

ARE WE MONITORING THE DKA ACCORDING TO STANDARDS? A CLINICAL AUDIT OF MONITORING PRACTICES IN ADULTS WITH DKA AGAINST THE JBDS-IP-23

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ABSTRACT

Background

Diabetic ketoacidosis (DKA) is a potentially life-threatening metabolic emergency in which safe management depends not only on appropriate treatment but also on frequent and structured monitoring of the clinical and biochemical response. The Joint British Diabetes Societies for Inpatient Care (JBDS-IP) 2023 guideline provides clearly defined recommendations for monitoring glucose, ketones, acid-base status, electrolytes, clinical observations, fluid balance and urine output during DKA treatment. However, adherence to these monitoring standards may vary in routine clinical practice. This clinical audit assessed compliance with the JBDS-IP 2023 monitoring recommendations among adults with DKA managed in a General Medicine setting at Ayub Teaching Hospital, Abbottabad.

Methods

A retrospective clinical audit was conducted in the Medical B Unit of Ayub Teaching Hospital, Abbottabad, covering the period from 10 October 2024 to 10 March 2025. All eligible adults aged 18 years or older with documented DKA who were managed in the unit during the audit period and had sufficient clinical records for assessment were included. A structured audit proforma based on the JBDS-IP 2023 guideline was used to review the frequency and timing of capillary blood glucose, blood ketones where an appropriate bedside facility was available, venous pH/bicarbonate, potassium, plasma electrolytes, clinical observations, fluid balance and urine output. Compliance was defined according to whether the required monitoring was documented at the recommended frequency and timing. Data were analysed using descriptive statistics and reported as frequencies and percentages.

Results

A total of 44 adult DKA admissions met the eligibility criteria. Compliance varied considerably across the individual monitoring standards. Hourly capillary blood glucose monitoring was achieved in 24 (54.5%) episodes, while hourly blood ketone monitoring was achieved in 12 of 31 eligible episodes (38.7%). Venous pH/bicarbonate and potassium monitoring at approximately 60 minutes was compliant in 30 (68.2%) episodes and at approximately 2 hours in 27 (61.4%). Further two-hourly pH/bicarbonate and potassium monitoring during early treatment was achieved in 22 (50.0%) episodes, while four-hourly plasma electrolyte monitoring was achieved in 20 (45.5%). Regular clinical observations showed the highest compliance at 34 (77.3%), followed by adequate fluid-balance documentation in 29 (65.9%) and urine-output monitoring in 25 (56.8%) episodes. Overall, only 5

(11.4%) episodes met all applicable predefined monitoring criteria, while 14 (31.8%) met most criteria with at least one documented gap and 25 (56.8%) had multiple monitoring gaps.

Conclusion

This audit identified important gaps in adherence to recommended DKA monitoring standards in the audited General Medicine setting. Clinical observations were documented more consistently, whereas repeated biochemical monitoring, particularly blood ketones, continued two-hourly biochemical assessment and four-hourly electrolyte monitoring, showed lower compliance. The findings highlight the need for a more consistent and structured approach to DKA monitoring, supported by clear documentation, staff education and regular audit-feedback. A repeat audit using the same predefined criteria would be appropriate to assess improvement in monitoring practice.

Keywords: Diabetic ketoacidosis • DKA monitoring • Clinical audit • JBDS-IP 2023 • Guideline adherence • Quality improvement • General Medicine

INTRODUCTION

Diabetic ketoacidosis (DKA) is an acute, potentially life-threatening complication of diabetes characterized by hyperglycaemia or a history of diabetes, ketonaemia and metabolic acidosis. Although advances in insulin therapy, fluid resuscitation and monitoring have substantially improved outcomes, DKA remains an important cause of acute hospital admission and carries a risk of serious complications during treatment, particularly hypoglycaemia, hypokalaemia, cerebral oedema and fluid-related complications.^{1,2} The increasing recognition of euglycaemic DKA and DKA in people with type 2 diabetes has also made clinical and biochemical assessment more important than relying on blood glucose alone.^{2,3}

Successful treatment of DKA depends not only on appropriate initiation of intravenous fluids, insulin and electrolyte replacement, but also on **frequent and structured monitoring of the patient's clinical and biochemical response**. Changes in blood glucose occur earlier than resolution of ketoacidosis; therefore, glucose alone is not a reliable marker of recovery. Serial assessment of ketones, venous pH or bicarbonate, potassium and other electrolytes is required to determine whether ketosis and acidosis are resolving appropriately and to identify treatment-related complications at an early stage.^{2,3} Current international consensus recommendations advise capillary glucose monitoring every 1–2 hours and repeated biochemical assessment, including electrolytes, β -hydroxybutyrate and venous pH, at regular intervals until DKA has resolved.²

