

CGMs in Toddlers: Balancing Glycemic Control with Developmental Risks

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Managing type 1 diabetes in toddlers presents a unique clinical challenge, demanding rigorous glycemic control to prevent both acute complications and long-term sequelae, all while navigating the unpredictable nature of early childhood. Continuous glucose monitoring (CGM) systems have transformed diabetes care for older children and adults, but their utility and safety in the youngest patients, specifically those aged 1 to 3 years, remain a subject of intense scrutiny among pediatric endocrinologists.

The question is not simply whether these devices can provide data, but whether the benefits of that data outweigh the practical and developmental hurdles inherent in applying advanced medical technology to a highly active, rapidly developing population. Clinicians must weigh the promise of improved time in range against potential skin trauma, device dislodgement, and the psychological impact on both child and caregiver.

KEY TAKEAWAYS

- **The Pivot:** CGMs offer superior glycemic control in toddlers with type 1 diabetes compared to traditional blood glucose monitoring.
- **The Data:** Improved time in range (TIR) by 10-15 percentage points is consistently observed with CGM use in this age group.
- **The Action:** Consider CGM for toddlers with type 1 diabetes, but counsel caregivers extensively on skin care, device adherence strategies, and potential developmental impacts.

Type 1 diabetes in toddlers, typically diagnosed between 1 and 3 years of age, demands an exceptionally delicate balance of insulin administration, dietary management, and activity monitoring. Hypoglycemia, particularly severe episodes, poses a significant threat to neurocognitive development in this vulnerable population, while persistent hyperglycemia contributes to the long-term risks of microvascular and macrovascular complications. Traditional capillary blood glucose monitoring, often performed multiple times daily, is invasive, painful, and provides only intermittent snapshots of glucose levels, making proactive management difficult and often reactive. This inherent limitation has driven the exploration of continuous glucose monitoring in younger patients.

Continuous glucose monitors, small wearable devices that measure interstitial glucose levels every few minutes, offer a more comprehensive picture of glycemic trends, enabling earlier detection of hypo- and hyperglycemia and facilitating more precise insulin dosing. For older children and adults, these devices have consistently demonstrated improvements in HbA1c, time in range, and reductions in hypoglycemic events. The physiological and behavioral differences in toddlers, however, introduce a distinct set of considerations. Their rapid metabolism, unpredictable eating patterns, and

high activity levels mean glucose fluctuations are often more pronounced and rapid, theoretically making continuous monitoring even more valuable, but also more challenging to implement effectively.

The practicalities of tiny patients and complex tech

The primary benefit of CGM in toddlers with type 1 diabetes centers on improved glycemic control. Multiple observational studies and small randomized controlled trials, though not always powered for definitive outcomes, consistently report that children using CGM achieve a higher percentage of time in range (TIR), typically defined as glucose levels between 3.9 and 10.0 mmol/L. One meta-analysis of studies involving children under 6 years of age, for instance, found an average increase in TIR of 12 percentage points (95% CI, 9-15 percentage points; P reductions in HbA1c, though often less dramatic than TIR improvements, are also observed. Studies typically show a decrease in HbA1c of 0.5% to 0.8% (P 60% reduction in severe hypoglycemia requiring external assistance (IRR 0.40; 95% CI, 0.25-0.64; P = .0001) in the CGM group compared to the control group over a 6-month period. This outcome is paramount given the known risks of severe hypoglycemia on cognitive development in very young children.

But the benefits come with practical challenges. Skin integrity is a major concern. Toddlers have delicate skin, and repeated application and removal of adhesive sensors can lead to irritation, rashes, and even skin breakdown. Caregivers report significant difficulties in finding suitable application sites that are both secure and comfortable, especially given a toddler's propensity for vigorous play and exploration. Device adherence is another hurdle. Young children are naturally curious and often attempt to pull off or tamper with devices. This leads to sensor dislodgement, data gaps, and increased costs due to premature sensor replacement. One study reported a sensor dislodgement rate of 25% in children under 4 years, significantly higher than in older age groups.

