In the Range: Real Talk on Diabetes Monitoring Best Practices

Episode 3: DKA in the Real World: Evidence and Cases that Matter

Presented by Cornerstone Medical Education and American Academy of CME.
Supported by an educational grant from Abbott Diabetes Care.

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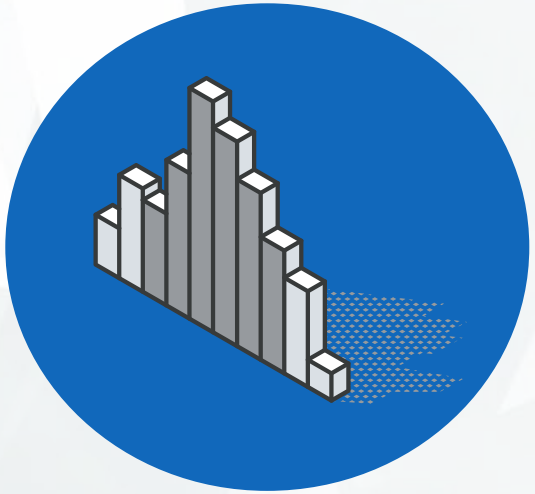
DKA Burden

Most common **hyperglycemic emergency** in persons living with diabetes

DKA is a leading **cause of death** among children and adults (< 58) with diabetes



1%–13% annual prevalence of DKA in adults with T1D across countries

Hospitalization for DKA: 1 in 5 cases attributed to T2D

Higher **mortality for T2D** (0.85%) with DKA than T1D (0.2%)

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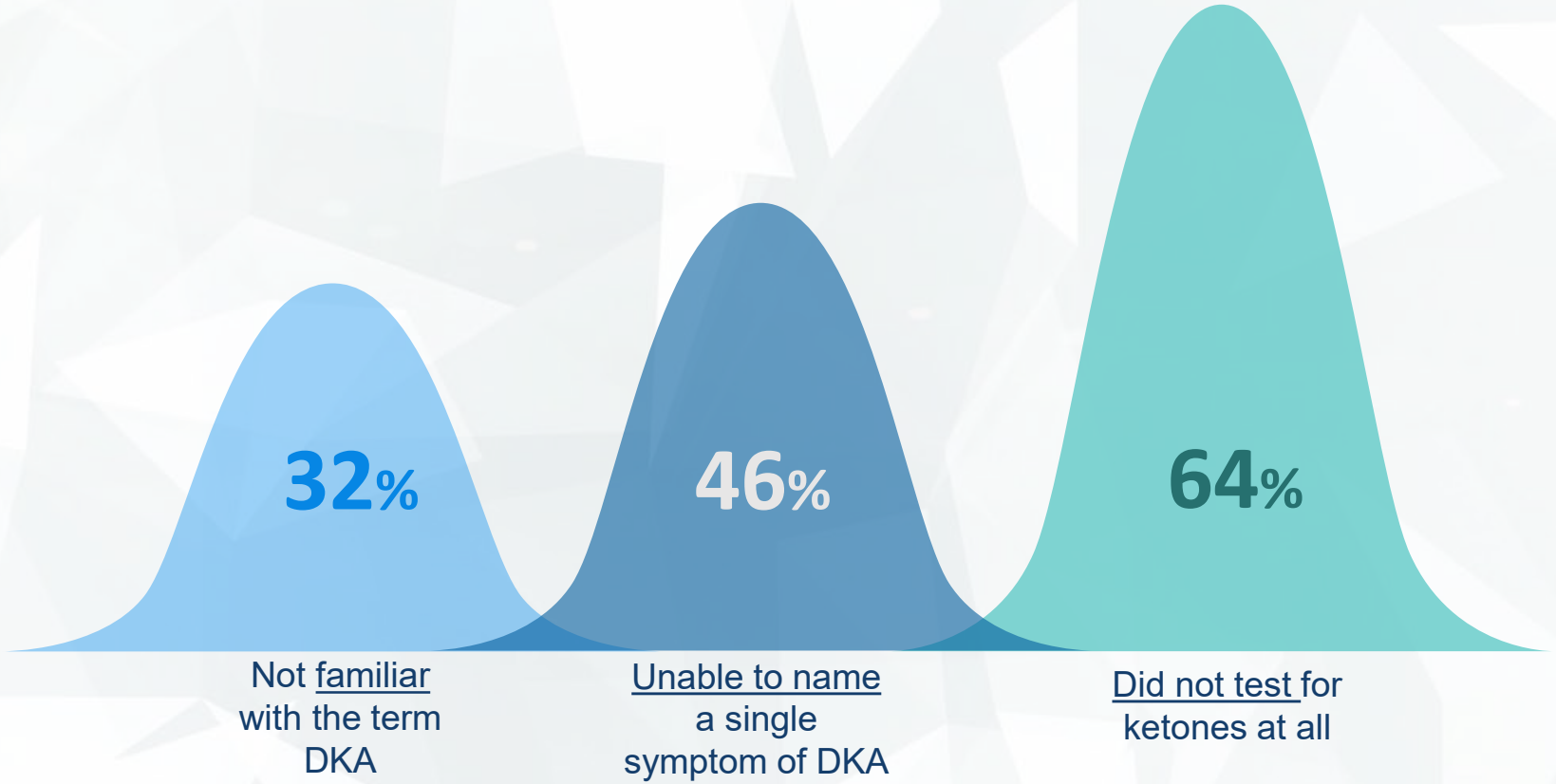
Umpierrez GE, et al. *Diabetes Care*. 2024; Nguyen KT, et al. *JDST*. 2022; Zhong VW, et al. *Diabetes Care*. 2018; Canales SP, et al. *Endocrine Pract*. 2024.