The **Joint British Diabetes Societies for Inpatient Care (JBDS-IP)** guideline provides a structured framework for the management and monitoring of adults with DKA. The revised March 2023 guideline recommends hourly capillary blood glucose monitoring and, where available, hourly capillary ketone measurement during the early treatment period. Venous bicarbonate and potassium should be checked at 60 minutes, 2 hours and then every 2 hours, with plasma electrolytes assessed at 4-hourly intervals. The guideline also emphasises regular clinical observations, accurate fluid-balance monitoring, maintenance of adequate urine output and assessment for complications such as hypoglycaemia, hypokalaemia, cerebral oedema and fluid overload.⁴ These recommendations are designed to ensure that treatment is adjusted according to the patient's physiological response rather than administered as a fixed sequence without reassessment. The same principles remain consistent with more recent international consensus guidance, which emphasises frequent glucose monitoring and serial assessment of electrolytes, β -hydroxybutyrate and venous pH until resolution of DKA.^{2,5} Despite the availability of detailed guidelines, translating recommended DKA management into routine clinical practice can be challenging. A recent multicentre UK evaluation of 753 DKA episodes demonstrated incomplete and delayed implementation of updated JBDS recommendations, highlighting that the presence of a guideline does not necessarily ensure consistent adherence at the bedside.⁶ This is

particularly relevant to monitoring, where missed or delayed measurements may reduce opportunities to identify inadequate treatment response or treatment-related electrolyte and glucose abnormalities in a timely manner. In Pakistan, recent evidence from a tertiary-care hospital in Karachi has also demonstrated variability in adherence to DKA management protocols, with lower overall protocol compliance associated with poorer inpatient outcomes.⁷ These findings suggest that assessing actual practice against clearly defined standards is an important component of improving the safety and reliability of DKA care.

DKA is also encountered in tertiary-care hospitals in Pakistan, including centres serving large referral populations in Khyber Pakhtunkhwa. A study from Hayatabad Medical Complex, Peshawar, reported 104 confirmed DKA admissions over a two-year period and demonstrated variation in disease severity and clinical presentation among patients presenting to a tertiary-care service.⁸ However, evidence specifically examining the **quality and completeness of DKA monitoring against contemporary guideline-based standards** remains limited in this setting. At a high-volume teaching hospital such as Ayub Teaching Hospital, Abbottabad, where adults with acute metabolic emergencies are managed by multidisciplinary medical teams, identifying gaps between recommended monitoring practices and actual bedside documentation can provide a practical starting point for quality improvement.

Therefore, this clinical audit was undertaken in the General Medicine setting of Ayub Teaching Hospital to assess whether the monitoring of adults with DKA was being performed in accordance with the **JBDS-IP 2023 guideline**. The audit focused on key clinical and biochemical monitoring parameters during DKA treatment, with the aim of identifying areas of non-compliance and providing a basis for targeted quality-improvement interventions to improve the consistency and safety of DKA monitoring.

Aims and Objectives

Aim

To assess compliance with recommended clinical and biochemical monitoring practices in adults

with diabetic ketoacidosis (DKA) against the **Joint British Diabetes Societies for Inpatient Care (JBDS-IP) 2023 guideline** at Ayub Teaching Hospital, Abbottabad.

Objectives

1. **To assess the frequency and completeness of clinical monitoring** in adults with DKA, including vital signs, fluid balance and urine output, against the monitoring standards recommended by the JBDS-IP 2023 guideline.
2. **To assess compliance with recommended biochemical monitoring**, including capillary blood glucose, blood ketones where available, venous pH/bicarbonate, serum potassium and other relevant electrolytes during DKA treatment.
3. **To determine the proportion of DKA admissions meeting the predefined JBDS-IP 2023 monitoring standards** during the initial and ongoing management of DKA.
4. **To identify specific areas of non-compliance and variation in monitoring practice** that may be addressed through targeted quality-improvement measures within the General Medicine setting.

Methods

Study Design

This study was conducted as a **retrospective clinical audit** of monitoring practices in adults with diabetic ketoacidosis (DKA). The audit assessed routine clinical practice against predefined monitoring standards derived from the **Joint British Diabetes Societies for Inpatient Care (JBDS-IP) 2023 guideline for the management of DKA in adults**.¹ The audit was designed as a criterion-based review of clinical records, with the primary purpose of determining the level of compliance with recommended clinical and biochemical monitoring standards during the management of DKA. Clinical audit is an established method of assessing whether care is being delivered in accordance with predefined evidence-based standards.²

Study Setting

The audit was conducted in the **Medical B Unit of Ayub Teaching Hospital (ATH), Abbottabad, Khyber Pakhtunkhwa, Pakistan**. ATH is a tertiary-care teaching hospital providing secondary

and tertiary medical services to a large referral population. Adults with DKA are routinely managed within the General Medicine service, with escalation to higher-dependency or specialist care according to clinical requirement.

Audit Period

The audit covered the period from **10 October 2024 to 10 March 2025**. All eligible adult DKA admissions managed in the Medical B Unit during this period were considered for inclusion.

Audit Population

The audit population comprised **adult patients with DKA managed in the Medical B Unit during the audit period**. DKA was defined according to the JBDS-IP 2023 guideline using the presence of all three components: blood glucose greater than 11 mmol/L, significant ketonaemia or ketonuria, and metabolic acidosis demonstrated by venous pH less than 7.3 and/or bicarbonate less than 15 mmol/L.¹

Inclusion Criteria

Patients were included if they:

- were **18 years of age or older**;
 - had a documented diagnosis of DKA according to the clinical record and applicable diagnostic criteria;
 - were managed in the Medical B Unit during the audit period; and
 - had clinical records available for assessment of the predefined monitoring parameters.
- ### Exclusion Criteria
- Patients were excluded if they:
- were younger than 18 years;
 - were managed entirely outside the Medical B Unit;
 - had hyperglycaemia or ketosis without documented evidence of DKA; or
 - had insufficient clinical documentation to assess the relevant audit criteria.

