HOSPITAL PRESENTATIONS WITH DIABETIC KETOACIDOSIS:

A RETROSPECTIVE REVIEW

RUNNING HEAD

DKA and ED presentations

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AUTHORS CONTRIBUTIONS

All authors (excluding KA) co-designed the study. KA and SJ collected the data. SJ analysed the data and drafted the initial manuscript. All authors provided intellectual input into the final manuscript.

APPROVALS

The work has been approved by the appropriate ethical committees related to the institution(s) in which it was performed. Ethical approval was obtained from the Children's Health Queensland Hospital and Health Service (HREC/19/QCHC/56600) and University of the Sunshine Coast (A191341) Human Research Ethics Committee. Public Health Act and appropriate site-specific approvals were obtained.

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AVAILABILITY OF DATA AND MATERIALS

The datasets generated and/or analysed during the current study are not publicly available due to lack of consent and authorisation allowing this.

ABSTRACT

BACKGROUND

Diabetic ketoacidosis (DKA) is a significant source of preventable episodes of care and cost. This study aimed to describe the demographic and clinical characteristics of people with type 1 diabetes (T1D) presenting to the Emergency Department (ED) with DKA in an area of socio-economic deprivation in metropolitan Queensland, Australia, and to describe factors associated with hospital admission and re-presentation in this population.

METHODS

This was a retrospective descriptive analysis of routine healthcare record data for January 2015-December 2019. People with T1D were identified through hospital discharge codes.

RESULTS

More than half (n=165) the estimated local T1D population (n=317) experienced an index ED presentation for DKA; mean±SD age at ED presentation was 31.1+/-19.3 years, 126 (76.4%) were aged ≥16 years and 20 (12.1%) were newly diagnosed. Index DKA presentation was significantly associated with female sex (p=0.04) but no other demographic or geographic variables. More than half the presentations (n=92, 55.8%) occurred outside regular business hours. Twenty-three representations occurred within 90 days, associated with older age (p=0.045) and lower residential socio-economic score (p=0.02).

CONCLUSION

Findings highlight the frequent problem of DKA and the importance of socio-economic influences. This flags the need and opportunity to improve support to people with T1D to promote diabetes self-care.

KEYWORDS

Diabetes Mellitus, Type 1; Diabetic ketoacidosis; Emergency Department; Type 1 diabetes; Socio-economic status.

1.0 INTRODUCTION

Diabetic ketoacidosis is a life-threatening complication of type 1 diabetes. Resulting from insufficient endogenous or pharmaceutical insulin, diabetic ketoacidosis is the documented cause of significant numbers of Emergency Department presentations and hospitalisations internationally (1, 2). Across Australia, for example, in 2014-15, there were 7,132 hospitalisations with a primary diagnosis of diabetic ketoacidosis (3), mostly (84%) for people with type 1 diabetes. In Australia reported rates of diabetic ketoacidosis hospitalisation are 2.4 times higher for those in the lowest compared to the highest socioeconomic groups (3), and socioeconomic factors are widely documented as important determinants of poor glycaemic control (4). The economic cost of diabetic ketoacidosis treatment has also increased, with mean hospital charges in Australia rising from $18,987 to $26,566 per admission between 2003 and 2014 (after adjusting for inflation). Aggregate charges also increased dramatically during this period, from $2.2 to $5.1 billion (5), with these calculations not taking account of the wider impact of hospital presentations and admissions on aspects such as staff workloads and patient waiting times for less acute healthcare. Australian and international guidelines make recommendations around factors that may help prevent diabetic ketoacidosis occurrence, such as episodes of preventative care and sick day management (6-8). Failure of young adults to continue to access specialist diabetes care after leaving paediatric services is unfortunately common outside metropolitan areas, with one in five having no specialist care and almost one in two using acute services for diabetes-related matters after transition from paediatric diabetes healthcare (9).

