

Managing hyperglycaemic emergencies in 2025

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Background

- Diabetes-related ketoacidosis (DKA)- extreme metabolic state due to insulin deficiency.
- DKA is associated with 5.2% risk of death and 23.4% with recurrent DKA¹
- JBDS guidelines in 2010; further revised in 2013, 2021 and 2023²
- Hyperosmolar Hyperglycaemic State (HHS), despite a lower prevalence than DKA, carries a higher mortality rate—up to 10 times in some reports.³
- JBDS guidelines in 2022⁴

1. Gibbs et al. Diabetologia. 2016
2. Savage et al. Diabetic Medicine. 2011
3. Pasquel, et al. Diabetes Care. 2014
4. Mustafa, et al. Diabetic Medicine. 2023

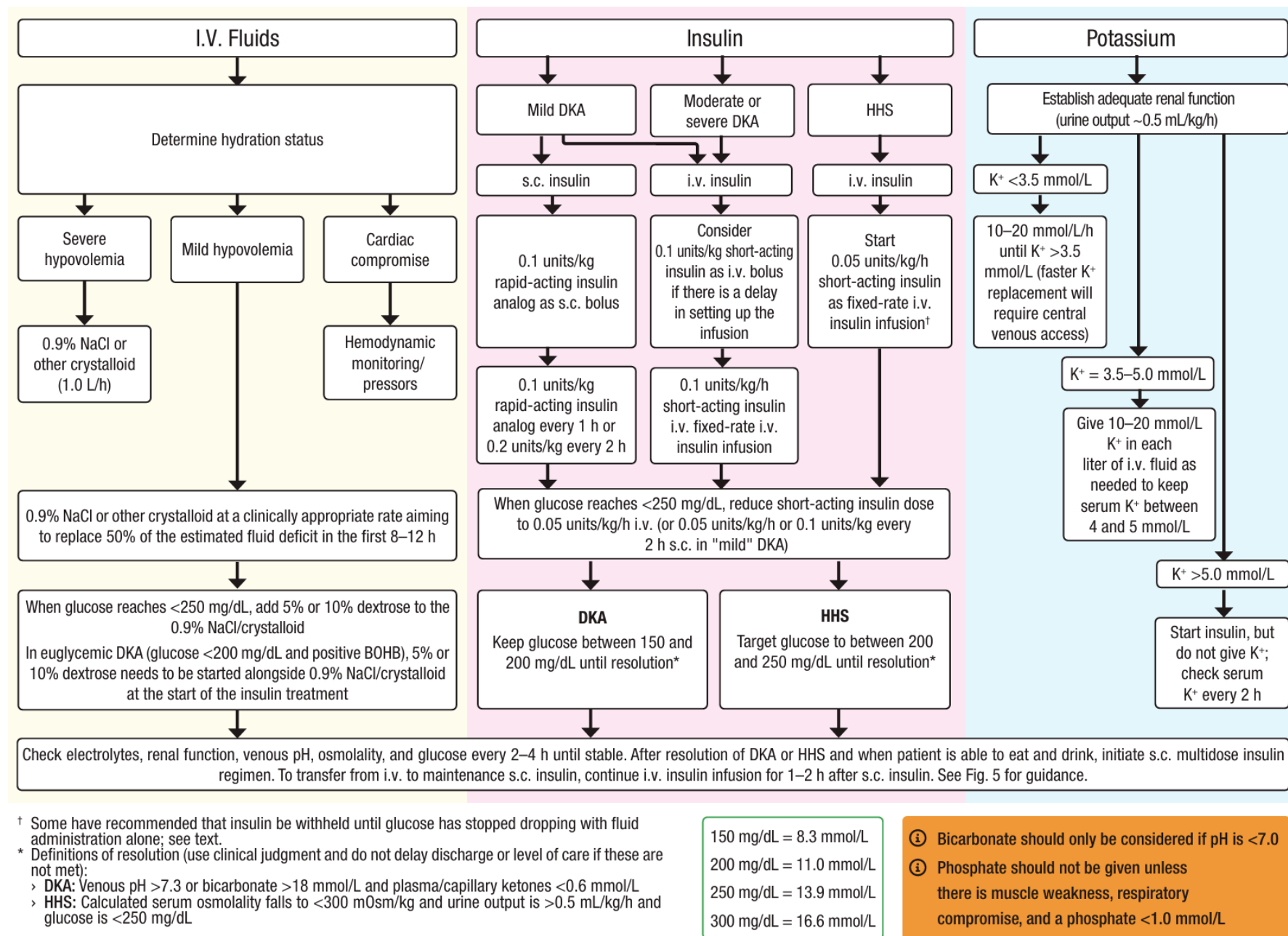


Figure 4—Treatment pathways for DKA and HHS. BOHB, β-hydroxybutyrate.

First Steps: Assessment and Stabilization

- Assess hydration status (thirst, dry mouth, etc.)
- Ensure adequate renal function (urine output > 0.5 mL/kg/hour)
- Confirm diagnosis (Mild, Moderate/Severe DKA, HHS)

Table 2—DKA classification and suggested level of care by severity: mild, moderate, or severe

	Mild DKA	Moderate DKA	Severe DKA
“D”: history of diabetes or elevated glucose level	Glucose $\geq$ 200 mg/dL (11.1 mmol/L)	Glucose $\geq$ 200 mg/dL (11.1 mmol/L)	Glucose $\geq$ 200 mg/dL (11.1 mmol/L)
“K”: ketonemia	β -Hydroxybutyrate 3.0–6.0 mmol/L	β -Hydroxybutyrate 3.0–6.0 mmol/L	β -Hydroxybutyrate >6.0 mmol/L
“A”: acidosis	• pH >7.25 to <7.30 or bicarbonate 15–18 mmol/L	• pH 7.0–7.25 • Bicarbonate 10 to <15 mmol/L	• pH <7.0 • Bicarbonate <10 mmol/L
Mental status	Alert	Alert/drowsy	Stupor/coma
Suggested level of care	Regular or observation nursing unit	Step-down unit or intermediate care unit	Intensive care unit

Not all variables need to be fulfilled to be defined as either mild, moderate, or severe, and the admission site and level of care are ultimately a clinical decision.

Fluid and Electrolytes Replacement

- 0.9% NaCl or similar, 1.0 L/hour initially (severe cases)
- **Euglycemic DKA (Glucose < 200 mg/dL):** Fluids with 5% or 10% dextrose in 0.9% NaCl
- Replace 50% of fluid deficit in 8-12 hours
- **Potassium Replacement:** Guided by serum potassium levels
- Cautious administration to avoid cardiac issues

Serum Potassium (mmol/L)	Action
< 3.5	10-20 mmol/L/hour until > 3.5 (monitor heart!)
3.5 - 5.0	10-20 mmol/L per liter of IV fluid
> 5.0	Start insulin, NO potassium initially

Insulin Therapy and Glucose Management

DKA Severity	Insulin Route	Initial Dose	Notes
Mild	s.c. (rapid-acting or regular)	As per s.c. regimen	
Moderate/Severe	i.v. (regular insulin)	0.1 units/kg bolus + 0.1 units/kg/hour infusion	Continuous monitoring

- **Glucose < 250 mg/dL (14 mmol/L):**
- Reduce insulin to 0.05 units/kg/hour (i.v. or s.c.)
- Add 5% or 10% dextrose to IV fluids

Expected outcome

It is unusual for DKA not to have resolved by 24 hours with appropriate treatment and requires senior and specialist input.

Patients should be eating and drinking and back on normal insulin. If this expectation is not met within this time period it is important to identify and treat the reasons for the failure to respond to treatment.

Conversion to subcutaneous insulin is ideally managed by the diabetes specialist team

Complications of DKA and their treatment



Hypokalaemia and hyperkalaemia -Potassium will almost always fall as the DKA is treated with insulin. Hence fluids with potassium is recommended after initial resuscitation.



Hypoglycaemia- The blood glucose may fall very rapidly with insulin and result in lengthening duration of treatment.



Cerebral oedema- Unknown, exact cause unclear; possible cerebral hypoperfusion with subsequent reperfusion may be the mechanism.

