ENDOCRINOLOGY AND DIABETES INSIGHT REPORT

Automated Insulin Delivery: Where Closed-Loop Systems Still Need Clinical Input

A global endocrinologist perspective on automated insulin delivery systems, time in range, patient selection, algorithm trust, workflow, meals and exercise, Type 2 expansion, and the clinical input that hybrid closed-loop care still requires.

Context → Signal → Judgement → Action

39	55	6	70.9%
complete responses	total survey records	countries represented	completion rate

WHY THIS REPORT

The question is no longer whether AID works. It is where the remaining work still lands.

Closed-loop insulin delivery has moved from an emerging device category into routine specialist diabetes practice. For endocrinologists, that changes the conversation from adoption alone to selection, data interpretation, trust, patient workload, and the moments when automation still needs help.

This report follows those moments across time in range, hypoglycemia and variability, workflow integration, meal and exercise handling, Type 2 expansion, and the next generation of automation.

The 2026 ADA Standards of Care position automated insulin delivery as a preferred insulin-delivery approach for people with type 1 diabetes and for adults with type 2 diabetes who use intensive insulin therapy. That makes the practical question more specific for endocrinology teams: can AID reduce glycemic burden without simply transferring work into meal announcements, troubleshooting, device education, and increasingly complex download review?

> **Survey lens:** 55 survey records, including 39 complete responses, across six countries. The core closed-loop questions shown in the export use a base of n=37. Open-ended comments were reviewed qualitatively without assigning unsupported theme counts.

EXECUTIVE SUMMARY

The pattern in six findings

FINDING 01

AID is already part of routine specialist practice

43.2% say more than half of their insulin-treated patients use closed-loop systems.

FINDING 02

TIR is the benefit specialists notice most

62.2% select increased time in range as the most consistent clinical improvement.

FINDING 03

Workflow still asks for interpretation

48.6% say the data are useful but still require clinician interpretation.

FINDING 04

Trust remains supervised

64.9% call algorithms generally reliable with occasional manual intervention.

FINDING 05

Meals and exercise expose the edge cases

32.4% name inadequate meal or exercise response as the leading real-world limitation.

FINDING 06

The next automation target is obvious

75.7% want fully automated meal detection and dosing above any other single advance.

01

SECTION 01 · ADOPTION

Closed-loop use is already embedded in many insulin-treated practices

CONTEXT

For an endocrinologist, adoption matters because the operational questions change once AID becomes routine: who is selected, how data are reviewed, and where automation still needs active intervention. Once AID is used across a larger share of the panel, implementation becomes a recurring clinic workflow rather than a one-time device-start decision. Teams have to standardize onboarding, data access, troubleshooting, settings review, and escalation when repeated patterns of hyperglycemia or hypoglycemia appear.

WHAT THE DATA SHOWS

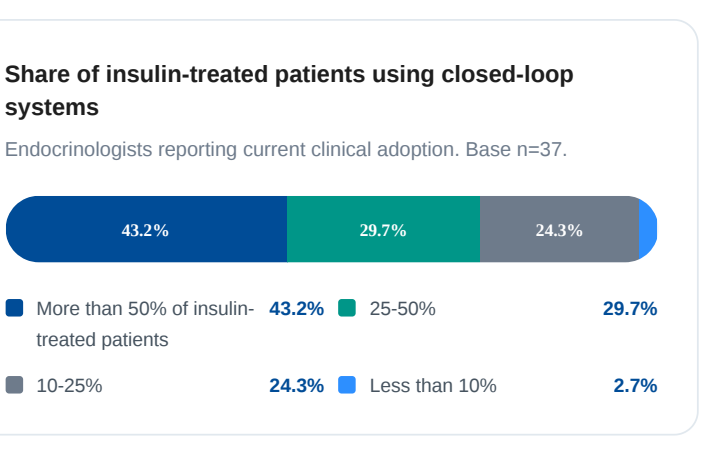
43.2% (16) report more than 50% of their insulin-treated patients using closed-loop systems; **29.7%** (11) report 25-50%; **24.3%** (9) report 10-25%; **2.7%** (1) report less than 10%.

