



Continuous Glucose Monitor Data in Adolescents With Prediabetes From Urban Schools

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Abstract

Continuous glucose monitors are now small, factory calibrated and inexpensive enough to be worn by adolescents who do not have diabetes, and school-based screening programmes in cities are an obvious place to use them. This communication considers what such data can and cannot tell clinicians and researchers about adolescents with prediabetes. It reports no measurements of its own. Three difficulties are discussed. Prediabetes in adolescence is defined by adult thresholds and is complicated by the transient insulin resistance of puberty, so the group being monitored is heterogeneous. The standard sensor metrics and targets were developed for people with established diabetes and have no agreed meaning at near-normal glucose concentrations, where sensor error is proportionally larger. And the school setting shapes the trace through fixed meal times, activity periods and sleep patterns, while raising particular questions of consent, privacy and stigma. A layered view of the data is proposed, from raw signal to interpretation, together with a short list of reporting items that would make studies in this population comparable. The technology is ready for descriptive research in schools. Its use to label or manage individual adolescents with prediabetes is not yet supported by evidence.

Keywords: Continuous glucose monitoring, Prediabetes, Adolescents, School health, Glycaemic variability, Time in range

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1. Introduction

Prediabetes is common in adolescence. Analysis of national survey data from the United States suggests that roughly one in five adolescents meets at least one of the laboratory definitions (Andes et al., 2020), and youth-onset type 2 diabetes, once established, tends to follow a more aggressive course than the adult form, with early loss of glycaemic control on oral treatment (TODAY Study Group, 2012). Schools in large cities bring together many young people from communities that carry a high burden of obesity and diabetes, and they are a natural base for screening and for research.

Continuous glucose monitoring (CGM) has an obvious appeal in this setting. A sensor worn on the

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arm for up to two weeks records interstitial glucose every few minutes without fingersticks, and current devices need no user calibration. The data are rich, and it is tempting to assume that they are also informative. This communication is a commentary on that assumption. It presents no original data. It sets out what is known about interpreting CGM at near-normal glucose levels in young people, what the school context adds, and what studies in this population should report.

2. A Heterogeneous Group Defined by Adult Thresholds

The diagnostic categories applied to adolescents are those derived in adults: fasting plasma glucose of 100 to 125 mg/dL, two-hour glucose of 140 to 199 mg/dL after an oral glucose load, or glycated haemoglobin of 5.7 to 6.4 per cent ([American Diabetes Association, 2024](#)). These three tests identify overlapping but different groups, and their ability to predict progression in youth is less well established than in adults ([Arslanian *et al.*, 2018](#)). Puberty adds a further complication. Insulin sensitivity falls during mid-puberty and recovers towards its end ([Moran *et al.*, 1999](#)), so that some adolescents cross a threshold for a time and then return to normal without intervention. Young people with impaired glucose tolerance also differ physiologically from adults with the same label, showing greater insulin resistance and a more exaggerated insulin response ([RISE Consortium, 2018](#)). A group of adolescents with prediabetes is therefore a mixture of transient physiology and early disease, and CGM traces from such a group will reflect both.

3. Metrics Without Reference Values

The language of CGM reporting comes from diabetes care. International consensus statements define a standard set of metrics, including mean glucose, coefficient of variation, and the percentage of time within, above and below a target range of 70 to 180 mg/dL, and recommend about fourteen days of data with the sensor active for most of that time ([Danne *et al.*, 2017](#); [Battelino *et al.*, 2019](#)). The targets attached to these metrics were set for people with type 1 and type 2 diabetes. They say nothing about what is desirable or abnormal in a person whose glucose rarely leaves the normal range, and no consensus targets exist for prediabetes at any age.

Reference data from people without diabetes help to frame the problem. In a multicentre study of healthy participants that included children, sensor glucose lay between 70 and 140 mg/dL for the great majority of the time, with brief excursions above that level after meals ([Shah *et al.*, 2019](#)). Other work has shown that some adults with normal standard tests have frequent and large postprandial excursions ([Hall *et al.*, 2018](#)). An occasional reading above 140 mg/dL is thus a normal event, and the question for prediabetes is one of degree and frequency for which thresholds have not been validated against outcomes. Derived indices should be used with similar care. The glucose management indicator, which converts mean sensor glucose into an estimate of glycated haemoglobin, was derived in people with diabetes ([Bergenstal *et al.*, 2018](#)) and its behaviour at lower glucose levels in adolescents is uncertain. Classical measures of variability such as the mean amplitude of glycaemic excursions were likewise designed to describe unstable diabetes ([Service *et al.*, 1970](#)).

Measurement error matters more near the normal range. Sensors measure interstitial fluid, which lags behind blood when glucose is changing, and readings can fall spuriously when the wearer lies on the sensor during sleep. Differences of the size that separate normal from mildly impaired glucose regulation are of the same order as the error of the device, so individual classification from a single wear period is unlikely to be reliable. Table 1 summarises these points for the commonly reported metrics.

