Preparing People with Diabetes for Surgery

Prof Ketan Dhatariya MBBS MSc MD MS FRCP PhD

Consultant in Diabetes and Endocrinology

Norfolk and Norwich University Hospitals

How Many People Have an Operation Per Year?

Global Surgery 2030: evidence and solutions for achieving health, welfare, and economic development

John G Meara, Andrew J M Leather*, Lars Hagander*, Blake C Alkire, Nivaldo Alonso, Emmanuel A Ameh, Stephen W Bickler, Lesong Conteh, Anna J Dare, Justine Davies, Eunice Dérivois Mérisier, Shenaaz El-Halabi, Paul E Farmer, Atul Gawande, Rowan Gillies, Sarah L M Greenberg, Caris E Grimes, Russell L Gruen, Edna Adan Ismail, Thaim Buya Kamara, Chris Lavy, Ganbold Lundeg, Nyengo C Mkandawire, Nakul P Raykar, Johanna N Riesel, Edgar Rodas‡, John Rose, Nobhojit Roy, Mark G Shrime, Richard Sullivan, Stéphane Verguet, David Watters, Thomas G Weiser, Iain H Wilson, Gavin Yamey, Winnie Yip*

Executive summary

Remarkable gains have been made in global health in the past 25 years, but progress has not been uniform. Mortality and morbidity from common conditions needing surgery have grown in the world's poorest

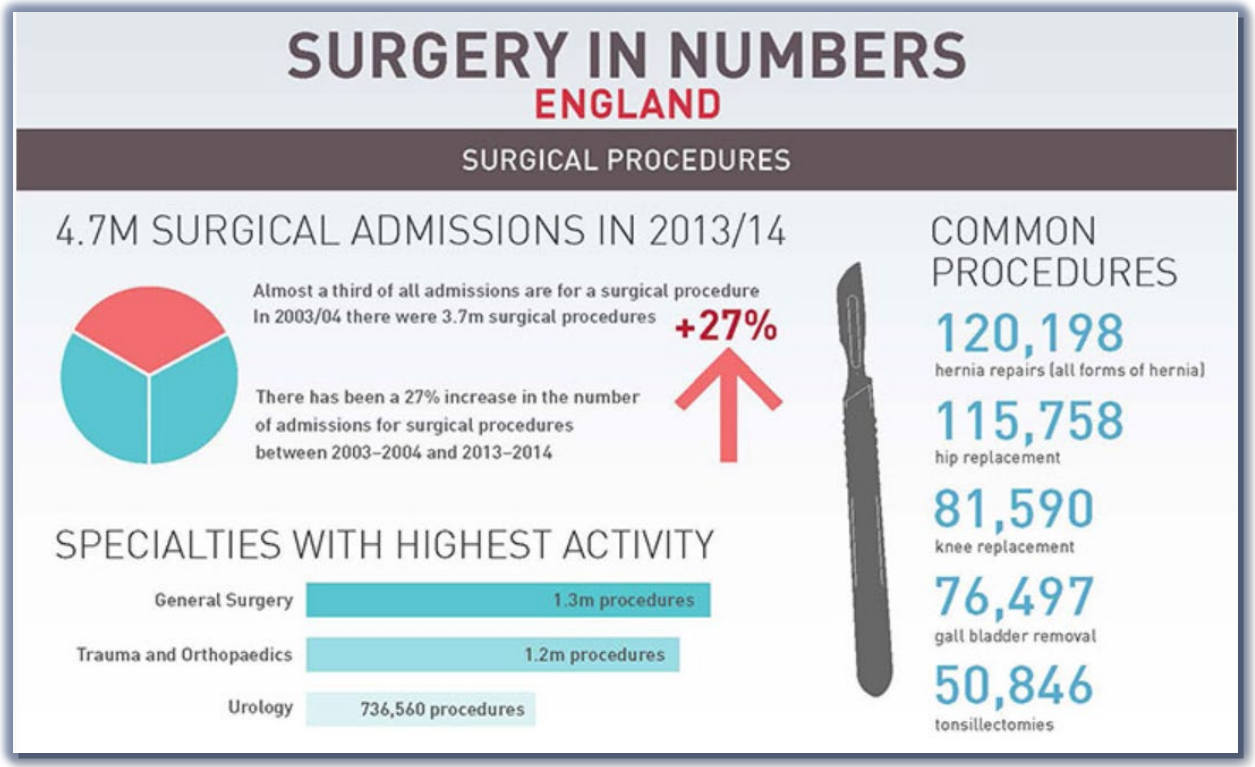
surgical and anaesthesia care in LMICs, and a template for a national surgical plan. Our five key messages are presented as follows:

- 5 billion people do not have access to safe, affordable surgical and anaesthesia care when needed. Access is

Lancet 2015; 386: 569–624
Published Online
April 27, 2015
http://dx.doi.org/10.1016/S0140-6736(15)60160-X

