



Diabetes Related Emergencies

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Topics to Cover

- DKA
- HHS
- Hypoglycaemia
- The 'Diabetic Foot'

DKA

A Brief History



Howard Root in Boston reports reduction in mortality from 12% to 1.6% between 1940 and 1944 – using up to 1770 units of insulin in the 1st 24h after admission

Malins and Black in Birmingham used between 140 and 1400 units of insulin in the first 24h depending on severity in 170 consecutive cases



Type 1 diabetes universally fatal

Joslin reports that 31 out of 33 patients with DKA survive – with gentle fluid replacement

Micks in Dublin used 100 units for those in 'pre-coma' and 100 units every 15 minutes - between 500 and 2000 units depending on severity of coma

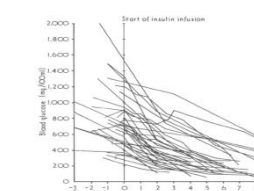
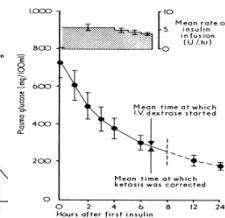
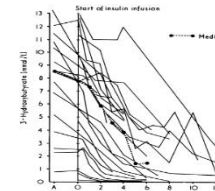


FIG. 1—Individual plasma glucose concentrations during insulin infusion.



RD Lawrence advocates very aggressive fluid management

3 consecutive papers in the BMJ showed that low dose insulin infusions (5-6 units/hr) work just as well as high dose in lowering glucose & ketones

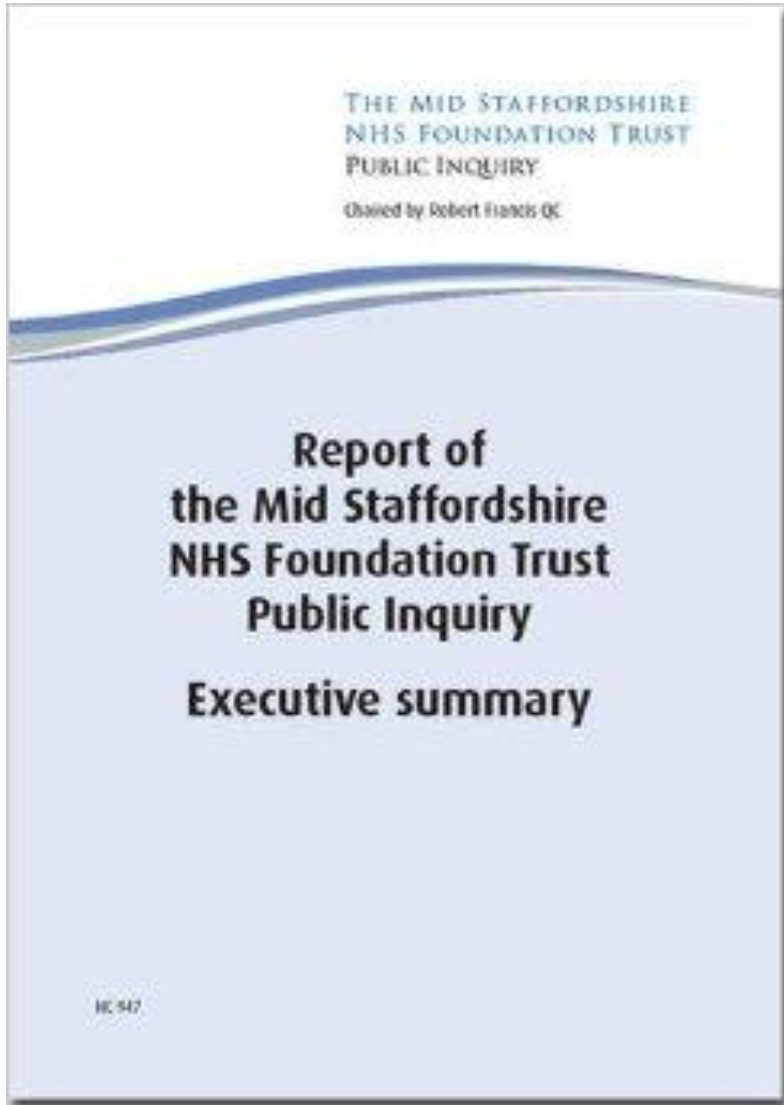
So...

- DKA was treated with
 - Fluid
 - Intravenous insulin
 - Potassium
 - \pm bicarbonate & phosphate

But how much and how fast?

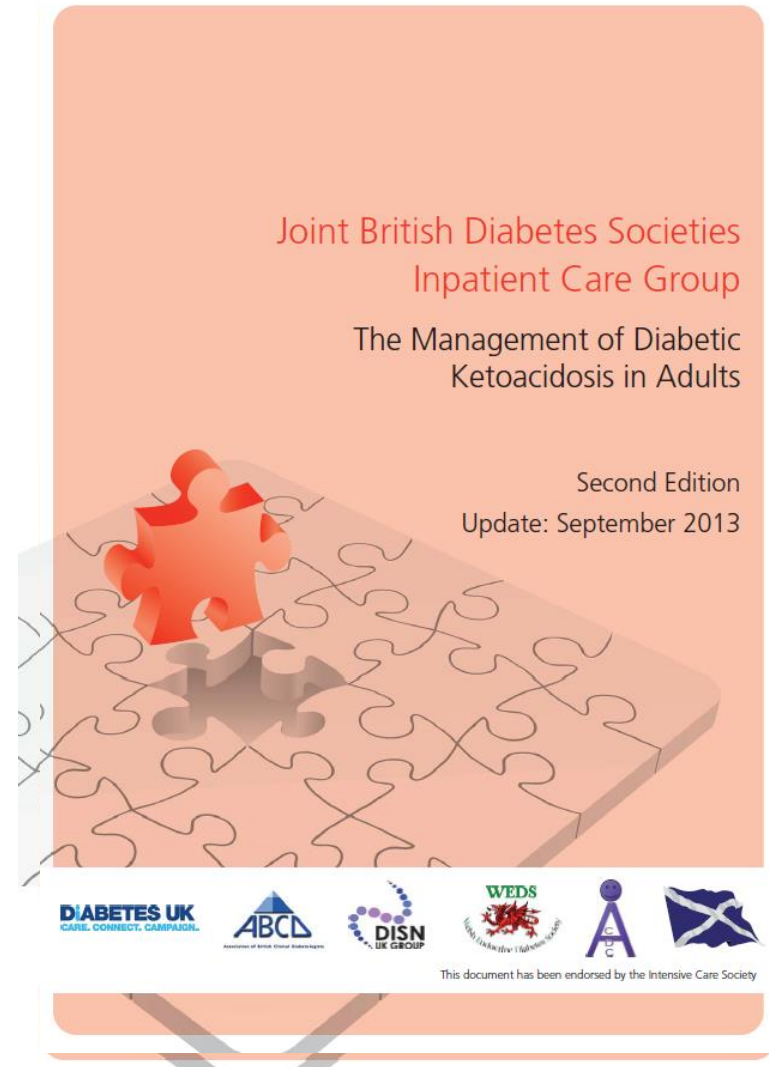
Danger

Part of this reports talks about variation in care – and the problems that led from these



Where Are We Now?

