Recurrent diabetic ketoacidosis admissions: gaps in education, discharge safety-netting and psychosocial support

A retrospective service evaluation informing a Quality Improvement Project

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Abstract

Background: Diabetic ketoacidosis (DKA) remains a common cause of emergency admission in people with type 1 diabetes (T1DM) and is associated with significant morbidity and mortality. Recurrent DKA admissions may reflect unmet needs beyond acute metabolic management, including gaps in structured education, discharge safety-netting and psychosocial support. Understanding local patterns of recurrent DKA is essential to inform preventative strategies.

Methods: We conducted a retrospective service evaluation at a large teaching hospital between 1st July and 31st December 2024. This study was designed as a baseline evaluation informing the first stage of a multi-cycle quality improvement (QI) project, conducted in accordance with SQUIRE 2.0 guidelines. Routinely collected, clinically coded discharge data were used to identify adults with T1DM admitted with DKA. Recurrent DKA was defined as two or more admissions within a rolling 12-month period, assessing admissions during the study window. Lifetime admissions within the cohort were also studied. Electronic health records were reviewed to identify demographic characteristics, documented triggers, psychosocial factors and sick-day rule education documentation. A survey of resident doctors was conducted to assess training exposure and confidence in delivering DKA prevention education.

Results: The 210 DKA admissions during the evaluation period corresponded to 57 unique adult patients with T1DM, of whom 41 (72%) were identified as having recurrent DKA (59% female [n=24]; 73% White British [n=30], 17% Asian [n=7], 5% Black or African [n=2], 5% Mixed ethnicity [n=2]). Admissions were concentrated within a small number of individuals: 17 patients (41%) had 2-4 lifetime DKA admissions, 16 patients (39%) had 5-9 admissions, and 8 patients (20%) had 10 or more admissions. Documented sick-day rule education was present in 61% of patients (n=25), absent in 34% (n=14), and 5% (n=2) self-discharged prior to diabetes team review. Psychosocial triggers were identified in a subset of patients, with mental health conditions and substance misuse most frequently documented among those with the highest admission frequencies. Of 20 resident doctors surveyed, only 35% (n=7) reported receiving formal teaching on sick-day rules, and 85% (n=17) reported low confidence in delivering personalised written discharge advice.

Conclusion: Recurrent DKA admissions are concentrated within a small, high-risk cohort and are associated with deficiencies in inpatient education, discharge safety-netting and psychosocial support. These findings support recurrent DKA as a marker of psychological and social vulnerability. This baseline evaluation identifies clear targets for a multi-faceted preventative quality improvement approach, including standardised discharge documentation, clinician education and integrated psychosocial support.

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Introduction

Diabetic ketoacidosis (DKA) remains a common cause of emergency hospital admission among adults with type 1 diabetes (T1DM) and is associated with substantial morbidity, mortality and healthcare resource utilisation.[1] While most DKA episodes are preventable, recurrent admissions continue to occur and disproportionately affect a small subgroup of patients.[2,3] At a local level, recurrent DKA admissions place significant strain on acute services and often represent missed opportunities to address modifiable risk factors during inpatient care and at discharge. Repeated presentations frequently indicate unmet educational, psychosocial and system-level needs, rather than a failure of acute metabolic management alone.

Existing literature demonstrates that recurrent DKA is strongly associated with psychosocial vulnerability, including mental health disorders, substance misuse, eating disorders and

social deprivation.[2] Case-control and cohort studies have shown that patients with recurrent DKA have higher rates of psychiatric co-morbidity and poorer engagement with diabetes services compared with those experiencing single episodes.[2,4] This has led to the concept of DKA acting as a "canary in the mine" for underlying mental health disorders, reflecting broader unmet care needs rather than isolated episodes of insulin omission.[5]

National guidance, including the Joint British Diabetes Societies (JBDS) DKA guidelines[6] and initiatives such as DEKODE (Digital Evaluation of Ketosis and Other Diabetic Emergencies), has led to improvements in the acute management of DKA, including reductions in time to resolution and standardisation of inpatient treatment.[7] However, there is less emphasis on preventing recurrence through consistent sick-day education, structured discharge safety-netting and integration of psychological support. Variability in the delivery and documentation of education during admission and at discharge remains a recognised gap in practice.