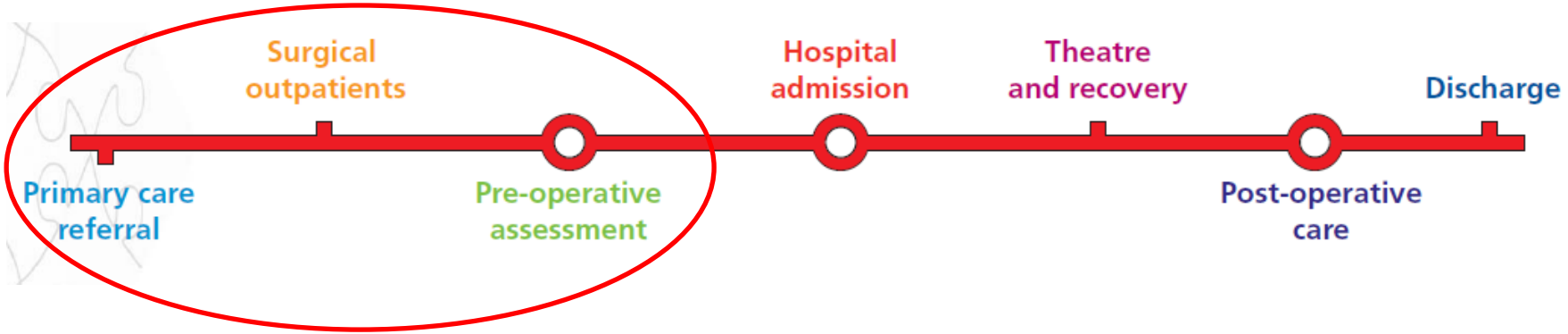
Meara JG et al Lancet 2015;386:569-624

UK Data are Quite Old

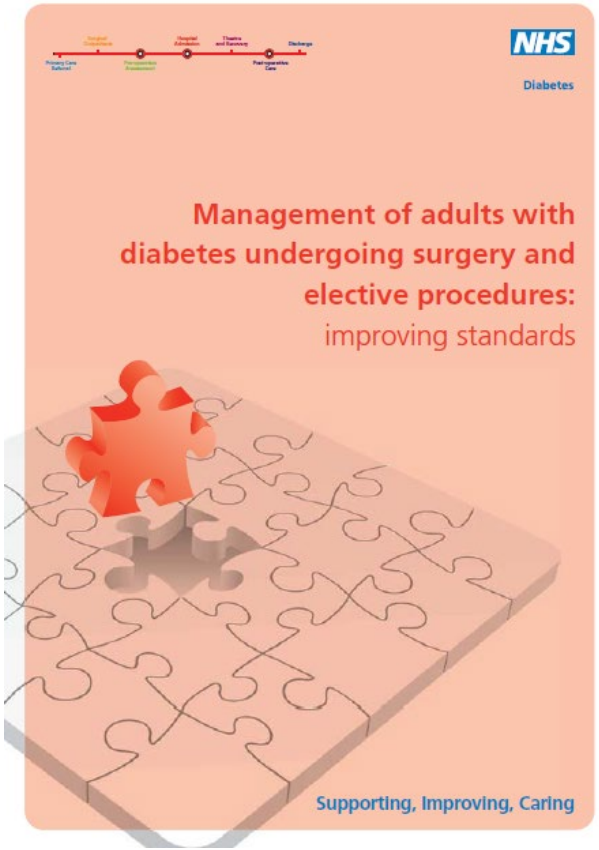


https://www.rcseng.ac.uk/news-and-events/media-centre/media-background-briefings-and-statistics/surgery-and-the-nhs-in-numbers/)

The Patient Journey

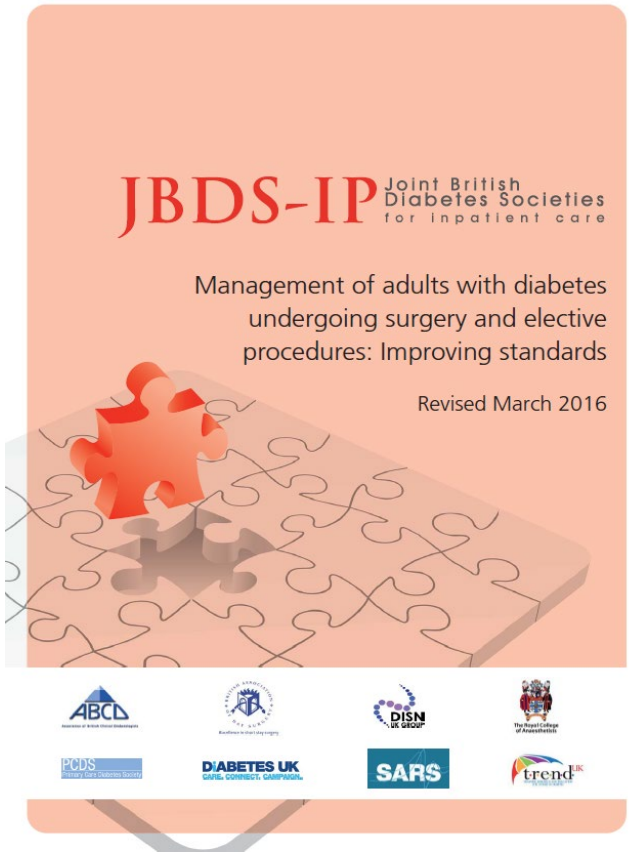


Guidance

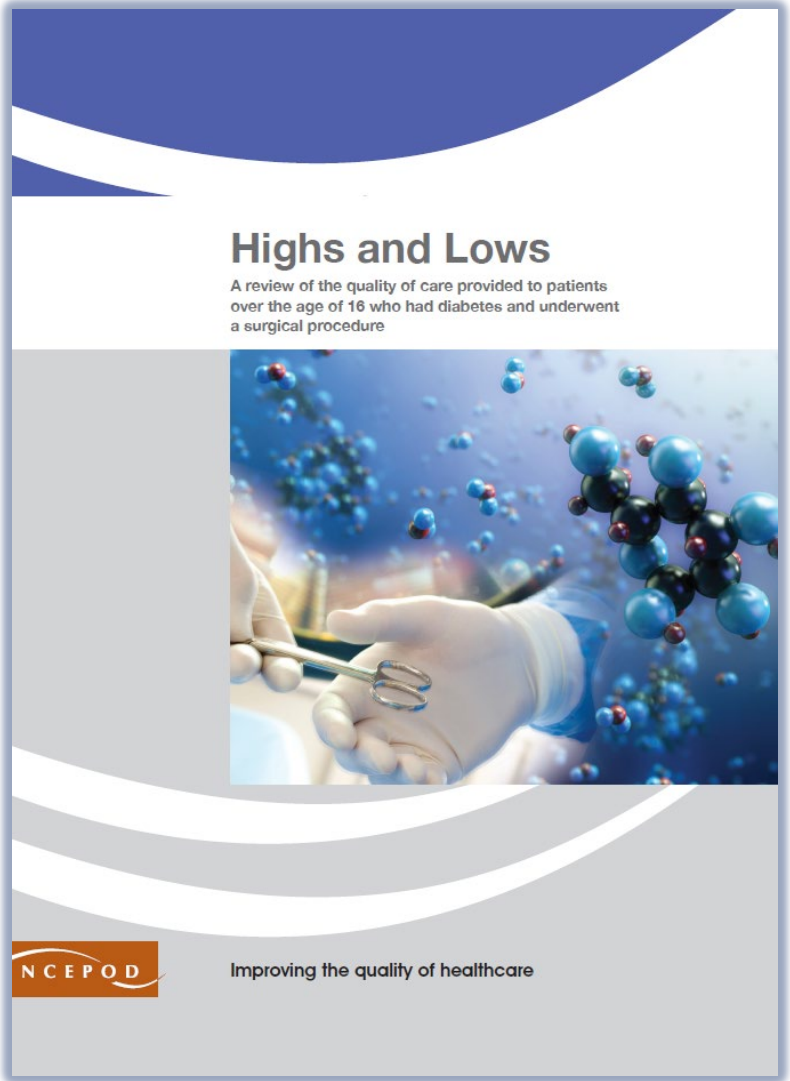


In 2011
Along Came
This…..