Audit Standard

The JBDS-IP 2023 guideline was used as the principal audit standard because it provides clearly defined monitoring requirements for adults undergoing treatment for DKA.¹ The audit assessed the following monitoring components:

No.	Monitoring Component	Requirement
1	Capillary blood glucose	Hourly monitoring during the initial management of DKA.
2	Blood ketones	Hourly capillary ketone measurement where a suitable ketone meter was available.
3	Venous bicarbonate and potassium	Measurement at 60 minutes, 2 hours and subsequently at 2-hourly intervals during the early treatment period.
4	Plasma electrolytes	Four-hourly assessment of relevant plasma electrolytes.
5	Clinical observations	Regular assessment and documentation of pulse, blood pressure, respiratory rate, oxygen saturation, temperature and level of consciousness/neurological status as clinically appropriate.
6	Fluid balance and urine output	Regular monitoring and documentation of fluid input, fluid output and urine output during treatment.

The audit focused specifically on monitoring practices and did not assess the appropriateness of individual insulin or fluid prescriptions unless required to interpret whether the relevant monitoring had been performed.

Audit Criteria and Compliance Definition

Each monitoring criterion was converted into an auditable measure based on the frequency and timing specified in the JBDS-IP 2023 guideline. For parameters requiring repeated measurements,

compliance was assessed against the **recommended monitoring interval**, rather than simply recording whether the investigation had been performed at any point during admission. A monitoring criterion was considered **compliant** when the required observation or investigation was documented at the recommended frequency and timing. Where the required monitoring was not documented, the criterion was recorded as non-compliant. For parameters that were not applicable to an individual patient or were unavailable for a clearly documented clinical reason, the criterion was recorded separately and excluded from the denominator where appropriate. In particular, hourly blood ketone monitoring was assessed in the context of availability of an appropriate bedside ketone measurement facility, consistent with the JBDS-IP guideline.¹

Data Collection

A structured audit proforma was developed from the selected JBDS-IP 2023 monitoring standards before commencement of data collection. Relevant information was obtained retrospectively from available patient records, including medical notes, nursing observation charts, fluid-balance charts, medication/infusion records and laboratory or point-of-care results.

For each eligible DKA episode, the following information was recorded where available:

- demographic and admission information;
- relevant DKA-related clinical information;
- frequency and timing of capillary blood glucose monitoring;
- frequency and timing of blood ketone measurements, where available;
- venous pH and bicarbonate measurements;
- potassium and other electrolyte measurements;
- clinical observations;
- fluid balance and urine output documentation; and
- documentation of the relevant monitoring parameters during DKA treatment.

The audit recorded the actual monitoring frequency against the predefined guideline standard to identify areas of incomplete, delayed or missing monitoring.

Data Analysis

Data were entered into a structured database and analysed using descriptive statistics. Categorical variables were presented as **frequencies and percentages**. Compliance with each audit criterion was calculated as the proportion of eligible DKA episodes in which the specified monitoring standard was achieved. The compliance rate for each criterion was calculated using the following formula:

Compliance (%) = Number of DKA episodes meeting the audit criterion ÷ Number of eligible DKA episodes for which the criterion was applicable × 100.

Overall compliance was reported for the individual monitoring components rather than combining clinically different parameters into a single composite measure unless a predefined composite measure was specified before analysis. The findings were presented as descriptive measures of current practice and were used to identify areas where monitoring did not meet the JBDS-IP 2023 standards.

Quality Control

A standardised data-collection proforma based directly on the JBDS-IP 2023 recommendations was used to maintain consistency during record review. The same definitions of eligibility and compliance were applied throughout the audit period. Data were checked for completeness and internal consistency before analysis. Patient-identifying information was not included in the final audit dataset or reporting.

Ethical and Governance Considerations

The project was conducted as a **clinical audit of existing clinical practice** and did not introduce an experimental intervention or alter patient management. Data were obtained retrospectively from routine clinical documentation. Confidentiality was maintained throughout the audit process, and patient-identifying information was excluded from the analysis and final report. The project was undertaken in accordance with the applicable institutional requirements for clinical audit, quality governance and approval.

Results

During the audit period, **44 adult admissions with diabetic ketoacidosis (DKA)** met the eligibility criteria and were included in the analysis. The demographic and clinical characteristics of the

audit population are presented in Table 1. The cohort included both established and newly diagnosed diabetes, with a slight male predominance. Type 2 diabetes accounted for a slightly larger proportion of admissions than type 1 diabetes.

