

Integrating Ketone and Glucose Monitoring for Optimized Diabetes Management: Key Ketone Monitoring Updates and Highlights from the ADA 2025 Conference [Podcast]

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Abstract: This article discusses innovations and advancements in diabetic ketoacidosis (DKA) and ketone monitoring technology from the 2025 American Diabetes Association (ADA) conference held from June 20–23, 2025, in Chicago, Illinois. The session, “Continuous Ketone Monitoring—Innovations and Clinical Applications” featured four expert presentations from Drs. Ketan Dhatariya, Lori Lafell, Jennifer Sherr, and Richard Bergenstal, each addressing the clinical implications of physiology and the impact of ketosis and DKA on people with diabetes; methods to detect ketones and current approaches to prevent DKA; ketone sensor performance criteria and current study data; and the potential clinical impact of continuous ketone monitoring. The discussion concludes by discussing a poster presented at the ADA which discussed ketone profiles in free-living people with type 1 diabetes using continuous ketone monitoring. The article closes by underscoring the desire by both clinicians and patients for continuous ketone monitoring to become mainstream sooner rather than later.

Keywords: American Diabetes Association, diabetic ketoacidosis, diabetes management, ketone monitoring, continuous ketone monitoring, type 1 diabetes, type 2 diabetes, beta-hydroxybutyrate

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Transcript

Voiceover

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Introduction

[00:00:35]: Hi there. I am David Kerr. I am speaking to you from Santa Barbara, California. Thank you for tuning in. Today on the podcast, we’d like to highlight a symposium that was held at the recent meeting of the American Diabetes Association (ADA) in Chicago.

[00:00:53]: The topic of the symposium was ketone monitoring in general, and specifically the potential value of continuous ketone monitoring to prevent diabetic ketoacidosis (DKA).

Ketosis and DKA—Physiology and Clinical Impact on People with Diabetes

[00:01:04]: So what happened at the symposium? Well, we began with a presentation from Ketan Dhatariya, and he began by discussing the known physiology of ketometabolism and the clinical challenge of diabetic ketoacidosis.¹

[00:01:16]: He began by reminding the audience that ketone production is incredibly sensitive to even small amounts of insulin and therefore absent or relative lack of insulin, is one of the major risk factors for the development of DKA in both type 1 and type 2 diabetes.

[00:01:35]: It was also interesting to hear from Dr Dhatariya, from an evolutionary perspective about ketones. They can actually be beneficial. They provide an alternative source of fuel during times of extreme starvation. And he also pointed out some intriguing animal data suggesting that ketones may actually influence longevity in a positive way.

[00:01:55]: Emerging evidence that ketones themselves may have beneficial effects on the cardiovascular system, which could be very relevant for people with type 1 diabetes in particular. The problem currently in the United States is that not everyone has access to the devices that measure ketones, particularly in the blood.

[00:02:15]: And there seems to be an over-reliance of urine testing for ketones. This is very relevant because DKA is actually an expensive complication of diabetes, with estimates ranging up to \$36,000 for a single episode.

[00:02:32]: The good news is that, the mortality, at least in the West, associated with DKA, is that it's fallen significantly both in type 1 and type 2 diabetes. But sadly, from a global perspective, DKA is still a real problem and a real risk for people living with diabetes around the world, especially in countries that are under-resourced.

Methods to Detect Ketones and Current Approaches to Prevent DKA²⁻⁷

[00:02:53]: In the next presentation, we had Lori Lafell from Harvard University, and she was discussing current methods for measuring ketones to prevent DKA. She began by making the point that we know about many of the risk factors for DKA, such as being female, having a background of migration, having high A1C levels, or requiring more insulin each day.

[00:03:17]: Those are important in adults. In children in the United States, DKA is actually more common in those aged between 10 and 14, among black patients, those having a higher A1C, and also those with public insurance.

[00:03:33]: Dr Lafell also reminded us some quite old data, but it's still very important today that intercurrent illness is a huge risk factor for DKA. And in the old studies where fever was induced in a controlled research environment, she showed evidence that what you see with a fever developing in someone with diabetes, is release of counter regulatory hormones and an increase in lipolysis, which can cause a rise in the ketones even before glucose levels begin to go up.

[00:04:05]: And that's an important clinical challenge for all of us. Dr Lafell then looked at some of the limitations associated with total reliance on urine testing. The important ones are that urine testing only detects acetoacetate and acetone and not the most important ketone, that is beta hydroxybutyrate or BHB.