Revised in
2016…..



https://abcd.care/sites/abcd.care/files/resources/Surgical_guidelines_2015_full_FINAL_amended_Mar_2016.pdf



National Confidential Enquiry into Patient Outcome and Death – NCEPOD Report 2018

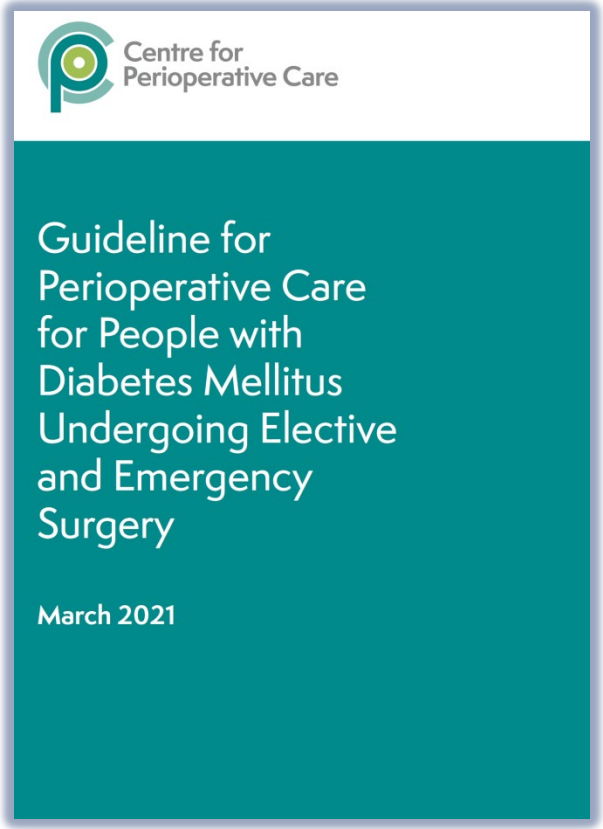
https://www.ncepod.org.uk/2018pd.html

Factors Leading to Poor Outcomes

- Failure to identify patients with diabetes or hyperglycaemia
- Lack of institutional guidelines for the management of hyperglycaemia
- Poor knowledge of diabetes amongst staff delivering care
- Complex polypharmacy and insulin prescribing errors

https://www.ncepod.org.uk/2018pd.html

Updated in March 2021



https://cpoc.org.uk/guidelines-resources-guidelines-resources/guideline-diabetes


Primary care referral
Surgical outpatients
Pre-operative assessment
Hospital admission
Theatre and recovery
Post-operative care
Discharge

Referrals from Primary Care

- Minimum dataset required in the referral

BOX 5

Minimum data required from GP when referring a patient for surgery/procedures (Appendix 12)

- Duration and type of diabetes
- Place of usual diabetes care (primary or secondary)
- Other co-morbidities
- Treatment
  - For diabetes oral agents/ insulin doses and frequency
  - For other co-morbidities
- Complications
  - At risk foot
  - Renal impairment
  - Cardiac disease
- Relevant measures (measured within the previous 3 months)
  - BMI
  - BP
  - HbA_{1c}
  - eGFR

https://abcd.care/sites/abcd.care/files/resources/Surgical_guidelines_2015_full_FINAL_amended_Mar_2016.pdf

How Well is this Currently Done?

- To better assess this, we looked at every primary care referral to 11 different surgical specialties across nine different NHS hospital Trusts over a 1 week period in August 2014

Referrals from Where?

Hospital	Number of surgical referrals received (%)
Addenbrooke's Hospital NHS Trust	135 (7.0)
Bedford Hospital NHS Trust	93 (4.8)
Hinchingbrooke Health Care NHS Trust	113 (5.9)
Luton and Dunstable University Hospital NHS Trust	44 (2.3)
Norfolk and Norwich University Hospitals NHS Trust	751 (39.1)
Queen Elizabeth Hospital Kings Lynn NHS Trust	189 (9.8)
West Suffolk NHS Foundation Trust	155 (8.1)
Mid Essex Hospital Services NHS Trust	360 (18.8)
Peterborough City Hospital NHS Trust	79 (4.1)

Pournaras D et al Int J Clin Pract 2017;71(7):e12971

Referrals to Whom?

Subspecialties	Number of referrals	Patients with DM (%)
Vascular Surgery	54	13 (24·1%)
General Surgery	419	53 (12·6%)
Maxillofacial Surgery	9	1 (11·1%)
T & O	459	47 (10·2%)
Urology	195	16 (8·2%)
Plastic Surgery	126	7 (5·6%)
O & G	205	10 (4·9%)
Breast Surgery	84	4 (4·8%)
Ear, Nose and Throat	353	13 (3·7%)
Neurosurgery	1	0 (0%)
Paediatric Surgery	7	0 (0%)
No data	7	0 (0%)

Pournaras D et al Int J Clin Pract 2017;71(7):e12971

Data Collection Tool for
Audit of Primary Care Referrals to Surgery for Patients with Diabetes across East Anglia

Please tick the relevant boxes

NHS Trust..... **Hospital number** .....

Gender ☐ Female ☐ Male **Age** .....years

1. Referral speciality (please tick) ☐ a) General surgery ☐ b) Orthopaedic

☐ c) Gynaecology ☐ d) Other (*please state*) .....

2. *Please state* anticipated procedure

.....