- In 2010 the JBDS produced a guideline on the management of DKA
- With > 20,000 hard copies given out or downloaded
- An updated guideline was published in late 2013
- A national survey was conducted in Autumn 2014



Overall Quality of JBDS Guidelines

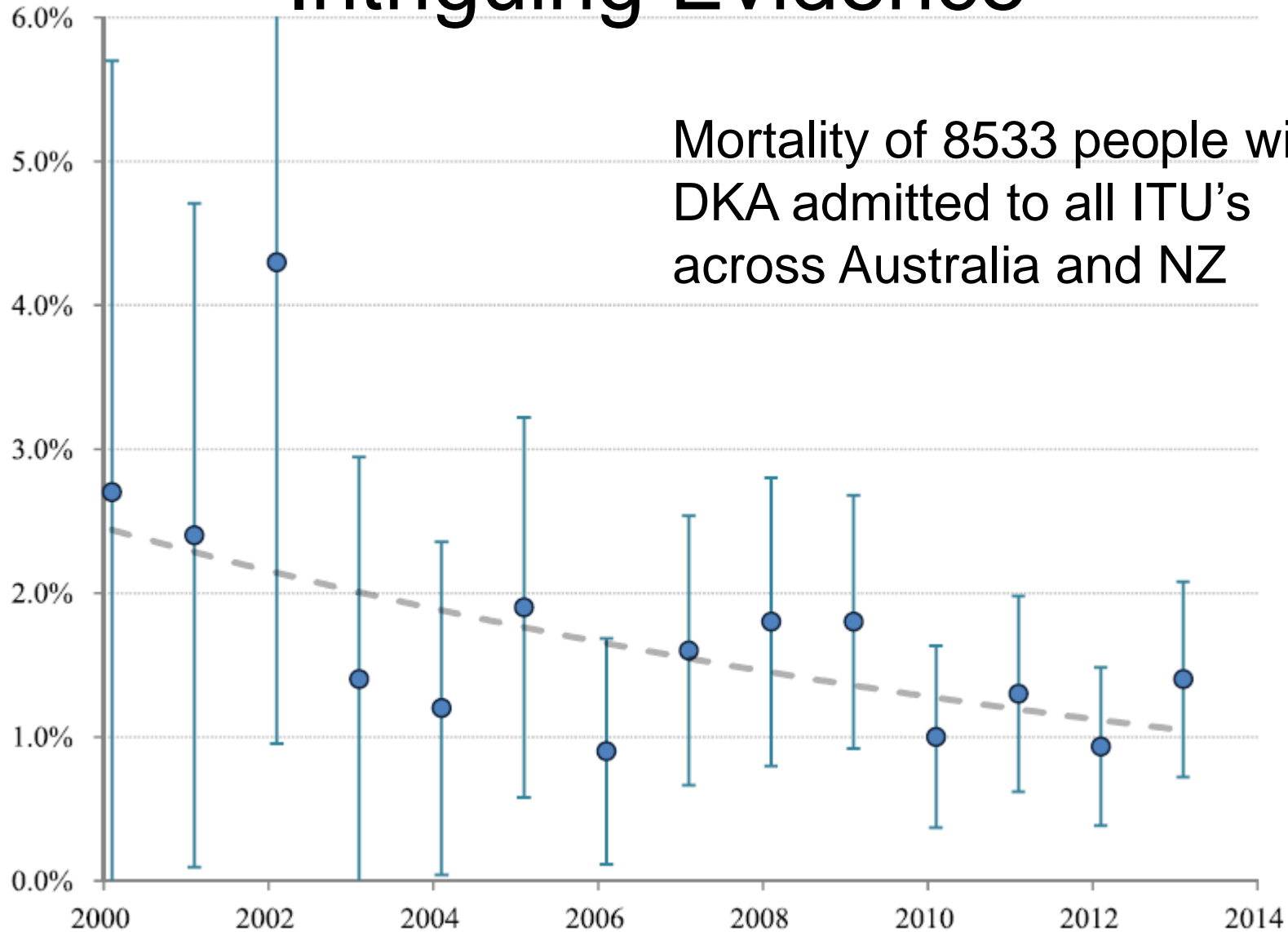


Over 90% of respondents rated the guidelines as 'Excellent' or 'Good'

A Question

- How do we know that what we are doing is correct?

Intriguing Evidence



Where Are We Going?

Joint British Diabetes Societies Inpatient Care Group

Data collection tool for the Management of Diabetic Ketoacidosis (DKA) in Adults

(Admission to Discharge)

Name of Hospital: _____ Your grade Consultant SpR CMT DISN Other _____

Year diabetes diagnosed? _____ Age _____ Gender: Male Female

1. Ethnicity Not stated

White	Mixed	Asian / British Asian	Black / Black British	Other
<input type="checkbox"/> a) British <input type="checkbox"/> b) Irish <input type="checkbox"/> c) Any other white background	<input type="checkbox"/> d) White /Black Caribbean <input type="checkbox"/> e) White / Black African <input type="checkbox"/> f) White and Asian <input type="checkbox"/> g) Any other mixed background	<input type="checkbox"/> h) Indian <input type="checkbox"/> i) Pakistani <input type="checkbox"/> j) Bangladeshi <input type="checkbox"/> k) Any other Asian	<input type="checkbox"/> l) Caribbean <input type="checkbox"/> m) African <input type="checkbox"/> n) Any other Black background	<input type="checkbox"/> o) Chinese <input type="checkbox"/> p) Any other ethnic group

2. Date / time of Admission: (dd/mm/yy hh:mm) 3. Date / time of Discharge: (dd/mm/yy hh:mm)

4. Did this episode of DKA occur in someone who was already an inpatient? Yes No Not recorded

5. How many previous admissions for DKA have they had in the last 12 months?..... 6. Date of death(dd/mm/yy)

7. Cause(s) of death: 1)..... 2)..... 3).....

Diagnosis of DKA (Where appropriate please put a x in the box)

8) Was the diagnosis confirmed according to diagnostic criteria? Yes No N/A

a) Blood ketones mmol/L	DIAGNOSIS OF DKA (JBDS): Ketonuria > 3.0mmol/L or significant ketonuria (more than 2+ on standard urine sticks) Blood glucose > 11.0mmol/L or known diabetes mellitus Bicarbonate (HCO ₃ ⁻) < 15.0mmol/L and/or venous pH < 7.3	10. Was treatment area?
b) Urine ketones		<input type="checkbox"/> a) Level 1? (eg general ward area) <input type="checkbox"/> b) Level 2? (eg high dependency area) <input type="checkbox"/> c) Level 3? (eg ITU) <input type="checkbox"/> d) Acute medical unit? <input type="checkbox"/> e) A&E <input type="checkbox"/> f) Other? (please state)
c) Blood glucosemmol/L		9. If you use different diagnostic criteria for diagnosing DKA – please list them here
d) pH		11. Do you use the JBDS DKA guidelines?
e) Bicarbonatemmol/L		<input type="checkbox"/> a) Yes <input type="checkbox"/> b) No

Joint British Diabetes Societies Inpatient Care Group

Institutional Standards for the Management of Diabetic Ketoacidosis (DKA) in Adults (Complete one per Institution)

Name of Hospital:		Date form completed:	
Form completed by		Grade	

(Put N/A= not applicable or NR = not recorded)

1. Guidelines	Yes	No	Don't know
a) Do you have a DKA treatment pathway?			
b) Do you have local guidelines for managing DKA?			
c) Do you have an Integrated Care Plan (ICP) for DKA?			
d) Are your guidelines current and valid?			
e) What are your guidelines based on? <input type="checkbox"/> i) Joint British Diabetes Societies guidance? <input type="checkbox"/> ii) Other..... (please state)			

2. Staffing	Yes	No	Don't know
a) In the clinical areas where patients with DKA are initially cared for, do you have trained health care professionals available to measure blood ketone levels 24 hours per day?			
b) Do you have dedicated inpatient diabetes specialist nurses at a staffing level of 1WTE per 300 beds? If the answer is NO – what is your current DISN staffing level per 300 beds?.....WTE			
c) Do you have a clinical lead responsible for the implementation & audit of DKA guidelines?			