[00:04:28]: She also pointed out that in the real world, the time and place where you need to have strips, the patient may not actually have access to them, or the strips may be inaccurate because they have been stored improperly, such as in a bathroom with high humidity. The advantage of blood testing of BHB is that it's measured quantitatively and in real time.

[00:04:49]: And at the moment, agreements suggest that normal levels of BHB are usually less than 0.5 millimoles per liter, but in DKA they can rise to three or even more millimoles per liter. Although there's really limited information comparing urine and blood testing in randomized controlled clinical trials, there's some suggestion that if people have access to blood testing, they are more likely to adhere to the sick day rules, and they are less likely to end up in hospital with DKA.

[00:05:22]: It's also noteworthy that if you only rely on urine testing during the recovery phase after an episode of DKA, patients may end up being over treated with the risk of hypoglycemia. So again, blood is best.

[00:05:38]: Importantly, Dr Lafell ended her presentation by making the point that across the United States there's huge variation in the approaches to sick day rules and there's an urgent need for standardization. This is incredibly important with the growing use of SGLT2 inhibitors in type 2 diabetes and the increasing interest of using this class of drug in type

1 diabetes, where there are concerns about the risk of so called euglycemic DKA, where ketosis and acidosis occur but without marked elevations in glucose levels.

Ketone Sensor Performance Criteria and Current Study Data⁸

[00:06:19]: The third presentation was from Jennifer Sherr from Yale University, and she was discussing the current status of ketone sensor performance, including the use of continuous ketone monitoring. So how do we test performance in the research setting?

[00:06:35]: Well, there are four simple ways to think about this. First of all, we could give people glucose challenges and look at changes in glucose and changes in ketones, and we can manipulate glucose to that extent as well. Other researchers have used low carbohydrate diets and looked at ketogenesis in those circumstances.

[00:06:57]: Other research have provided drinks containing ketones to people. And also the other approach that can be used is to take people who are using insulin pump therapy and interrupt the infusion and see what happens to ketone and glucose levels.

[00:07:17]: So, Dr Sherr shared some of the data, particularly looking at insulin cessation in type 1 and type 2 diabetes and the results show that, as we would suspect, that when insulin infusion is discontinued, there is a rapid rise in ketones in type 1 diabetes, and this rise can occur before significant hyperglycemia.

[00:07:39]: There's also a great deal of inter-individual variability in both the rate of rise and the peak increments in ketones as well as glucose. She also showed data showing that resolution of ketonemia is well tracked by these continuous ketone monitors.

Continuous Ketone Monitoring—How Broad is the Potential Clinical Impact?⁹

[00:07:57]: In the final presentation, we had Richard Bergenstal from the International Diabetes Center in Minnesota, and he brought all of the previous discussion together by asking the question, how broad will the clinical impact of continuous ketone monitoring be?

[00:08:13]: And really it's all about preventing diabetic ketoacidosis. So to assess the progress that's been made and what needs to happen, Dr Bergenstal suggested a roadmap to think about where things are at the moment and where they need to be.

[00:08:29]: The questions associated with the roadmap are really straightforward, such things as asking: Is there a clinical problem? Who can benefit the most? What is the risk factor that we want to mitigate? Which metric to follow? The technology that's being used – is it accurate, easy to use and reliable?

[00:08:47]: What about the alerts and the visualizations and the risk factor goals? And most importantly, what is the action plan to improve the risk factor metrics for professionals and people with diabetes? So Dr Bergenstal went through this roadmap with respect to continuous ketone monitoring.

[00:09:04]: The clinical problem is obvious. It's DKA, including euglycemic DKA. In terms of who can benefit from the technology, there are many potential groups, including adults and children with type 1 diabetes, those with type 2 diabetes, especially where there's a history of DKA during acute illness, for those using an insulin pump, for people with high glucose levels perhaps where insulin omission may be responsible, those people who have a history of disordered eating, and more recently, patients who wish to try low carbohydrate or ketogenic diets.

[00:09:42]: Continuous ketone monitoring may also be helpful during pregnancy, and as I mentioned earlier, in patients who are going to start or who have started SGLT2 inhibitors. Dr Bergenstal mentioned some intriguing real-world data that's unpublished at the moment.

[00:10:02]: These were data from 165,000 individuals, using meters where ketones were measured, and the data consists of over 3 million tests. And as I said, these will soon be available, but essentially they show that in people with diabetes, from time to time, levels of beta hydroxybutyrate do rise, but really high levels outside the setting of DKA, are less common.