Management of

DKA



A **Airway**



B **Breathing**



C **Circulation**



D **Diabetes**



E **Electrolytes and pH**



F **Fluid replacement**



G **Hourly Glucose**



H **HbA1C**



I **Fixed rate Insulin**



J **Clinical Judgement**



K **Hourly Ketones**

and



D **Diabetes team referral**

Classic DKA

Diagnostic criteria

All of these must be present to make the diagnosis
D- Blood glucose ≥ 11 mmol/L or history of diabetes (glucose will be < 11 mmol/L in euglycaemic ketoacidosis)
K- Blood ketones ≥ 3 mmol/L or urine ketones $\geq 2+$
A- pH < 7.3 or bicarbonate < 18 mmol/L

Euglycaemic Ketoacidosis

Diagnostic criteria

• Glucose < 11 mmol/L and history of diabetes
 • Blood ketones ≥ 3 mmol/L or urine ketones $\geq 2+$
 • pH < 7.3 or bicarbonate < 18 mmol/L

DKA with End Stage Renal Failure

Diagnostic criteria

All of these must be present to make the diagnosis
D- Blood glucose ≥ 11 mmol/L or history of diabetes (glucose will be < 11 mmol/L in euglycaemic ketoacidosis)
K- Blood ketones ≥ 3 mmol/L or urine ketones $\geq 2+$
A- pH < 7.3 or bicarbonate < 18 mmol/L
AND
 (eGFR < 10 or CKD on active dialysis)

Recommended Review checklist during DKA

Audited by



For more information, please review the [management of diabetic ketoacidosis in adults](#) by Joint British Diabetes Societies Inpatient Care Group

Classic DKA

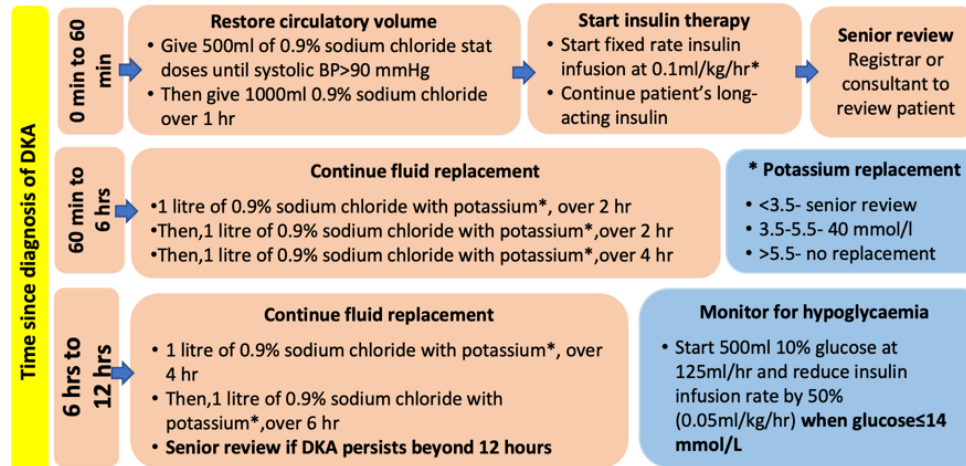
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† Rule out **Euglycaemic ketoacidosis** and **Hyperglycaemic Hyperosmolar State (HHS)** in high risk acutely unwell patients with diabetes (Eg: Pregnancy, those on SGLT-2 inhibitors (gliflozins))

Consider ITU referral if any of the following:

1. Young or elderly or pregnant
2. Heart or liver or kidney failure
3. Severe DKA judged by: blood ketones > 6 mmol/L or bicarbonate < 5 mmol/L or pH < 7.1 or potassium < 3.5 mmol/L or GCS < 12 or persistent hypoxia or persistent brady/ tachycardia or anion gap > 16



Monitoring

- Hourly glucose and hourly ketones
- Bicarbonate & potassium at 1 hr & 2 hr after diagnosis & 2 hourly thereafter
- Check infusion rate if:**
 - Ketones not reducing by 0.5mmol/hr
 - Bicarbonate not increasing by 3mmol/hr
 - Glucose not reducing by 3mmol/hr
- If glucose < 4 mmol/L, follow hypoglycaemia guidelines and ensure fixed rate insulin infusion is running at 0.05ml/kg/hr if DKA still persists



Scan this to watch a YouTube video explaining this guideline.

DKA Resolution and further management

- DKA is resolved when ketones < 0.6 mmol/L and pH > 7.3 or bicarbonate > 18 mmol/L
- If DKA is resolved, switch to variable rate insulin infusion and seek diabetes specialist review for further management

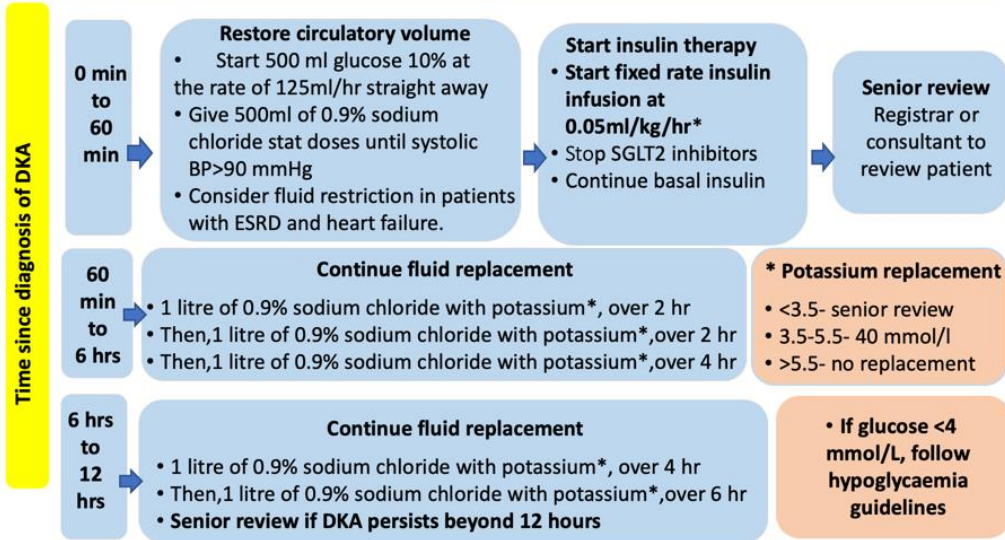
* **How to prepare an insulin infusion:** Using an insulin syringe, draw up 50 units of Actrapid® Insulin. Add to 49.5ml 0.9% Sodium Chloride in a 50ml syringe (provides 1 unit insulin/1ml solution)

Euglycaemic Ketoacidosis

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- Blood ketones ≥ 3 mmol/L or urine ketones $\geq 2+$
- pH < 7.3 or bicarbonate < 18 mmol/L

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 - Monitor for hypoglycaemia



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DKA Resolution and further management

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DKA with End Stage Renal Failure

Diagnostic criteria

All of these must be present to make the diagnosis

- D-** Blood glucose ≥ 11 mmol/L or history of diabetes (glucose will be <11 mmol/L in euglycaemic ketoacidosis)
- K-** Blood ketones ≥ 3 mmol/L or urine ketones $\geq 2+$
- A-** pH < 7.3 or bicarbonate < 18 mmol/L

AND

(eGFR < 10 or CKD on active dialysis)

Start Dry insulin therapy – insulin without concomitant fluid therapy

- Start fixed rate insulin infusion at 0.1 ml/kg/hr*
- Continue basal insulin

Restore circulatory volume

- Do not routinely give fluids to people with ESRD and DKA.
- Give 250ml boluses of 0.9% sodium chloride or 10% Dextrose stat doses until systolic BP >90 mmHg **only if hypotensive or fluid depleted.**
- Do not give potassium-containing fluid supplements

Monitoring

If glucose ≤ 14 mmol/L, reduce dry FRIII by 50% to 0.05 ml/kg/hr

- Hourly glucose and **hourly ketones**
- Check dry FRIII infusion rate if:**
 - Ketones not reducing by 0.5 mmol/hr
 - Discuss with renal team if bicarbonate remains static
 - Monitor for hypoglycaemia

If glucose < 4 mmol/L, follow hypoglycaemia guidelines and ensure fixed rate insulin infusion is running at 0.05 ml/kg/hr if DKA still persists

DKA Resolution and further management

- DKA is resolved when ketones <0.6 mmol/L and pH > 7.3 or bicarbonate > 18 mmol/L
- If DKA is resolved, switch to dry variable rate insulin infusion and seek diabetes specialist review and renal review for further management

* **How to prepare a dry insulin infusion:** Using an insulin syringe, draw up 50 units of Actrapid® Insulin. Add to 49.5ml 0.9% Sodium Chloride in a 50ml syringe (provides 1 unit insulin/1ml solution)

Review Checklist during DKA Management at 3, 5, 9 & 13 Hours

Patient Name: _____

Date: _____

Hospital No: _____

Ward: _____



Date & Time of DKA Diagnosis : _____

Long-acting insulin given during DKA episode : Yes/No



Time since Diagnosis	3 hours	5 hours	9 hours	13 hours
Blood Glucose <14mmol/l	Yes/No	Yes/No	Yes/No	Yes/No
If glucose <14, FRIII reduced to 0.05 u/kh/h	Yes/No	Yes/No	Yes/No	Yes/No
10% Dextrose started if glucose <14mmol/hr	Yes/No	Yes/No	Yes/No	Yes/No
Total fluids given* (Recommended)	☐ 2000ml	☐ 3000ml	☐ 4000ml	☐ 5000ml
Hourly Glucose (Recommended)	☐ (3)	☐ (5)	☐ (9)	☐ (13)
Hourly Ketones (Recommended)	☐ (3)	☐ (5)	☐ (9)	☐ (13)
pH & K ⁺ (Tested through Venous Blood Gas) (Recommended)	☐ (2)	☐ (5)	☐ (9)	☐ (13)
Ketones <0.6 mmol/L for 2 consecutive hours	Yes/No	Yes/No	Yes/No	Yes/No
If yes – then DKA resolution documented	Yes/No	Yes/No	Yes/No	Yes/No