3. Monitoring	Yes	No	Don't know
a) In the clinical areas where patients with DKA are initially cared for, do you have the facility to measure blood ketones in your Trust?			
b) Do you have blood glucose testing meters that are centrally connected in your Trust?			

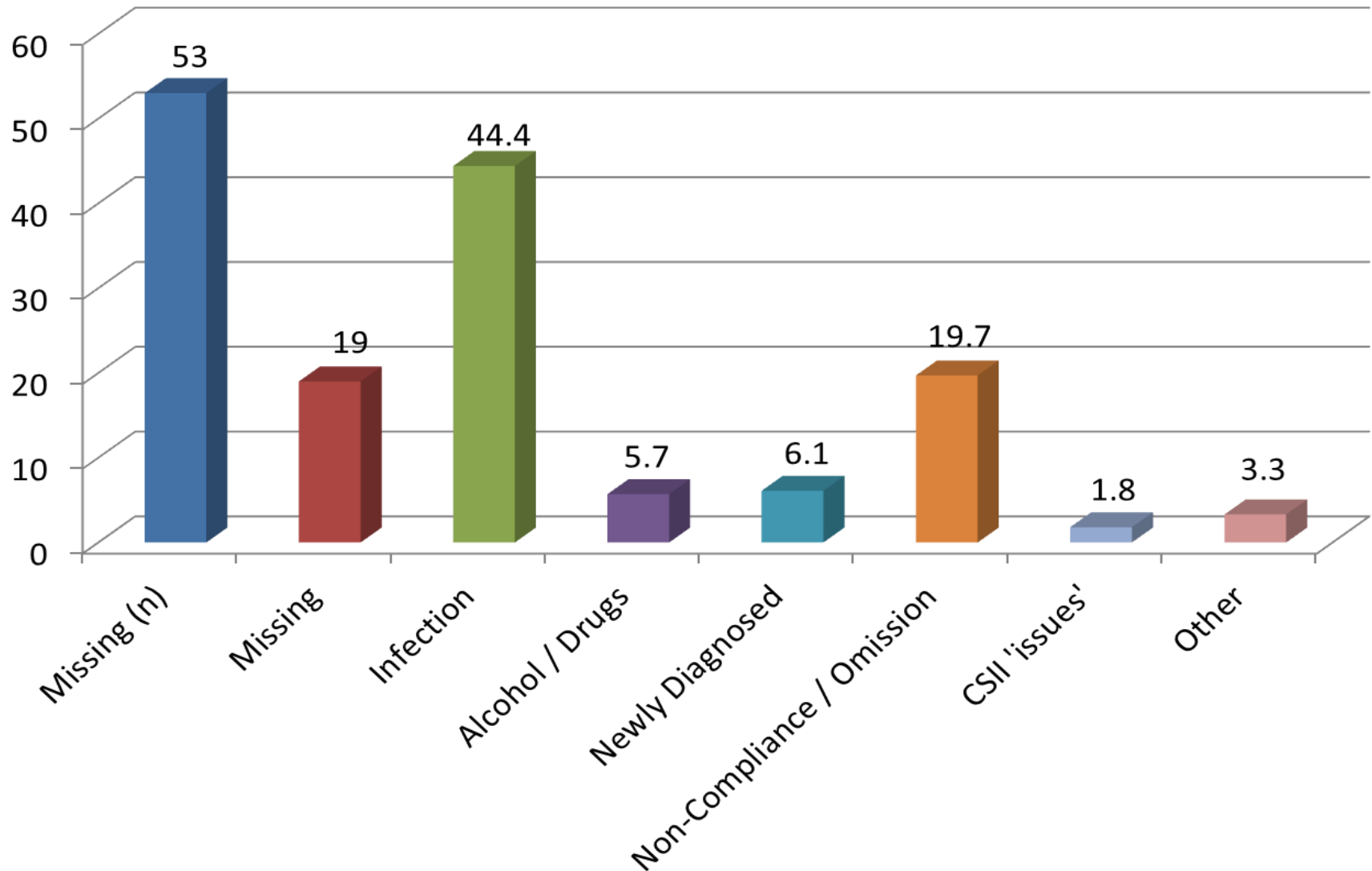
4. Audit / Education	Yes	No	Don't know
a) Do you have a quality assurance scheme in place for both glucose and ketone meters?			
b) Have you audited the outcomes of your patients admitted with DKA the last past?			
c) Do you monitor against performance indicators eg those listed in the JBDS guideline?			
d) Do you have a rolling educational programme for medical staff?			
e) Do you have a rolling educational programme for nursing staff?			

5. Patients	Yes	No	Don't know
a) Do your patients have access to the specialist diabetes team within 24 hours of admission?			
b) Do your patients have the choice to self-manage their diabetes?			

Results

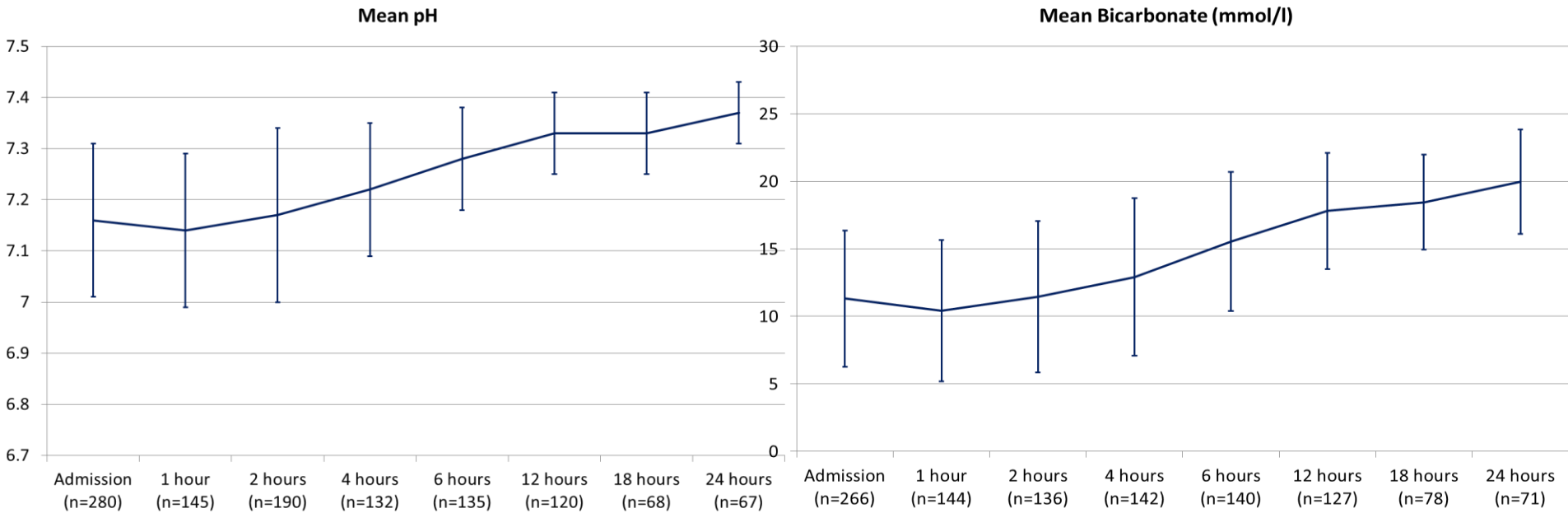
- 283 forms were received from 72 hospitals between May and November 2014
- There are hundreds of messages in the data!
- A few of the main ones are:

Precipitants (%)



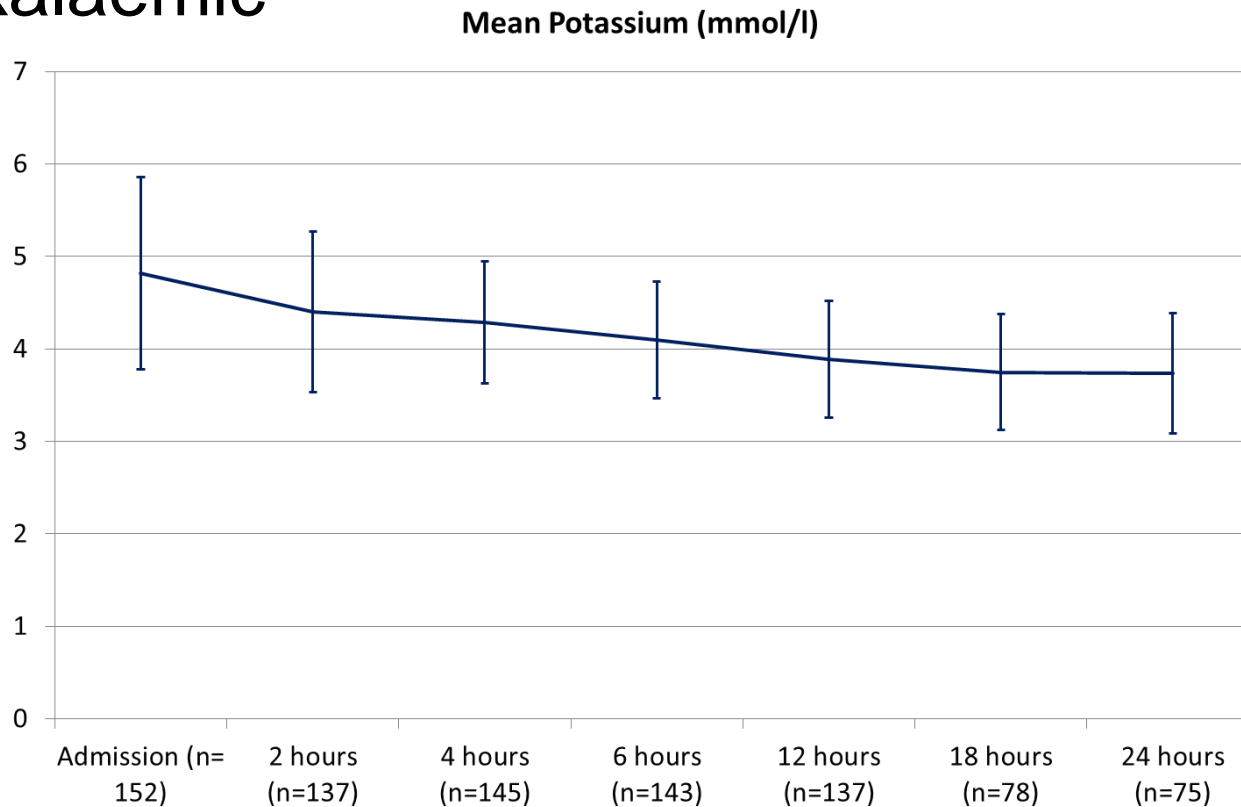
Fixed Rate Intravenous Insulin

- The use of 0.1 units/kg/hr led to excellent rises in pH and bicarbonate – so DKA resolved by 18.77 hours



Potassium

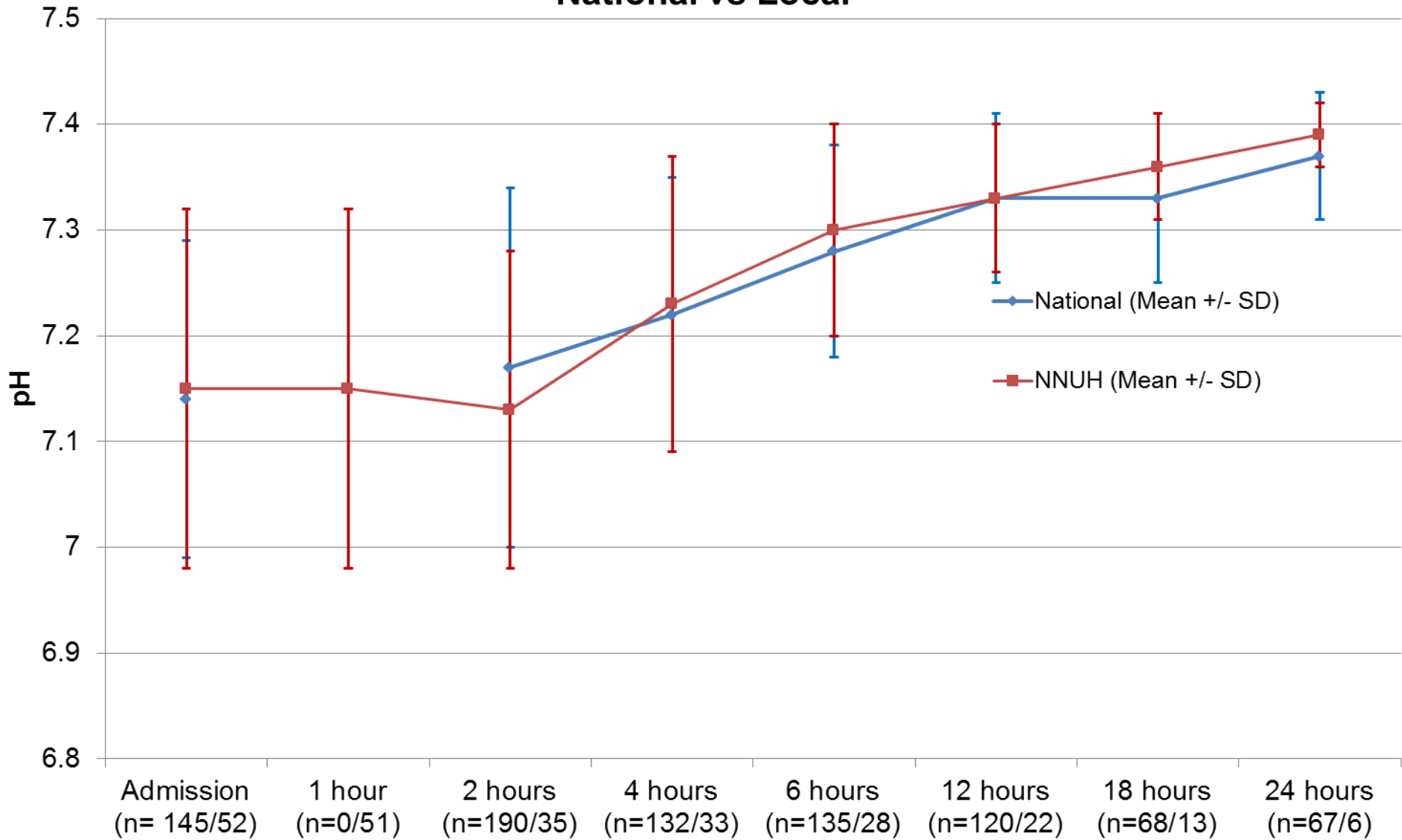
- But despite an aggressive potassium replacement regimen – more than 50% of patients became hypokalaemic