Despite diabetic ketoacidosis being identified as a significant source of preventable episodes of care and cost, data are not routinely available for Emergency Department presentations for diabetic ketoacidosis by people with type 1 diabetes. This omission is particularly striking for socio-economically deprived areas, where such data are essential to inform policy development. Undertaken as part of a quality assurance initiative, this study aimed to describe the demographic and clinical characteristics of people with type 1 diabetes presenting to the Emergency Department with diabetic ketoacidosis in an area of socio-economic deprivation in Queensland, Australia, and to describe factors associated with hospital admission and re-presentation in this population.

2.0 METHODS

2.1 Design and data collection

This retrospective descriptive study used routinely collected healthcare record data from Caboolture Hospital, a public hospital located in metropolitan Queensland, Australia. Caboolture is widely acknowledged as an area of socio-economic disadvantage, most recently confirmed by 2016 Socio-Economic Indexes for Areas scores (10). The local area and surrounding communities are serviced by Caboolture Hospital, a major secondary hospital that provides a wide range of clinical services to over 150,000 people annually (11). The Emergency Department at Caboolture Hospital provides 24-hour specialised care to around 54,000 children and adult patients annually (12, 13). Assuming people with type 1 diabetes are similarly distributed across Queensland, around 317 local residents are estimated with type 1 diabetes (14, 15).

Diabetes support for children and adults is available at the Caboolture Hospital and includes input from a part-time visiting diabetes nurse educator. Primarily, support is provided through local public and private diabetes services, operating during standard business hours (9am-5pm), offering adult and paediatric consultations and access to various healthcare professionals. A protocol around referrals between the Caboolture Hospital and local diabetes services does not exist.

Data were collected from hospital systems including the Emergency Department Information Systems (EDIS), Queensland Health Enterprise Reporting Service (QHERS), Australian Clinical Labs (AUSLAB), Patient Flow Manager, the Viewer, MyPlan and the Electronic Medical Records to identify factors associated with poor outcomes for children and adults with type 1 diabetes presenting to the Caboolture Hospital Emergency Department with diabetic ketoacidosis from 01 January 2015 to 31 December 2019.

Ethical approval was obtained from the Children's Health Queensland Hospital and Health Service (HREC/19/QCHC/56600) and University of the Sunshine Coast (A191341) Human Research Ethics Committee. Public Health Act and appropriate site-specific approvals were also obtained.

2.2 Procedure

Presentations with type 1 diabetes were identified through hospital discharge codes (E10:11-Diabetic Ketoacidosis and E14.1 Ketoacidosis-Diabetic). Data were then requested from the appropriate Information Systems department using the dates and unique record numbers of eligible presentations. All clinical/case records were reviewed by a research assistant (KA) trained to identify specific study parameters. Inter-rater reliability of data extraction was performed on a random selection of 17 (14.6%) case records by an experienced diabetes nurse researcher (SJ). Intra-class coefficients of greater than0.99 were obtained for both raters (16).

2.3 Data analyses

Socio-Economic Indexes for Areas (SEIFA) scores for the residences of presenting patients were obtained from publicly available data provided by the Australian Bureau of Statistics (17). These scores rank areas in Australia according to relative socio-economic advantage and disadvantage, based on information from the five-yearly Census (18). Scores are standardised to a distribution where the average equals 1,000 and roughly two-thirds of the scores lie between 900 and 1100. Lower scores represent greater socio-economic disadvantage, with approximately 15% of collection districts scoring lower than 900 (19). Diabetic ketoacidosis incidence was calculated by dividing total diabetic ketoacidosis presentations by the total number of Emergency Department presentations for any healthcare matter during the study period (268,945**)** (13).

Descriptive statistics are reported as frequency (%), mean ±standard deviation (SD) and median (interquartile range [IQR] 25, 75, and range). Data were categorised where appropriate in persons aged less than 16, 16-24 and greater than or equal to 25 years, due to widely documented age-related differences in precipitating factors around diabetic ketoacidosis onset and management. Associations with admission to hospital were examined using Chi-square, t-tests and univariate linear regression; results were reported as beta and 95% confidence intervals (95% CI). Kruskall-Wallis and ANOVA analyses were undertaken for differences between three or more groups. For regression analyses, the dependent variables were dichotomised for any hospital admission and re-presentation within 90 days following discharge from the index Emergency Department presentation. Explanatory variables were

chosen based on clinical or theoretical assumptions: age at presentation, sex, SEIFA scores, blood glucose (not for the re-presentation analyses), and use of continuous subcutaneous insulin infusion therapy (CSII). Data were not collected on diabetic ketoacidosis-related ICU admissions and were provided for index (first in date range) presentations only, unless stated otherwise; incomplete data occurring due to limited documentation or absent values were retained for use in analyses where possible. All analyses were performed using SPSS version 26 (IBM, New York).

