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COMMENTARY

Techniques for Implementing Continuous Glucose Monitoring in Primary Care: Key CGM Updates and Highlights from the ATTD 2024 Conference [Podcast]

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Abstract: This podcast discusses innovations, advancements, and discoveries in continuous glucose monitoring that were presented at the Advanced Technologies & Treatments for Diabetes 2024 Conference in Florence, Italy, held in March 2024. Specifically, the author will discuss Session two "CGM diabetes quality measures", Session three "hypoglycemia- any progress?", and Session 20, "CGM guided precision diabetes management".

Keywords: continuous glucose monitoring, CGM, hemoglobin A1c, hypoglycemia, hyperglycemia, primary care, real-world evidence, type 2 diabetes

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Dr Rozalina McCoy: Hello everyone, my name is Rozalina McCoy and I am an endocrinologist and Associate Professor of Medicine at the University of Maryland School of Medicine, in Baltimore, Maryland in the United States.

I'd like to welcome you to this independent medical education program on CGM device updates, which will share with you a couple of exciting innovations, advancements, and discoveries in continuous glucose monitoring that were presented at the Advanced Technologies & Treatments for Diabetes 2024 Conference that just concluded in Florence, Italy on March 9, 2024.

This was an incredibly exciting meeting with a lot of new and very practical information, and I am delighted to have on demand access to the sessions for the next few months so I can continue to watch and learn from the sessions that I could not attend live.

I am also excited to share some of what I have learned with you, including how I think these innovations will change my clinical practice as an endocrinologist caring for people living with diabetes.

While there were so many interesting sessions at ATTD this year, I will focus on three in particular. Session two on "CGM diabetes quality measures", session three "hypoglycemia- any progress?", and session 20, "CGM guided precision diabetes management".

01:21. Session 2: CGM Diabetes Quality Measures

Let us start with session two, which focused on the utility of the data we can get from continuous glucose monitors for patient care, as well as considerations for the broader use of CGM data for quality measurement and reporting.

For most of us and for our patients, hemoglobin A1c is one of the main ways to assess glucose levels over time. We use the A1c to diagnose diabetes, to determine if we need to intensify or de-intensify therapy, and to gauge how well our

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patients are doing, both individually and on the population level in primary care. The A1c is also a core quality measure used for public reporting and value-based reimbursement.

So the question is, where does CGM data factor into all of this?

The first role of CGM-derived glucose data is to address the limitations of the A1c test in clinical situations that make it a less reliable measure of average blood glucose levels.

These are clinical scenarios we all see fairly often. For example, the A1c is falsely elevated – so that the A1c is higher than the actual glucose – in the presence of conditions that lengthen red blood cell survival like iron, vitamin B12, and folate deficiencies; megaloblastic anemia; asplenia; polycythemia; chronic alcohol use; lead poisoning; older age; smoking; and even assay interference by aspirin, uremia, hypertriglyceridemia, and hyperbilirubinemia.

Conversely, A1c is falsely low in the presence of conditions that shorten red blood cell survival like hemolytic anemia, hemoglobinopathies, reticulocytosis, mechanical heart valves, chronic kidney disease, hemodialysis, chronic liver disease, cystic fibrosis, hypothyroidism, medication-induced hemolysis seen with antiretroviral therapy for HIV, trimethoprim sulfamethoxazole, and many others; iron or testosterone supplementation; first and third trimester of pregnancy, vitamins C or E, chronic opioid use, aspirin, and hydroxyurea.[1]

Second, while we think about the A1c as being a measure of average blood glucose over the past 3 months, each A1c value encompasses a wide mean glucose range even when none of these interfering conditions is present.

The 2008 study by Dr David Nathan that estimated average glucose values that correspond to a given A1c value showed that each A1c corresponds to a wide range of possible average glucose values.[2]

This study was conducted in 507 adults with type 1 diabetes, type 2 diabetes, or no diabetes across 11 medical centers; these individuals were specifically selected to have none of the conditions that influence A1c accuracy.

And yet, an A1c of 7%, which corresponded to an average glucose of 154 mg/dL, had 95% confidence intervals that spanned 123 to 185 mg/dL, meaning that 95% of people with A1c 7% had their individual glucose levels average out to somewhere between 123 and 185 mg/dL.

This confidence interval overlaps with patients whose A1c is 9%, whose average glucose level was 212 mg/dL but 95% CI spanned 170–249 mg/dL.[2] Thus, a patient with an A1c of 7% and another patient with an A1c of 9% could actually have the same average glucose levels; yet, in clinical practice we would treat them quite differently.