Table 1. Demographic and clinical characteristics of patients with DKA (n=44)

Characteristic	n (%) or mean $\pm$ SD
Age, years	31.8 $\pm$ 12.6
Age range, years	18-68
Sex	
Male	25 (56.8)
Female	19 (43.2)
Diabetes status	
Type 1 diabetes	19 (43.2)
Type 2 diabetes	21 (47.7)
Newly diagnosed diabetes	4 (9.1)
Common documented precipitating factor	
Suspected/confirmed infection	15 (34.1)
Insulin omission or poor adherence	11 (25.0)
New diagnosis of diabetes	4 (9.1)
Gastrointestinal illness/reduced oral intake	3 (6.8)
Acute coronary syndrome	2 (4.5)
Recent steroid exposure	1 (2.3)
No clear precipitating factor documented	8 (18.2)

The most frequently documented presenting features were nausea or vomiting, polyuria/polydipsia and clinical evidence of

dehydration. Abdominal pain and increased respiratory effort were also commonly recorded (Table 2).

Table 2. Clinical presentation at admission

Clinical feature	n (%)
Nausea and/or vomiting	31 (70.5)
Polyuria/polydipsia	28 (63.6)

Clinical feature	n (%)
Clinical dehydration	22 (50.0)
Abdominal pain	17 (38.6)
Increased respiratory rate/deep breathing	14 (31.8)
Generalised weakness	24 (54.5)
Altered level of consciousness	6 (13.6)
Fever or clinical evidence of infection	13 (29.5)

Initial biochemical findings are summarised in Table 3. The majority of patients had marked

hyperglycaemia and metabolic acidosis at presentation.

Table 3. Initial biochemical characteristics of the audit population

Parameter	Result
Plasma/capillary glucose, mmol/L	26.9 ± 7.9
Blood β-hydroxybutyrate, mmol/L*	5.2 (3.6–6.9)
Venous pH	7.19 ± 0.10
Serum bicarbonate, mmol/L	10.8 ± 4.3
Serum potassium, mmol/L	4.6 ± 0.8
Serum sodium, mmol/L	136 ± 6
Serum creatinine, mg/dL	1.6 ± 0.9

*Blood ketone values were available for patients in whom bedside blood ketone measurement was performed.

Compliance with JBDS-IP 2023 Monitoring Standards

Considerable variation was observed in adherence to the recommended monitoring schedule. The highest level of compliance was seen for routine

clinical observations, whereas the lowest compliance was observed for repeated biochemical monitoring at the recommended intervals (Table 4).

Table 4. Compliance with individual JBDS-IP 2023 monitoring standards

Audit criterion	Eligible episodes, n	Compliant, n (%)
Hourly capillary blood glucose monitoring	44	24 (54.5)
Hourly blood ketone monitoring*	31	12 (38.7)
Venous pH/bicarbonate and potassium at approximately 60 minutes	44	30 (68.2)

Audit criterion	Eligible episodes, n	Compliant, n (%)
Venous pH/bicarbonate and potassium at approximately 2 hours	44	27 (61.4)
Further 2-hourly pH/bicarbonate and potassium monitoring during early treatment	44	22 (50.0)
Four-hourly plasma electrolyte monitoring	44	20 (45.5)
Regular clinical observations documented	44	34 (77.3)
Adequate fluid-balance documentation	44	29 (65.9)
Urine output monitoring/documentation	44	25 (56.8)

**Blood ketone monitoring was assessed in the 31 episodes in which an appropriate bedside blood ketone measurement facility was available.*

Overall, only a small proportion of DKA episodes had complete documentation of all applicable monitoring requirements throughout the audited period. **Five of the 44 episodes (11.4%)** met all applicable predefined monitoring criteria. A

further **14 episodes (31.8%)** met most, but not all, of the applicable criteria, while **25 episodes (56.8%)** had one or more substantial gaps in the recommended monitoring schedule.

Table 5. Overall adherence to applicable monitoring criteria per DKA episode

Level of adherence	DKA episodes, n (%)
All applicable monitoring criteria met	5 (11.4)
Most criteria met, with at least one documented gap	14 (31.8)
Multiple monitoring gaps identified	25 (56.8)
Total	44 (100)

The most frequent areas of incomplete compliance were **hourly blood ketone monitoring, four-hourly electrolyte assessment and continued 2-hourly biochemical monitoring during the early treatment period**. Clinical observations showed comparatively better documentation, although complete compliance with fluid balance and urine output monitoring was also not consistently achieved.

Figures

Graphical Summary of Audit Results

Figure 1

Figure 1. Demographic characteristics and precipitating factors of patients with DKA (n=44)