THE INSIGHT

The conversation is no longer whether AID belongs in specialist diabetes care. In this sample, it is established enough that workflow and edge cases become the more useful questions. High adoption also makes differences between systems more visible. Clinicians are comparing not only glucose outcomes, but how much patient attention, educator time, and follow-up effort each platform requires to produce those outcomes.

WHY IT MATTERS

As adoption rises, clinics need repeatable ways to review data, coach users, troubleshoot exceptions, and decide when the system is helping versus when the patient or clinician has to step back in. As AID scales, workflow quality becomes part of clinical performance. A device that works well physiologically can still be difficult to sustain if every review requires multiple portals, manual downloads, or lengthy troubleshooting.



Share of insulin-treated patients using closed-loop systems

Endocrinologists reporting current clinical adoption. Base n=37.

02

SECTION 02 · PATIENT SELECTION

Hypoglycemia and variability drive selection more than HbA1c alone

CONTEXT

The patient who looks most suitable for AID is often the one whose glucose pattern is difficult to stabilize, not simply the one with the highest HbA1c. Patient selection in AID is rarely driven by A1C alone. Frequent hypoglycemia, high variability, missed boluses, fear of lows, lifestyle unpredictability, and the ability to respond to device prompts can matter just as much in the real consultation.

WHAT THE DATA SHOWS

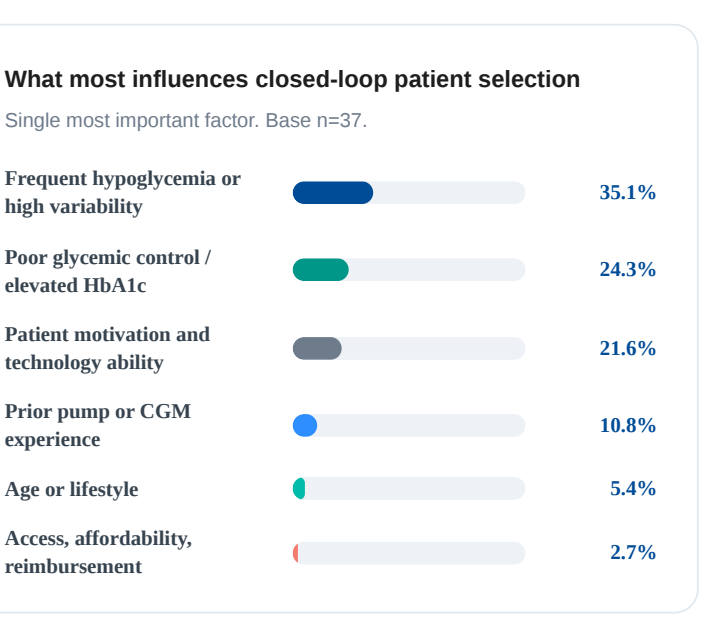
35.1% (13) choose frequent hypoglycemia or high variability as the main driver; **24.3%** (9) choose poor glycemic control; **21.6%** (8) choose patient motivation and technology ability.

THE INSIGHT

Endocrinologists appear to use AID as a variability-management tool as much as an HbA1c tool. That makes day-to-day pattern instability central to selection. The pattern suggests endocrinologists are prioritizing instability that patients feel day to day, not only average glycemia. It also reinforces that hybrid closed-loop care still depends on the patient being able to manage alarms, infusion-set problems, sensor failures, meals, and periods when automation is interrupted.

WHY IT MATTERS

Selection frameworks should make room for hypoglycemia exposure, variability, self-management capacity, and lifestyle patterns rather than reducing eligibility to a single laboratory threshold. Selection conversations therefore need to combine glycemic need with readiness, support, dexterity, digital comfort, and the practical ability to wear and maintain the system.



What most influences closed-loop patient selection

Single most important factor. Base n=37.

03

SECTION 03 · CLINICAL BENEFIT

Time in range is the benefit clinicians notice most consistently

CONTEXT

In AID follow-up, the value of the system is increasingly read through continuous glucose patterns rather than a single retrospective number. Time in range gives clinicians a view that A1C cannot provide on its own. It shows whether improvement is occurring across the day, whether gains are coming at the cost of more time below range, and whether a particular pattern is concentrated around meals, overnight periods, or activity.