Recurrent DKA is a multifactorial condition arising from the interaction of biomedical, behavioural and psychosocial factors. Frameworks of chronic disease self-management and health behaviours recognise that patient education alone is insufficient without adequate clinician training, consistent messaging and system-level support. In the context of DKA, effective prevention relies on timely sick-day education, clear escalation advice, appropriate psychological support, and continuity of care across transitions from hospital to community.[2]

This work was undertaken as a retrospective service evaluation, forming the baseline phase of a quality improvement project designed in accordance with SQUIRE 2.0 guidelines. The aims were to:

1. Characterise the demographic profile and admission patterns of adults with recurrent DKA at a large teaching hospital.
2. Identify common triggers and contributing psychosocial factors associated with recurrent DKA admissions.
3. Evaluate the provision and documentation of sick-day rule education and discharge safety-netting advice.
4. Assess resident doctors' training exposure and confidence in delivering DKA prevention education, to identify targets for system-level improvement.

Methods

Study design and setting

This was a retrospective service evaluation conducted at a large teaching hospital, forming the baseline assessment of a multi-cycle quality improvement project developed in accordance with SQUIRE 2.0 guidelines. As a service evaluation using routinely collected data, formal research ethics approval was not required; this was confirmed through the Trust's governance processes.

Patient identification and cohort definition

Electronic patient records were identified through the Trust's informatics department using ICD-10 diagnostic coding for DKA (E10.1) for admissions between 1st July 2024 and 31st December 2024. Coded admissions were screened against the inclusion and exclusion criteria, with records excluded where they related to patients with type 2 diabetes (T2DM) on insulin, paediatric admissions, secondary or gestational diabetes, or when they did not meet the DKA case definition on biochemical review.

Inclusion criteria were: adults aged 18 years or older with a confirmed diagnosis of T1DM who experienced two or more admissions for DKA within a rolling 12-month period. Recurrence was assessed using admissions occurring during the study window and the total number of lifetime admissions was studied within that cohort. Patients with T2DM, secondary diabetes, gestational diabetes, or a single DKA admission during the study period without a prior qualifying admission were excluded.

DKA was diagnosed in accordance with JBDS criteria (pH <7.3, bicarbonate <15 mmol/L, ketonaemia ≥3 mmol/L or ketonuria ≥2+, blood glucose >11 mmol/L), as applied by the treating clinical team and reflected in the ICD-10 coded discharge diagnosis. Biochemical parameters were reviewed in the electronic health record to confirm consistency with JBDS diagnostic thresholds.

All patients meeting the recurrent DKA definition within the study period formed the eligible population and were included in the evaluation; no sampling was performed.

Data extraction and variables

Electronic patient records and discharge summaries for all included patients were reviewed by three trained reviewers using a standardised data extraction spreadsheet with pre-defined fields and variable categories. All variables were defined a priori based on JBDS guidance and the existing DKA literature prior to data collection. Triggers were classified into pre-specified categories; sick-day rule education was recorded as present, absent or unable to assess (in cases of self-discharge); and psychosocial factors were recorded when explicitly documented in clinical notes by any member of the clinical team. Discrepancies between reviewers were resolved by discussion and consensus. Data were extracted on the following variables:

- Demographic characteristics: age, sex and ethnicity.
- Admission frequency: total lifetime DKA admissions recorded in the electronic health record.
- Documented triggers for DKA admission, classified into the following pre-specified categories based on clinician documentation in the electronic record: intercurrent illness or infection; insulin non-adherence; mental health conditions; alcohol or substance misuse; adverse social circumstances; and lack of diabetes education. Multiple triggers per admission were recorded where documented. Triggers were classified based on clinician documentation in the health record; patient-reported triggers were not independently obtained.
- Sick-day rule education: documented as present, absent or unable to assess due to self-discharge, based on the presence of a formal education entry by the diabetes team

in the inpatient record or discharge summary.
- Psychosocial factors: recorded when specifically documented in the clinical notes by any member of the clinical team.