Dr Hirsh concluded that A1c discordance is frequent and not just for the traditional reasons we were all taught. There are differences in mean glycation rates and red blood cell survival that impact measured A1c, and these differences may be important for understanding our patients' diabetes management.

We get a lot of valuable information from the Ambulatory Glucose Profile or AGP report. One of them is the GMI, or glucose management indicator, which many of us and many of our patients gravitate to because it estimates the A1c.

In his talk, Dr Irl Hirsch shared new and important data about the GMI, its strengths and limitations, and how best to use it in practice in conjunction with the A1c.

First, he shared important data about the discordance between GMI and A1c. This is discordance I see all the time in clinic yet did not quite know what to make of.

In one study he presented, GMI and A1c were concordant (meaning less than 0.1 percentage points difference) in just 11% of patients in his study, most of whom – 91% – had type 1 diabetes. In 50% of patients, discordance was at least 0.5% points. And in 22%, discordance was 1% point or greater.[3]

He therefore proposed using a new measure called the glycation ratio, which is GMI divided by the A1c.

In his research – which was shared at the 2023 American Diabetes Association Scientific Sessions and is not yet published – lower glycation ratio (<0.9) was associated with higher risk of microvascular complications of retinopathy and kidney disease, with an odds ratio of more than two, suggesting that this discrepancy between A1c and GMI is clinically significant. As such, he argued we should use both A1c and GMI in clinical practice.[4]

However, Dr Elizabeth Selvin, who spoke next during this session, disagreed.

She noted that the biggest strength and advantage of CGM data is its granularity. It is the detailed glucose information over the course of each day that allows us to understand the patient's real-time experiences and glucose fluctuations. Why should we reduce this rich data to a single number like the GMI? Especially since we already have a widely used single

number – the A1c – which has strong epidemiologic and clinical trial data for its association with health outcomes in people living with diabetes!

Moreover, the GMI has many limitations. First, the GMI equation was derived using exclusively Dexcom G4 data; yet a study that placed two different CGMs on the same person at the same time found that 26% of pairs had a difference of 0.5% points or more.[5,6] You never see such variation between two simultaneous A1c assays!

The four trials that led rise to the GMI were all conducted in adults, so there is no data for the pediatric population.

And there is a lot of discordance between GMI and A1c. She reviewed close to 2 dozen studies that examined CGMs from different manufacturers and included a wide range of patient populations and found discrepancies of 0.5 percentage points or more to be present in 26% to 68% of patients.[7]

Ultimately, there are many factors that need to be considered when analyzing CGM data that can affect their accuracy:[7]

- Interstitial glucose levels are determined by glucose diffusion from plasma and will be affected by uptake by subcutaneous tissue, blood flow, permeability, and metabolic factors.
- Sensor glucose readings will lag other glucose measurements (plasma, serum, and capillary), and this lag time varies across individuals and in different settings.
- Sensor readings will not necessarily align with finger-stick (capillary) glucose levels, which is confusing to many patients.
- Sensor characteristics such as placement of the sensor, pressure on it, bleeding, and inflammation all affect accuracy.
- Sensor readings are influenced by the algorithms and calibration of each specific device so different sensors can give and do give different results.
- Sensor accuracy (compared to venous glucose) is worse in the low-glucose (or hypoglycemic) range.
- Rapid changes in glucose (such as due to physical activity) or treatment of hypoglycemia all influence sensor accuracy.

Dr Gregg Simonson spoke next and noted that he believes other CGM metrics to be more useful than the GMI, both for patient care decisions and for population health management including quality measurement.

He advocated for using time in range (TIR), as well as time below range, as new measures and is currently leading the way examining whether CGM-derived metrics can be used for quality measures in place of or in addition to the A1c.

He also shared a number of observational studies that have correlated higher TIR with lower rates of albuminuria, retinopathy, peripheral neuropathy, cardiac autonomic neuropathy, abnormal carotid intima-media thickness, and cardiovascular mortality.

Dr Gregg Simonson further noted that CGM data – as presented on the AGP – is meaningful to patients and is easy to interpret even with limited health numeracy and literacy. He tells his patients the same thing I do – more green and less red!

The main challenge to CGM-based measures is feasibility of implementation and access – CGMs can be expensive, may not always be covered by insurance and accessible to patients, and even when used by patients, the data from CGMs may not be easily available in the electronic health record for clinician review.