WHAT THE DATA SHOWS

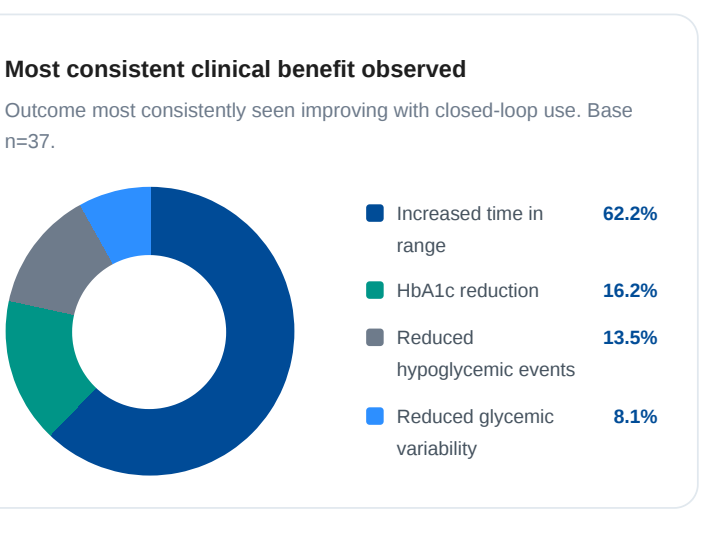
62.2% (23) name increased time in range as the most consistent improvement; **16.2%** (6) select HbA1c reduction; **13.5%** (5) select fewer hypoglycemic events; **8.1%** (3) select reduced variability.

THE INSIGHT

The strongest perceived benefit is the one clinicians can see across the day. TIR is functioning as a practical summary of how well therapy handles everyday glucose exposure. The strong preference for TIR suggests that many endocrinologists are judging AID by the shape of glucose exposure rather than by a quarterly average alone. That fits how CGM data are increasingly used during medication and device review.

WHY IT MATTERS

Data review tools and patient conversations should make TIR patterns understandable and actionable, especially around the periods when automation is least successful. A clinically useful review should connect TIR with time below range, time above range, glycemic variability, and the specific repeated scenarios that still require intervention.



Most consistent clinical benefit observed

Outcome most consistently seen improving with closed-loop use. Base n=37.

04

SECTION 04 · PATIENT BEHAVIOUR

Automation can improve confidence without eliminating education

CONTEXT

AID reduces some dosing burden, but it also asks patients to understand alarms, infusion sites, meal handling, exercise modes, and what to do when automation is interrupted. Automation can remove some of the calculation burden of insulin therapy, but it creates a new set of skills. Patients still need to understand alarms, site changes, sick-day rules, exercise settings, meal behavior, and what to do if the system leaves automated mode.

WHAT THE DATA SHOWS

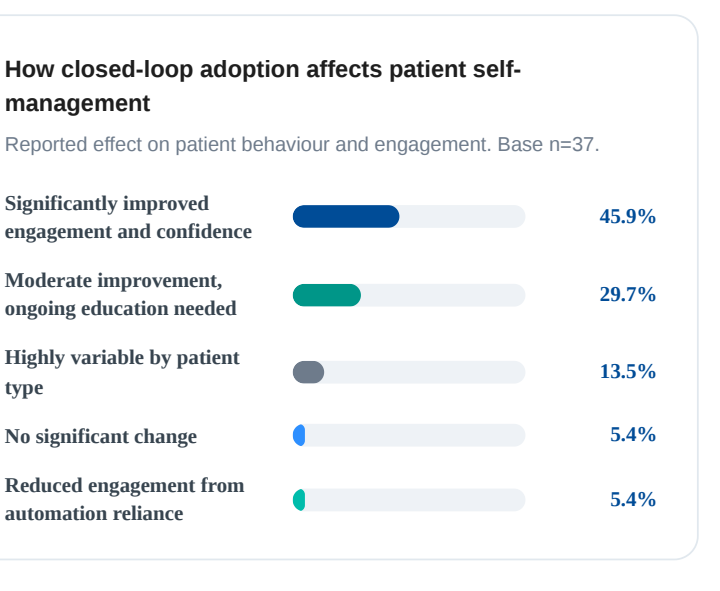
45.9% (17) report significantly improved engagement and confidence; **29.7%** (11) report moderate improvement with ongoing education needs; **13.5%** (5) say the effect is highly variable by patient type.