Junior doctor survey

An anonymous survey was administered electronically via Microsoft Forms to resident doctors working in acute medical areas across the Trust during the study period. Eligible participants were all the medical doctors involved in the care of patients with DKA. The survey was developed locally to address the specific educational gaps identified in this evaluation and was not a validated instrument. Participants were recruited via departmental email distribution lists and cascade from rota coordinators; the survey was voluntary and anonymous.

Survey domains included: whether formal teaching on sick-day rules for patients with T1DM had been received; and self-reported confidence in delivering personalised sick-day rule education and producing written discharge advice aimed at preventing DKA recurrence.

Statistical analysis

This evaluation used descriptive statistics only, which is consistent with the service evaluation design. Categorical variables are presented as counts (n) and proportions (%). No formal statistical comparisons were performed between subgroups. Key quantitative data are presented in tabular form in addition to the figures described below.

Results

Cohort characteristics

The 210 DKA admissions during the study period corresponded to 57 unique adult patients with T1DM, of whom 41 (72%) met the inclusion criteria for recurrent DKA; the remaining 16 (28%) had a single qualifying admission during the study window. The cohort comprised 24 females (59%) and 17 males (41%). Ethnicity distribution was: White British 73% (n=30), Asian 17% (n=7), Black or African 5% (n=2), and Mixed ethnicity 5% (n=2) (Table 1).

Lifetime DKA admission burden

Admissions were concentrated within a small number of individuals, indicating a high-risk subgroup contributing disproportionately to the overall DKA burden. Distribution of lifetime DKA admissions was as follows: 17 patients (41%) had 2-4 lifetime admissions, 16 patients (39%) had 5-9 admissions, and eight patients (20%) had 10 or more lifetime admissions. The median number of lifetime admissions across the cohort was five (range 2-28). Patients in the highest admission category (10 or more admissions) accounted for a disproportionately large share of total admissions within this cohort (Table 2).

Sick-day rule education and diabetes team involvement

Documentation of sick-day rule education by the diabetes team was present in 61% of patients (n=25). However, 34% of patients (n=14) had no documented sick-day education recorded in either the inpatient notes or discharge summary. A further 5% (n=2) self-discharged prior to review by the diabetes team, precluding formal education documentation (Table 3).

Figure 1. Flow of admissions and patients included in the evaluation of recurrent diabetic ketoacidosis (DKA), 1st July – 31st December 2024.

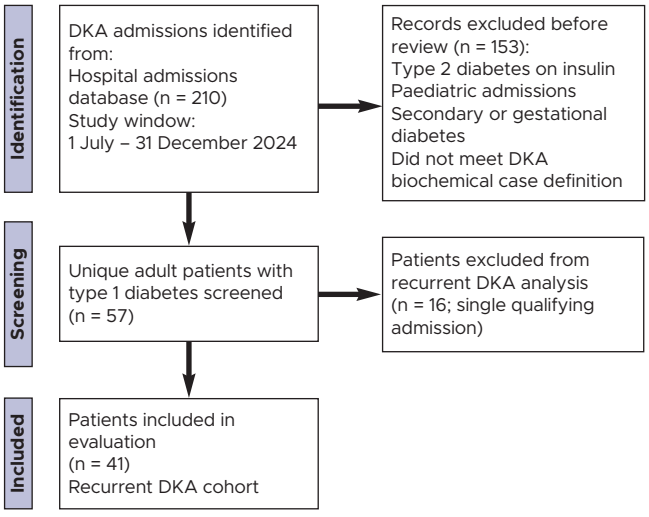

Table 1. Demographic characteristics of the recurrent DKA cohort (n=41)

Characteristic	n	Proportion (%)
Sex		
Female	24	59%
Male	17	41%
Ethnicity, n (%)		
White British	30	73%
Asian	7	17%
Black or African	2	5%
Mixed ethnicity	2	5%