Signature

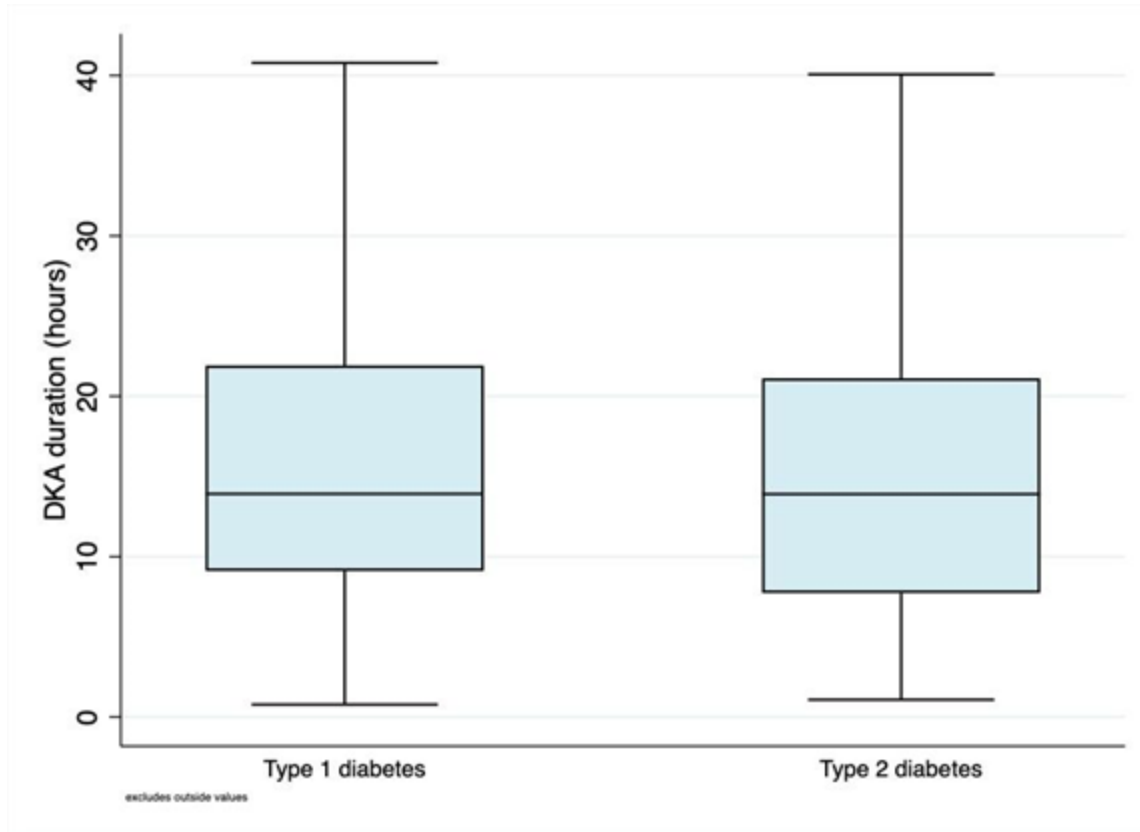
Name of Staff

Date & Time

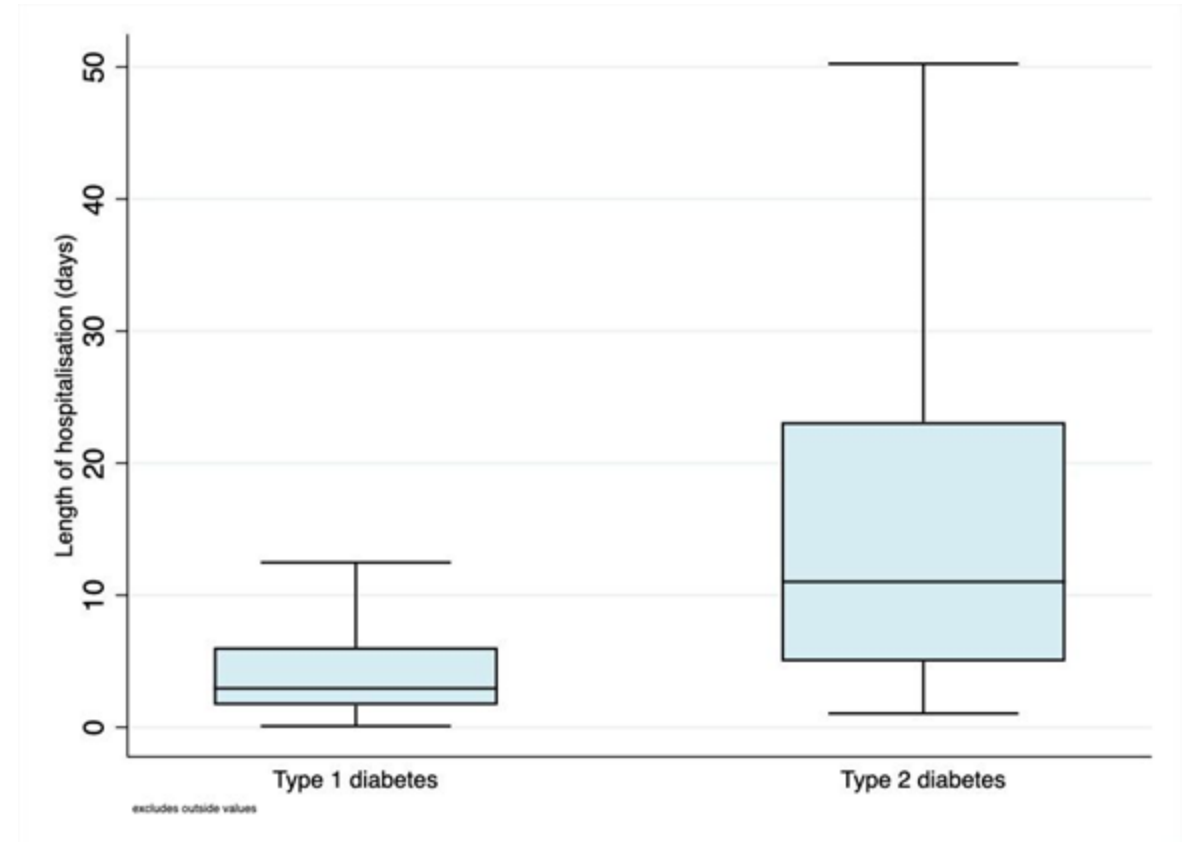
*Total fluid given should take into account special cases like renal impairment & Heart Failure