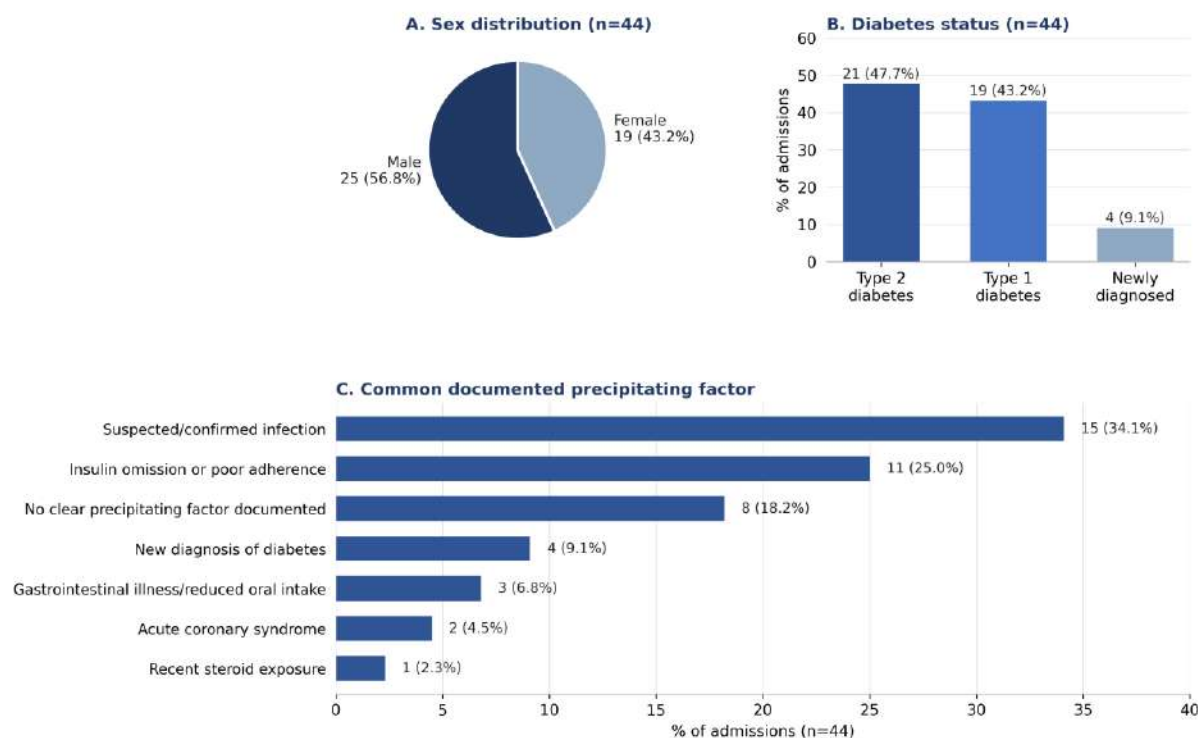


Figure 1 presents the demographic profile (sex, diabetes status) and documented precipitating factors for the 44 audited DKA episodes.

Figure 2

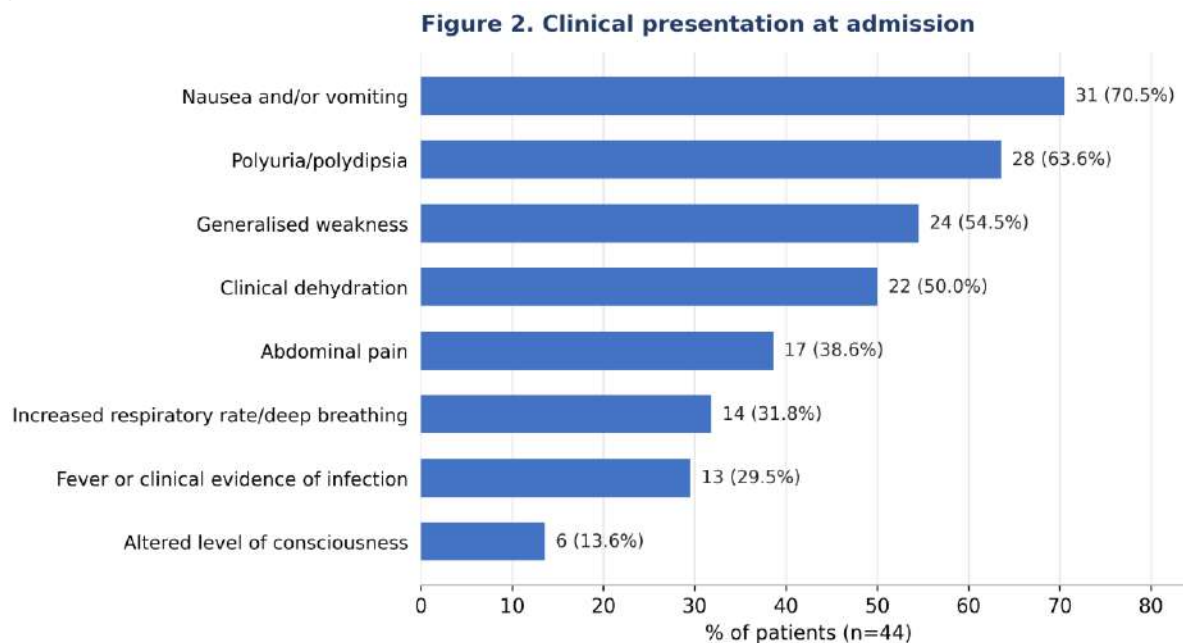


Figure 2 shows the frequency of clinical features documented at presentation.