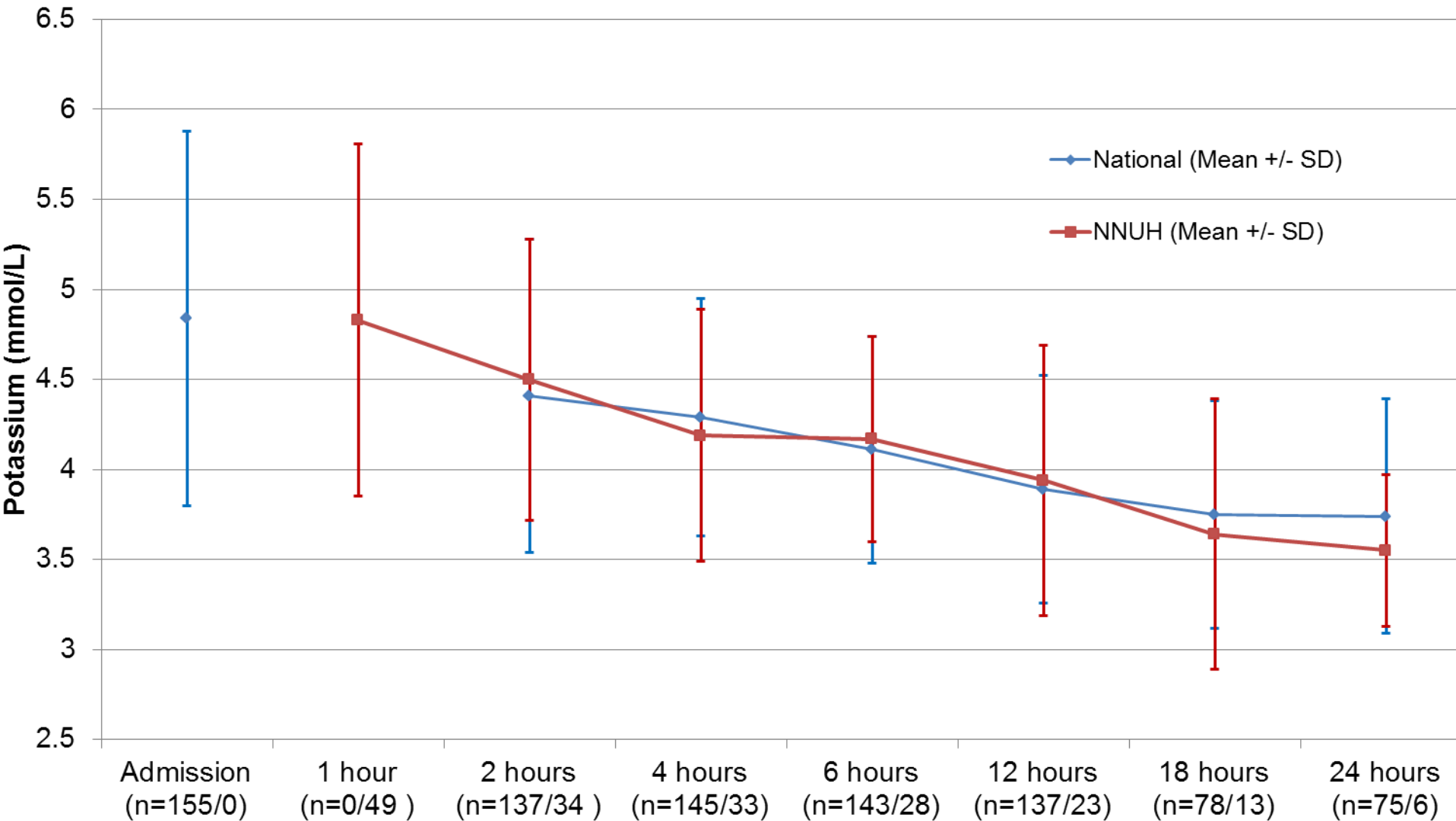
Which is Similar to other Data

- In 40 consecutive cases in a single centre in Canada
 - 38% developed significant hypokalaemia (<3.3mmol/l) during the first 48 hours
 - Most were preventable
 - Not stopping insulin during hypokalaemia
 - Inadequate potassium replacement

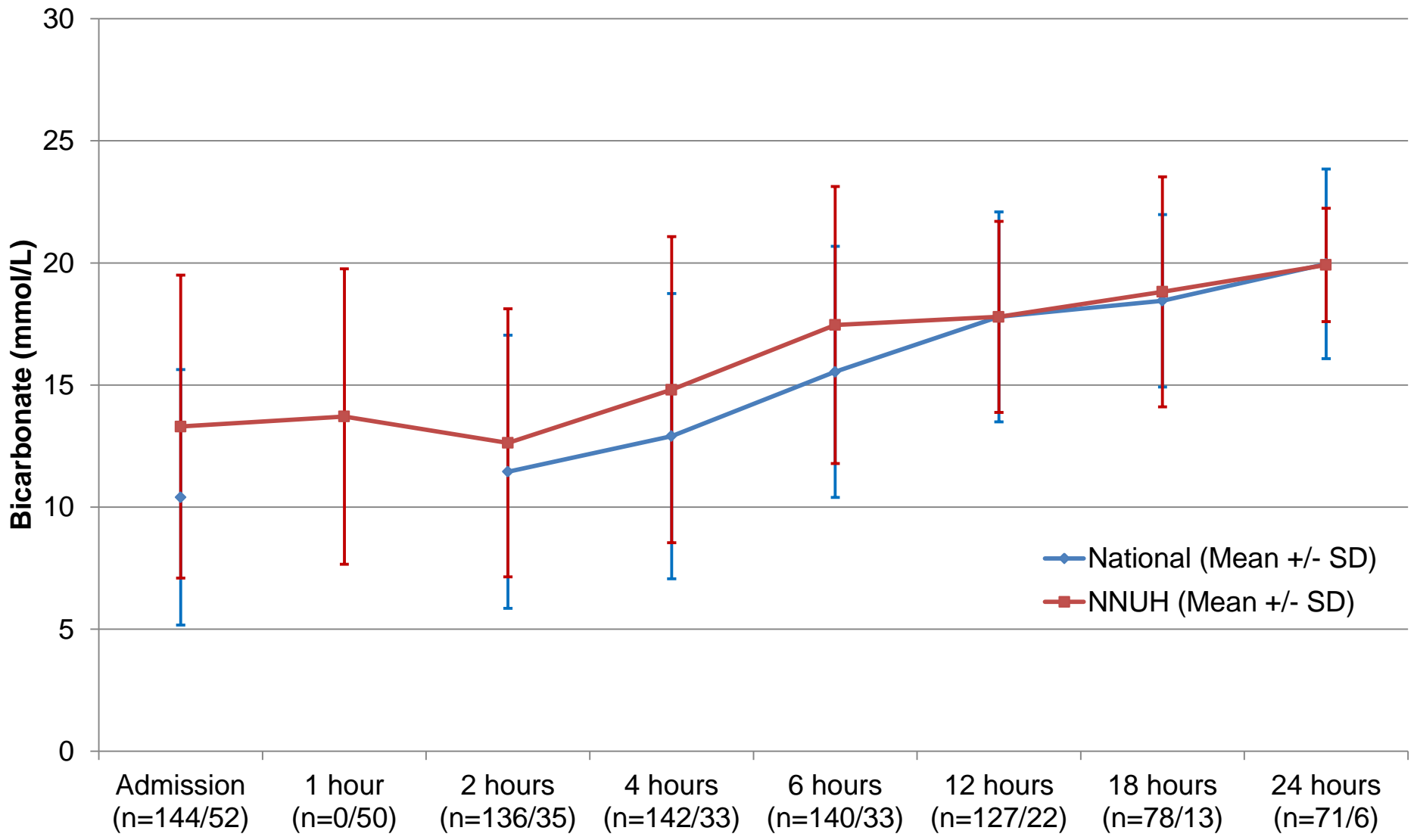
Comparison of pH Values of Patients Presenting with DKA - National vs Local