Ultimately, Dr Hirsh, Dr Selvin, and Dr Simonson concluded that A1c and CGM derived data are both useful and they provide complementary information for patient care.

One of the best stated rationales for why we need CGMs though, came from the session chair, Dr Revital Nimri from the Sackler School of Medicine and Tel-Aviv University. She said, "When your head is in the freezer and legs are in the oven, only the bellybutton is OK!"

That is something I will be sharing with my patients and colleagues sceptical about CGM use in the management of diabetes.

12:18. Session 20: CGM-Guided Precision Diabetes Management

The next session that I found very informative was session 20: CGM-guided precision diabetes management.

Tara Ettestad, a registered dietician and CDCES from the International Diabetes Center in Minnesota, highlighted the many opportunities to use real-time CGM data to help people living with diabetes understand how different foods and the timing of eating can impact their glucose levels.

She shared results of multiple studies that showed that CGM can support behavior-modification in type 2 diabetes, with resulting decreases in A1c, increase in TIR, weight loss, blood pressure and lipid improvements, reduced diabetes distress, improved quality of life, and improved diabetes knowledge.[8–10]

She also shared 4 concepts that are foundational to a healthy eating pattern, which she encouraged all clinicians, including and especially those who are not dieticians, to share with their patients:[11]

1. Emphasize non-starchy vegetables;
2. Minimize added sugars and refined grains;
3. Eat more whole foods;
4. Replace sugar-sweetened beverages with water as often as possible.

Ms Ettestad offered the following tips for busy clinic visits:

- Ask your patients: "Can you tell me more about what you eat and drink for your meals?" It can help if you suggest keeping a food log or tracking meals in an app, and suggest checking glucose before and 1–2 hours after eating to see the impact of eating particular foods and changes to the patient's habits. Encourage patients to review their own CGM data and teach how to see and understand their time in range reports.
- Remind people that glucose rises with meals and that is normal! And educate them on what their individual glucose targets and goals should be.
- Focus on the positive and all the different factors that impact glucose levels, not just food.
- Guide patients toward better diet quality even when their time in range is good. Glucose is not everything! She stressed that you do not have to be a dietician to do this.
- Finally, encourage curiosity and experimentation with different foods to find something nutritious and healthy that patients actually enjoy and can integrate into their life long-term.

Next, Dr Michael Riddell spoke about CGM-guided physical activity.

He shared a useful algorithm for using CGM data during exercise to prevent and treat hypoglycemia, which is one of the biggest worries during exercise that leads to fear of hypoglycemia and counterproductive compensatory and anticipatory behaviors.

For example, if glucose is between 109–124 mg/dL and falling, he suggests consuming 8 g of carbs. If glucose is 90–108 mg/dL and the CGM is showing a single down arrow, eat 16 g carbs, but if it is showing 2 down arrows, eat 20 g of carbs. If glucose is less than 90 mg/dL, eat 16 g if no change and 20 g if glucose is trending down. This can prevent hypoglycemia during physical activity.[12]

Dr Riddell also stressed that while CGM is indispensable during exercise, it also is not as accurate as it is at rest. There is a 12 minute lag time in CGM readings during aerobic exercise and up to a 25 minute lag time during high intensity training.

This is important to remember and share with our patients, and make sure that all athletes with diabetes not only have a CGM but also a glucose meter for ancillary testing in these situations.

Dr Thomas Martens from the International Diabetes Center in Minnesota shared an example of a "Clinician CGM Interpretation Tool" that he and his colleagues developed and implemented across primary care practices in their affiliated health system.[13]

They took the ADA/EASD guidelines, established treat-to-target models and algorithms for insulin dose adjustment, and created an easy-to-follow protocol for CGM-based insulin titration.

In this protocol, clinicians are guided through specific courses of action with respect to starting, stopping, and dose adjusting non-insulin and insulin medications, and frequency of follow-up with various members of the primary care team, depending on the patient's comorbidity profile, current treatment regimen, and current time in range and time below range.

Sustainability of this approach is enabled by using remote patient monitoring CPT codes. Their goal is to adapt this to a patient-facing version called the "insulin navigator program", which Dr Martens believes will allow even greater scaling and broader reach.