Outcome of DKA

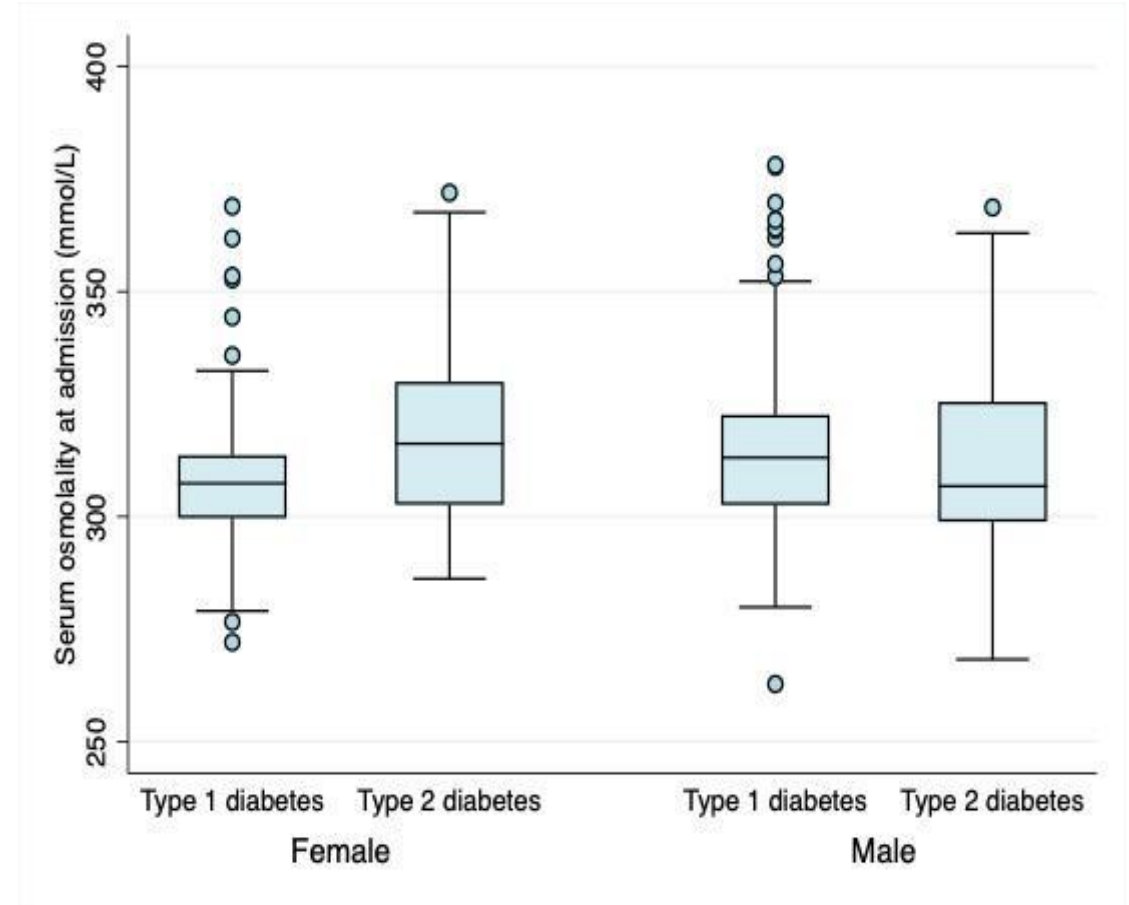
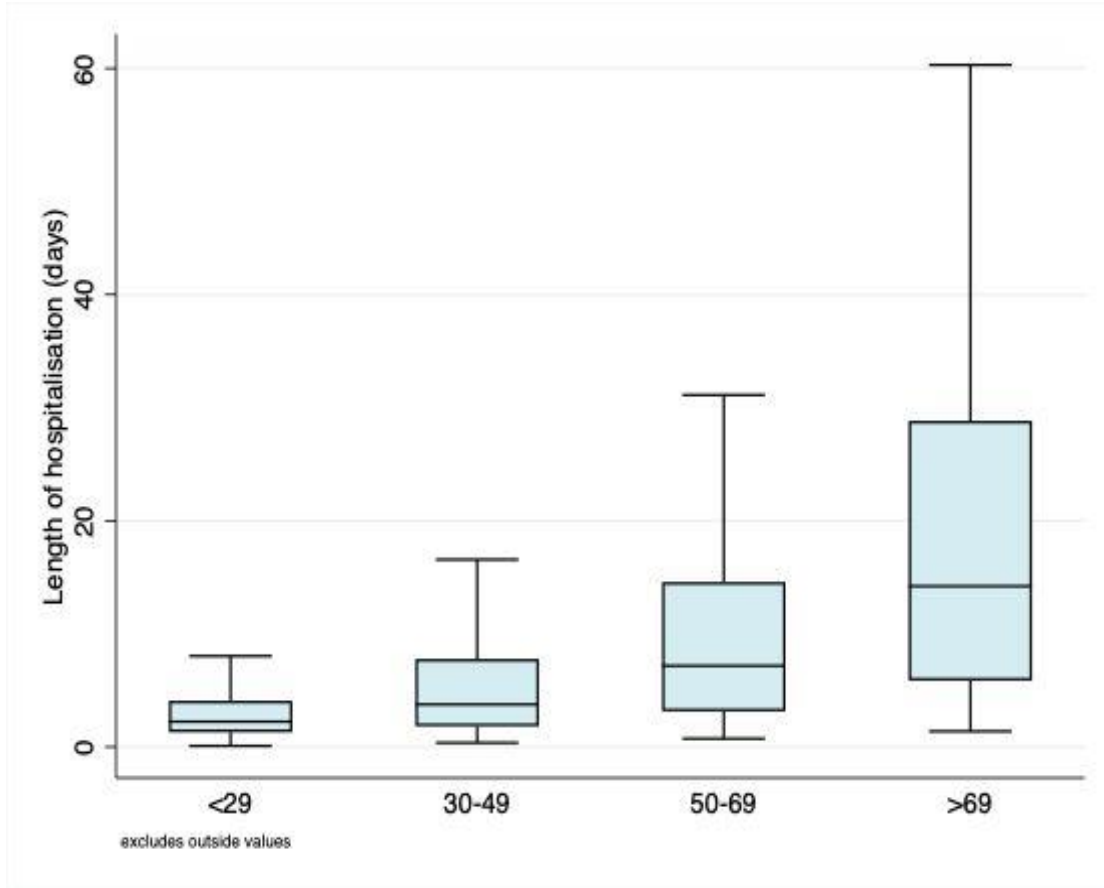
DKA duration



Length of hospitalisation



Age and sex-based differences



Hyperosmolar hyperglycaemic state (HHS) guidelines

Diagnosis and Initial Management

Diagnostic criteria:

1. Hyperglycaemia: plasma glucose ≥ 33 mmol/L
2. Hyperosmolality: total serum osmolality ≥ 320 mOsm/kg
3. NO significant ketonaemia (≤ 3 mmol/L) or ketonuria ($< 2+$)
4. NO significant acidosis: pH ≥ 7.3 and bicarbonate ≥ 15 mmol/L

Mixed DKA/HHS

1. Marked hypovolaemia
2. Marked hyperosmolality
3. pH < 7.3 and
4. Blood ketones > 3.0 mmol/L or ketonuria ($\geq 2+$)

Follow DKA guidelines if above criteria met

Initial treatment

- Calculate osmolality (mOsm/kg) = $(2 \times \text{Na}^+) + \text{glucose} + \text{urea}$
- IV fluids (0.9% sodium chloride) at 1L/h in severe hypovolaemia. Caution advised in heart failure, CKD or body weight < 50 kg
- Fixed rate insulin (0.05 units/kg/hr Actrapid) **ONLY** if ketones between 1 and 3 mmol/L or mild ketonuria ($< 2+$)
- Identify and treat the underlying precipitating cause for HHS
- Ensure early referral to diabetes team for ongoing management

Further management

Fluids

- Assess hydration status
 - Severe hypovolaemia → 0.9% sodium chloride at 1L/h.
 - Mild hypovolaemia → 0.9% sodium chloride at clinically appropriate rate to replace 50% of estimated fluid deficit by the first 8 – 12h.
 - Cardiac compromise → monitor haemodynamic status/ vasopressors.
- Commence 5% or 10% dextrose at 125ml/hr if glucose < 14 mmol/L **AND** patient is on intravenous insulin infusion.
- Aim for replacement of all fluid deficit by 24h.

Insulin

- 0.05 units/kg/h of Actrapid as fixed rate intravenous infusion only if ketones between 1 & 3 mmol/L or ketonuria ($< 2+$).
- Do not stop long-acting insulin if using pre-admission.
- Restart short acting insulin once patient able to eat and drink. Continue IV insulin infusion for 1-2h after SC.
- If first presentation of diabetes, liaise with the diabetes team to commence regular insulin.

Potassium

- < 5 mmol/L → 10 – 20 mmol/L to maintain serum K^+ at 4 – 5 mmol/L.
- > 5.0 mmol/L → commence insulin & check serum K^+ every 2h.
- > 6.0 mmol/L → senior review/ICU outreach.

Monitoring

Hourly

- **Ketones**
- **Glucose** - Aim decline 5mmol/L/h. Target glucose 11.0 – 14 mmol/L until resolution.
 - Decreasing < 5 mmol/L/h:
 - If there is a negative fluid balance & no signs of fluid overload, increase the rate of 0.9% sodium chloride.
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2 – 4 hourly until stable

- **Electrolytes, renal function, venous pH**
- **Osmolalities** - 2hrly up to 12h and 4hrly between 12-24h
 - Aim 3-8 mOsm/kg/h decrease in osmolality
 - Decreasing 3-8 mOsm/kg/h → Continue the same rate of fluids.
 - Decreasing by < 3 mOsm/kg/h → Increase rate of 0.9% sodium chloride (if no fluid overload).
 - Decreasing > 8 mOsm/kg/h → Consider reducing the fluid rate and/or insulin (if started).
 - Increasing osmolalities
 - Negative fluid balance → Increase rate of 0.9% sodium chloride.
 - Adequate fluid balance → Consider switching to 0.45% sodium chloride at same rate.

Resolution criteria:

1. Calculated serum osmolality < 300 mOsm/kg
2. Corrected hypovolaemia (urine output ≥ 0.5 ml/kg/h)
3. Blood glucose < 14 mmol/L

- If any queries or concerns, please contact the diabetes registrar on-call between 0900 and 1700 during weekdays or the general medical registrar on call during out-of-hours.
- Please refer the patient to the diabetes team via PICS at the earliest opportunity to ensure timely input.
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Fluids - Assess hydration status - Severe hypovolaemia → 0.9% sodium chloride at 1L/h. - Mild hypovolaemia → 0.9% sodium chloride at clinically appropriate rate to replace 50% of estimated fluid deficit by the first 8 – 12h. - Cardiac compromise → monitor haemodynamic status/ vasopressors. - Commence 5% or 10% dextrose at 125ml/hr <u>if glucose < 14 mmol/L AND patient is on intravenous insulin infusion.</u> - Aim for replacement of all fluid deficit by 24h.	Insulin 0.05 units/kg/h of Actrapid as fixed rate intravenous infusion only if ketones between 1 & 3 mmol/L or ketonuria ($< 2+$). - Do not stop long-acting insulin if using pre-admission. - Restart short acting insulin once patient able to eat and drink. Continue IV insulin infusion for 1-2h after SC . - If first presentation of diabetes, liaise with the diabetes team to commence regular insulin.	Potassium < 5 mmol/L → 10 – 20 mmol/L to maintain serum K^+ at 4 – 5 mmol/L. > 5.0 mmol/L → commence insulin & check serum K^+ every 2h. > 6.0 mmol/L → senior review/ICU outreach.