3. Is the diagnosis of diabetes mentioned in the referral letter? ☐ Yes ☐ No

If 'No' is the patient taking any diabetes drugs (check 'cheat sheet')? ☐ Yes ☐ No

4. Type of diabetes	☐ a) Type 1	☐ b) Type 2	☐ c) Not provided
5. Place of usual diabetes care	☐ a) Primary	☐ b) Secondary	☐ c) Not provided

6. Duration of diabetes ..... ☐ months / ☐ years ☐ Not provided	**8. BMI** .....kg/m^2 ☐ Not provided	**9. BP** ___/___ mm Hg ☐ Not provided

7. Comorbidity		**10. HbA1c (within the last 3 months)?**
a) ☐ IHD	d) ☐ Foot disease	a) ☐ No ☐ Yes *If 'Yes' what was the result?*
b) ☐ ↑BP	e) ☐ Neuropathy	b) .....% or ..... mmol/mol ☐ Not provided
c) ☐ Renal disease	f) ☐ Not provided	**11. eGFR** ..... ☐ Not provided

Diabetes Treatment. Please *tick* the drugs that the patient is on ☐ Not known

☐ a) Acarbose	☐ e) Glibenclamide	☐ i) Linagliptin	☐ m) Nateglinide	☐ q) Sitagliptin
☐ b) Dapaglifozin	☐ f) Gliclazide	☐ j) Liraglutide	☐ n) Pioglitazone	☐ r) Tolbutamide
☐ c) Exenatide	☐ g) Glimeperide	☐ k) Lixisenatide	☐ o) Repaglinide	☐ s) Vildagliptin
☐ **d) INSULIN**	☐ h) Glipizide	☐ l) Metformin	☐ p) Saxagliptin	☐ **t) NONE**

Results - 1

- 1919 referrals during that week
  - 1053:851 F:M
  - Median age 53 years (6 weeks- 98 years)
- 169 patients had diabetes (8.8%)
- More than one in five patients with DM as demonstrated by the drug history were referred with no mention of their DM in the referral letter

Pournaras D et al Int J Clin Pract 2017;71(7):e12971

Results - 2

- Only 7.7% had a recent HbA_{1c} reading
- Half of all referrals had no documentation DM related co-morbidities
- Also 11.8% of referrals had no documentation of insulin or oral hypoglycaemic medication

Pournaras D et al Int J Clin Pract 2017;71(7):e12971

In the UK

- Around the time of our study, the prevalence of diabetes was 6.2%
- 8.8% of 4.7M = 413,000 people with diabetes had an operation in 2014 in the UK

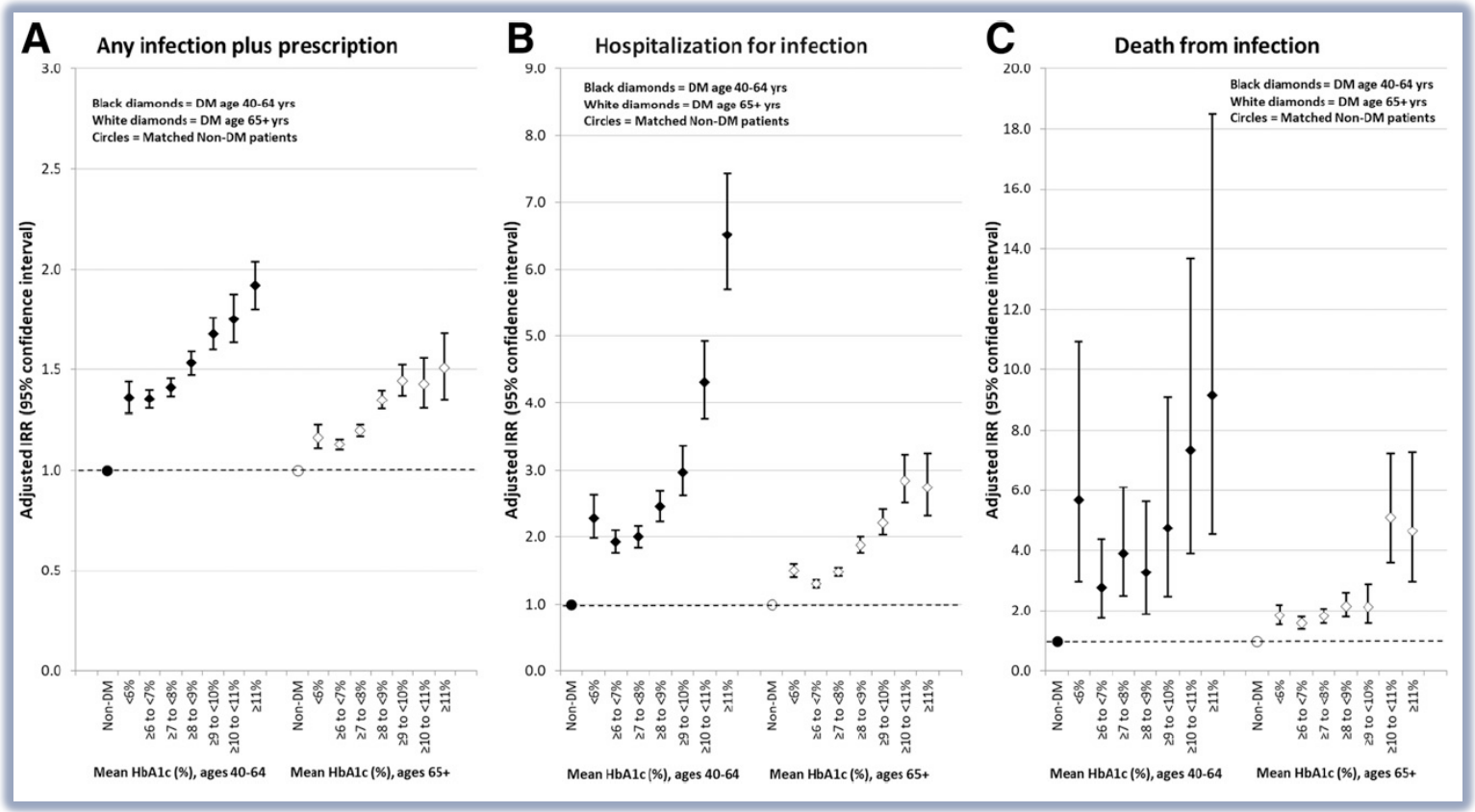
Do Peri-Operative High Glucose Levels Cause Harm?