THE INSIGHT

Automation does not remove self-management. It changes its shape. The strongest responses still leave room for education, troubleshooting, and patient-specific readiness. The survey suggests confidence can improve without education disappearing. In practice, education changes from teaching every dose decision to teaching exception management and helping patients recognize the situations in which the algorithm needs support.

WHY IT MATTERS

Education should focus less on memorizing device functions and more on recognizing the situations where the user has to intervene or seek help. Successful AID programs need initial training and periodic refreshers, especially after software changes, device switches, recurrent lows, repeated missed meal boluses, or long periods out of automated mode.



How closed-loop adoption affects patient self-management

Reported effect on patient behaviour and engagement. Base n=37.

05

SECTION 05 · WORKFLOW

The data are useful, but nearly half still require interpretation

CONTEXT

The challenge in a diabetes clinic is not getting more data. It is turning CGM and pump output into a decision quickly enough to fit a real consultation. For many endocrinology teams, the challenge is not access to data but the amount of it. CGM traces, pump settings, auto-corrections, meal entries, activity modes, and alerts can sit across different dashboards and vendor platforms.

WHAT THE DATA SHOWS

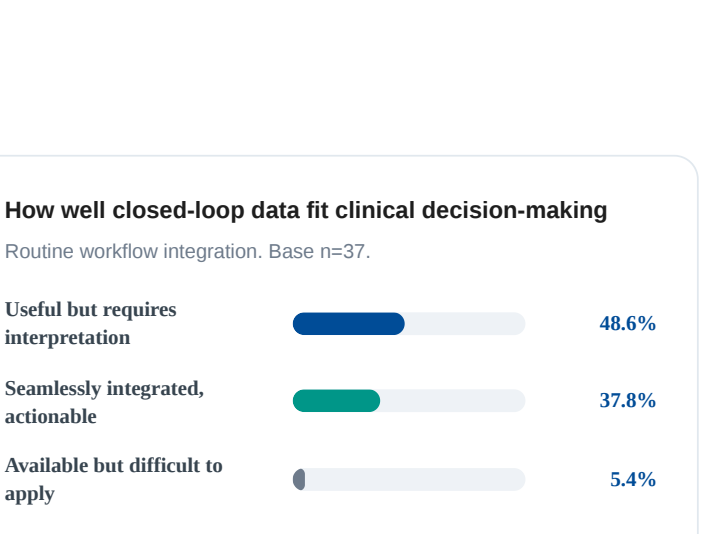
48.6% (18) say the data are useful but still require interpretation; **37.8%** (14) describe integration as seamless with clear actionable insights.

THE INSIGHT

AID data have crossed the threshold from availability to usefulness, but interpretation remains part of the clinical work for the largest group. Useful-but-interpretive data means information richness can still consume consultation time. The clinical burden is deciding which patterns are actionable and which are normal noise within a complex week of diabetes self-management.

WHY IT MATTERS

Better summaries should surface the few patterns that change treatment, rather than requiring endocrinologists to reconstruct the story from multiple device views. Standardized summaries, trend prioritization, and interoperable data views could reduce cognitive load and allow clinicians to spend more of the visit on decisions rather than navigation.



How well closed-loop data fit clinical decision-making

Routine workflow integration. Base n=37.

06

SECTION 06 · ALGORITHM TRUST

Trust is high, but it still includes manual intervention

CONTEXT

For autonomous dosing to feel clinically trustworthy, endocrinologists need confidence not only in average performance but also in what happens around meals, activity, sensor lag, and unusual patterns. Algorithm trust is tested most in edge cases: sensor error, infusion-set failure, illness, steroid exposure, unexpected exercise, prolonged hyperglycemia, and meals that are delayed, missed, or difficult to estimate. These are the moments when a generally reliable system can still require active judgement.