Figure 3

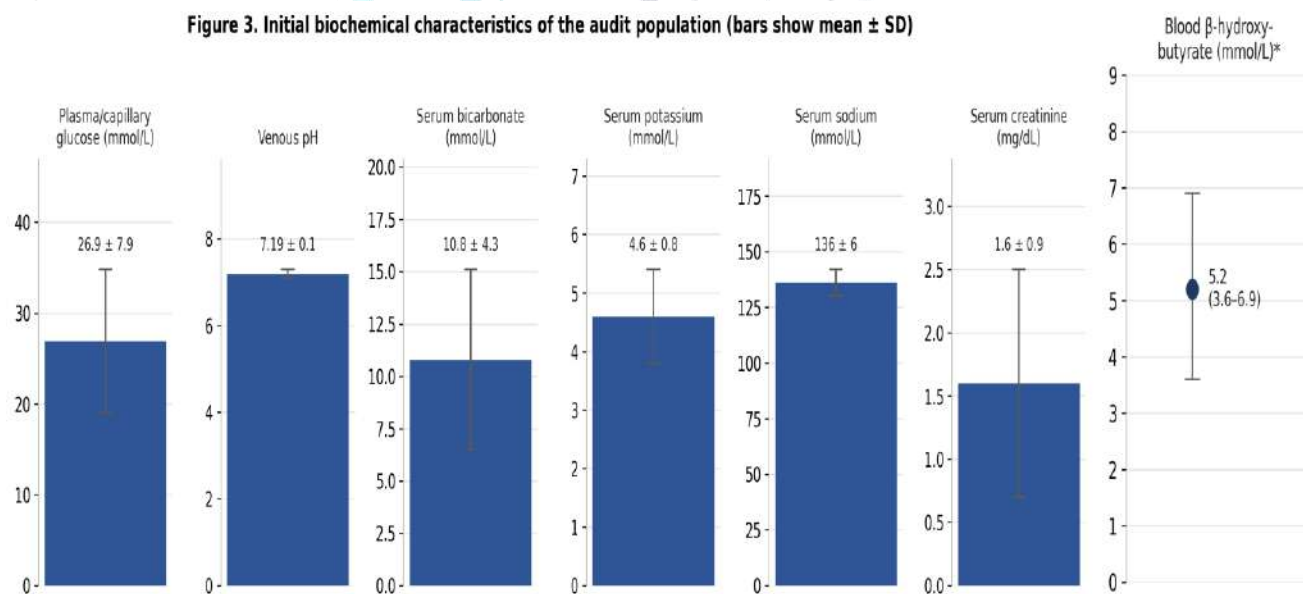


Figure 3 displays initial biochemical parameters as mean $\pm$ SD (bars) or median (IQR) for blood β -hydroxybutyrate (point estimate).

Figure 4

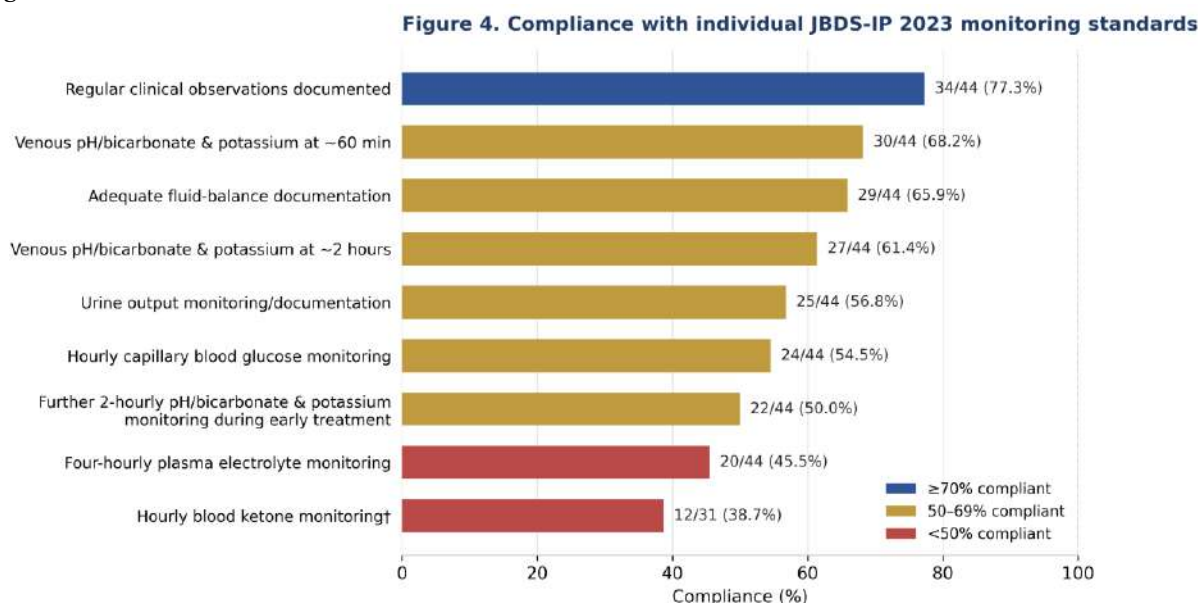


Figure 4 ranks compliance with each individual JBDS-IP 2023 monitoring standard, colour-coded by compliance band.