- High pre-operative glucose or HbA1c has been related to adverse outcomes following

- spinal
- vascular / endovascular
- colorectal
- cardiac
- trauma
- mastectomies
- emergency
- foot and ankle
- neurosurgery
- transplant
- HBP
- cholecystectomy
- cardiac
- burns

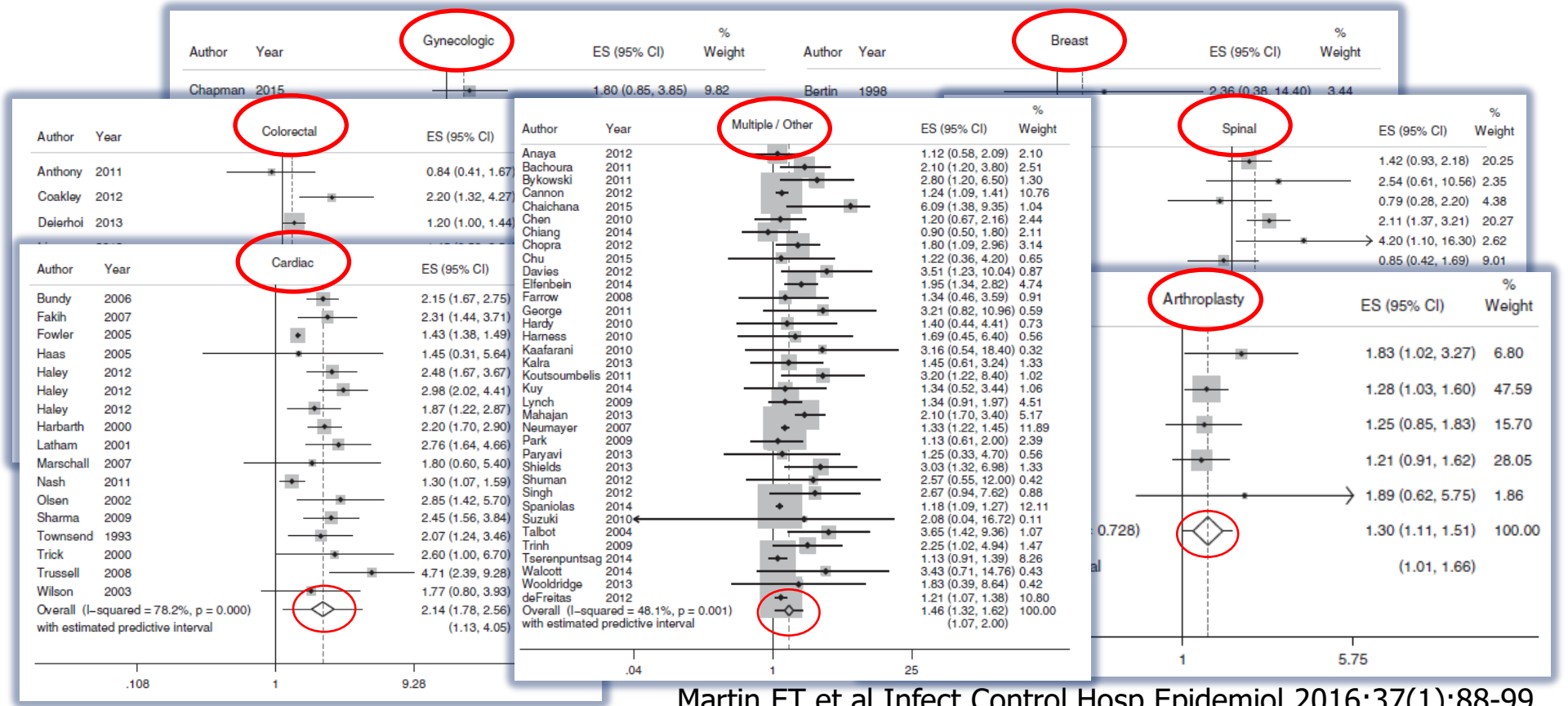
Walid MS et al J Hosp Med 2010;5:E10-E14
O'Sullivan CJ et al Euro J of Vasc Endovasc Surg 2006;32:188-197
Gustafsson UO et al Brit J Surg 2009;96:1358-1364
Halkos ME et al Ann of Thorac Surg 2008;86:1431-1437
Kreutziger J et al J Trauma 2009;67(4):704-8
Vilar-Compte et al Am J Infect Control 2008;36(3):192-198
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