Hyperosmolar hyperglycaemic state (HHS) guidelines Diagnosis and Initial Management		
Diagnostic criteria: - Hyperglycaemia: plasma glucose ≥33 mmol/L - Hyperosmolality: total serum osmolality ≥320mOsm/kg - NO significant ketonaemia (≤3mmol/L) or ketonuria (< 2+) - NO significant acidosis: pH≥7.3 and bicarbonate ≥15mmol/L		Mixed DKA/HHS - Marked hypovolaemia - Marked hyperosmolality - pH <7.3 and - Blood ketones >3.0 mmol/L or ketonuria (≥ 2+) Follow DKA guidelines if above criteria met
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RESEARCH ARTICLE



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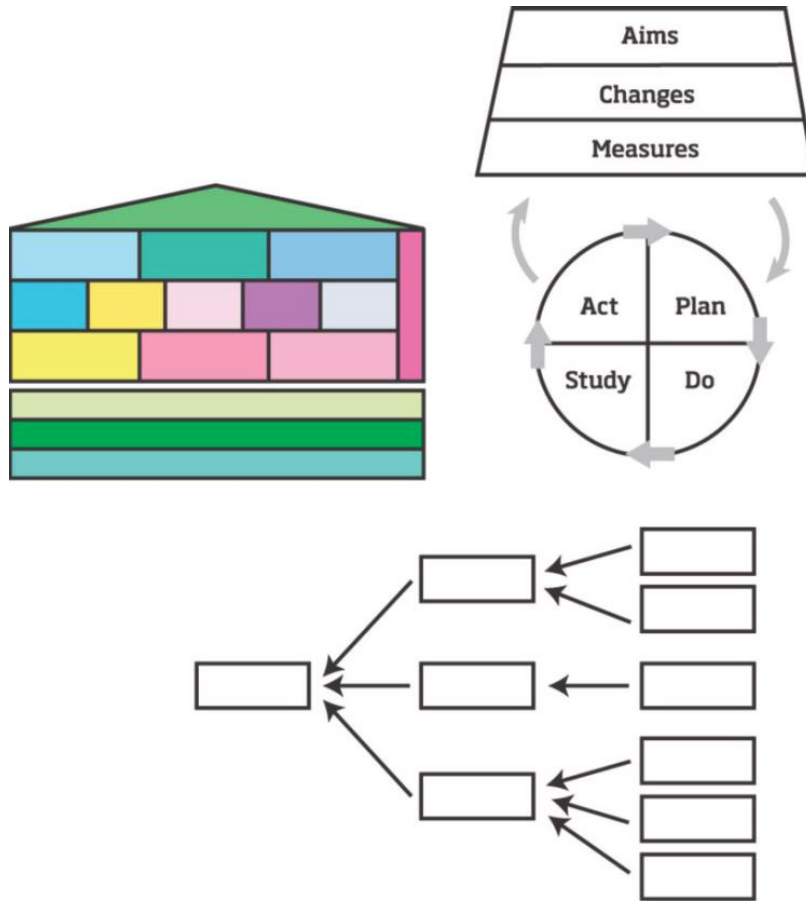


Guidelines for the management of diabetes-related ketoacidosis (DKA) have been poorly adopted and implemented, resulting in a lack of improvement in outcomes

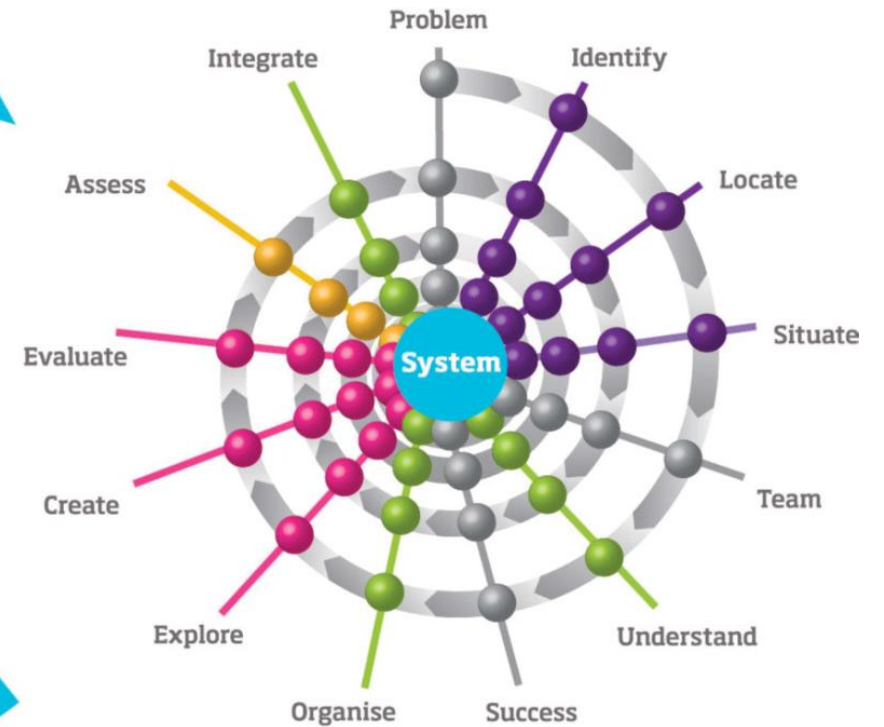
Angelica Sharma, Lakshmi Rengarajan, Parth Narendran, Ketan Dhatariya, Punith Kempegowda ,
DEKODE Working Group

