Continuous Glucose Monitoring Improves Glycemic Outcomes in Children With Type 1 Diabetes: Real-World Data From a Population-Based Clinic

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Although recent clinical trials of continuous glucose monitoring (CGM) use have shown positive glycemic benefit (1,2), outcomes outside the research setting may differ and real-world studies over a long time period are limited.

In April 2017, CGM was fully subsidized in Australia for people living with type 1 diabetes (T1D) <21 years. Perth Children's Hospital is the sole pediatric diabetes center in Western Australia and is where almost all patients <18 years of age are seen (1,192 patients in 2019). This provided unique opportunity to determine the glycemic outcomes in a state-wide population-based pediatric cohort before and after commencement of CGM in a real-world setting. The aim of this study was to investigate impact on glycemic control with commencement of subsidized CGM.

An observational longitudinal study of Western Australian children with T1D attending Perth Children's Hospital between January 2015 and July 2019 was performed, with the following inclusion criteria: age <18 years, diagnosed for >2 years, and at least 2 pre– and post–CGM clinic visits. Participants were using Dexcom or Medtronic CGM available through subsidy.

The primary outcome was HbA_{1c} measured at 3-monthly clinic visits. Values up to 3 years pre– and up to 2 years post–CGM commencement were included. A multilevel piecewise growth modeling approach with maximum likelihood estimation was used for exploration of the impact of CGM on HbA_{1c}. Models were constructed to provide estimates of mean time trend in HbA_{1c} prior to commencement of CGM (preintervention slope), mean change in HbA_{1c} level post–CGM commencement (level change), and mean change in time trend of HbA_{1c} after commencement of CGM (slope change). A generalized estimating equation was used to explore the relationship between CGM use and likelihood of achieving international glycemic target HbA_{1c} <7%5 (3 mmol/mol) (3).

A total of 348 children met inclusion criteria. Mean (SD) follow-up time of the cohort was 3.6 (0.66) years, with a minimum of 1.6 years and maximum of 4.5 years. Mean duration pre-CGM was 2.4 (0.5) years and post–CGM duration was 1.2 (0.5) years. Mean age of the group at CGM onset was 13.4 (2.9) years, with mean duration of diabetes 7.2 (3.0) years. Mean HbA_{1c} at CGM start was 8.5% (1.5%) (69 mmol/mol).

Results of the model are presented (Fig. 1) alongside raw HbA_{1c} means by 3-month intervals. Model-estimated HbA_{1c} based on pre-CGM and post-CGM growth parameters is presented, along with 95% CIs. Projected HbA_{1c} based on pre-CGM parameters is also included. The HbA_{1c} time trend pre-CGM, on average, was a 0.29% increase per year (95% CI 0.24, 0.34). Following uptake of CGM, the HbA_{1c} time trend was a 0.15% increase per year (95% CI 0.03, 0.27), with a significant difference in slope between pre- and post-CGM (difference −0.14% [95% CI −0.26, −0.02], $P = 0.02$). CGM use was associated with a significant level change of −0.39% (95% CI −0.50, −0.28, $P < 0.001$). The interaction models found no significant differences in level or slope change as a function of socioeconomic status, insulin regimen, or duration of diabetes. Results of a generalized estimating equation for examining likelihood of achievement of HbA_{1c} <7% (53 mmol/mol) indicate significant difference in level ($P < 0.001$) and slope ($P < 0.001$) following CGM use. Pre-CGM proportion of patients achieving target over time was decreasing; however, post-CGM proportion of subjects with HbA_{1c} in target range was significantly higher and maintained (Fig. 1).

This real-world observational study shows an immediate and sustained reduction in HbA_{1c} after commencement of CGM in a population-based cohort of children with T1D. These findings align with results from randomized clinical trials (1,2) and emphasize the value of CGM in clinical practice.