WHAT THE DATA SHOWS

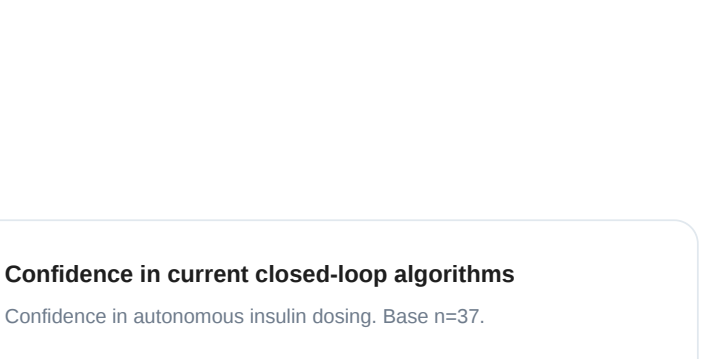
64.9% (24) call current algorithms generally reliable with occasional manual intervention; **27.0%** (10) report high confidence in most clinical scenarios; **8.1%** (3) report moderate confidence requiring frequent oversight.

THE INSIGHT

The dominant position is neither distrust nor full autonomy. It is supervised trust: the system usually works, but the clinician expects exceptions. The dominant response is best understood as conditional trust. Clinicians are willing to let the system do substantial work, but they still expect to recognize when physiology or device performance has moved outside the algorithm's comfortable range.

WHY IT MATTERS

Future systems will be judged by how rarely those exceptions interrupt life and how clearly the system explains what happened when they do. Trust is strengthened when override behavior is predictable, the reason for an automated change is understandable, and both patient and clinician know the safe fallback plan when the loop is interrupted.



Confidence in current closed-loop algorithms

Confidence in autonomous insulin dosing. Base n=37.

07

SECTION 07 · REAL-WORLD LIMITS

Meals and exercise remain the most visible edge of automation

CONTEXT

Hybrid closed-loop systems are strongest when glucose changes are predictable. Meals and activity introduce fast, behavior-dependent shifts that expose the remaining gap between automated control and everyday life. Meals and exercise are difficult because glucose dynamics can change faster than current insulin kinetics and because real life is inconsistent. Mixed meals, delayed absorption, unplanned activity, late boluses, and exercise after insulin-on-board all challenge otherwise strong automation.

WHAT THE DATA SHOWS

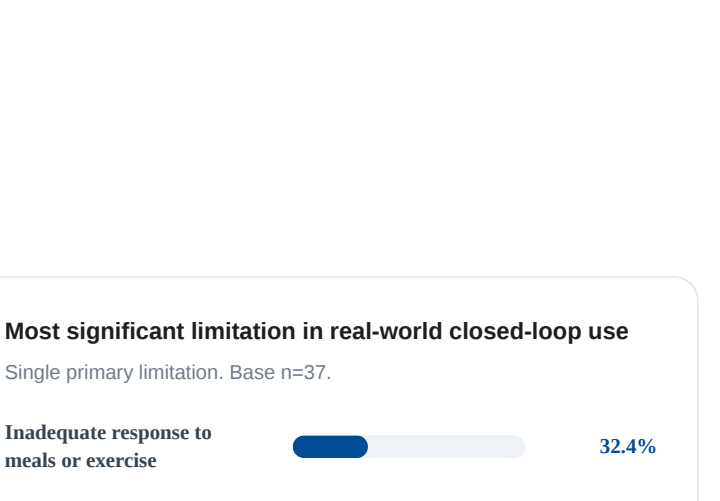
32.4% (12) name inadequate response to meals or exercise as the main limitation; **21.6%** (8) name cost and reimbursement; **16.2%** (6) name sensor accuracy and lag.