Comparison of Potassium Values of Patients Presenting with DKA - National vs Local



Comparison of Bicarbonate Values of Patients Presenting with DKA - National vs Local



Take Home Message

- Despite the existence of widely adopted national guidance – there are areas that need addressing
- Has the slow evolution of the ‘evidence’ resulted in ‘complacency’?
- We need to make sure the guidance that we give has a robust evidence base

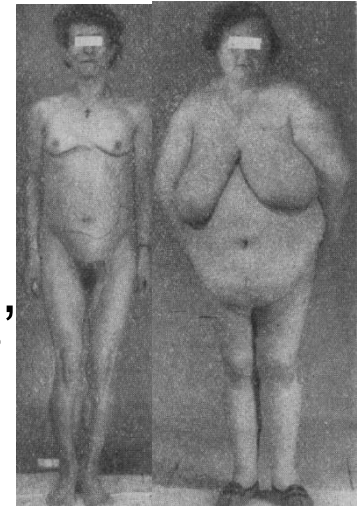
HHS

First Mention in English?

- On the 18th August 1886 by Dreschfeld in the Bradshawe Lecture at the Royal College of Physicians of London
 - Diabetic coma “though of small compass, is yet full of interest both to the physician and to the pathologist”
- He described 3 types of coma
 - Drowsiness, passing onto coma
 - An excited nervous system (resembling alcohol intoxication), then drowsiness and coma
 - Dyspnoea with acetone (the most frequent sort)

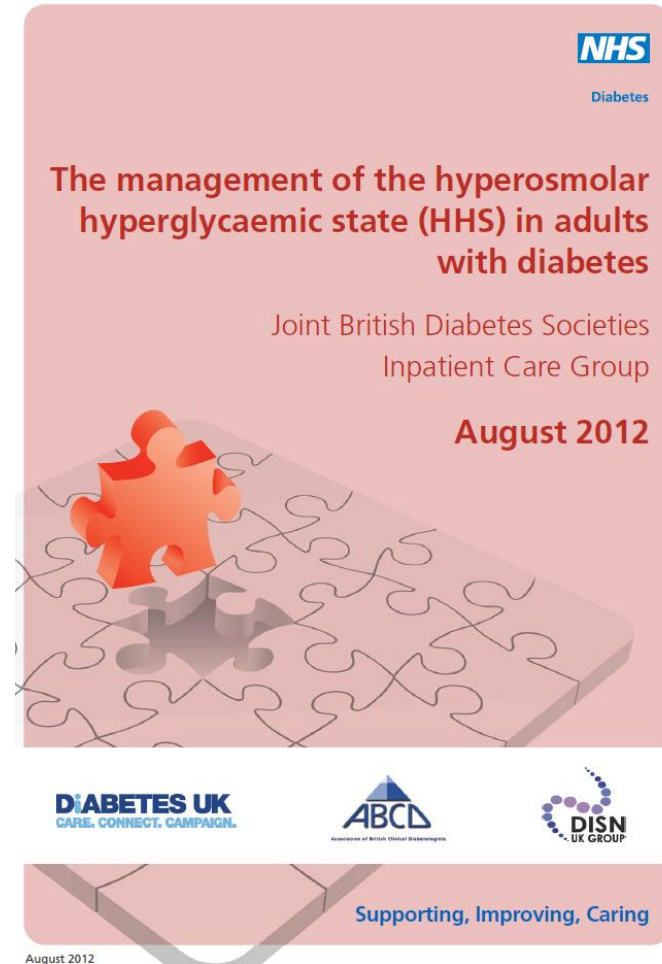
Early Mentions of Non Ketotic Diabetes

- RD Lawrence in 1951
 - Described ‘lipo-plethoric’ or ‘fat diabetics’
 - And the rarer ‘lipo-atrophic’ or ‘thin diabetics’
 - This was associated with ‘intense lipidaemia’
- Sament and Schwartz in 1957 describe a case where 270 units of insulin reduced glucose from 87mmol/L to 39mmol/L
 - describing much greater insulin sensitivity compared to DKA



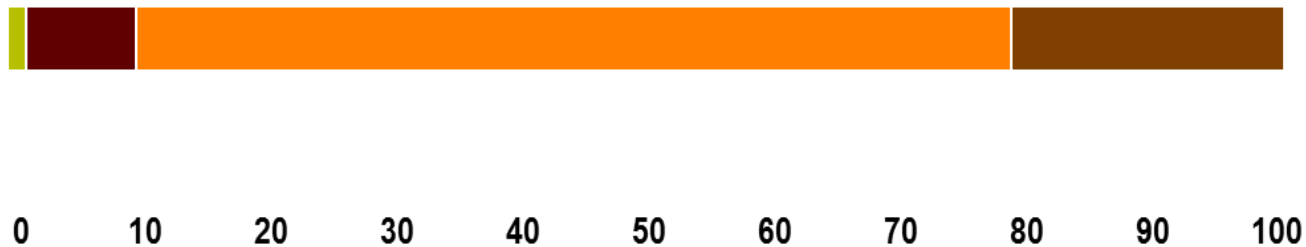
Joint British Diabetes Societies for Inpatient Care

- In August 2012 JBDS published a national guideline on the management of HHS



Overall Quality of JBDS Guidelines

HHS



Response by category (%)

