



# What is Euglycaemia in Acutely Unwell Inpatients?

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# Definition of Hyperglycaemia in a Hospitalised Patient

- A blood glucose value of?
  - The ADA says  $>7.8\text{mmol/l}$
  - JBDS says in someone with diabetes the target should be 6 – 12 mmol/l (end of life care 6 – 15 mmol/l)
- ADA also says
  - Stress hyperglycaemia – high glucose in those not known to have diabetes and an  $\text{HbA}_{1c} <48\text{ mmol/mol}$

**JBDS-IP** Joint British  
Diabetes Societies  
for inpatient care

# Is There Evidence of Harm From Dysglycaemia?

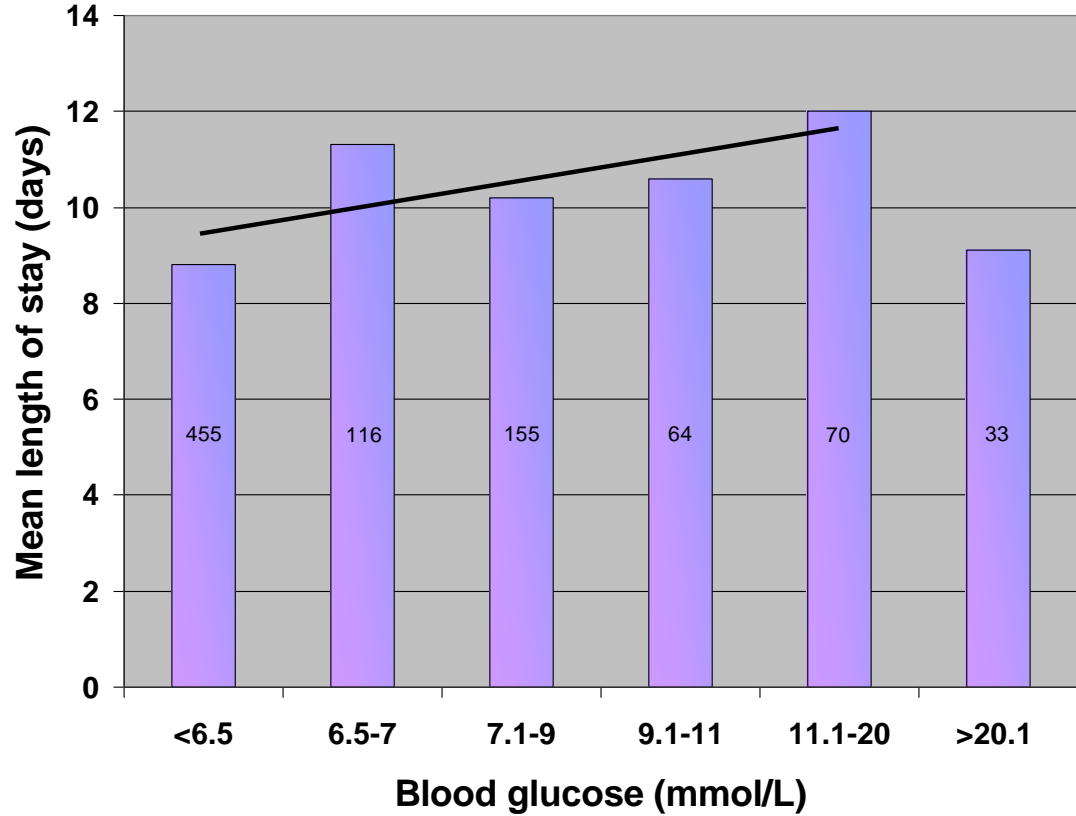
- Yes – plenty
- In all sort of times related to hospital admission and in many specialties

# At the Front Door

# Hyperglycaemia on Admission

- We have previously published data for all 1,502 patients admitted through our AMU in February 2010
- We assessed
  - admission blood glucose,
  - LOS
  - 28-days readmission and mortality
  - whether admission blood glucose  $\geq 11.1$ mmol/l in non-diabetic individuals was followed-up