First published: 10 February 2025 | <https://doi.org/10.1111/dme.70010>

Quality Improvement

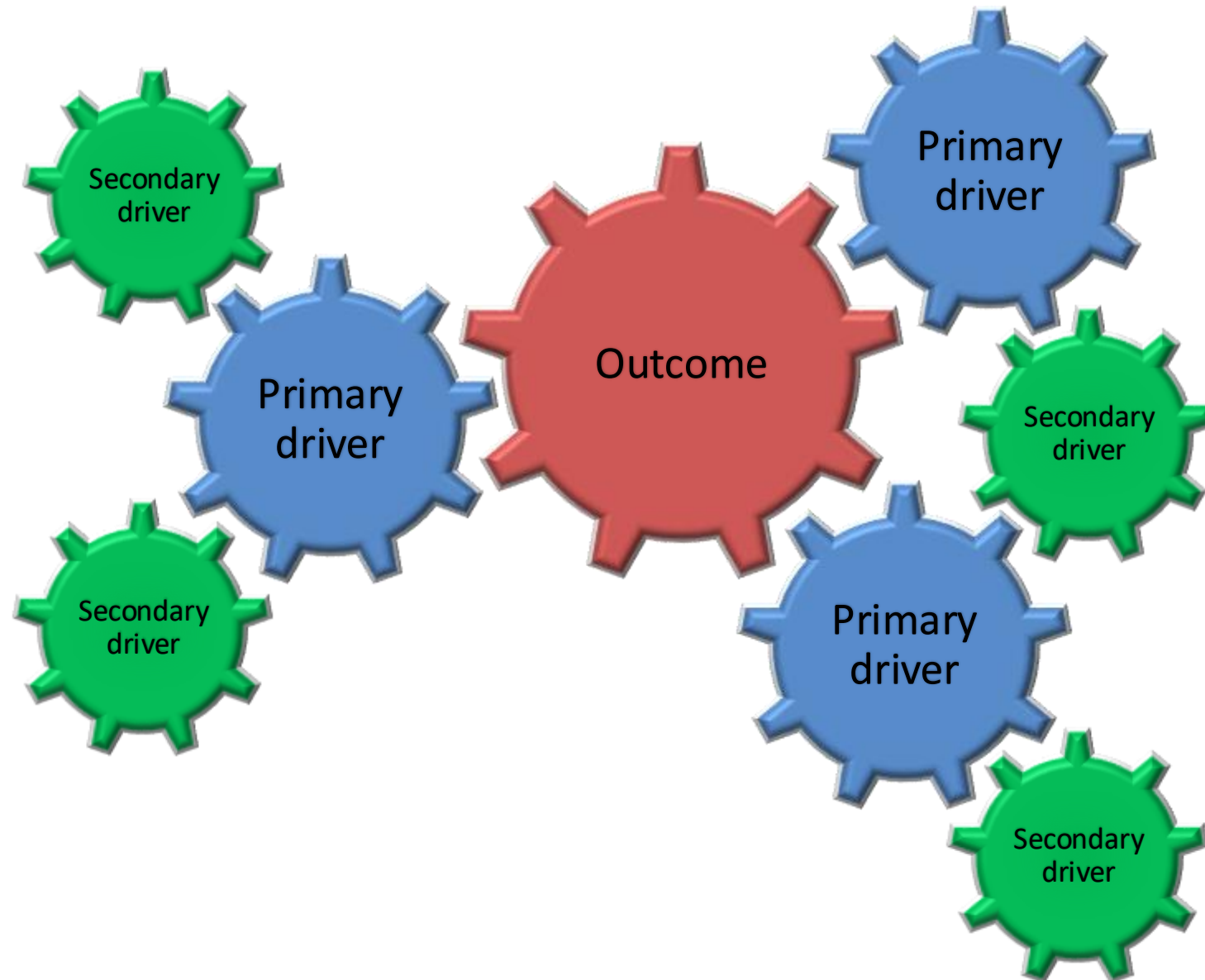


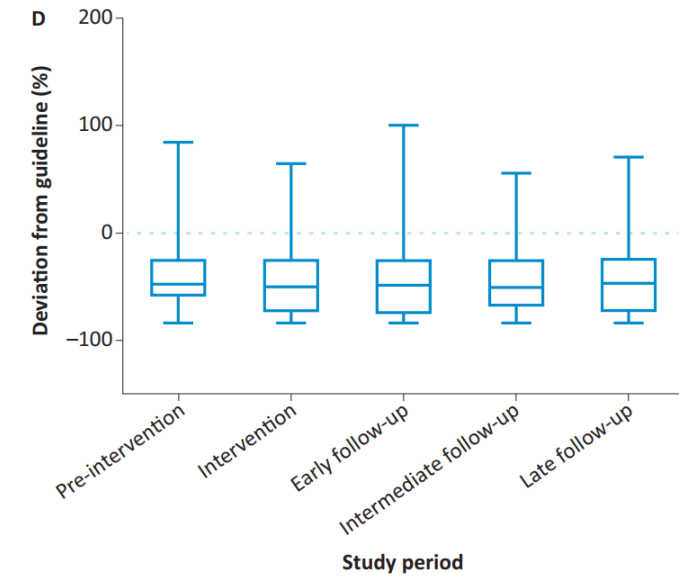
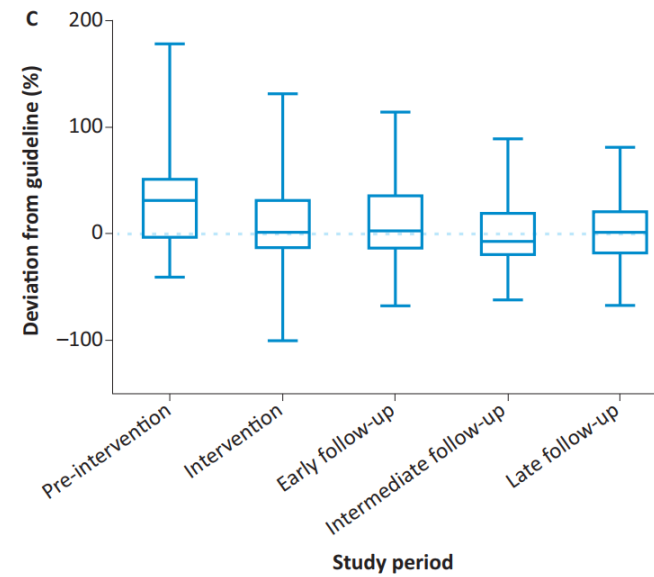
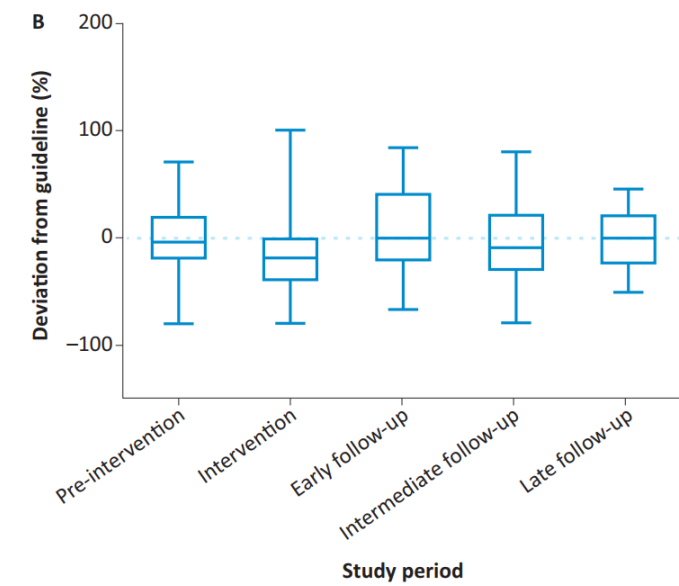
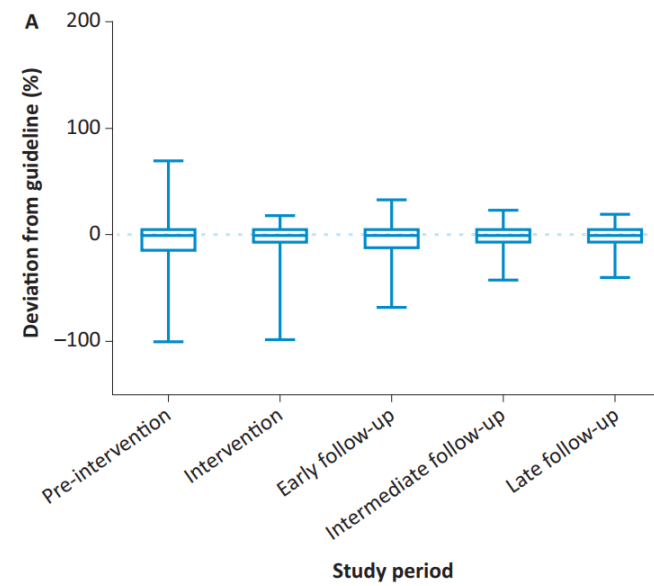
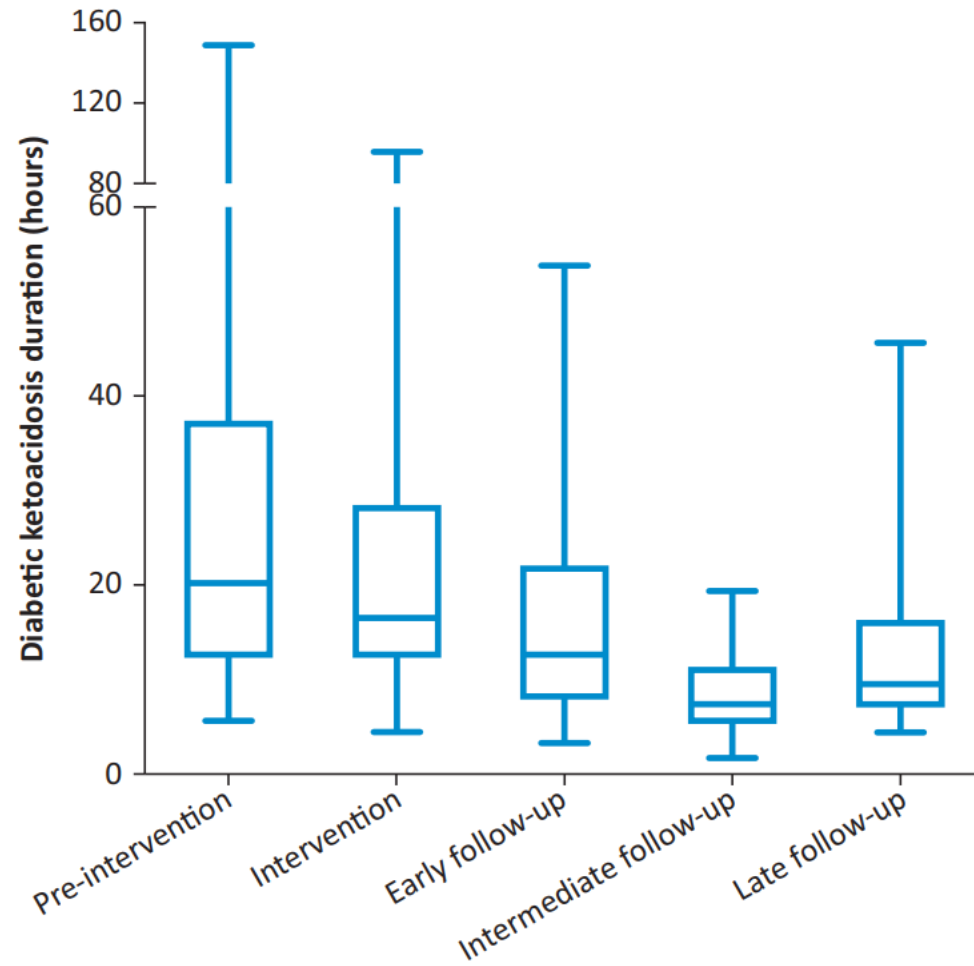
Improvement tools