3.0 RESULTS

3.1 Patient characteristics

Overall, 165 patients with type 1 diabetes had index Emergency Department presentations for diabetic ketoacidosis (approximately 52% of the estimated local population with type 1 diabetes and 6.1 per 10,000 of all Emergency Department presentations). Mean ±SD (min-max) age at presentations was 31.1±19.3 (1-85) years; 39 (23.6%) patients were aged less than 16 years, 39 (23.6%) were aged 16-24 years, and 126 (76.4%) greater than or equal to16 years; where known (n=45), age at type 1 diabetes diagnosis was 16.5 ±12.1 (2-51) years (Table 1). The sexes were almost equally represented (female n=87, 52.7%); all but three (1.8%) patients resided in Queensland. Mean HbA1c (n=90) was 9.7±2.3% (3.8-17.7), though the timing of measurements was often unclear; males had significantly higher HbA1c (n=36, 10.7± 2.4% vs. n=54, 9.02±2.0%; t=3.516; p=0.001). Prior to Emergency Department presentations, most participants were administering insulin using basal-bolus (n=105, 63.6%) regimens, but patients aged less than 16 years utilised such regimens less than patients aged 16-24 or greater than or equal to 25 years ($p<0.001$). The youngest group also made greater use of insulin pumps (p=0.004). Use of continuous or flash glucose monitoring was poorly documented (n=3/24 (12.5%), and n=0/20 (0%), respectively). Co-morbidities were common, including depression (n=28, 17%) and substance abuse (n=18, 10.9%). Overall median (IQR; range) SEIFA score was 929 (898, 975.5; 213), and was similar between patients aged less than 16 (929 [898, 979; 144]), 16-24 (929 [898, 979, 144]) and ≥25 (925 [898, 934.3, 213]) years. Most (n=142, 86.6%) patients resided in an area with a SEIFA score of less than 1000, and 68 (41.5%) in an area scoring less than 900.

3.2 Emergency Department presentations

Presentations were generally evenly distributed throughout the week (Table 2), with no statistically significant difference between days of the week. Over half the presentations (n=92, 55.8%) occurred outside regular business hours, with patients presenting to the Emergency Department having walked in (n=86, 52.1%) or arrived by ambulance (n=78, 47.3%). Reasons prompting an index Emergency Department presentation included insulin omission (n=48, 29.1%), underlying illness (n=45, 27.3%), and onset of type 1 diabetes (n=20, 12.1%). . Presenting symptoms included nausea and/or vomiting (n=117, 70.3%) and lethargy (n=37, 22.4%).

While timing of documented blood analyses in relation to presentation were not always clear, mean±SD blood glucose (n=159) was 27.8±11.9 (7.1-74) mmol/L; patients aged greater than or equal to 25 years had a higher blood glucose than patients aged less than 16 or 16-24 years (F=4.783; p=0.01). Mean±SD pH level (n=162) was 7.2±0.1 (6.8-7.6) and bicarbonate level (n=160) was 13.4±5.8 (0.82-29) mEq/L (Table 2). No blood ethanol or substance use details were documented, despite identification of both as comorbid conditions. Mean±SD Emergency Department index length of stay was 6 hours 2 mins±3 hours 28 mins (range 34 mins-23 hours 35 mins).

3.3. Hospitalisations

Most diabetic ketoacidosis presentations (n=141, 85.5%) resulted in a hospital admission (Table 3); 28 (19.9%) presentations resulted in an admission to the intensive care unit. Regardless of hospital admission, most patients were ultimately discharged home (n=126, 76.4%) although 19 (11.5%) were discharged to another hospital and 20 (12.1%) to other locations. Overall hospital length of stay was mean 2.6±2.7 days (1-18); patients aged greater than or equal to 25 years had a longer length of hospital stay than patients aged less than 16 or 16-24 years (F=2.78; p=0.02).