THE INSIGHT

The leading limitation is physiological and behavioral timing, not lack of algorithmic sophistication in the abstract. This is where patient behavior and algorithm kinetics collide. The survey makes the limitation concrete: the remaining gap is not abstract intelligence, but how well the system handles the ordinary unpredictability of eating and movement.

WHY IT MATTERS

The next meaningful gain will come from better handling of meals, activity, sensor dynamics, and patient behavior without adding more interaction burden. Improvements in meal detection, late-bolus handling, activity adaptation, and faster insulin action would directly reduce the situations that still generate manual corrections and patient frustration.



Most significant limitation in real-world closed-loop use

Single primary limitation. Base n=37.

08

SECTION 08 · TYPE 2 EXPANSION

Endocrinologists are already open to broader Type 2 use

CONTEXT

As AID indications expand, the clinical question becomes which insulin-treated people with Type 2 diabetes gain enough benefit to justify device burden, training, and cost. Insulin-treated type 2 diabetes is heterogeneous. Insulin resistance, meal patterns, comorbidities, dexterity, health literacy, cost, and the amount of clinical support available can vary widely across patients who might otherwise appear eligible for AID.

WHAT THE DATA SHOWS

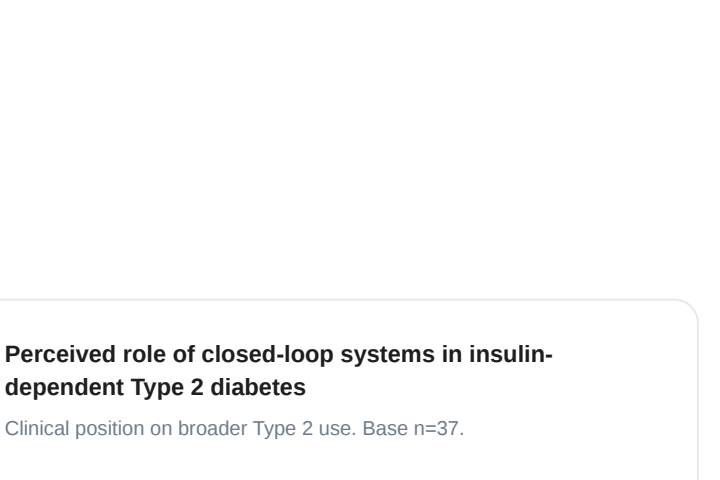
51.4% (19) strongly support broader adoption in insulin-dependent Type 2 diabetes; **27.0%** (10) see it as appropriate for select high-risk patients.

THE INSIGHT

The direction of travel is expansion, but not without patient selection. Most respondents either support broader use or see a role in selected higher-risk patients. The openness to broader Type 2 use is important, but it should not be read as one-size-fits-all enthusiasm. Endocrinologists appear ready to expand use when the expected glycemic benefit is matched by practical capability and support.

WHY IT MATTERS

Type 2 pathways will need simple selection criteria, scalable education, and payer models that make technology access realistic outside specialist Type 1 programs. Scaling AID in Type 2 diabetes will require simplified training, sustainable reimbursement, and clinic models that can support a larger and more diverse user population without creating new access gaps.



Perceived role of closed-loop systems in insulin-dependent Type 2 diabetes

Clinical position on broader Type 2 use. Base n=37.

09

SECTION 09 · NEXT ADVANCE

The clearest next ask is automated meal detection and dosing

CONTEXT

When specialists are asked to choose one advance, the answer shows what they believe is still doing too much of the work outside the algorithm. Fully automated meal detection targets the most persistent user task in hybrid closed-loop care. It also targets a common source of glycemic variability when boluses are forgotten, delayed, or mismatched to carbohydrate absorption.