Infections



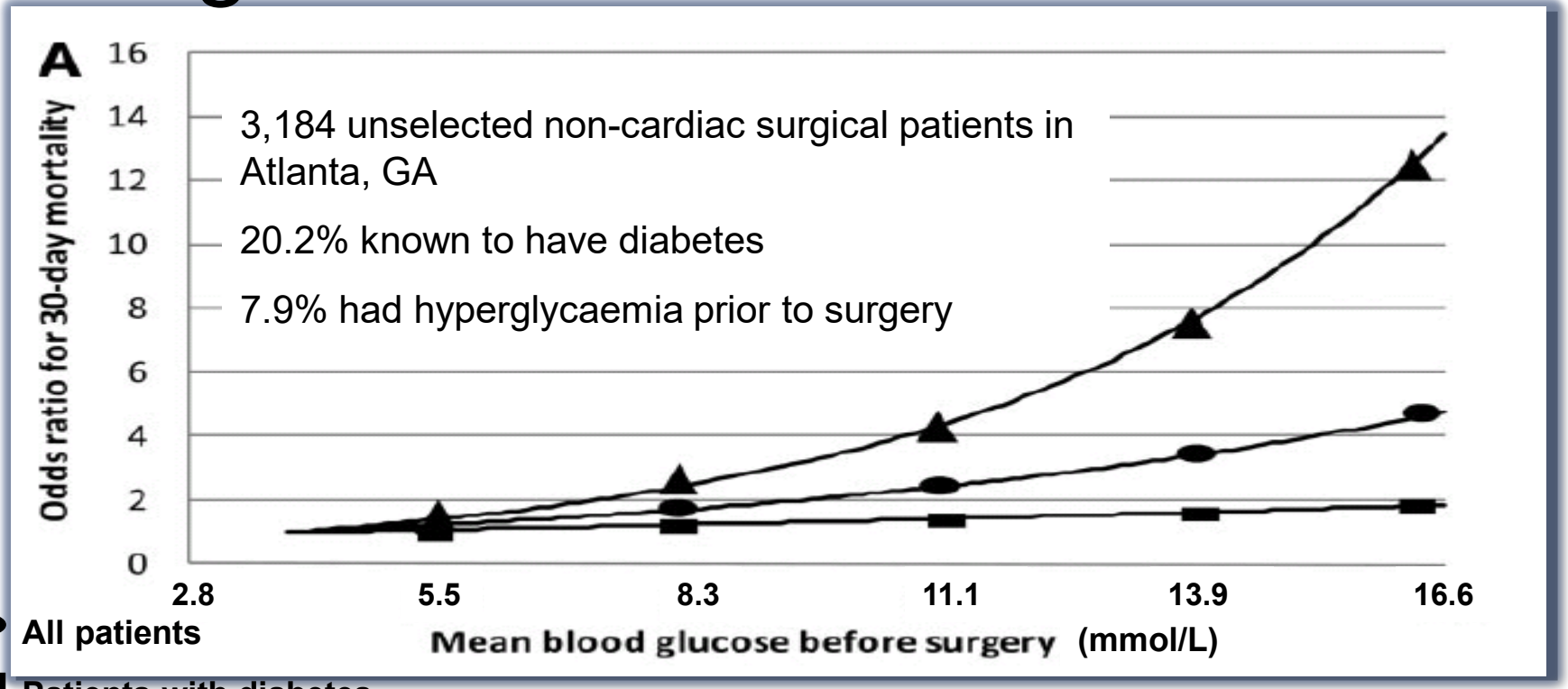
Critchley JA et al Diabetes Care 2018;41(10):2127-2135

Glucose and SSI – A Variety of Specialities



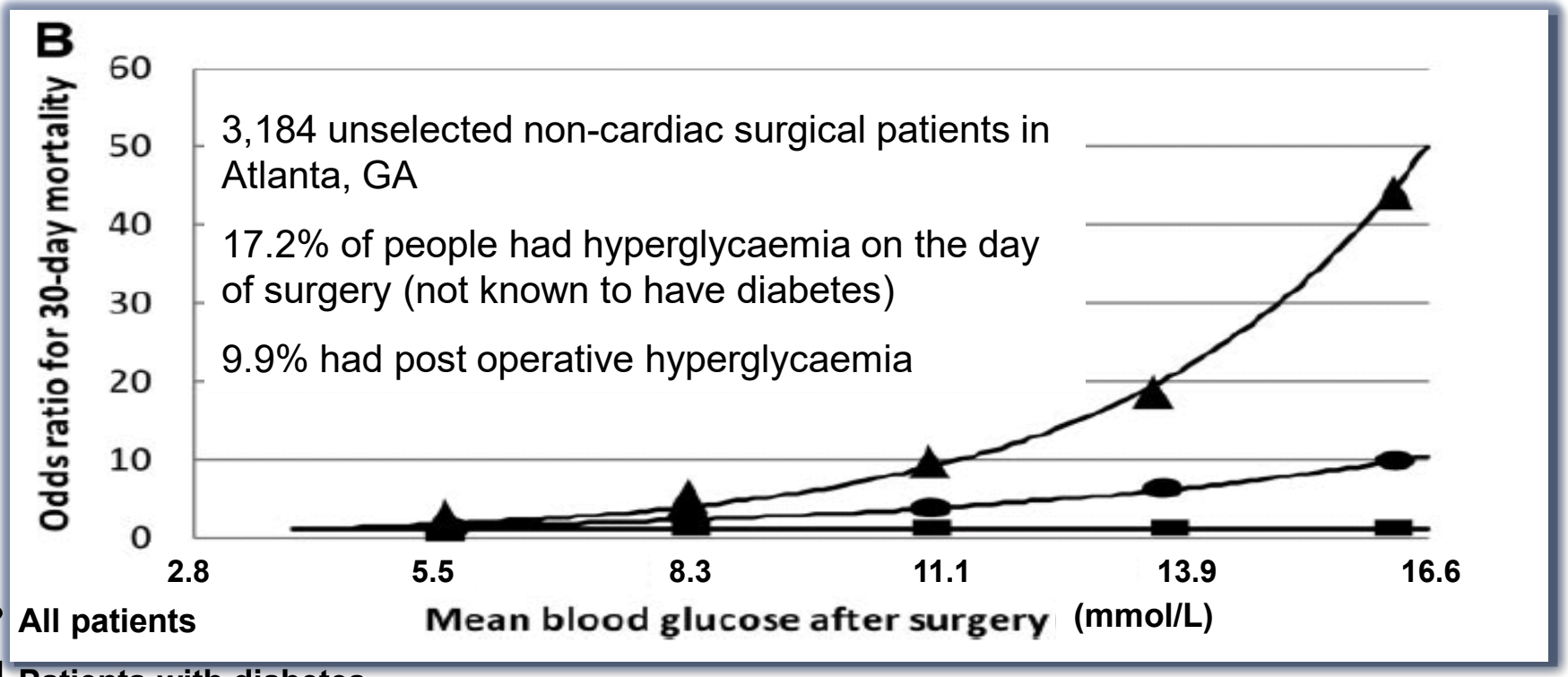
Martin ET et al Infect Control Hosp Epidemiol 2016;37(1):88-99

Do High Glucose Levels Cause Harm?