A greater proportion of females compared to males (n=79, 90.8% vs. n=62, 79.5%; p=0.04) were admitted to a hospital ward from the Emergency Department. Forty-one (24.8%) patients were provided a prescription for insulin upon discharge, and no patients were recorded as deceased. In univariate regression, female sex was significantly associated with hospital admission (Beta=0.93; 95% CI=0.16 to 0.98; p=0.04) but not age at presentation, SEIFA scores, blood glucose or use of CSII.

3.4 Emergency Department re-presentations

Within 90 days following discharge from the index Emergency Department presentation, 23 (19.5%) patients had again presented to the Emergency Department, 10 (43.5%) for blood glucose related matters. Patients who re-presented were of older age (38.5 vs. 29.2 years, t=-2.069; CI=-18.2 to -0.4; p=0.04) and their residential areas had lower SEIFA scores (918 vs. 944, t=2.425; CI=4.8 to 47.6; p=0.02). In univariate regression, older age (Beta=0.23; 95% CI=1.00 to 1.05; p=0.045) and lower SEIFA scores (Beta=-0.016; 95% CI=0.97 to 1.00; p=0.02) were significantly associated with re-presentation to the Emergency Department within 90 days of the index presentation. A total of 36 (21.8%) patients had a further Emergency Department presentation more than 90 days following discharge from the index presentation, 13 (36.1%) for blood glucose related matters. Ten patients had greater than Emergency Department re-presentations during the study period. Of the 482 Emergency Department presentations for blood glucose and other healthcare matters during the study period, 427 (88.6%) resulted in hospitalisation.

4.0 DISCUSSION

4.1 Principal findings

Our study explored the demographic and clinical characteristics of people with type 1 diabetes presenting with diabetic ketoacidosis to the Emergency Department of a public hospital in a low socio-economic area of metropolitan Queensland, Australia. A key initial finding was the high proportion of the estimated local type 1 diabetes population who attended the Emergency Department with diabetic ketoacidosis during the 5-year study period: almost one in two (47%), excluding those presenting with new-onset of type 1 diabetes. Another key finding was that one in five (19.5%) of these patients with type 1 diabetes presented again within 90 days following discharge from the index Emergency Department presentation; older age and greater socio-economic disadvantage (lower SEIFA scores) were significantly associated with these re-presentations. Finally, only one in three (35.2%) admitted to hospital for diabetic ketoacidosis had a documented referral to the local public diabetes service.

4.2 Interpretation within the context of the wider literature, implications for policy, practice and research

That a high proportion of the local type 1 diabetes population had attended the Emergency Department with diabetic ketoacidosis during the 5-year study period was a finding not dissimilar to data elsewhere in Australia. In a retrospective cohort analysis of admissions for diabetic ketoacidosis in youth with diabetes presenting to four hospitals in Western Sydney, New South Wales in 2011, for example, there were 55 diabetic ketoacidosis admissions from 39 patients (20). Among children and young people with type 1 diabetes, rates of admission to hospital from the Emergency Department were higher among females than males (3, 21), as in our data, and mean length of hospital stay among children and young people with type 1 diabetes for diabetic ketoacidosis was similar at 2.9 days vs (our study) 2.6 days (3). Factors widely but not exclusively associated with low socioeconomic status, such as limited use of diabetes-related technology and substance abuse, were present (22); in a contemporary Australian adult cohort with type 1 diabetes, for example, consumption of alcohol or illicit drugs have been reported to contribute to Emergency Department presentation for diabetic ketoacidosis (23). Further work is required to comprehensively identify those factors which deter and facilitate good diabetes self-management, including access to public diabetes services, and determine how best to address barriers to type 1 diabetes management and timely presentation for any diabetic ketoacidosis for people in low socio-economic areas. More broadly, there is clearly a need for public health advocacy for investment to address inequities at the level of social determinants of healthcare (24).