Figure 5

Figure 5. Overall adherence to applicable monitoring criteria per DKA episode (n=44)

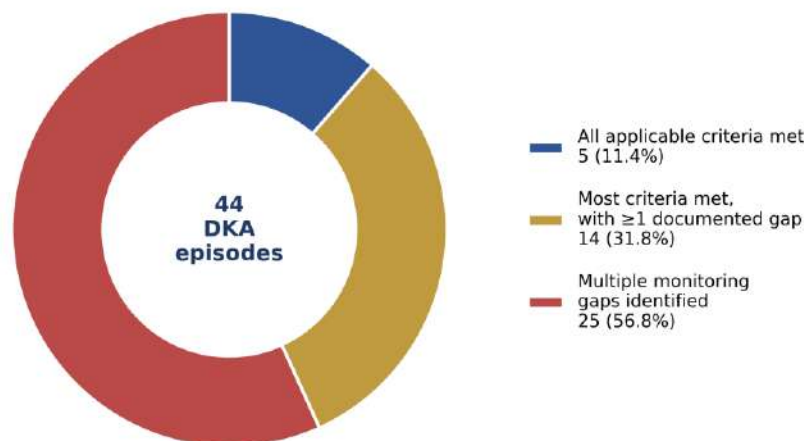


Figure 5 summarises overall adherence to all applicable monitoring criteria per DKA episode.

Discussion

This clinical audit identified important gaps in the monitoring of adults with diabetic ketoacidosis (DKA) against the JBDS-IP 2023 recommendations in the Medical B Unit of Ayub Teaching Hospital. Among 44 eligible DKA admissions, compliance varied considerably

between monitoring components. Clinical observations had the highest documented compliance (77.3%), while hourly blood ketone monitoring, four-hourly plasma electrolyte monitoring and continued two-hourly biochemical monitoring showed the greatest gaps. Only 5 (11.4%) episodes met all applicable

monitoring criteria throughout the audited period, while 25 (56.8%) had multiple monitoring gaps. These findings suggest that, although some elements of routine DKA monitoring were being performed reasonably consistently, maintaining the recommended frequency of serial biochemical assessment throughout treatment remained a major area for improvement.

The findings are clinically relevant because DKA management requires repeated reassessment rather than a single assessment at presentation. Blood glucose may improve relatively early during treatment without complete resolution of ketoacidosis; therefore, monitoring of ketones and acid-base status is important for assessing the actual response to treatment. The JBDS-IP 2023 guideline specifically recommends frequent assessment of capillary glucose and ketones, together with serial bicarbonate, potassium and electrolyte measurements during treatment.¹⁻⁴ The relatively lower compliance observed for repeated biochemical measurements in this audit therefore represents an important gap in the process of DKA care, particularly because these measurements provide information that cannot be obtained reliably from glucose monitoring alone. Hourly capillary blood glucose monitoring was achieved in 24 of 44 episodes (54.5%). Although this was higher than several of the other biochemical monitoring measures, almost half of the audited episodes did not meet the predefined hourly monitoring standard. This is important because insulin and intravenous fluid therapy can produce relatively rapid changes in glucose concentration, and excessive or inadequately monitored reductions may increase the risk of hypoglycaemia.^{2,4} The finding also indicates that the difficulty was not restricted to laboratory-based investigations; even a monitoring parameter that is readily available at the bedside was not consistently documented at the recommended frequency.

Blood ketone monitoring showed the lowest compliance among the individual criteria, with only 12 of 31 eligible episodes (38.7%) meeting the hourly standard. Importantly, the denominator was restricted to the 31 episodes in which an appropriate bedside blood ketone measurement facility was available, as prespecified

in the audit methodology. This distinction is important when interpreting the result: the finding should not be considered evidence that bedside ketone testing was universally unavailable. Rather, it indicates that even where the facility was available, the recommended frequency of monitoring was not consistently achieved. Earlier JBDS guidance has identified capillary blood ketone measurement as the preferred method for monitoring the response to treatment, while recognising venous pH and bicarbonate as alternatives when blood ketone measurement is unavailable.⁹ The current finding therefore provides a clear area for local improvement through better integration of ketone monitoring into the routine DKA observation process.

The pattern of biochemical monitoring was also notable. Monitoring of venous pH/bicarbonate and potassium at approximately 60 minutes was compliant in 30 episodes (68.2%), falling to 27 episodes (61.4%) at approximately 2 hours and 22 episodes (50.0%) for subsequent two-hourly measurements during early treatment. Four-hourly plasma electrolyte monitoring was compliant in only 20 episodes (45.5%). This progressive reduction in compliance suggests that the main problem may not simply be failure to initiate monitoring at presentation, but difficulty maintaining the recommended monitoring schedule over the course of treatment. In a condition in which treatment itself produces changing glucose, potassium and acid-base status, failure to continue serial assessment may result in delayed recognition of treatment-related abnormalities or inadequate response to therapy.^{1,2,4}

The relatively better compliance with clinical observations (77.3%) is encouraging and suggests that routine bedside assessment was more consistently incorporated into DKA care than some of the scheduled biochemical investigations. However, even this relatively stronger domain did not achieve complete compliance. Similarly, adequate fluid-balance documentation was achieved in 65.9% of episodes and urine-output monitoring in 56.8%. These findings are relevant because fluid replacement is an important component of DKA treatment and requires ongoing assessment of the patient's clinical

response and fluid status.^{1,4} The gap between clinical observations and fluid-balance/urine-output documentation also suggests that monitoring should be viewed as a complete process rather than as isolated observations.