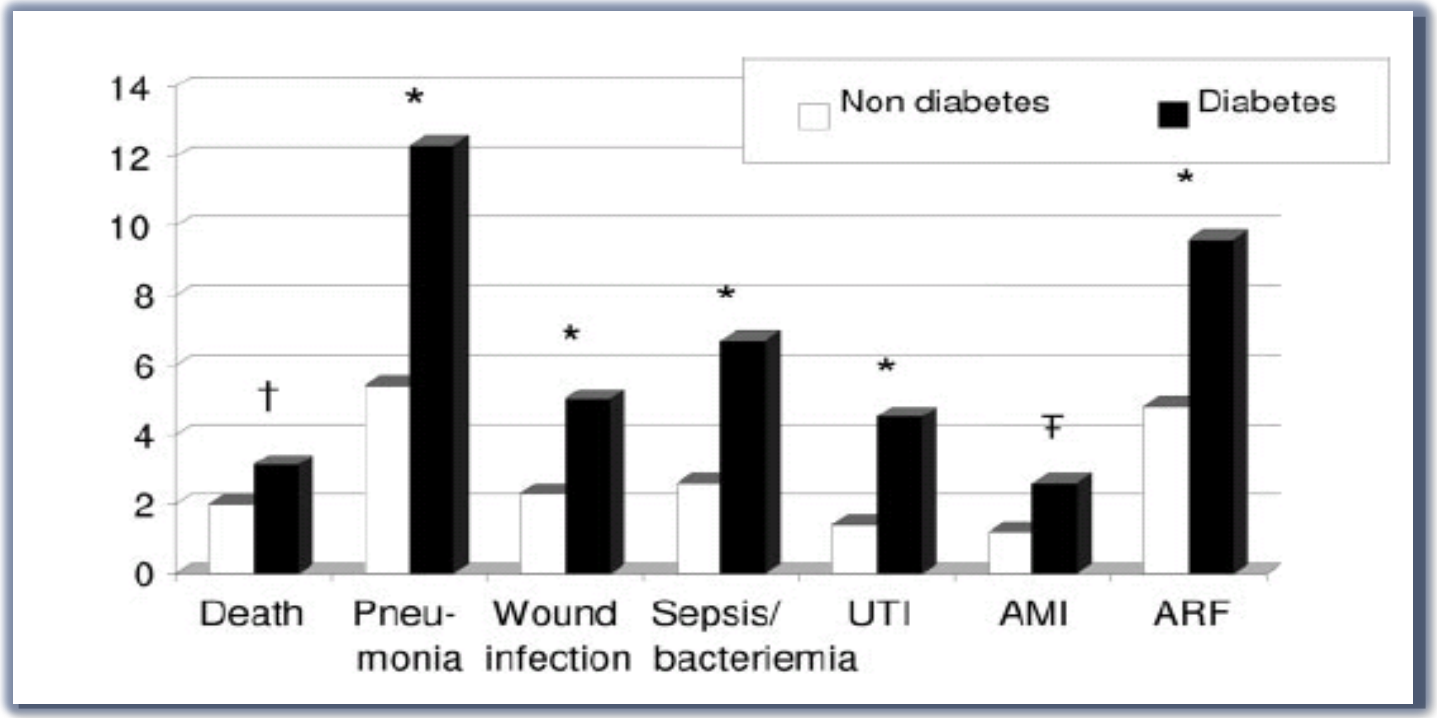
Frisch A et al Diabetes Care 2010;33(8):1783-1788

Do High Glucose Levels Cause Harm?



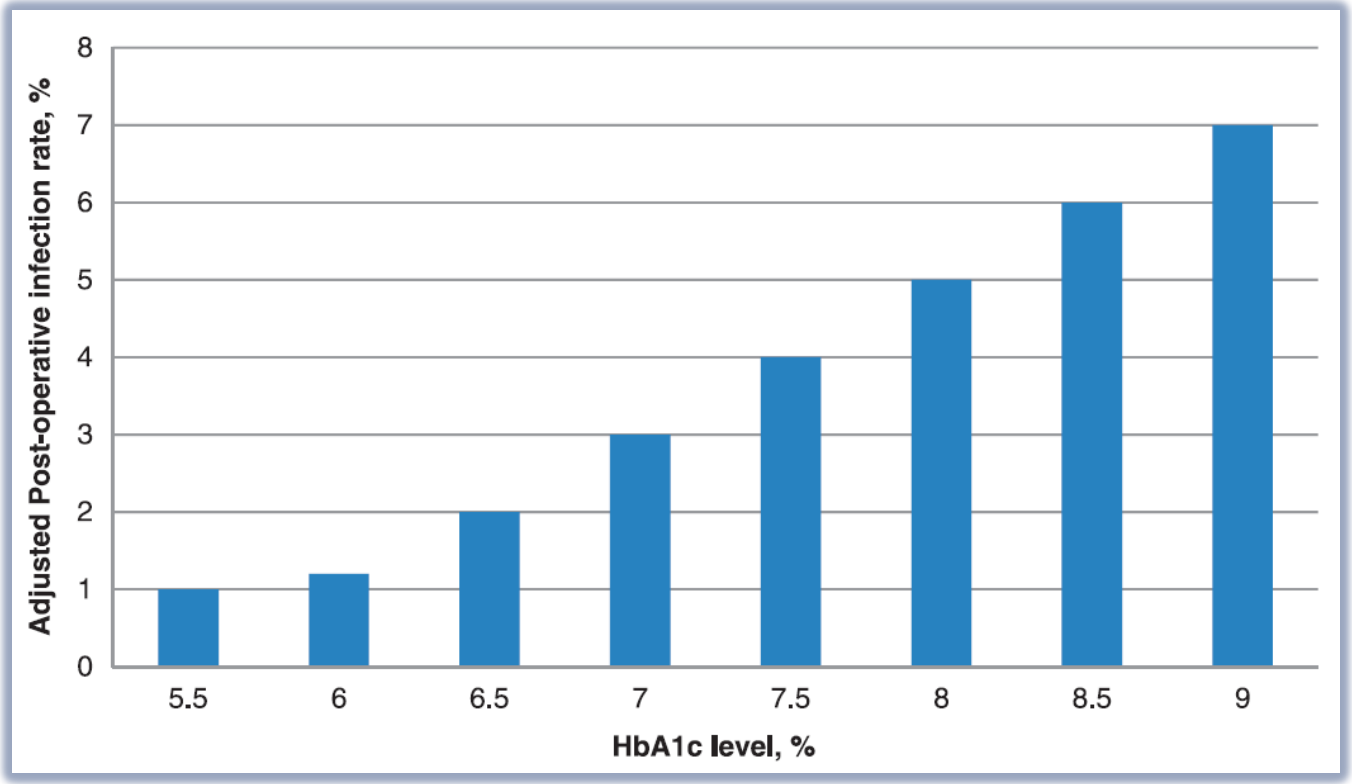
Frisch A et al Diabetes Care 2010;33(8):1783-1788

Do High Glucose Levels Cause Harm?