Systems approach







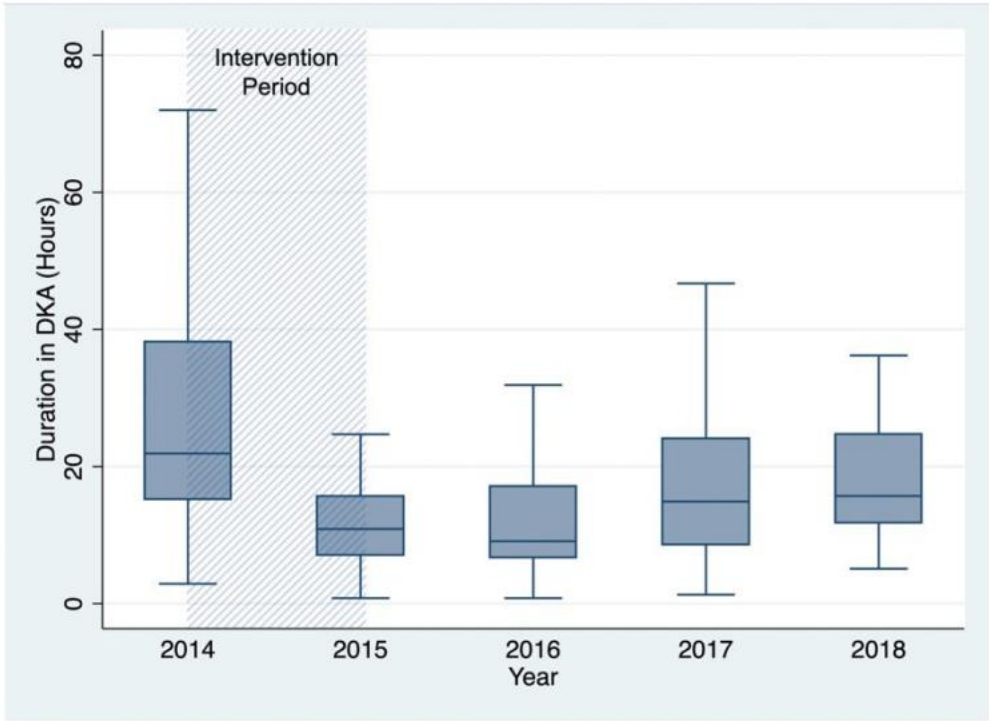
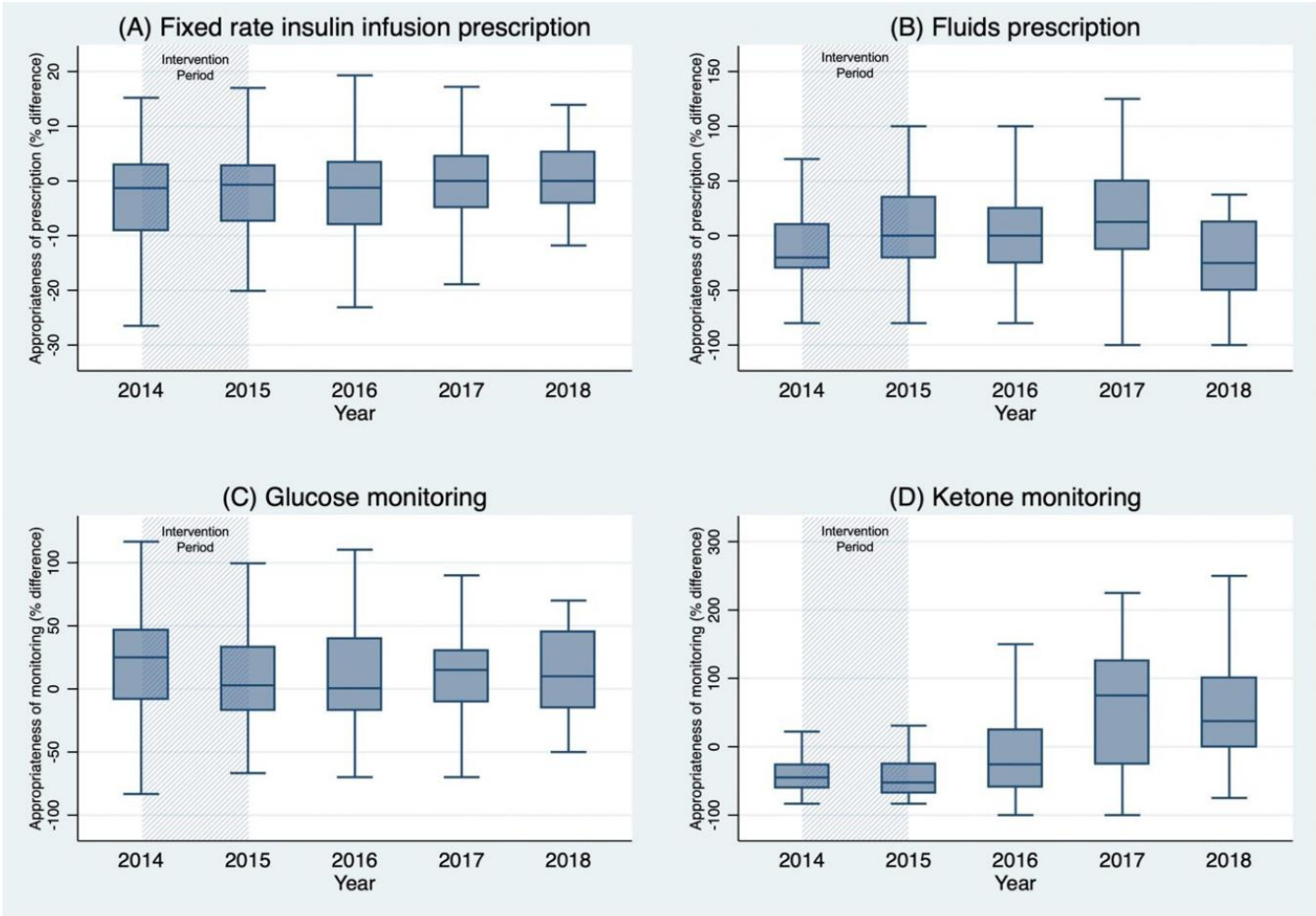


Figure 5 Duration of DKA per year. DKA, diabetic ketoacidosis.



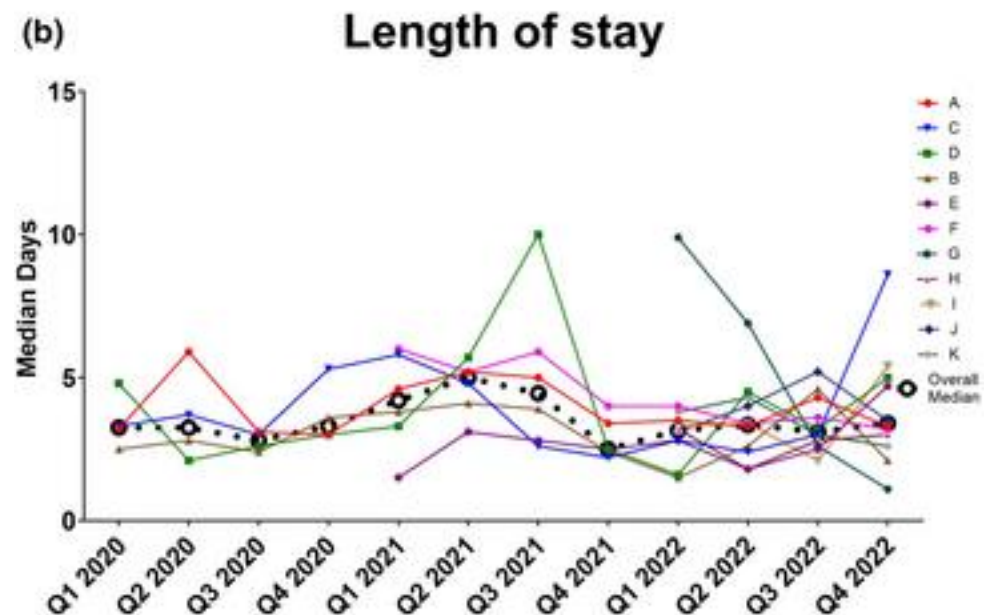
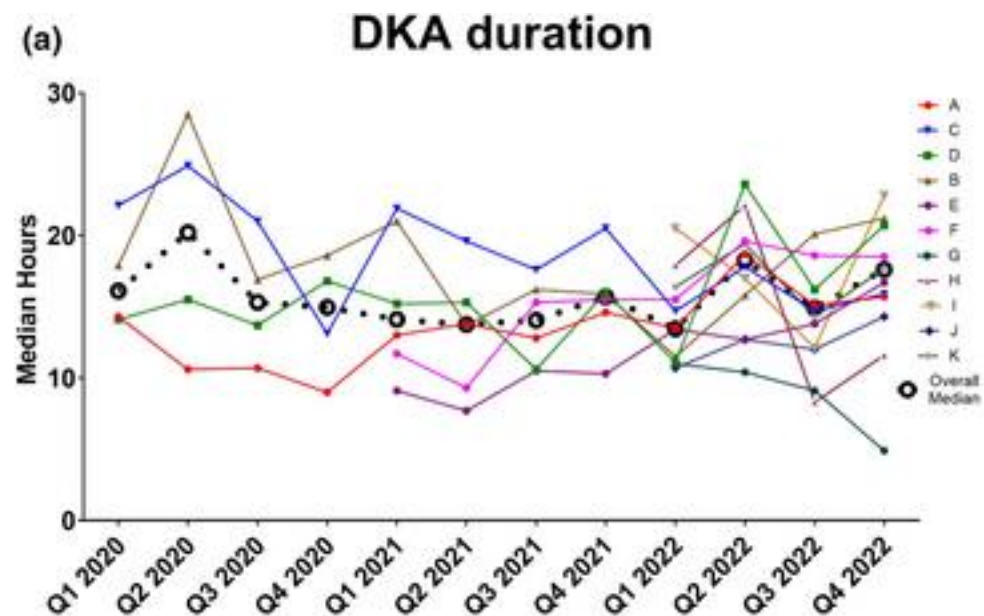
DEKODE—A cloud-based performance feedback model improved DKA care across multiple hospitals in the UK