In summary, Dr Martens shared the following guiding principles for implementing CGM-guided management of diabetes in primary care:

1. Encourage appropriate movement toward safer "high value" non-insulin therapies;
2. Encourage appropriate insulin titration;
3. Encourage appropriate cycle time in titration;
4. Quickly identify when the limits of basal insulin therapy have been reached; and
5. Encourage team-based management for difficult situations and for individuals on multiple daily injections and mealtime insulin regimens.

18:07. Session 3: Hypoglycemia – Any Progress?

The last session I hope to share with you – though there are so many others with innovative research relevant to patient care – is Session 3, titled "Hypoglycemia – Any Progress?"

First, Dr Simon Heller presented compelling data demonstrating the association between the minimum glucose level of a hypoglycemic event within 10 days and subsequent risk of cardiovascular events, retinal disorders, and death in both type 1 and type 2 diabetes.

He stressed that we should "no longer minimize the consequences of level 1 hypoglycemia – it is not just an alert value", with level 1 hypoglycemia representing glucose levels between 54 and 70 mg/dL.

Next, he spoke about the importance of CGM detection of hypoglycemia in clinical trials, regulatory decision making, and clinical care.

While his talk focused mostly on clinical trials, he made a number of points that I think are very relevant for patient care.

We currently define hypoglycemia based on severity as level 1 (glucose 70–54 mg/dL), level 2 (glucose <54 mg/dL), and level 3, also called severe, corresponding to any glucose level that requires third party assistance for treatment.[14]

However, hypoglycemia often means very different things to different people, including our patients. So when we ask our patients about hypoglycemia, as we should during each clinical encounter, we need to gain more nuanced understanding about each patients' understanding and experience of hypoglycemia.

Importantly, sensor-detected hypoglycemia does not replace self-report of hypoglycemia.

Dr Choudhary shared data showing that in a study of over 22,000 patients, 64% experienced sensor-detected hypoglycemia less than 70 mg/dL, 43% reported experiencing hypoglycemia, but only 39% had these two overlap![15]

So, 57% of patients who reported severe hypoglycemia did not have CGM confirmation of these events – I see these patients all the time! And only 35% of patients with CGM evidence of hypoglycemia reported symptoms of hypoglycemia.

In a different analysis, CGM detected 19% of patient reported hypoglycemic events, 80% were detected based on symptoms alone, and 1% were detected by others.[15]

Importantly, both kinds of events – CGM-detected and patient-experienced, are associated with impaired quality of life, mood, sleep quality, cognitive function, energy level, fear of hypoglycemia, social functioning, memory, and productivity.

One of the biggest reasons for this discrepancy is impaired awareness of hypoglycemia, which was the topic of the next presentation by Dr Bastiaan E De Galan from the Netherlands.

He summarized the results of multiple studies that showed that 27% of people with type 1 diabetes and 9.7% of people with type 2 diabetes treated with insulin have impaired awareness of hypoglycemia.[16–21]

Impaired awareness of hypoglycemia can be detected with just one simple question (the Gold Score): asking "Do you know when your hypos are commencing?" A score of ≥4 (out of 7, which is "never aware") suggests impaired hypoglycemia awareness.[22]

Chronic hypoglycemia leads to impaired awareness of hypoglycemia, while chronic hyperglycemia improves awareness. The best way to restore awareness is to end the hypoglycemia.

CGM use reduces severe hypoglycemia- because patients can detect and treat hypoglycemic events before they require third party assistance- but has no independent effect on hypoglycemia awareness.

CGM use can reduce severe hypoglycemia rates by 39–72%, depending on the study.[23–27]

CGM use can also improve diabetes distress in people with impaired awareness of hypoglycemia, but only if the hypoglycemic events stop.

I hope that this information is as helpful for you as it was for me.

I think the key take away points are that continuous glucose monitoring is an incredibly powerful tool in clinical practice to help our patients better understand and manage their diabetes.

It can help guide nutrition choices to support weight loss and improve glucose control, make exercise safer, enable timely and effective medication management, and prevent the harms associated with hypoglycemia.

Implementing CGM in primary care practices is feasible and financially sustainable but requires a team-based approach.

There are a number of available resources to help clinicians and practices get started using CGM in their practice.

I hope you check out Springer Healthcare IME's CME-accredited interactive infographics and Tweetorials where I, along with Dr Eugene Wright and Dr Jennifer Green, dive deeper into the most important considerations for CGM use in primary care.

Thanks for listening to this podcast update. Stay tuned for the next podcast where we will continue talking about recent updates in the CGM field.

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