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## Incidence of Euglycemic Diabetic Ketoacidosis in Adults With Type 1 Diabetes in the United Kingdom Before the Widespread Use of Sodium Glucose Cotransporter 2 Inhibitors



**To the Editor:** Diabetic ketoacidosis (DKA) is a potentially life-threatening condition characterized most frequently by the presence of a glucose level greater than 11.1 mmol/L (200

mg/dL), ketonemia of 3 mmol/L or greater, and acidosis with a pH less than 7.3 or a bicarbonate less than 15.0 mmol/L.<sup>1</sup> Definitions vary, with the American Diabetes Association guideline suggesting that the diagnosis of DKA be made if the glucose concentration is greater than 13.9 mmol/L (250 mg/dL).<sup>2</sup> However, it has been recognized that DKA can occur with relatively low glucose concentrations—so-called euglycemic DKA (euDKA). This entity was first reported in 1973 by Munro et al,<sup>3</sup> who reported that of 211 people with DKA, 17.5% had a glucose concentration at presentation less than 16.7 mmol/L (300 mg/dL).

The newest class of oral glucose lowering agents, the sodium glucose cotransporter (SGLT) inhibitors have recently been licensed or gained approval for use in people with type 1 diabetes. However their use has been associated with an increased risk of developing DKA compared with placebo; 4.3%, 4.0%, and 3.4% were the highest rates reported for empagliflozin, dapagliflozin, and sotagliflozin, respectively.

With the heightened awareness of euDKA surrounding the use of SGLT inhibitors, and a lack of data to show what the background rate was, we wanted to assess the incidence of euDKA in a UK population with type 1 diabetes before the widespread use of these agents.

We combined data from a UK national survey on the management of DKA undertaken in 2014 and a local survey, both done before the widespread use of SGLT-2 inhibitors.<sup>4,5</sup> The two data sets were not significantly different apart from admission bicarbonate concentrations. For the national dataset (n=274), the mean admission glucose ( $\pm$ SD) was 28.7 $\pm$ 10.9 mmol/L (517 $\pm$ 196 mg/dL); for the local dataset (n=57), the mean glucose was 29.4 $\pm$ 19.2 mmol/L (529 $\pm$ 345 mg/dL;  $P=0.73$ ). The admission pH ( $\pm$ SD) 7.12 ( $\pm$ 0.41) and 7.14 ( $\pm$ 0.17;  $P=0.49$ ). The admission ketones were 6.2 $\pm$ 5.9 mmol/L and 5.1 $\pm$ 1.7 mmol/L ( $P=0.93$ ). However, the admission bicarbonate was 11.3 $\pm$ 5.1 mmol/L for the national survey and 13.1 $\pm$ 6.1 mmol/L for the local survey ( $P<0.01$ ). Despite the higher bicarbonate in the local survey, we believe that the severity of the DKA between the 2 groups was similar enough to allow the glucose data to be combined.

These results are shown in the Table.<sup>4,5</sup> The data are shown using thresholds of “euglycemia” of less than 11.0 mmol/L (200 mg/dL) per the diagnostic threshold for diabetes used by the Joint British Diabetes Societies,<sup>1</sup> 13.9 mmol/L (250 mg/dL) as advocated by the American Diabetes Association,<sup>2</sup> or less than 16.7 mmol/L (300 mg/dL), as has been used previously.<sup>3</sup>

TABLE. Prevalence of Euglycemic Diabetic Ketoacidosis in People With Type 1 Diabetes in the United Kingdom<sup>a</sup>

	Number	Admission glucose <11.0 mmol/L (200 mg/dL) <sup>1</sup>	Admission glucose <13.9 mmol/L (250mg/dL) <sup>2</sup>	Admission glucose <16.7 mmol/L (300 mg/dL) <sup>3</sup>
National survey (2014) <sup>4</sup>	277	6	14	23
Local audit (2015) <sup>5</sup>	57	4	4	6
	334	10	18	29
		3.0%	5.4%	8.7%

<sup>a</sup>Data from a national survey<sup>4</sup> and local audit.<sup>5</sup> Data are divided into different thresholds of “euglycemia.”

In summary, these data should help clinicians to understand the absolute and relative risks of eDKA in those with type 1 diabetes in the current era, in particular when this diagnosis and this concern is becoming more pressing with the advent of the SGLT inhibitors that potentially increase the likelihood of developing it.

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**Potential Competing Interests:** Dr Dhatariya was an independent adjudicator for the sotagliflozin phase 3 trials; he was also part of the team that Sanofi Diabetes put together for the US Food and Drug Administration application for sotagliflozin. Dr Macfarlane reports no competing interests.

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## A National Needs Assessment of Point-of- Care Ultrasound Training for Hospitalists



**To the Editor:** Point-of-care ultrasound (POCUS) is the use of

ultrasound at the bedside to answer a specific diagnostic question or guide performance of an invasive procedure.<sup>1,2</sup> Though many medical schools and internal medicine residency programs have started teaching POCUS,<sup>3</sup> most practicing hospitalists completed their training without any experience in POCUS.<sup>1-3</sup> Now, many practicing hospitalists are seeking continuing medical education courses to learn how to use POCUS. Currently, it is unknown how hospitalists are using POCUS and what training needs exist.

We conducted a national needs assessment to assess current POCUS use and training needs among hospitalists. A cross-sectional Web-based survey was sent to hospital medicine groups (HMGs) at all 116 Veterans Affairs (VA) medical centers with acute inpatient beds between April 7, 2016, and July 25, 2016. Hospital medicine group leaders answered 47 questions on the current use and desire for training in POCUS on behalf of their HMG. Core POCUS applications for hospitalists were included based on published guidelines.<sup>2</sup>

The response rate from HMG leaders was 45.2% (28 of 62) from the 62 VA hospitals with hospitalist sections. We found the majority of responding HMGs (82.1%; 23 of 28) currently use at least 1 POCUS application. The majority of HMGs that use POCUS reported using it for bedside procedures (paracentesis, thoracentesis, and central line placement) and diagnostic evaluation of pleural fluid and peritoneal fluid (Figure).

Among all HMGs that use POCUS, the majority desired additional training in paracentesis, thoracentesis, central line placement, and evaluation of pleural effusions, peritoneal free fluid, pericardial

effusion, pneumothorax, left ventricular function, pulmonary edema, abscess, urinary retention, and joint effusions. A markedly greater proportion of HMGs that currently use POCUS, compared with those that do not use POCUS, desired additional training.

These data represent the first national needs assessment for POCUS use by hospitalists. The Society of Hospital Medicine has endorsed use of ultrasound by hospitalists to guide bedside procedures and perform focused diagnostic evaluations.<sup>4,5</sup> The most frequently reported use of POCUS was for procedural applications (paracentesis, thoracentesis, and central line placement), while relatively few HMGs currently use diagnostic POCUS applications. The two most frequently reported barriers to POCUS use were lack of trained physicians and lack of ultrasound equipment per chiefs of staff at VA facilities that do not use POCUS.

An intriguing finding of our study is that HMGs that currently use POCUS desire additional training in the same applications. It is unclear why current use of POCUS is associated with greater desire for training. Perhaps initial exposure to POCUS fosters a better understanding of its potential benefits and motivates users to seek additional training. Conversely, those who have not been exposed to POCUS may not appreciate its potential benefits and, therefore, have less desire for training. If true, the percentage of hospitalists seeking training may increase substantially in coming years as more hospitalists are exposed to POCUS. These data demonstrate a largely unmet need for additional POCUS training and can inform future educational design for systemwide implementation of POCUS use among HMGs in the VA and other health care systems.