Re-presentations for diabetic ketoacidosis were not uncommon. Elsewhere, around one-third of all Emergency Department re-presentations are reported as avoidable (25, 26), with reasons for re-presentation including disease misdiagnosis, premature or inappropriate discharge, uncertainty about clinical conditions and insufficient follow-up instructions (27-30). Some may re-present because they do not have a General Practitioner and do so to obtain a prescription for insulin; 41 (24.8%) patients were provided a prescription for insulin upon discharge in our study. Presentations may be linked to inadequate diabetes knowledge but the average Emergency Department length of stay of six hours does not allow much time for knowledge assessment, identification and remediation of any deficits. A screening tool to identify patients with diabetes at high risk of re-presentation (30) could perhaps be

modified for patients with diabetic ketoacidosis. The SEIFA score was identified as a significant predictor of representation, and further work should tease out the mechanisms by which this occurs.

The difference in SEIFA scores around re-presentation were of particular interest. The impact of socio-economic status on type 1 diabetes management has been well documented, when considering factors such as dietary and lifestyle intervention, and our findings indicate the influence when considering representation. Further research to identify ways to better support patients once discharged are warranted and may necessitate changes to models of diabetes services.

The low proportion of patients admitted to hospital for diabetic ketoacidosis who had a documented referral to the local diabetes service also raises questions. It is feasible that some patients may have been linked to other geographical diabetes services or to private practitioners, but a first quality assurance initiative should ensure that all people with type 1 diabetes who present to the Emergency Department with diabetes-related problems receive diabetes specialist follow-up care. As well as the General Practitioner, the diabetes care team responsible for people with type 1 diabetes presenting to Emergency Department should be included in the discharge notification with a request for follow-up. Those not currently registered should have a referral generated to diabetes specialist care. Next, referral and access processes for specialist diabetes services should be reviewed, to ensure systems take account of socioeconomic considerations and how variations potentially impact access to community support services. Further, the differing support needs and preferences of younger and older patients should be born in mind, considering the differences seen in presentations between the study groups. Given that the overall SEIFA score is low, differences within the community may not be as important as the failure to ensure that everyone has access to standard care.

The provision of information around sick day management should be part of routine care and readily available, but a brief intervention such as a specialised discharge handout for patients with details of relevant contacts, troubleshooting and sick day management information might add value. Considering wide-spread use of mobile phones, patients could be routinely asked to photograph any discharge handout so this information is always with them, while any sick-day management plans provided them could be copied to their community care providers or general practitioner. Such plans could be generic but allow for individualised recommendations, important for example for patients on

continuous subcutaneous insulin infusion therapy. Such interventions should be evaluat Emergency Department and their cost-effectiveness in terms of avoidance of Emergency Department presentations and hospital admissions considered in comparison to traditional approaches such out-of-hours on-call services. Other, non-healthcare-related, variables may also warrant consideration, such as food security and homelessness.

4.3 Strengths and limitations

The strengths of this study lie with the five-year period and comprehensive use of ICD discharge codes to elicit presentations for diabetic ketoacidosis. A chief limitation was the use of data originally collected as clinical healthcare records, as their quality and completeness did not match what is normally expected of research data. Routine data collection did not include details of individual socio-economic factors such as living situation, job description and hours worked. Neither could we access reliable data relating to the use of continuous glucose monitoring, which may have influenced blood glucose control. Funding for this technology is available pending eligibility as part of the National Diabetes Services Scheme (31), so low socio-economic status should not bar its use. Emergency Department presentations for diabetic ketoacidosis were only sourced from a single public hospital, so presentations to other sites will have been missed and the pattern of presentations revealed for this site may not be generalisable. There were no definitive data available on the number of people with type 1 diabetes residing locally, to estimate what proportion of the total population is represented in these data. Finally, while we noted the paucity and recommended expanded access to specialist services, we had no data around the capacity of the local public and private diabetes services during the data collection period. Such factors should be considered in future research and for service quality improvements.