# LOS vs Admission Glucose

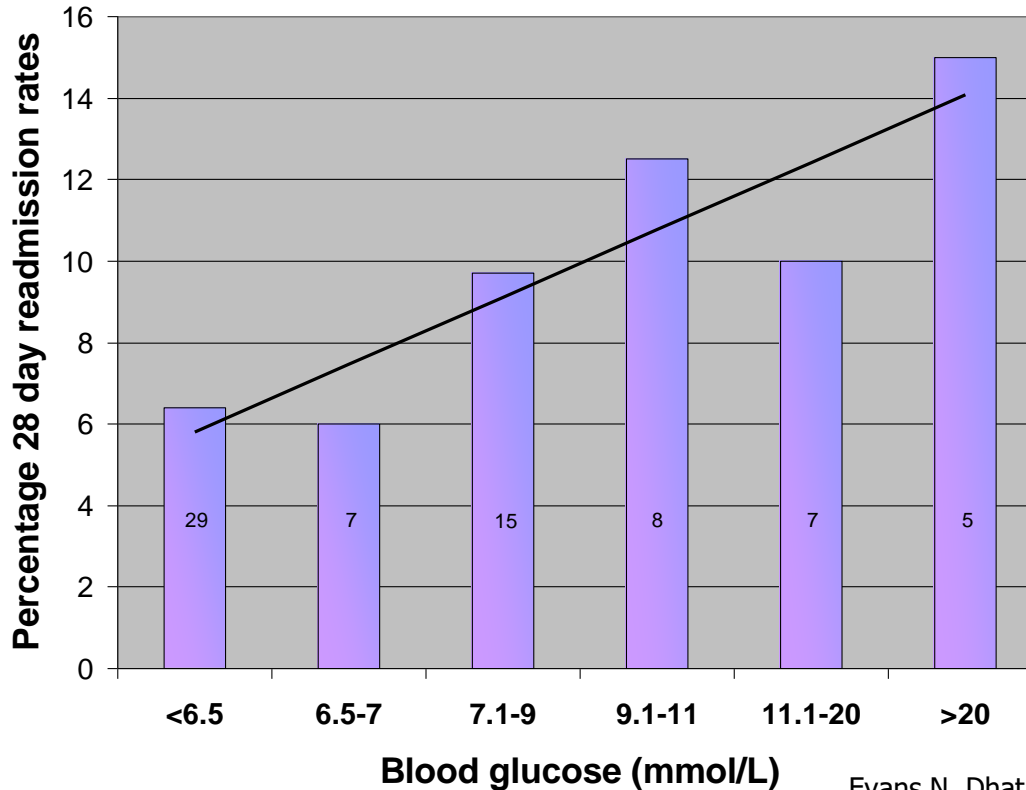


Trend  $R^2 = 0.5556$

$P=0.002$

Those above  
20mmol/L excluded  
(most under the  
diabetes team)

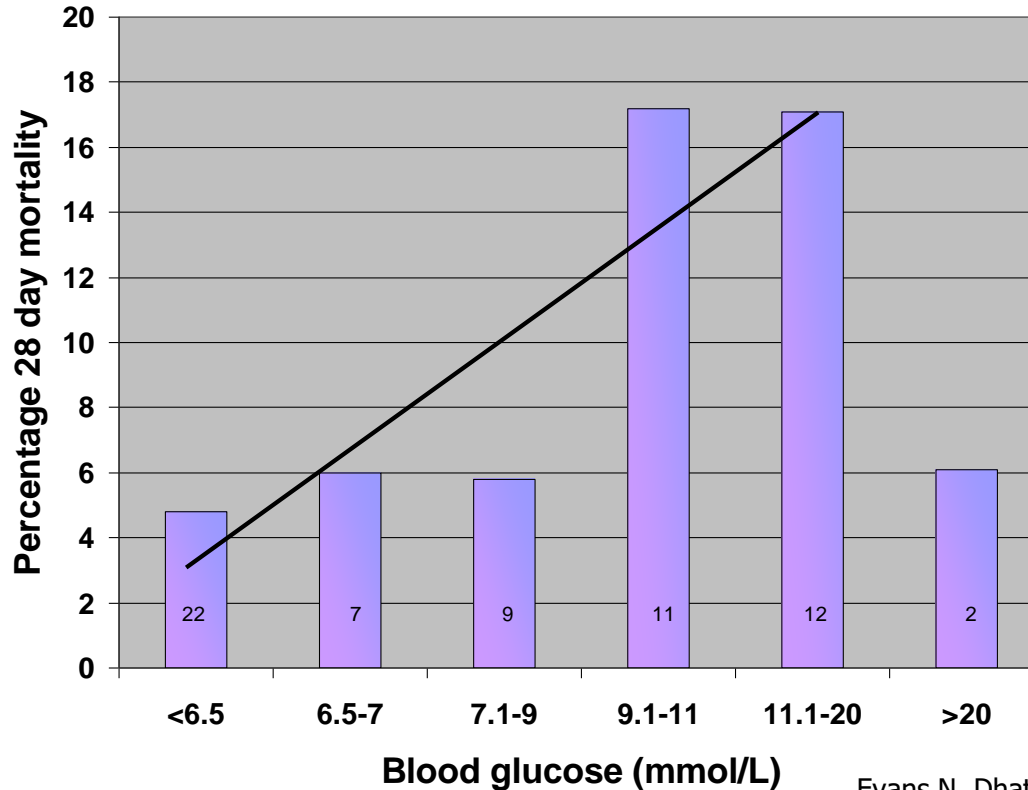
# 28 Day Readmission vs Admission Glucose