[00:10:29]: The good news is that there's a huge amount of ongoing research funded by the National Institutes of Health in the area of ketone monitoring. Dr Bergenstal describes some of the projects which are looking at ketosis risk in those

who are using multiple daily injections of insulin, those using automated insulin delivery systems, and also, as mentioned again previously, the impact of SGLT2 inhibition on risk in those individuals.

[00:10:58]: More work looking at the time course of ketosis with insulin withdrawal and the amounts of insulin and carbohydrate required to reverse ketosis, and whether continuous ketone monitoring can be beneficial in this area. There's a lot of discussion about thresholds of ketone measurement, what would be considered normal, what's abnormal, what's risk, what's high risk, and so on and so forth.

[00:11:24]: There are also other studies examining the accuracy of the technologies themselves and the effects of ketogenic diets and intermittent fasting on ketosis risk. There's also some work looking at patients with some renal disease and SGLT2 inhibition and whether or not continuous ketone monitoring will be helpful.

[00:11:44]: So it's all very well measuring ketones continuously, but we need to show the data to both people with diabetes and to professionals and Dr Bergenstal spent quite a bit of time discussing the presentation of the information. At present, everyone is familiar with the ambulatory glucose profile (AGP), so one approach might be that we can simply embed continuous ketone monitoring data within AGP.

[00:12:15]: The alternative, of course, would be to have separate visualizations for ketones, which would look similar but would be separate from the data generated by continuous glucose monitoring.¹⁰ These are under great discussion within the diabetes community at the moment and importantly, the action plans of what we need to do with the data.

[00:12:37]: This is going to be crucial if we are going to see benefits from this technology. At the end of the session, we had some questions answered by the panel. These cover a variety of topics. The ones that were really striking was the potential value of continuous ketone monitoring.

[00:12:54]: If you add continuous ketone monitoring to continuous glucose monitoring with additional biological and psychosocial information, it may be possible to use that to model risk and stratify people into subgroups of risk where interventions could take place much earlier for the benefit of people living with diabetes.

[00:13:15]: There followed discussion about the cutoff levels and thresholds and what the device should show. And there's an intriguing discussion, where at the beginning of the symposium it was mentioned that low levels of ketones may have some cardiovascular benefit. This could have value for people with type 1 diabetes because there's a risk to this in terms of DKA. The jury is undecided, but watch this space. There's going to be a lot more intriguing research coming out.

Ketone Profiles in Free-Living People with Type 1 Diabetes Using Continuous Ketone Monitoring¹¹

[00:13:44]: So elsewhere at the ADA there was some other work related to ketone measurements, most notably a study from Australia which was part of the large multicenter partner study.

[00:13:54]: The investigators here aimed to provide insights into what are so called normal levels of ketones in people with type 1 diabetes participating in the study. So they looked at individuals who were wearing both a continuous glucose and continuous ketone monitor for two weeks during the run-in phase of the study.

[00:14:15]: They found that when they compared those individuals whose ketones never rose above 0.6 millimoles per liter with those with higher levels, the only factors which seemed to impact this were the duration of diabetes and lower carbohydrate intake.

[00:14:31]: There was no difference in other things such as the BMI or blood pressure or insulin delivery mode, the presence of complications, time and range, A1C, C peptide, and so on and so forth. So the researchers concluded that for most adults not on SGLT2 inhibitors, their ketone body levels are rarely over 0.6 millimoles at least over this two week period.

[00:14:56]: So overall there was a huge amount of interest and let me tell you enthusiasm at the ADA about the potential value of continuous ketone monitoring for both type 1 and type 2 diabetes. As always, more work needs to be done, but I think the message is that the clinicians and people with diabetes are hoping this technology can become mainstream sooner rather than later.

[00:15:20]: Thank you for listening to this podcast. If you'd like to find out more, then come to the *Integrating Ketone and Glucose Monitoring for Optimized Diabetes Management* CME program we have on offer. As well as this podcast, **[00:15:35]:** within the program, we have a ketone monitoring masterclass. We also allow you to experience on demand digital eLearning modules to examine the whole landscape of ketone monitoring. We welcome you to come join us.

Voiceover

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Abbreviations

ADA, American Diabetes Association; AGP, Ambulatory Glucose Profile; BHB, Beta-hydroxybutyrate; BMI, Body Mass Index; CME, Continuing Medical Education; CGM, Continuous Glucose Monitoring; CKM, Continuous Ketone Monitoring; DKA, Diabetic Ketoacidosis; HbA1c/A1C, glycated hemoglobin; HCP, Healthcare Professional; IME, Independent Medical Education; NIH, National Institutes of Health; SGLT2, Sodium–glucose cotransporter-2.

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