5.0 CONCLUSIONS

This research provides important insights into the demographic, clinical and Emergency Department presentation characteristics of people with type 1 diabetes presenting to the Emergency Department in diabetic ketoacidosis, in a low socio-economic area of metropolitan Queensland, Australia, and the factors that are associated with hospital admission in this population. Findings highlight the high

frequency of the problem of diabetic ketoacidosis and flag the importance of socio-economic influences. An admission with diabetic ketoacidosis may present an opportunity to reduce future Emergency Department presentations for diabetic ketoacidosis by making specialist advice available at the point of emergency contact and by ensuring follow-up by a diabetes team. Further research is needed to address how this may be configured with evaluation to determine its effectiveness and cost-effectiveness to support care delivery.

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DECLARATIONS OF INTEREST

None.

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Table 1: Patient characteristics

Variable	Overall n (%)* n=165*	Age <16 years n=39*	Age 16-24 years n=39*	Age ≥25 years n=87*	p value
Age at presentation, Mean+/-SD (min-max) years	31.1+/-19.3 (1-85)	10.6+/-3.7 (1-15)	19.9+/-2.8 (16-24)	45.3+/-15.9 (25-85)	-
Age at T1D diagnosis, Mean+/-SD (min-max) years	n=45 12.3+/-13.4 (0-85)	n=32 7.7+/-4.2 (0-14)	n=9 14.3+/-6.1 (6-23)	n=32 22.3+/-13.6 (5-51)	-
Female	87 (52.7)	18 (46.2)	23 (59.0)	46 (52.9)	0.53
HbA1c^#, Mean+/-SD (min-max)	n=90 9.7+/-2.3% (3.8-17.7%)	n=19 8.6+/-1.5% (3.8-10.6%)	n=20 10.0+/-2.1% (6.8-13.5%)	n=51 9.9+/-2.5% (6.8-17.7%)	0.06
Insulin regime prior to presentation:					
Basal bolus	105 (63.6)	13 (33.3)	27 (69.2)	65 (74.7)	**<0.001**
BD injections	3 (1.8)	1 (2.6)	1 (2.6)	1 (1.1)	0.80
Insulin pump	21 (12.7)	11 (28.2)	4 (10.3)	6 (6.9)	**0.004**
Other	27 (16.4)	13 (33.3)	6 (15.4)	8 (9.2)	-
Not recorded	9 (5.5)	1 (2.6)	1 (2.6)	7 (8.0)	-
Co-morbidities:					
Eye disease	10 (6.1)	0	0	10 (11.5)	-
Kidney disease	6 (3.6)	0	0	6 (6.9)	-
Hypertension	14 (8.5)	0	0	14 (16.1)	-

Hypothyroidism	11 (6.7)	0	2 (5.1)	9 (10.3)	-
Depression	28 (17.0)	2 (5.1)	7 (17.9)	19 (21.8)	-
Anxiety	12 (7.3)	1 (2.6)	2 (5.1)	9 (10.3)	-
Substance abuse	18 (10.9)	0	5 (12.8)	13 (14.9)	-

**=Unless stated; ^=Timing unclear;*

[#]One patient had a HbA1c of 3.8%. Excluding this patient, the minimum HbA1c was 6.8%, (n=3).

Table 2: Emergency Department index presentation characteristics

Variable	n (%) n=165*	Age <16 years n=39*	Age 16-24 years n=39*	Age ≥ 25 years n=78*	p value
ED presentation day:					
Monday	29 (17.6)	5 (12.8)	6 (15.4)	18 (20.7)	-
Tuesday	26 (15.8)	10 (25.6)	4 (10.3)	12 (13.8)	-
Wednesday	21 (12.7)	3 (7.7)	6 (15.4)	12 (13.8)	-
Thursday	24 (14.5)	5 (12.8)	6 (15.4)	13 (14.9)	-
Friday	24 (14.5)	8 (20.5)	5 (12.8)	11 (12.6)	-
Saturday	20 (12.1)	4 (10.3)	6 (15.4)	10 (11.5)	-
Sunday	21 (12.7)	4 (10.3)	6 (15.4)	11 (12.6)	-
Outside business hours	93 (56.4%)	21 (53.8)	21 (53.8)	51 (58.6)	0.83
Method of presentation:					
Walk in	86 (52.1%)	30 (76.9)	23 (59.0)	33 (38.4)	
Ambulance	78 (47.9%)	9 (23.1)	16 (41.0)	53 (61.6)	
Reasons prompting presentation included:					
Insulin omission	48 (29.1)	2 (5.1)	12 (30.8)	34 (39.1)	**0.001**
Underlying illness	45 (27.3)	7 (17.9)	9 (23.1)	29 (33.3)	0.16
Incorrect insulin dosage	5 (3.0)	0	1 (2.6)	4 (4.6)	-
Insulin pump failure	7 (4.2)	4 (10.3)	1 (2.6)	2 (2.3)	-
Unknown type 1 diabetes	20 (12.1)	11 (28.2)	5 (12.8)	4 (5.1)	**<0.001**
Presenting symptoms:					
Nausea and/or					