The psychological burden on caregivers also warrants consideration. While CGM can reduce anxiety related to undetected glucose fluctuations, the constant stream of data and alerts can also be overwhelming. Parents must learn to interpret complex glucose trends, respond to alarms, and integrate this technology into an already demanding care routine. The potential for alarm fatigue is real, leading to desensitization or even intentional disabling of alerts, which negates a key safety feature of the device. Training and ongoing support for caregivers are therefore not merely helpful, but essential for successful CGM implementation in this age group.

The impact of CGM on neurocognitive development is a complex and less well-defined area. While reducing severe hypoglycemia is protective, the constant presence of a medical device and the associated monitoring can, theoretically, affect a child's sense of normalcy and autonomy. Some experts express concern that early and intensive medicalization might inadvertently foster anxiety or an unhealthy preoccupation with health status. However, current evidence largely points to the protective effects of improved glycemic control. A longitudinal study following children with type 1 diabetes from diagnosis through early school years found that those with better glycemic control, often facilitated by CGM, demonstrated better performance on tests of executive function and memory at age 6, with a mean difference of 5 points on a standardized cognitive assessment (P = .02) compared to those with poorer control. This suggests that the benefits of tighter control likely outweigh the theoretical developmental risks of device presence.

Still, the long-term effects of continuous device wear on body image and psychological well-being in children who have never known life without a medical device remain largely unstudied. Most research focuses on immediate glycemic outcomes or short-term quality of life measures for caregivers, not the nuanced developmental trajectory of the child themselves. The open-label nature of most CGM studies is an obvious caveat; neither participants nor researchers can

be blinded to device use, which introduces potential for bias in reported outcomes and adherence. Furthermore, many studies are observational or small-scale, lacking the robust statistical power of large, multi-center randomized controlled trials seen in adult populations. This gap matters, as definitive evidence for long-term neurocognitive benefits or harms from CGM in toddlers is still emerging.

The cost of CGM systems is another significant barrier. While many European healthcare systems offer some level of reimbursement, out-of-pocket expenses for sensors, transmitters, and associated supplies can be substantial, creating disparities in access. This economic factor often dictates whether a family can realistically sustain CGM use, regardless of clinical benefit. The training required for both clinicians and caregivers is also considerable, demanding dedicated resources and time, which are often stretched thin in pediatric diabetes clinics. Whether these systems are truly a net positive for every toddler with type 1 diabetes, considering all these factors, is not a simple yes or no. It requires a highly individualized assessment, extensive caregiver education, and robust ongoing support.

CLINICAL IMPLICATIONS

Continuous glucose monitoring offers a clear advantage in achieving tighter glycemic control for toddlers with type 1 diabetes, a population where precise management is paramount for both immediate safety and long-term neurocognitive health. The consistent improvement in time in range and reduction in severe hypoglycemic events are compelling reasons for clinicians to consider these devices. This is not a marginal gain; it is a substantial shift in the ability to manage a volatile metabolic condition in a vulnerable age group. But the decision to initiate CGM in a toddler cannot be made lightly. Clinicians must engage in extensive, frank discussions with caregivers about the practical realities: the potential for skin irritation, the challenges of device adherence in an active child, and the learning curve associated with interpreting and responding to continuous data. The psychological burden on parents, while often mitigated by reduced anxiety over undetected glucose swings, can also be significant due to alarm fatigue and the constant vigilance required.

The industry must address the specific needs of this population. Smaller, more robust sensors with gentler adhesives are needed. Furthermore, healthcare systems must ensure equitable access, as the cost barrier remains a significant impediment for many families. Without comprehensive support and tailored devices, the full potential of CGM in toddlers will remain unrealized, benefiting only those with the resources and resilience to overcome the current practical hurdles.

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