Gaps in DKA: Patient Unawareness

Multinational, multicenter survey of endocrine outpatient clinic patients (N=333) with average duration of T1D of 22 years



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Hepprich M, et al. *BMJ Open DRC*. 2023.

Gaps in DKA: No Self-Monitoring

< 20%

Test ketone levels, even when glucose is > 16.7 mmol/L for 1 hour or more

38%

Never test ketones when nauseated and/or vomiting

45%

Never test ketone levels when they detect a fever

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Albanese-O'Neil A, et al. *Diabetes Care*. 2017; Viridi N, et al. *Diabetes Technology & Therapeutics*. 2023.

Rising Burden of DKA over 21 Years

- Long-term real-world data on DKA in UK adults: incidence, recurrence, and predictors in type 1 (T1DM) and type 2 diabetes (T2DM) using linked primary and secondary care records (1999 to 2019)
- Results: (N=78,856 T1, N=577,088 T2)
  - 16.4% of T1D and 1.29% of T2D experienced at least 1 DKA episode
  - Annual incidence rose from 1.21% to 4.17% (T1D), and 0.06% to 0.34% (T2D)
  - Of those who experienced DKA, recurrence affected 31.5% of people with T1D and 12.1% with T2D
  - Recent DKA was the strongest predictor of recurrence
  - Other predictors included
    - Female sex, younger age, socioeconomic deprivation, multimorbidity

Table 1– Adjusted predictors of first DKA

Predictor	T1DM IRR (95 % CI)	T2DM IRR (95 % CI)
Female vs male	1.42 (1.34–1.50)	1.27 (1.19–1.35)
Age 40–64 y vs 18–39 y	0.47 (0.43–0.50)	0.40 (0.35–0.45)
Age ≥ 75 y vs 18–39 y	0.48 (0.36–0.62)	0.41 (0.30–0.55)
IMD quintile 5 vs 1	2.66 (2.42–2.93)	1.47 (1.33–1.63)
CCI ≥ 3 vs 0	2.25 (1.99–2.53)	1.46 (1.33–1.61)
Recent DKA ≤ 28 d	11.4 (10.1–12.8)	108.7 (88.5–133.5)

All associations shown were statistically significant at P < 0.001 (quasi-Poisson model, adjusted for

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Seidu SI, et al. *ATTD*. 2026.

Providers' Perspectives on Healthcare Burden of Ketones in Diabetes

- 1st phase of a larger mixed methods study with providers, diabetes educators, adult PWD, caregivers of pediatric PWD and caregiver-adolescent PWD dyads
- Qualitative, semi-structured interviews conducted with board-certified endos and PCPs managing PWD in the US
- Participants recruited through the T1D Exchange Registry and through a survey vendor partner
- Thematic analysis identified key factors associated with the role and impact of communication between patients, caregivers, and providers

Wysham C, et al. *Diabetes Technol Ther*. 2026.

