AID's benefits for all patients willing to use this technology.

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Financial Disclosures

A.C : Dexcom, Insulet, Medtronic, Tandem.
I.H.: Abbott, Dexcom, Insulet, Medtronic, Novo Nordisk, Sanofi, Tandem, Ypsomed

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