Trend  $R^2 = 0.7918$

Of the 1,502 admissions in February 2010, 71 (4.73%) were readmitted within 28 days

## 28 Day Mortality vs Admission Glucose



Trend  $R^2 = 0.7874$

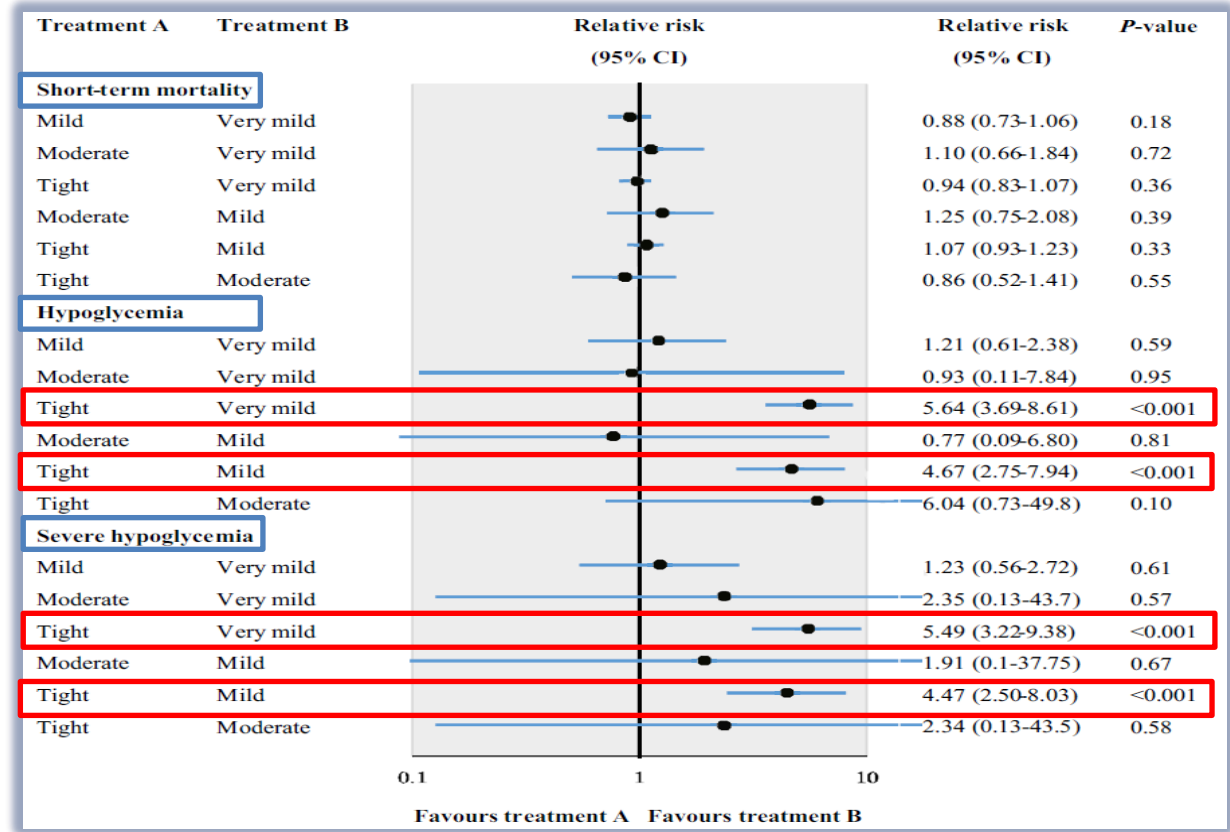
$P < 0.0001$

Of the 1,502 admissions in February 2010, 63 (4.19%) died within 28 days



# Intensive Care

# Glycaemic Targets and Outcomes in ITU



5 fold increase in risk of hypoglycaemia with tight glycaemic control

# Patient Condition & Targets on ITU

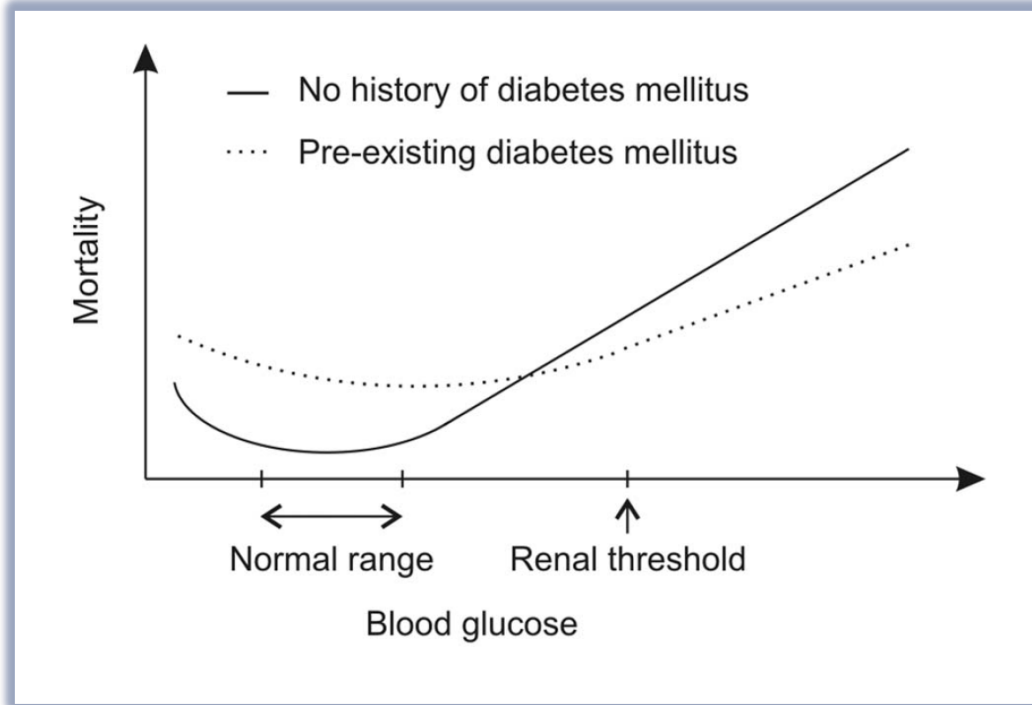
Condition	Glucose control recommendation	Studies with patient number	Ref.
Non-diabetic ICU patients	140-180 mg/dL	29 studies with 8432 total patients and 26 studies with 13567 total patients	Wiener <i>et al</i> <sup>[30]</sup> (2008) and Griesdale <i>et al</i> <sup>[31]</sup> (2009), respectively
Diabetic ICU patients	If HbA1c < 7%: 140-180 mg/dL If HbA1c > 7%: > 200 mg/dL	1 retrospective study with 415 total patients	Egi <i>et al</i> <sup>[34]</sup> (2011)
Surgical ICU	If ICU stay is for more than 3 d, ventilator dependent, on dialysis, or with cardiac comorbidities: < 150 mg/dL	1 prospective study with 4864 total patients across 17 yr	Furnary <i>et al</i> <sup>[40]</sup> (2004)
Neurocritical ICU patients	If not: < 180 mg/dL If hypoglycemia can be prevented: 110-140 mg/dL If not: 140-180 mg/dL	16 studies with 1258 total patients	Kramer <i>et al</i> <sup>[43]</sup> (2012)
STEMI ICU patients	< 200 mg/dL	No high quality studies available Consensus by NICE	Nice Guidelines <sup>[47]</sup> (2011)
Sepsis ICU patients	< 180 mg/dL	1 randomized control trial with 6104 patients	Based of NICE-SUGAR study <sup>[17]</sup>
Pregnant ICU patients	No consensus	N/A	Van de Velde <i>et al</i> <sup>[53]</sup> (2013)

ICU: Intensive care unit; N/A: Not applicable; HbA1c: Glycosylated hemoglobin; NICE-SUGAR: Normoglycemia in Intensive Care Evaluation-Survival Using Glucose Algorithm Regulation.