Providers' Perspectives on Healthcare Burden of Ketones in Diabetes

- Endocrinologists (Adult and Pediatric) and Primary Care Physicians from across the US participated in qualitative semi-structured interviews to explore a range of ketone monitoring and management issues.

Guidance on ketone testing is often lacking, and ketone testing is inconvenient for patients

- **Providers emphasize ketone checks for T1D, T2D monitoring is more selective**
- **Management** during **illness is especially important**
- **People with diabetes** generally **favor urine ketone strips**, they don't like finger pokes even if it is more accurate

Wysham C, et al. *Diabetes Technol Ther*. 2026.

How Patient Confidence in Ketone Interpretation Relates to Testing Behavior

Online survey of 1,419 U.S. adult with T1 and ketone test kits

Results (N= 276 low confidence in understanding ketone levels)

- **Unconfident** T1s were:
  - **Less likely to test** across every situation (high BG, nausea, illness, confusion; $p<0.05$)
  - **Unsure** of prior DKA events (17% vs 8%; $p<0.005$)
  - Unsure of provider discussions regarding DKA (9% vs 4%; $p<0.005$)
  - More likely to be **extremely concerned** about DKA (9% vs 6%, $p<0.05$)

Conclusions: This **mismatch between understanding, behavior and concern** suggests **critical gaps in both patient education and provider communication** needed to improve ketone testing practices and reduce DKA risk.

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De Plante P, et al. *ATTD*. 2026.

DKA Challenges Remain: Symptom Recognition, Equipment, and Time

Methods: This cross-sectional study (April 2025) surveyed adults from the French SFDT1 cohort with T1DM ≥ 12 months using a 45-item questionnaire covering sociodemographics, diabetes management, DKA knowledge, ketone monitoring and barriers. Subgroup analyses considered insulin delivery, Time in Range (TIR), age and DKA history.

Results

- A total of 553 adults responded (mean age 46 years; T1DM duration 28 years; HbA1c 7.0%; continuous glucose monitoring 93%). 62% reported prior DKA. Treatment included multiple daily injections (MDI 20%), insulin pumps (CSII 26%), and automated insulin delivery systems (AID 49%). Awareness was high: 95% had heard of ketosis, 91% of DKA, and 88% recognised its severity, though 30% misattributed non-specific symptoms. Knowledge was higher among CSII/AID users, those aged <25 years or with prior DKA. 39% were regularly reminded by clinicians to monitor ketones; 3% tested often and 58% sometimes, with higher rates in CSII/AID users and individuals with prior DKA. Interest in a dual glucose-ketone sensor was high (82%). Leading barriers were poor symptom recognition (56%); lack of equipment (52%), and time constraints (52%), particularly among CSII/AID users or those with TIR<70%.

Conclusions

- Despite strong awareness in this well-controlled cohort, **challenges remain around symptom recognition, equipment, and time**. High interest in dual glucose-ketone sensors highlights limitations of current methods and the need for accessible, patient-centric solutions to support DKA prevention.

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Cosson E, et al. *Diabetes Technol Ther*. 2026

Correlation Between Blood Glucose and BHB Rise (DKA Risk)

Background

- The metabolic dynamics between blood glucose and ketone during insulin deficiency remains unknown. In this study, we aim to observe and track the changes in β-hydroxybutyrate (BHB) and glucose during insulin pump suspension among patients with T1D by using continuous ketone monitoring (CKM).

Methods

- The study is a single-center feasibility trial involving adult T1D patients (≥18 years) receiving CSII. Two in-clinic visits with frequent venous blood draws were randomly scheduled. BHB was measured by Randox Imola, and glucose was measured by Yellow Spring Instrument 2900. Two CKM sensor (GK5C, SiBionics) were attached to each upper arm. During the in-clinic visit, patients' insulin pumps will be suspended for no longer than 6 hours.

Results

- 14 patients with T1D on CSII were recruited with a total of 27 in-clinic visits (mean±SD Age: 31.4±10.2 years, female: n=7. median duration of CSII use: 5.9 years). Among the 27 visits, the baseline BHB was 0.13±0.09 mmol/L, and peak level was 1.04±0.41 mmol/L. 89% exceeded BHB level of 0.6mmol/L at 5 hours after insulin pump suspension, and 44% exceeded 1.0mmol/L at 7 hours after suspension. BHB reached 1.0 mmol/L while glucose was ≤ 13.9 mmol/L in 5 (18.5%) visits. During the visit, CKM demonstrated a strong concordance with venous blood BHB in trends.