The overall pattern observed in this audit is consistent with published evidence showing that the existence of a DKA guideline or protocol does not automatically result in complete adherence in routine clinical practice. The 2025 DEKODE multicentre evaluation reported poor and inconsistent implementation of DKA guideline recommendations across 753 episodes, highlighting a continuing gap between evidence-based recommendations and bedside practice.⁹ Similarly, a 2025 retrospective study from Aga Khan University Hospital, Karachi, found substantial variation in adherence to a DKA management protocol, although that study evaluated broader treatment compliance and its relationship with mortality rather than monitoring alone.¹⁰ The findings from our audit are therefore broadly consistent with the wider literature while addressing a more specific question: whether the recommended monitoring schedule itself is being followed in routine medical practice.

Previous quality-improvement studies also suggest that adherence to structured DKA pathways can improve when protocols are supported by implementation strategies rather than simply being made available. Evans et al. reported that implementation of an evidence-based DKA protocol was associated with improved treatment processes, including more timely fluid and potassium management, although protocol fidelity remained incomplete.¹¹ Similarly, a multidisciplinary implementation programme reported an improvement in DKA guideline compliance from 67% to 88% after education and structured implementation.¹² More recent work has demonstrated that audit and feedback can produce sustained improvements in DKA management, with regular feedback following baseline audit associated with improvements in selected DKA care processes and a reduction in time to DKA resolution.¹³ These findings are relevant to the present audit because the identified deficiencies are potentially amenable to relatively

practical interventions such as a standardised DKA monitoring chart, clear bedside documentation prompts, staff education and regular audit-feedback.

The results should nevertheless be interpreted within the scope of this audit. This was a retrospective clinical audit of 44 DKA admissions in a single General Medicine unit, and the primary purpose was to assess compliance with predefined monitoring standards. The audit did not evaluate mortality, duration of DKA, length of hospital stay, hypoglycaemia, hypokalaemia or other patient outcomes. Therefore, the observed monitoring gaps should not be interpreted as demonstrating that these gaps directly caused adverse clinical outcomes. Similarly, no causal relationship can be established between individual monitoring practices and patient outcomes from the present dataset. The value of the findings is instead in identifying specific and measurable processes of care that did not consistently meet the selected guideline standard.

An additional consideration is that this audit relied on documentation in retrospective clinical records. A monitoring event that was performed but not recorded would have been classified as non-compliant according to the predefined audit criteria. Consequently, the findings represent documented compliance with the monitoring standards and may not capture every aspect of undocumented bedside practice. Nevertheless, documentation itself is an important component of safe DKA care because timely and visible recording allows subsequent members of the clinical team to recognise treatment response, identify deterioration and make appropriate adjustments.

The finding that only 11.4% of DKA episodes met all applicable monitoring criteria highlights the importance of addressing the monitoring process as a whole rather than concentrating on a single parameter. At the same time, the individual compliance figures indicate where improvement efforts can be targeted. Blood ketone monitoring, continued two-hourly biochemical assessment and four-hourly electrolyte monitoring represent particularly important opportunities for improvement, while glucose monitoring, urine output and fluid-balance documentation also

require reinforcement. A practical local response could include a dedicated DKA monitoring chart or checklist incorporating the required timing of glucose, ketones, venous pH/bicarbonate, potassium, electrolytes, clinical observations, fluid balance and urine output. Such a tool could reduce reliance on memory and make overdue investigations more visible to the treating team. Evidence from other settings supports the use of structured protocols and order sets as implementation tools. Standardised DKA protocols have been associated with improved adherence to recommended investigations and treatment processes, while audit and feedback can further reduce variation in care.¹³⁻¹⁵ However, these interventions should be adapted to the local environment. In the present setting, particular attention should be given to the availability of bedside ketone testing, access to timely laboratory investigations, nursing documentation systems and workload within the medical unit. The aim should not simply be to introduce another form, but to make the recommended monitoring schedule practical, visible and easy to follow during routine DKA management.

Conclusion

This clinical audit identified important gaps in compliance with the JBDS-IP 2023 monitoring standards among adults with diabetic ketoacidosis managed in the Medical B Unit of Ayub Teaching Hospital. Although routine clinical observations showed comparatively better compliance, monitoring of blood ketones, repeated venous pH/bicarbonate and potassium, and four-hourly plasma electrolytes was less consistently performed at the recommended frequency. Overall, only 11.4% of DKA episodes met all applicable monitoring criteria, while more than half had multiple documented monitoring gaps. These findings indicate that the main area for improvement is the consistency and continuity of structured monitoring throughout DKA treatment rather than monitoring at presentation alone. A standardised DKA monitoring approach, supported by clear documentation, staff education and regular audit-feedback, may help improve adherence to the recommended monitoring schedule. Repeat audit using the same predefined criteria will be important to determine whether

such measures result in sustained improvement in DKA monitoring practice.

Additional Information

Conflicts of Interest: None

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