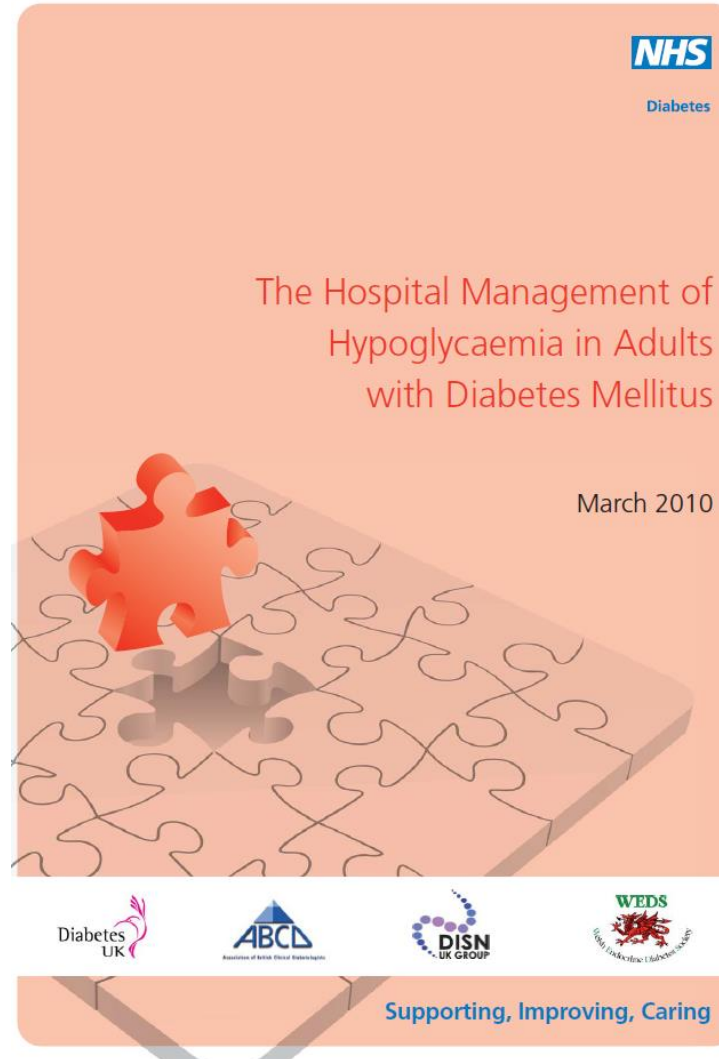
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ADA and JBDS HHS Definitions

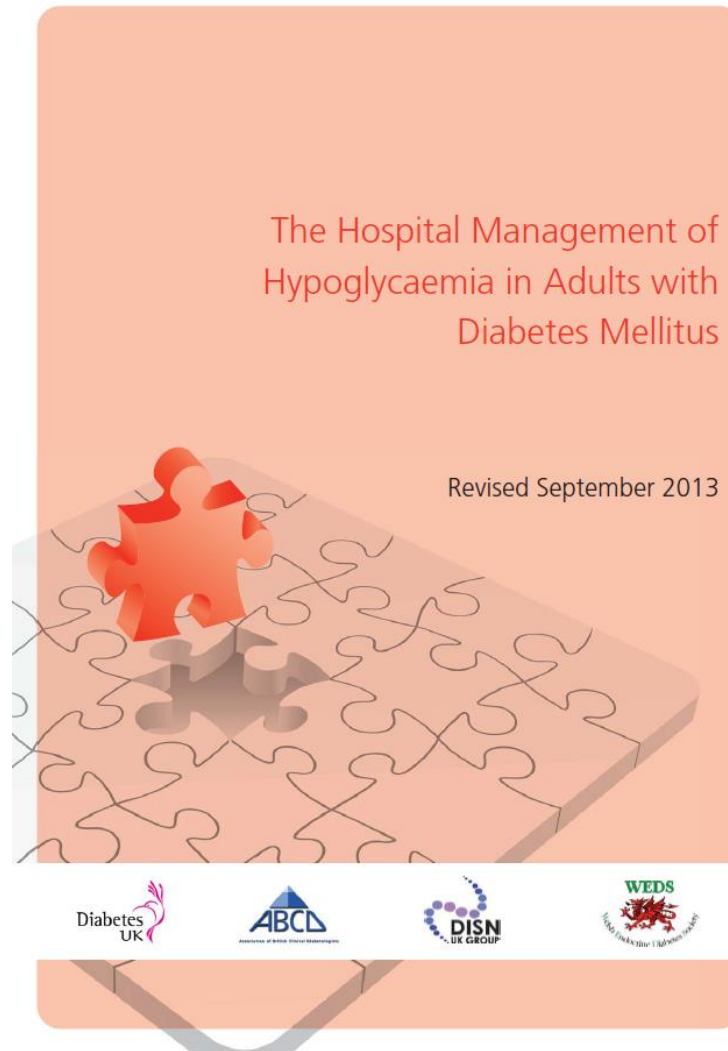
	ADA (2009)	JBDS (2012)
Plasma glucose	>600mg/dl (33.3mmol/l)	>540mg/dl (30mmol/l)
Arterial pH	>7.3	>7.3
Serum bicarbonate	>18mEq/l	>15mmol/l
Urine ketones	Small	Not referenced
Serum ketones	Small	<3.0mmol/l
Effective serum osmolality	>320mOsm/Kg	>320mOsm/Kg
Anion gap	Variable	Not referenced
Mental status	Stupor / coma	Not referenced