Conclusions

- Our study confirmed that glucose may not rise significantly while BHB was elevated. The study highlights the necessity of CKM during the CSII treatment to ensure patient safety.

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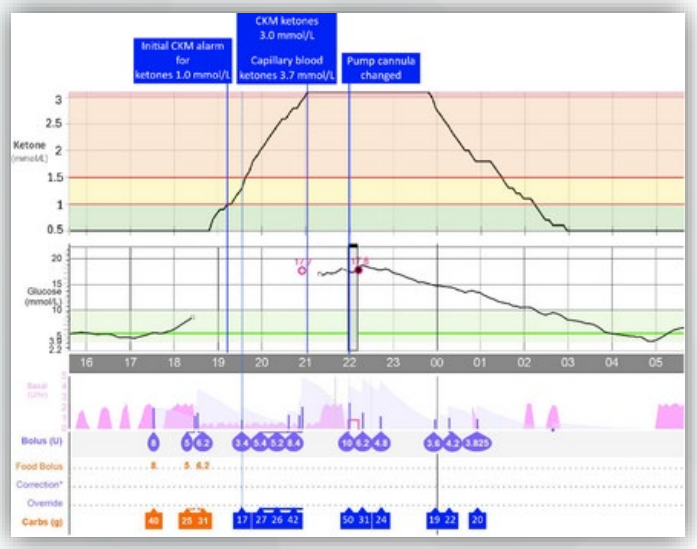
Liu P, et al. *Diabetes Technol Ther*. 2026.

Application:
Clinical Case Study from ATTD

A 55-year-old male with type 1 diabetes for 53 years and undetectable C-peptide levels has excellent glycaemic management (HbA1c 6.9% [51.9 mmol/mol]; continuous glucose monitor [CGM] time-in-range [3.9-10 mmol/L] 83%, timeabove-range [>10 mmol/L] 14%, time-below-range [<3.9 mmol/L] 3%) on an automated insulin delivery system comprising of a tubed insulin pump.

- His last episode of DKA was during childhood.
- As part of a clinical trial (ACTRN12624000448549), he wore a CKM and received education in responding to ketone information.
- During a 2.5 hour gap in CGM data due to sensor warm-up, he experienced a rapid rise in ketone levels from 0.6 mmol/L to >3.1 mmol/L due to insulin pump cannula dislodgement. Glucose levels peaked at 17.8 mmol/L. The first indication of insulin insufficiency was a CKM alarm notification of elevated ketones >1.0 mmol/L, which prompted recognition of the issue and treatment of ketonemia by replacing the cannula and administering additional insulin. Ketonemia resolved without hospital attendance (Figure). He was asymptomatic throughout.



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Kong YW, et al. *Diabetes Technol Ther*. 2026.

Application: Case Study

- A 68-year-old man with type 2 diabetes, HFrEF (LVEF 32%), CKD stage 3a (eGFR 52 mL/min/1.73 m²), and obesity (BMI 33 kg/m²) was admitted with acute decompensated heart failure while taking empagliflozin 10 mg daily. He had 3 days of worsening breathlessness, nausea, fatigue, and minimal oral intake. Baseline glycaemic control was poor (HbA1c 86 mmol/mol [10.0%]). On admission, observations showed HR 108 bpm, BP 98/64 mmHg, RR 24/min, and SpO_2 93% on air. Blood tests showed glucose 11.8 mmol/L, ketones 1.8 mmol/L, bicarbonate 21 mmol/L, pH 7.34, and creatinine 148 µmol/L, suggesting early ketosis without overt DKA.
- In the context of acute illness, poor intake, volume depletion, empagliflozin use, and raised HbA1c, this case highlights the potential value of continuous ketone monitoring to detect evolving SGLT2 inhibitor–associated euglycaemic DKA earlier.

Key Takeaways

- Patient is high risk for DKA, especially due to acute illness and empagliflozin use
- Continuous glucose and ketone monitoring are critical during hospitalization and after discharge
- Early detection of ketosis/DKA symptoms helps prevent hospitalization
- Data suggests rising DKA incidence, particularly in T2D in the UK
- Recurrent DKA risk factors include prior DKA, female sex, certain ethnicities, deprivation, and multimorbidity