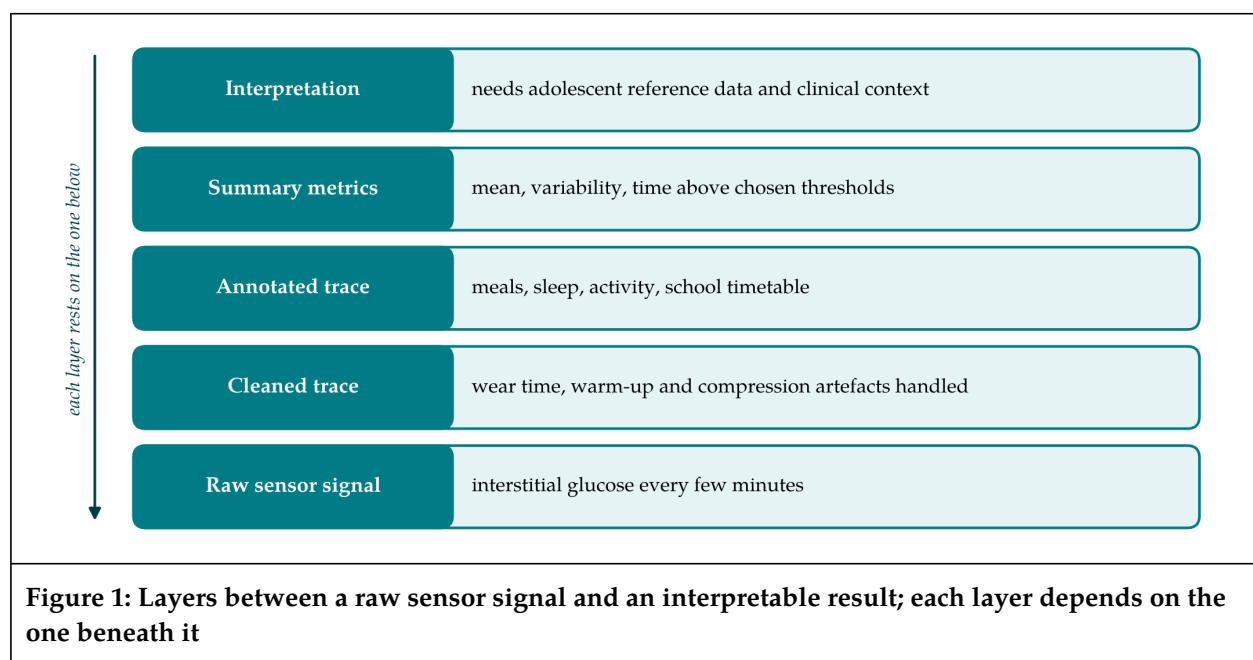
4. What the Urban School Setting Adds

A glucose trace is a record of behaviour as much as of physiology. On school days adolescents eat at times fixed by the timetable, often from a limited menu, and their activity is concentrated in breaks, physical education lessons and the journey to and from school. Sleep is shortened on school nights and extended at weekends. A trace collected across a school fortnight will carry these patterns, and comparison between pupils, or between schools, is uninterpretable without them. At minimum, studies need the timing of

meals, some record of what was eaten, activity, and sleep, and should analyse school days and other days separately. Figure 1 sets out the layers that lie between the raw signal and any statement about an individual adolescent.

Table 1: Common continuous glucose monitoring metrics and their standing in adolescents with prediabetes		
Metric	Origin	Caution in this population
Mean sensor glucose	Diabetes care (Danne <i>et al.</i>, 2017)	Narrow spread; differences close to sensor error
Time in range 70 to 180 mg/dL	Consensus targets (Battelino <i>et al.</i>, 2019)	Near ceiling in almost everyone; poorly discriminating
Time above 140 mg/dL	Studies of people without diabetes (Shah <i>et al.</i>, 2019)	Plausible, but no validated cut-off
Coefficient of variation	Diabetes care	Strongly affected by meal content and activity
Glucose management indicator	Derived in diabetes (Bergenstal <i>et al.</i>, 2018)	Not validated at near-normal glucose
Excursion amplitude	Unstable diabetes (Service <i>et al.</i>, 1970)	Sensitive to how peaks are defined

The setting also raises questions that a clinic does not. A visible sensor identifies the wearer to peers, and adolescents selected because of weight or a screening result may experience this as stigmatising. Parental permission and the young person's own assent are both required, and the school should not have access to individual glucose data. Real-time display of readings can cause anxiety or prompt dietary restriction in adolescents who have no disease, and blinded recording avoids this. Recruitment through schools that agree to take part, and through families who return consent forms, will not produce a representative sample, and reports should describe who was approached and who declined.



A single wear period is also a snapshot. Glucose patterns in adolescents shift with examination periods, holidays and sports seasons and, in those still growing, with pubertal stage, so one fortnight cannot stand for a year. Repeated wear periods some months apart would show how stable an individual pattern is. Sensors detach more readily in active young people, and data lost in this way are unlikely to be

missing at random with respect to activity; the extent of such loss should be reported and not silently excluded.

5. Suggested Reporting Items

Comparability between studies would be improved by a few consistent items. These are the criterion by which prediabetes was defined and whether it was confirmed on repeat testing; pubertal stage; the device, its wear period and the proportion of time with valid readings; whether the display was blinded; how the first day of wear and suspected compression artefacts were handled; the thresholds used for time above range, stated in advance; separate results for school days and other days; and the contextual data collected on meals, activity and sleep. Guidance on youth-onset type 2 diabetes does not list CGM among the tests recommended for screening or diagnosis (Arslanian et al., 2018), and reports should be clear that their purpose is descriptive.

6. Conclusion

Continuous glucose monitoring can describe the daily glucose patterns of adolescents with prediabetes in more detail than any single blood test, and urban schools are a practical place to gather such descriptions. The data are easy to collect and hard to interpret. The group is heterogeneous, the metrics lack reference values and validated thresholds for this age and glucose range, and the trace is shaped by the school day. Until longitudinal studies link sensor-derived measures in adolescence to later outcomes, CGM in this population is best treated as a research tool, reported with enough context to be compared, and kept apart from decisions about individual young people.

Conflict of interest

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