vomiting	116 (70.3)	24 (61.5)	28 (71.8)	64 (73.6)	
Lethargy	37 (22.4)	13 (33.3)	7 (17.9)	17 (19.5)	
Abdominal pain	31 (18.8)	9 (23.1)	4 (10.3)	18 (20.7)	
Altered consciousness	13 (7.9)	2 (5.1)	3 (7.7)	8 (9.2)	
Diarrhoea	28 (17)	5 (12.8)	7 (17.9)	16 (18.4)	
Polyuria	22 (13.3)	9 (23.1)	6 (15.4)	7 (8.0)	
Polydipsia	28 (17.0)	12 (30.8)	7 (17.9)	9 (10.3)	
Tachycardia	12 (7.3)	0	2 (5.1)	10 (11.5)	
Blood glucose, mmol/L Mean+/-SD (min-max) ^	n=159 27.8+/-11.9 (7.1-74.0)	25.0+/-10.0 (10.4-51.4)	n=37 24.6+/-9.9 (7.1-60.3)	n=84 30.5+/-12.9 (10.6-74.0)	**0.01**
pH level, Mean+/-SD (min-max) ^	n=162 7.2+/-0.1 (6.8-7.6)	n=38 7.2+/-0.1 (6.8-7.4)	7.2+/-0.1 (6.8-7.4)	n=86 7.2+/-0.2 (6.8-7.6)	0.94
Bicarb level, mEq/L, Mean+/-SD (min-max) ^	n=160 13.4+/-5.8 (0.8 -29.0)	n=37 13.5+/-5.7 (0.8-25.0)	n=38 13.6+/-6.3 (4-27.0)	n=86 13.3+/-5.6 (5.0-29.0)	0.97

**=Unless stated; ED=Emergency department; ^=Timing not always clear.*

Table 3: Healthcare service use

Variable	n (%)* n=165*	Age <16 years n=39*	Age 16-24 years n=39*	Age ≥25 years n=87*	p value
Admitted to a ward	141 (85.5)	32 (82.1)	31 (79.5)	78 (89.7)	
Referral to:					
diabetes service	58 (35.2)	14 (35.9)	15 (38.5)	29 (33.3)	
endocrinology team	41 (24.8)	5 (12.8)	13 (33.3)	23 (26.4)	
diabetes educator	92 (55.8)	22 (56.4)	21 (53.8)	49 (56.3)	
dietitian	40 (24.2)	10 (25.6)	7 (17.9)	23 (26.4)	
Reviewed by:	n=39	n=5	n=13	n=21	
endocrinology team	22 (56.4)	5 (100)	7 (53.8)	10 (47.6)	
	n=93	n=22	n=21	n=50	
diabetes educator	82 (85.7)	21 (95.5)	18 (85.7)	43 (86.0)	
	n=39	n=10	n=7	n=22	
dietitian	38 (97.4)	10 (100)	7 (100)	21 (95.5)	
Discharge location:					
Home	126 (76.4)	31 (79.5)	29 (74.4)	66 (75.9)	
Another hospital	19 (11.5)	8 (20.5)	4 (10.3)	7 (8.0)	
Other	20 (12.1)	0	6 (15.4)	14 (16.1)	
Total LOS, Mean+/-SD (min-max) days	2.6+/-2.7 (1-18)	1.9+/-1.2 (1-5)	2.1+/-1.5 (1-8)	3.2+/-3.4 (1-18)	**0.02**

LOS=Length of stay.