WHAT THE DATA SHOWS

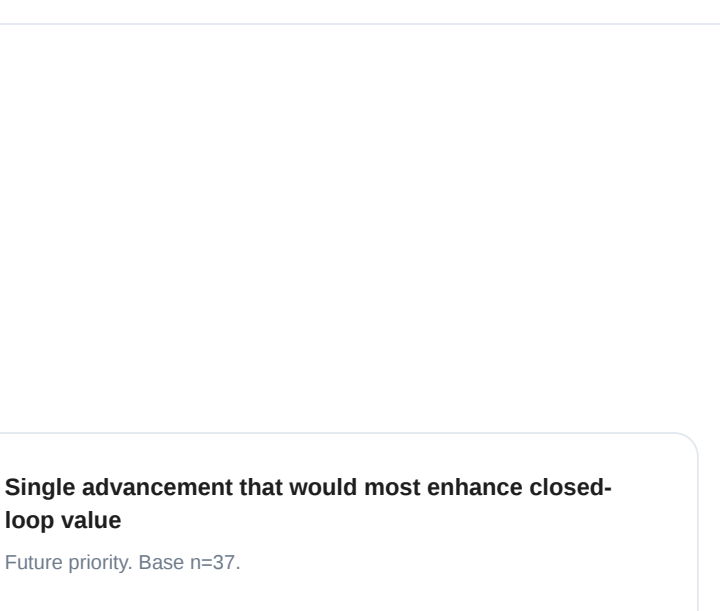
75.7% (28) choose fully automated meal detection and dosing; **8.1%** (3) choose faster-acting insulin; **5.4%** (2) choose AI-driven personalization.

THE INSIGHT

The priority is not more automation as a label. It is removing the meal-related task that still defines hybrid closed-loop use. The strong preference for this advancement shows that clinicians are defining progress by attention saved, not simply by algorithm sophistication. A more autonomous system is valuable when it removes a recurring task without adding hidden safety trade-offs.

WHY IT MATTERS

Innovation messages that emphasize AI sophistication will feel less relevant than improvements patients and clinicians can experience at the next meal. Future evaluation should look beyond A1C and TIR to late and missed meals, exercise transitions, time spent out of automated mode, burden of alarms, and how often users still need rescue corrections.



Single advancement that would most enhance closed-loop value

Future priority. Base n=37.

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SECTION 10 · PEER VOICE

The open-text comments make the same problem more concrete: hybrid still means human input

WHAT WAS ASKED

Respondents were asked for the biggest unmet need or limitation preventing closed-loop systems from delivering their full potential in clinical practice. The open responses make the same limits more tangible. Clinicians mention cost and coverage, sensor lag, meal handling, the need for faster insulin, patient adherence with bolusing, separate pump and sensor sites, and incomplete personalization for activity and lifestyle.

WHAT THE RESPONSES SHOW

Comments repeatedly point to meal detection and missed or late boluses, faster insulin, CGM lag, personalization to individual behavior, staying in automated mode, pump and sensor burden, and cost or coverage.

THE INSIGHT

The qualitative signal is consistent with the structured data. Endocrinologists are not asking for automation in the abstract. They are asking for systems that adapt better to real meals, activity, device behavior, and individual routines. The comments converge on one theme: hybrid closed loop is clinically useful, but its remaining work is concentrated in exactly the parts of diabetes that are hardest to standardize. Several respondents want systems that adapt better to missed, late, or inaccurate meal input rather than assuming ideal user behavior.

WHY IT MATTERS

Product development that removes interaction burden while preserving clinical transparency is more likely to feel meaningful than another layer of dashboard complexity. This peer voice is valuable because it shifts future design away from theoretical autonomy and toward robustness in imperfect real-world use, where patients sometimes miss boluses, exercise unexpectedly, lose automated mode, or face coverage interruptions.

> Several responses ask for meal detection, less reliance on bolusing, and better handling of missed or late meal inputs.
>
> MEALS AND BOLUSES

> Respondents mention algorithm adaptation to individual behavior, CGM lag, and maintaining automated mode.
>
> PERSONALIZATION AND SENSOR PERFORMANCE

> Cost, coverage, education burden, and managing separate pump and sensor insertion sites also appear in the comments.
>
> ACCESS AND DEVICE BURDEN

?

PEOPLE ALSO ASK · TOPIC FAQ

Frequently asked questions about automated insulin delivery systems

What is a closed-loop insulin delivery system?

A closed-loop insulin delivery system links continuous glucose monitoring with an insulin pump and an algorithm that adjusts insulin delivery based on glucose data. Most current systems are hybrid rather than completely hands-off.