Table 2. Distribution of lifetime DKA admissions in the recurrent DKA cohort (n=41)

Lifetime DKA admissions	n	Proportion (%)
2-4 admissions	17	41%
5-9 admissions	16	39%
10 or more admissions	8	20%

Table 3. Documentation of sick-day rule education in the recurrent DKA cohort (n=41)

Education documentation status	n	Proportion (%)
Documented by diabetes team	25	61%
No documentation recorded	14	34%
Self-discharged prior to review	2	5%

Triggers for DKA admission

Triggers for DKA were frequently multifactorial, with multiple triggers documented per patient in several cases. The most common precipitating factors were intercurrent illness or infection (n=9, 22%) and insulin non-adherence (n=6, 15%). Psychosocial contributors were documented in a subset of patients, including mental health conditions (n=4, 10%), alcohol or substance misuse (n=4, 10%), and adverse social circumstances (n=2, 5%). Lack of diabetes education was identified as a contributing factor in a small number of patients (n=2, 5%) (Figure 2).

It should be noted that psychosocial factors were recorded based on clinician documentation in the health record, rather than systematic screening. The relatively low absolute numbers of documented psychosocial triggers may therefore reflect documentation bias rather than a true low prevalence. Notably, patients with the highest number of lifetime DKA admissions (10 or more) were more likely to have documented psychosocial triggers compared with those in lower admission categories, suggesting a potential association between psychosocial vulnerability and admission frequency, though formal statistical comparison was not performed.

Figure 2. Bar chart showing documented triggers for recurrent DKA admissions across the cohort (n=41). Multiple triggers per patient may be recorded. Categories include intercurrent illness/infection, insulin non-adherence, mental health conditions, alcohol or substance misuse, adverse social circumstances and lack of diabetes education

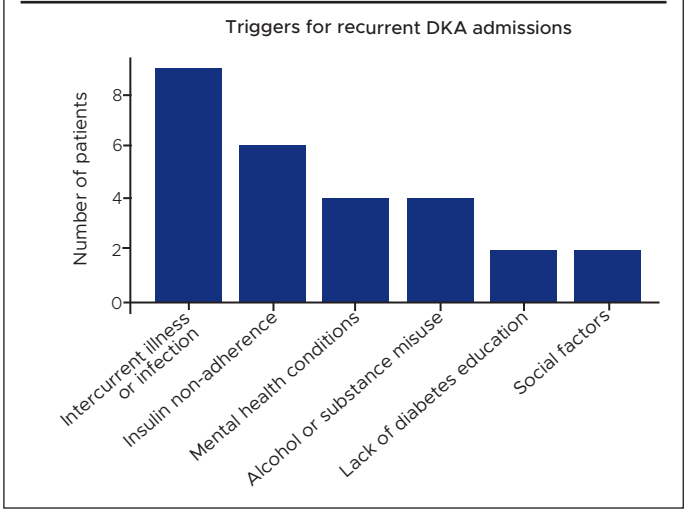

Table 4. Summary of junior doctor survey results (n=20 respondents)

Survey item	n	%
Received formal teaching on sick-day rules		
Yes	7	35%
No	13	65%
Confident delivering personalised DKA prevention education		
Yes	3	15%
No	17	85%

Junior doctor survey

The survey was completed by 20 resident doctors. Only 35% of respondents (n=7) reported having received formal teaching on sick-day rules for patients with T1DM, while 65% (n=13) reported receiving no formal teaching in this area. Furthermore, 85% of respondents (n=17) reported that they were not confident in providing personalised sick-day rule education or producing clear written discharge advice aimed at preventing DKA recurrence (Table 4).