Hypoglycaemia

There's a Guideline for That

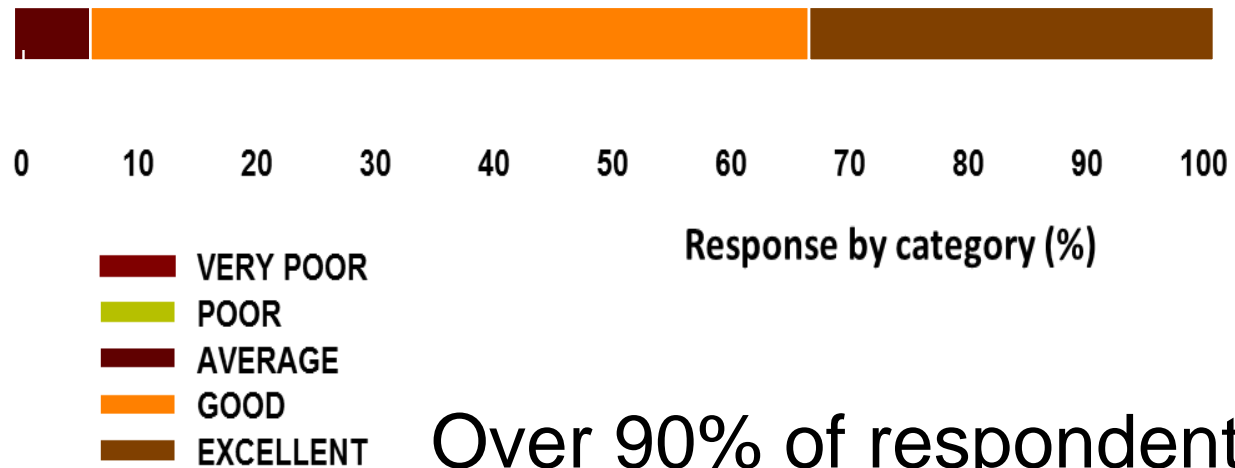


It's Also Been Revised



Overall Quality of JBDS Guidelines

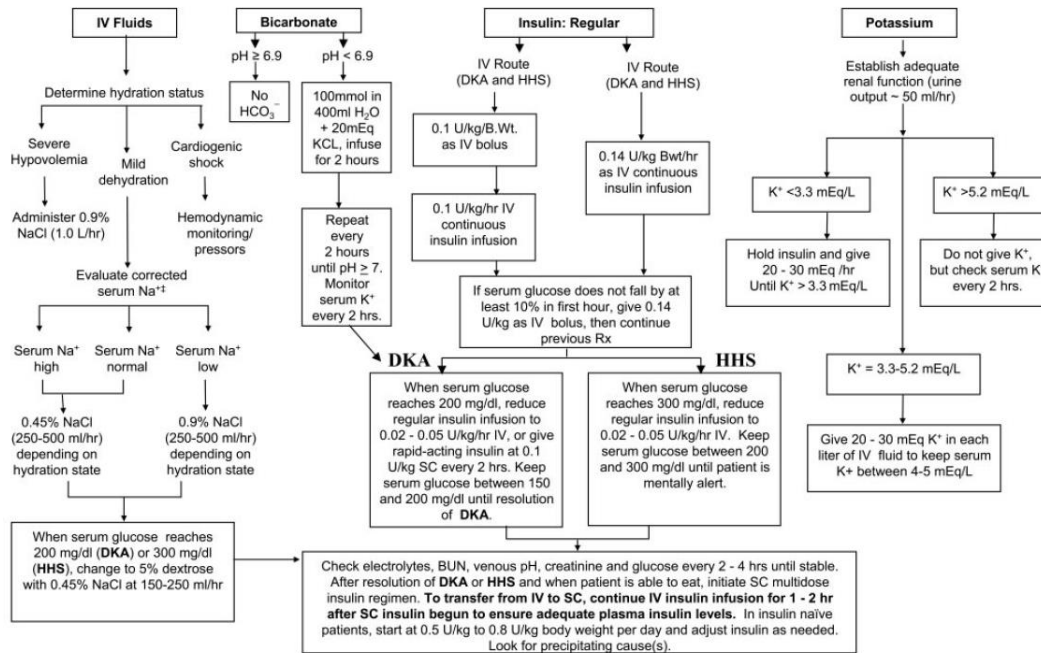
Hypoglycaemia



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Do These Regimens Work?

- No idea
- Another national survey is needed!



The management of the hyperosmolar hyperglycaemic state (HHS) in adults with diabetes

Joint British Diabetes Societies
Inpatient Care Group

August 2012

Supporting, Improving, Caring

August 2012

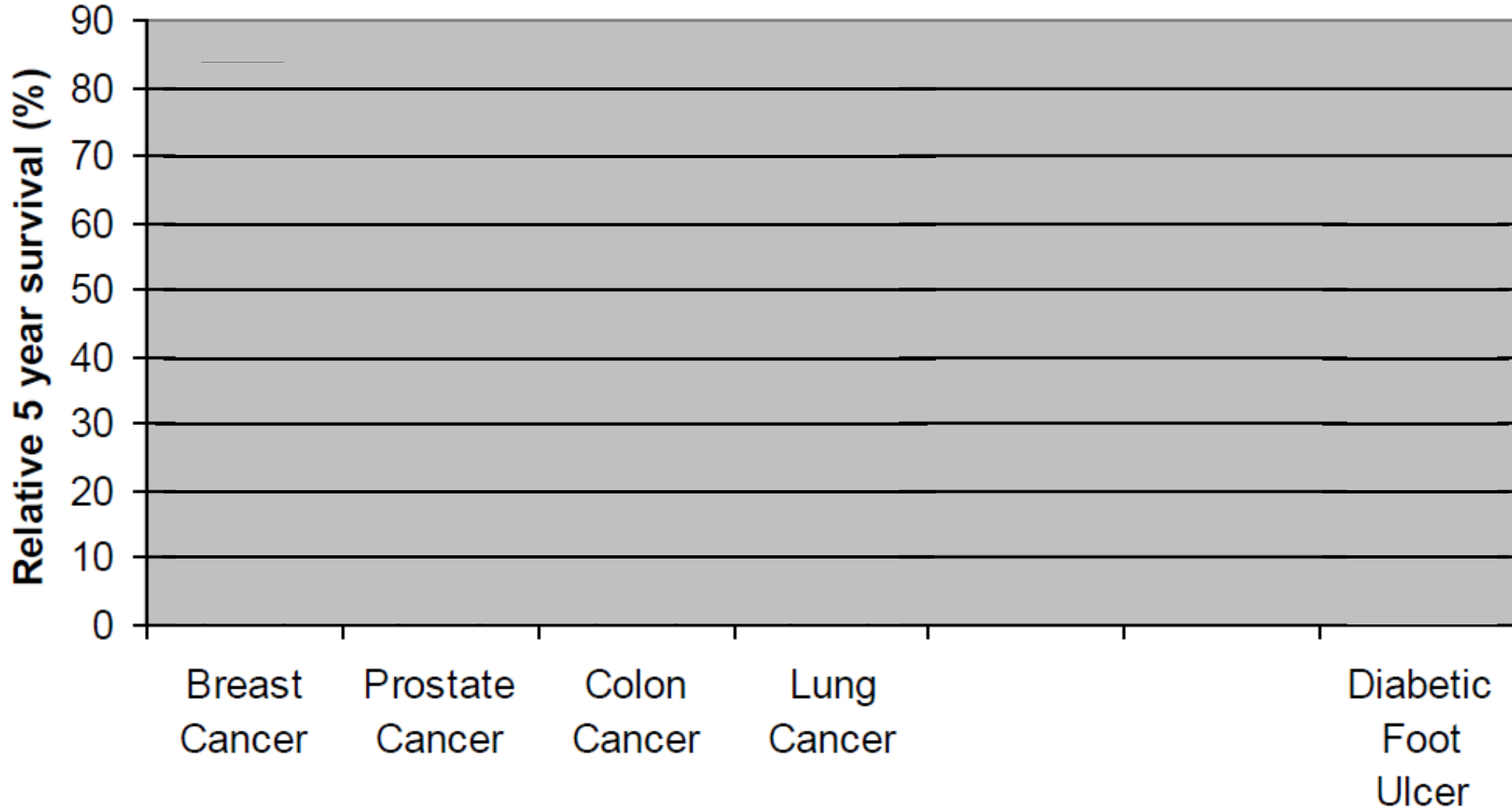
An Interim Summary

- The management of DKA and HHS has come a long way over the last 75 years
- The evolution of treatment pathways has been incremental and national guidelines have, to date, been consensus based
- Evidence is needed to see if they do what we want them to do

Type in 'ABCD' and 'JBDS' into Google to get all the guidelines for free

The 'Diabetic Foot'

Mortality of DFU vs Common Cancers



Some Epidemiology

- Foot ulceration is the leading cause of diabetes related hospital admissions
- 70% of amputations are a result of diabetic foot ulceration
- £1 out of every £150 in the NHS is spent on the diabetic foot
- The 'diabetic foot' is the most common cause of acute hospital admission

A Perfect Storm?

- Problems develop due to
 - Ischaemia
 - Infection
 - Neuropathy

Look Away **NOW** if you are
Squeamish



Charcot

What is Wrong with This Foot?



What is Wrong with This Foot?



Charcots

- It is uncommon – occurring in $<0.5\%$ of people with diabetes
- It makes up 50% or more of my workload
- Due to a combination of factors
 - Peripheral neuropathy
 - Selective sympathetic neuropathy
 - Disruption pre-capillary sphincters
 - High throughput foot
 - Disruption of bone surface regulation
 - Trauma
 - Renal failure

Charcots

- Diagnosis can be very difficult
- Hot red swollen foot
- Temperature difference of $>2^{\circ}\text{C}$ between feet
- When in doubt – refer where they may do an MRI

A Question to End With

- The prevalence of diabetes in hospitals is high (15-30%)
- Having diabetes as an inpatient is associated with increased levels of harm
- Having undiagnosed diabetes and just hyperglycaemia is associated with MORE harm
- Should there be a standardised ‘order set’ for all patients admitted to hospital – that is the same for all laboratories?
 - (e.g. random glucose, HbA1c)



Diabetes Related Emergencies

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