Do closed-loop systems eliminate meal boluses?

Not usually. Many current systems still work best when meals are announced or bolused, although the amount of user input varies by system. Fully automated meal handling remains an important development goal.

Why is time in range important in AID care?

Time in range shows how much of the day glucose stays within a target range. It can reveal daily control patterns that HbA1c alone cannot show, including periods of hyperglycemia and hypoglycemia.

Why can exercise still be difficult for automated insulin delivery?

Exercise can change insulin sensitivity quickly and unpredictably. Activity settings, insulin on board, meal timing, sensor lag, and the type and duration of exercise can all affect how well an algorithm responds.

Do endocrinologists still need to review closed-loop data?

Yes. AID reduces some dosing burden, but clinicians still review patterns, settings, hypoglycemia risk, meal and exercise responses, device use, and situations where the algorithm needs adjustment.

Can AID be used in Type 2 diabetes?

Yes. Current guidance supports AID for many insulin-treated people with Type 2 diabetes, with device choice individualized to clinical needs, preferences, skills, and access.

CLINICAL LENS

What the remaining gaps look like in an endocrinology clinic

The same technology can feel highly automated in one patient and highly supervised in another. Four practical lenses help explain the difference.

Meal handling

The automation lens

The largest future ask is automatic meal detection and dosing, and meals or exercise are the leading current limitation.

Focus: Reduce dependence on perfect meal timing and bolus behavior.

Data interpretation

The consultation lens

Nearly half find the data useful but still interpretive, so clinic time remains part of the technology burden.

Focus: Surface the patterns that change a treatment decision.

Patient capability

The self-management lens

Engagement often improves, but education and troubleshooting remain necessary.

Focus: Teach exception management, not just device operation.

Access and expansion

The equity lens

Broader Type 2 adoption is supported, but cost and reimbursement remain visible barriers.

Focus: Make selection and access scalable beyond highly resourced programs.

CLOSING PERSPECTIVE

The next step for AID is not more automation on paper. It is fewer moments that still need rescue.

Automated insulin delivery is moving closer to standard diabetes care, and the survey shows why endocrinologists are comfortable using it: time in range is visible, confidence is generally high, and many clinicians already use these systems across a substantial share of insulin-treated patients. The remaining friction is concentrated in the situations clinicians recognize immediately from practice: meals that are late or unannounced, exercise that changes insulin needs quickly, sensor lag, device burden, and data that still take time to interpret.

That shifts the innovation question. The most valuable next-generation system may not be the one with the longest feature list, but the one that reduces the number of times a patient or clinician has to notice the system, correct it, explain it, or work around it. Clinical trust will continue to depend on transparent override logic, reliable CGM input, practical training, and workflows that surface the few patterns that actually change a treatment decision.

1. **Design for real meals**
   Prioritize meal detection, late bolus handling, and faster response to rapidly changing glucose.
2. **Make review faster**
   Translate device data into a small number of clinically actionable patterns.
3. **Keep override logic visible**
   Support trust with clear explanations of when and why automation changes insulin delivery.
4. **Scale beyond the early adopter**
   Pair Type 2 expansion with education, access, and reimbursement pathways.

Share what closed-loop care looks like in your practice.

Join the MDForLives Panel to contribute your clinical perspective to future diabetes technology insights.

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DATA SOURCE AND CONTEXT

1. MDForLives Endo insights survey 1, SGID 8773636. Survey export: 55 total records, 39 complete, 16 partial, 70.9% completion rate. Question-level bases vary by completion depth.
2. American Diabetes Association. Standards of Care in Diabetes - 2026, Section 7: Diabetes Technology. https://diabetesjournals.org/care/article/49/Supplement_1/S150/163922/7-Diabetes-Technology-Standards-of-Care-in
3. American Diabetes Association. Standards of Care in Diabetes - 2026, pharmacologic treatment recommendations including automated insulin delivery. https://diabetesjournals.org/care/article/49/Supplement_1/S183/163934/9-Pharmacologic-Approaches-to-Glycemic-Treatment

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