Discussion

This retrospective service evaluation demonstrates that recurrent DKA admissions are concentrated within a small, high-risk cohort and are associated with substantial gaps in preventive care, particularly around inpatient education, discharge safety-netting and psychosocial support. Despite the availability of national guidance, documentation of sick-day rule education and DKA-specific discharge advice was inconsistent in 39% of patients, representing missed opportunities to reduce preventable readmissions.[6]

Our findings are consistent with existing literature demonstrating that recurrent DKA is strongly associated with psychosocial vulnerability, including mental health conditions, eating disorders and diabetes-related distress.[2,4] Studies have shown that people who experience recurrent DKA episodes have higher rates of psychiatric comorbidity and are less engaged with diabetes care than those with only one episode.[2,4] This pattern supports the recognition of DKA as an early warning signal for underlying mental health challenges and broader gaps in care, rather than being solely the result of occasional missed insulin doses.[5] In this context, and given the apparent association between higher admission frequency and documented psychosocial triggers observed in this cohort, education alone is unlikely to prevent recurrence without integrated psychological and social support.[2,5]

The junior doctor survey provides important insight into system-level contributors to these gaps. Although most respondents recognised the importance of diabetes team involvement, 65% reported no formal training in sick-day rules, and 85% described low confidence in delivering personalised education or producing clear written discharge advice. Similar variability in clinician confidence and educational delivery has been described previously and may contribute to inconsistent application of national guidance at the point of discharge.[6] Given that resident doctors frequently lead discharge processes in acute care settings, targeted education and standardised tools are essential to ensure consistent messaging and effective safety-netting.

While national initiatives such as the JBDS guidelines and DEKODE have improved acute inpatient DKA management, including reductions in time to resolution, prevention of recurrence has received comparatively less operational focus.[6,7] Our findings suggest that embedding preventive strategies into routine care pathways, particularly at discharge, may help bridge this gap. Standardisation of discharge documentation, supported by accessible patient-facing resources, represents a

pragmatic approach to improving consistency without substantially increasing clinician workload.[6]

Quality improvement interventions

This manuscript represents the baseline evaluation phase of a planned multi-cycle quality improvement project. The findings have informed the design of several interventions, which have now been implemented at the Trust. A subsequent cycle of this project will focus on prospective evaluation of these interventions, including assessment of changes in recurrent DKA admission rates.

Proposed interventions include: (1) development of a standardised discharge letter template incorporating DKA-specific safety-netting advice and a QR code linking directly to the Trust's sick-day rule resources, in line with JBDS recommendations; (2) annual acute medicine teaching sessions covering both DKA management and prevention, supplemented by induction materials at each rotation changeover for resident doctors; and (3) establishment of a dedicated recurrent DKA service, scheduled to launch on 13th May 2026, providing structured follow-up and reinforcement of education, for patients at the highest risk.

Limitations

This evaluation has several limitations. First, it was conducted at a single centre with a limited sample size, restricting generalisability. Second, the retrospective design relied on documentation in electronic health records, which may underestimate education that was delivered but not formally recorded; psychosocial factors in particular may have been under-documented given the absence of systematic screening. Third, although data were extracted by three reviewers with discrepancies resolved by consensus, formal inter-rater reliability statistics were not calculated. Fourth, the junior doctor survey used a locally developed, non-validated instrument with a response rate of approximately 36%, and assessed self-reported confidence rather than observed practice. Fifth, the 16 patients with T1DM who experienced a single DKA admission during the study window were not formally compared with the 41 recurrent-DKA patients on demographic or clinical characteristics; such a comparison was outside the scope of this baseline service evaluation but would be a useful adjunct in subsequent cycles of the quality improvement project. Despite these limitations, the findings provide a robust baseline assessment and identify clear targets for system-level improvement.

Conclusion

Recurrent DKA admissions reflect a complex interplay of clinical, educational and psychosocial factors. Addressing this burden requires a shift from a purely acute-care focus towards structured prevention strategies incorporating standardised education, improved discharge safety-netting, workforce training and integrated mental health support.[2,5] This baseline evaluation identifies clear targets for intervention, and a subsequent quality improvement cycle will evaluate the impact of proposed changes on recurrent DKA admission rates and care quality for this vulnerable patient population.

Key messages

- Recurrent DKA is driven by a small, highly vulnerable cohort responsible for a disproportionate share of admissions
- Significant gaps exist in education and discharge safety netting
- Psychosocial factors and system-level barriers are key drivers of recurrence

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