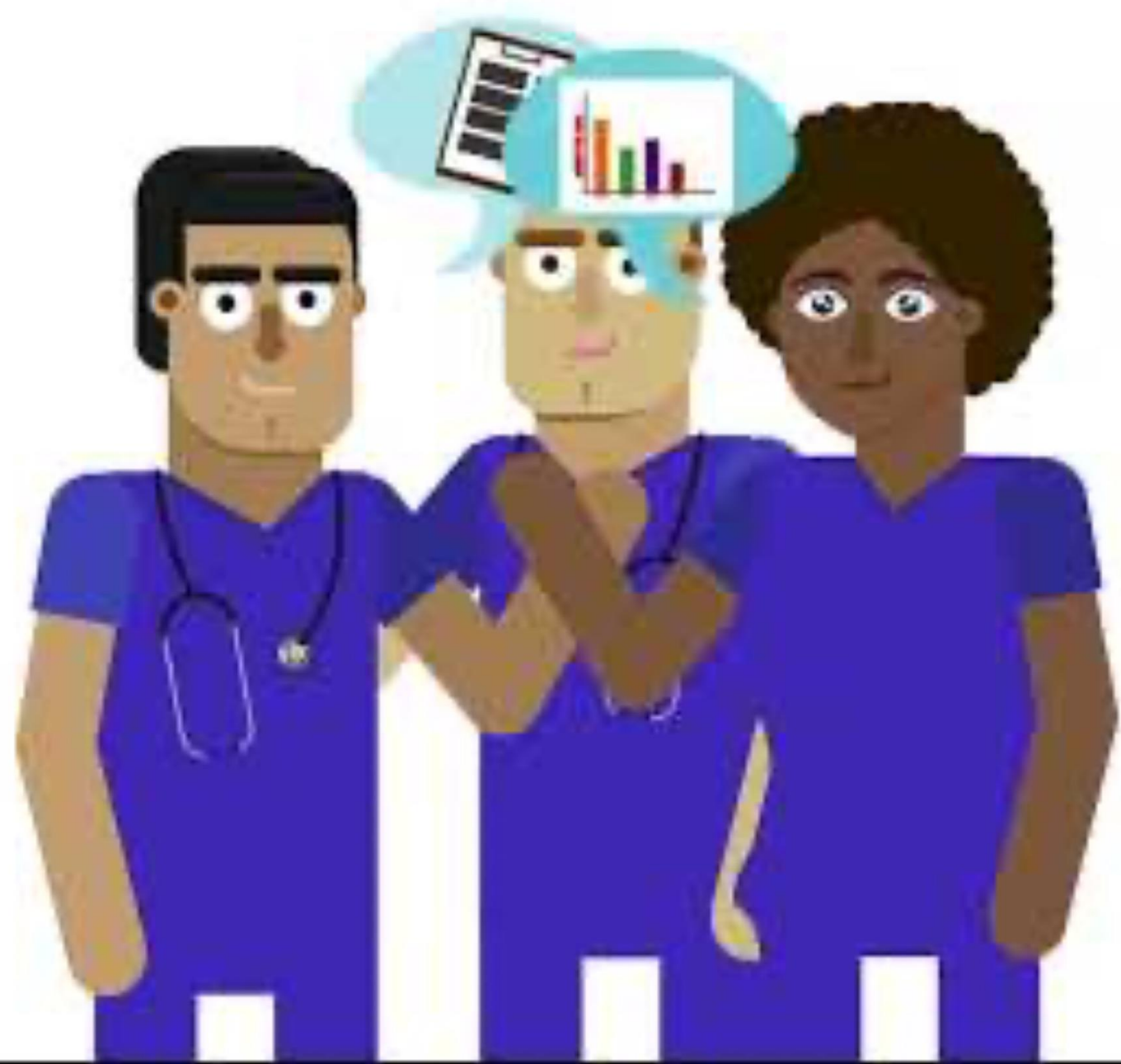
Lakshmi N. Rengarajan, Catherine Cooper, Kashish Malhotra, Angelica Sharma, Nevil Philip, Anu Ann Abraham, Ketan Dhatariya, Parth Narendran, Punith Kempegowda ✉, DEKODE and DEVI Group

First published: 17 February 2025 | <https://doi.org/10.1111/dme.70004>

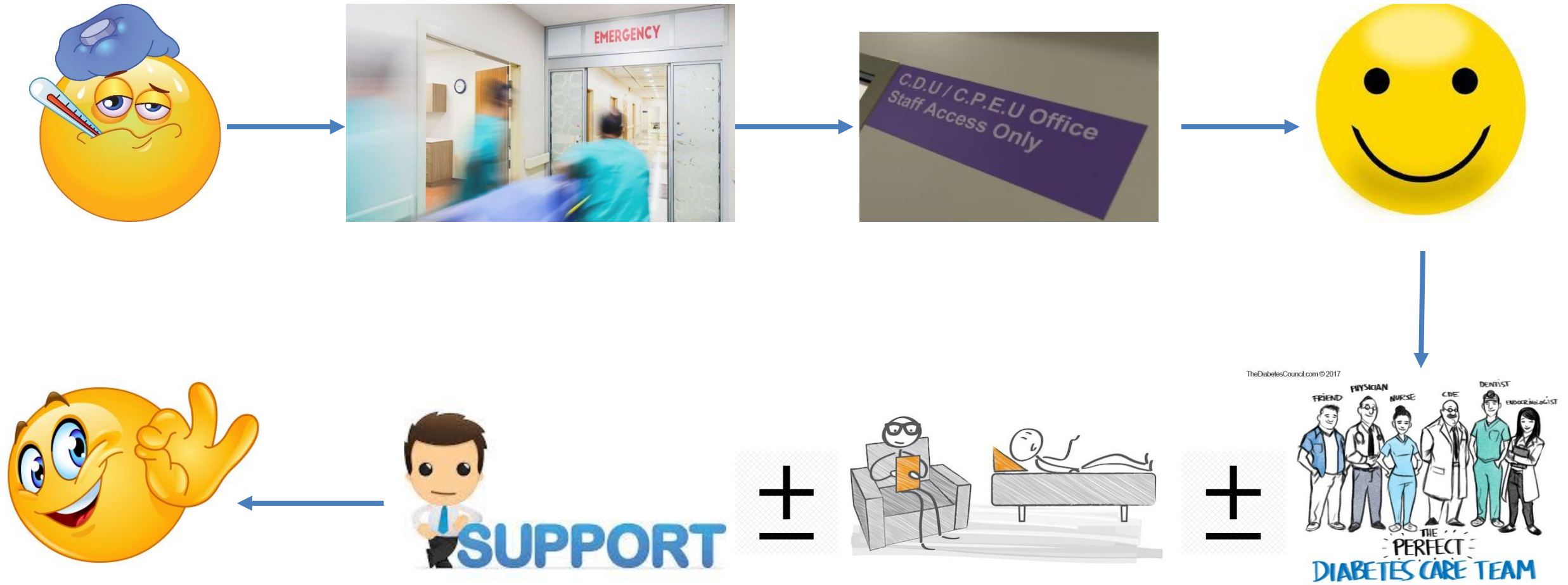
What are the implications of the study?

- We demonstrate a sustainable QIP that improves adherence to national guidelines in some indicators for DKA care and serves as an early warning system to identify adverse trends.





DKA journey



Unanswered questions

Guidelines driven by expert consensus rather than systematic literature review

How about end-user perspectives

Variation in real-world care

Factors influence care after diabetes emergency resolution

And what about the post-discharge care

... and more

JEDI

Juniors for Education Dissemination & Implementation



Nevil Philip

- Implementing DEKODE



Amynta Arshad

- Best way to teach D&E



Lucy Bompfrey

- Studying Recurrent DKA



James French

- Systematic review of HHS



Kalyaani Persad

- National Coordinator DEKODE



Aspasia Manta

- Variation in DKA care



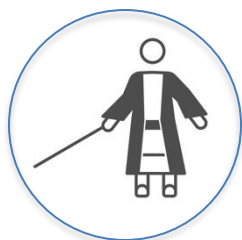
Maitreyi Redkar

- End user perspectives



Aqeelah Khatoon

- Post-diabetes emergencies care



Summary



Hyperglycaemic emergencies are life-threatening & need immediate & appropriate care



The main pillars of treatment are fluids and insulin



Glucose and potassium should be appropriately replaced to prevent complications



It involves a multitude of specialities and varying grades of HCP to provide the best care.



Regularly review your service to ensure the best care is provided



Scan here to know
more and join the
DEKODE initiative.

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NIHR | Midlands Patient Safety
Research Collaboration



Association of
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Diabetologists**



Acknowledgements

All members of the
DEVI collaboration



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