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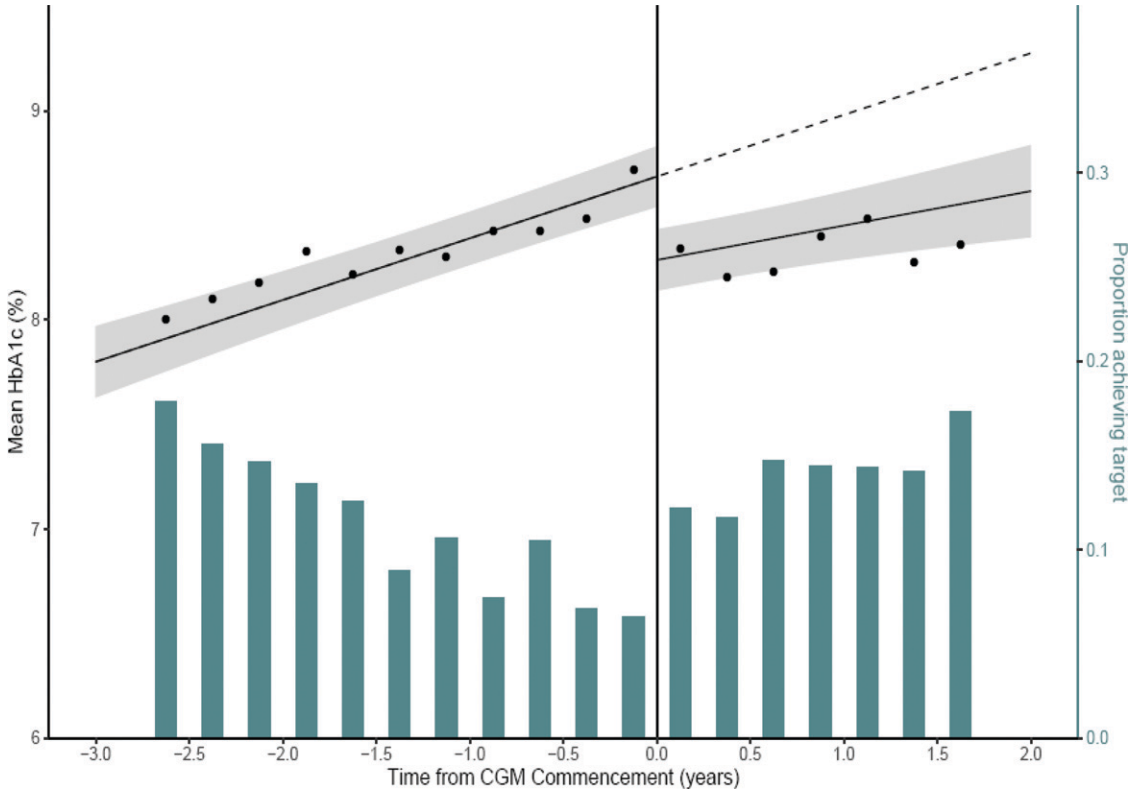

Figure 1–Change in trend of HbA_{1c} over time (upper graph) and proportion of patients meeting International Society for Pediatric and Adolescent Diabetes (ISPAD) HbA_{1c} target (lower bar graph) after commencing CGM. Left *y*-axis: Solid black dots represent mean HbA_{1c} of cohort at 3-month intervals pre- and post-CGM. Solid black lines show the trend of increase in HbA_{1c} both pre- and post-CGM. Dotted line shows the projected HbA_{1c} trend based on the pre-CGM growth parameters had CGM not been commenced. Right *y*-axis: Colored bars indicate proportion of patients achieving ISPAD HbA_{1c} target of $<$7% (53 mmol/mol) pre- and post-CGM.

This analysis shows that with subsidized CGM, improvement in HbA_{1c} can be achieved irrespective of socioeconomic status. This is a point of difference from other real-world studies, as many countries do not provide universal subsidy for CGM (4) and limit access to those who can afford the device.

While it could be argued that the change in HbA_{1c} seen is small, a critical finding is the sustained reduction in HbA_{1c} trend overtime. This is particularly important, considering the mean age of participants in this study was early adolescence, a time well-known for a decline in metabolic control (5).

A strength of this study is the longitudinal design in which the participants act as their own control. This limited the number of participants to 348 (compared with the 76.1% of our clinic group who used CGM) but removes between-person confounding factors.

In summary, this study demonstrates that glycemic outcomes improve and can be sustained with use of CGM. The universal subsidy of CGM overcomes the financial and socioeconomic barriers in accessing this technology that has a role in optimizing diabetes management. An important area for future research would be outcomes over a longer period together with cost-effectiveness analyses.

Duality of Interest. No potential conflicts of interest relevant to this article were reported.
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