# Guidelines on the Management of Glucose in the ICU

Year	Organization	Population	Treatment Threshold (mmol/l)	Target Glucose
2021	American Diabetes Association (ADA)	ICU	10	7.8-10
2018	Canadian Diabetes Association (CDA)	ICU	10	5.9-10
2012	Society of Critical Care Medicine (SCCM)	ICU	10	8.3
2011	American College of Physicians (ACP)	SICU/MICU	Do not use IIT to strictly control or normalize BG in MICU/SICU patients with or without diabetes	7.1-11.0
2009	Surviving Sepsis Campaign (SSC)	ICU	10	8.3
2009	American Association of Clinical Endocrinologists (AACE)	ICU with acute coronary syndrome	10	7.8-10
2016	RSSDI	ICU	10	7.8-10

# ITU



- “The ideal blood glucose target remains unclear and may depend on the context”

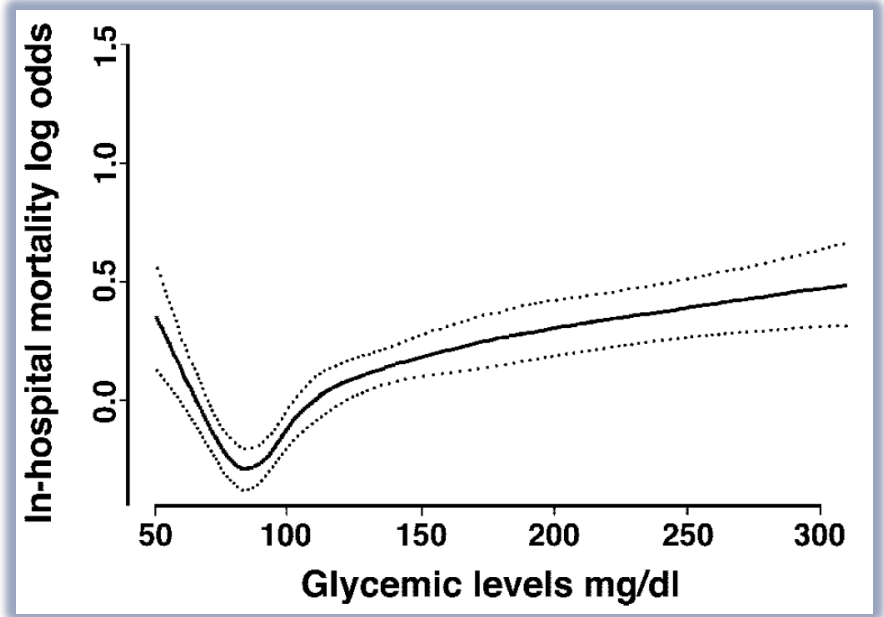
# Surgery

# Do Peri-Operative High Glucose Levels Cause Harm?

- High pre-operative glucose or HbA<sub>1c</sub> has been related to adverse outcomes following
  - spinal
  - vascular / endovascular
  - colorectal
  - cardiac
  - trauma
  - mastectomies
  - emergency
  - foot and ankle
  - neurosurgery
  - transplant
  - HBP
  - cholecystectomy
  - cardiac
  - burns

Walid MS et al J Hosp Med 2010;5:E10-E14  
O'Sullivan CJ et al Euro J of Vasc Endovasc Surg 2006;32:188-197  
Gustafsson UO et al Brit J Surg 2009;96:1358-1364  
Halkos ME et al Ann of Thorac Surg 2008;86:1431-1437  
Kreutziger J et al J Trauma 2009;67(4):704-8  
Vilar-Compte et al Am J Infect Control 2008;36(3):192-198  
Park C et al Transplantation 2009;87(7):1031-1036  
Ambiru S et al J Hosp Infect 2008;68(3):230-233  
Chuang SC et al J Formos Med Ass 2004;103(8):607-612  
Shibuya N et al J Foot Ankle Surg 2013;52(2):207-211  
Sadoskas D et al Foot Ankle Spec 2016;9(1):24-30  
Domek N et al J Foot Ank Surg 2016;55(5):939-943  
Jehan F et al J Trauma Acute Care Surg 2018;84(1):112-117  
Younger AS et al Foot Ank Surg 2009;30(12):1177-1182  
Dolp R et al Crit Care 2019;23(1):28  
Cha J-J et Cardiovasc Diabetol 2020;19:97  
Shapey IM et al Diab Obes Metab 2021;23(1):49-57

# So what is 'Euglycaemia' - Some Older Data



- Risk of mortality in hospital according to glucose
- Safest glucose was 78 – 101 mg/dL (4.3 – 5.6 mmol/l)





# My Final Thoughts

- Euglycaemia is the glucose concentration that is associated with the least harm
- In the UK, this means a target glucose
  - for most inpatients of 6 – 12mmol/l
  - those who are at the end of life of 6 – 15mmol/l
- The honest answer is no-one knows (yet)



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