Frisch A et al Diabetes Care 2010;33(8):1783-1788

402 Emergency Surgical Patients



Jehan F et al J Trauma Acute Care Surg 2018;84(1):112-117

More Observational Data

- Observational data from 55 US hospitals over 5 years looked at the outcomes of 18,278 patients 11,633 of whom who had a BG measured pre op, on day 1 post op or day 2 post op
- 55.4 ± 15.3 years
- 65.7% women

Kwon S et al Ann Surgery 2013;257(1):8-14

Outcomes

TABLE 2. Adjusted Multivariate Logistic Regression Analysis on the Effect of Perioperative Hyperglycemia (>180 mg/dL at Any Point on the Day of Surgery, Postoperative Day 1, or Postoperative Day 2) on Outcomes Presented as Odds Ratio and 95% Confidence Intervals (Within Parenthesis)

	Composite Infections (n = 491)	Deaths (n = 48)	Reoperative Interventions (n = 257)	Anastomotic Failures (n = 43)	Myocardial Infarctions (n = 13)
Hyperglycemia	2.0 (1.63–2.44)	2.71 (1.72–4.28)	1.8 (1.41–2.3)	2.43 (1.38–4.28)	1.15 (0.43–3.1)

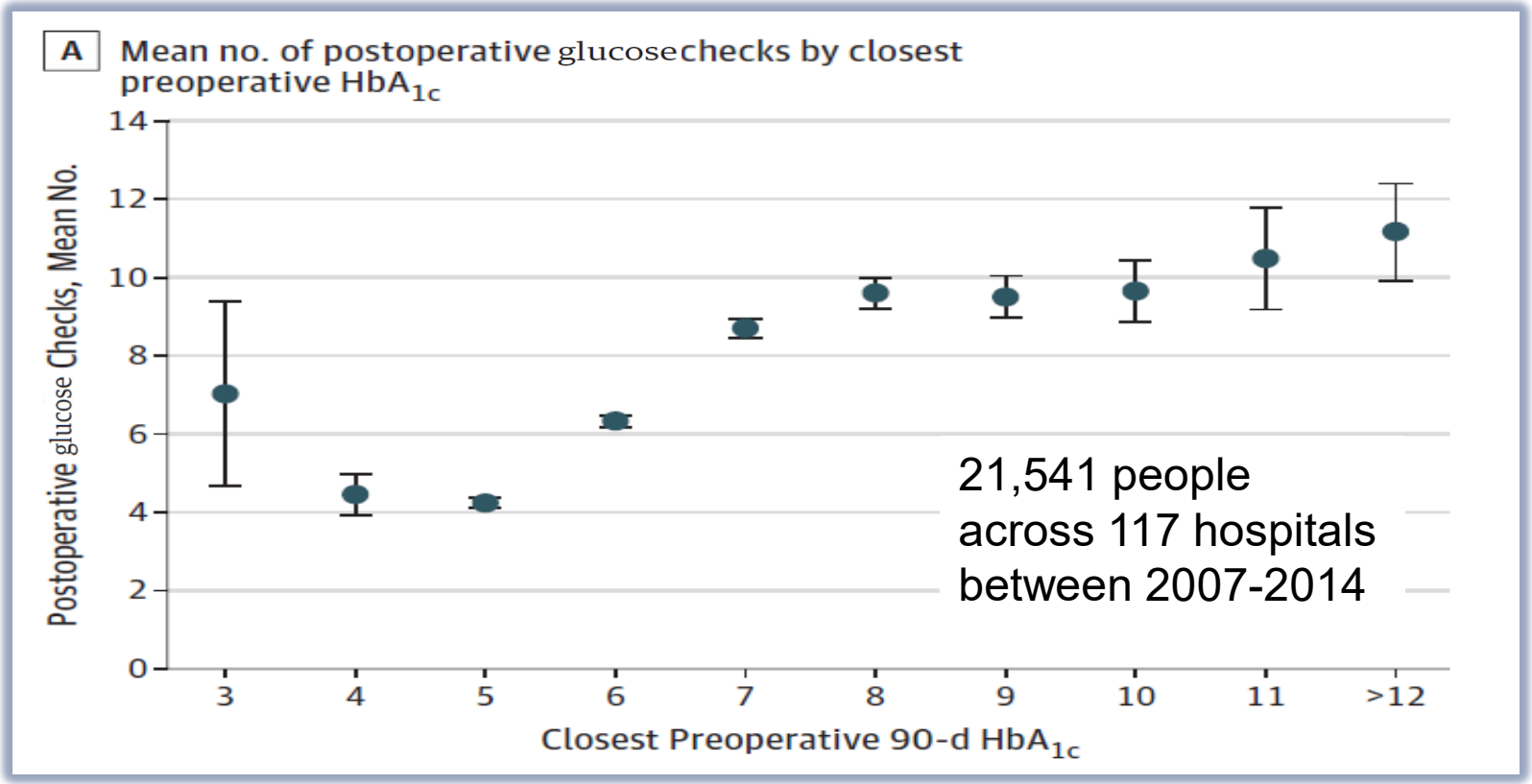
High glucose levels were associated with poor outcomes

Diabetes[§]					
Noninsulin-dependent	0.51 (0.37–0.69)	0.48 (0.25–0.93)	0.63 (0.44–0.9)	0.45 (0.21–0.99)	0.77 (0.15–4.08)
Insulin-dependent	0.52 (0.35–0.76)	0.78 (0.36–1.68)	0.54 (0.35–0.85)	0.49 (0.18–1.32)	1.66 (0.26–10.71)

But – **knowing** that someone had diabetes was protective (?increased vigilance)

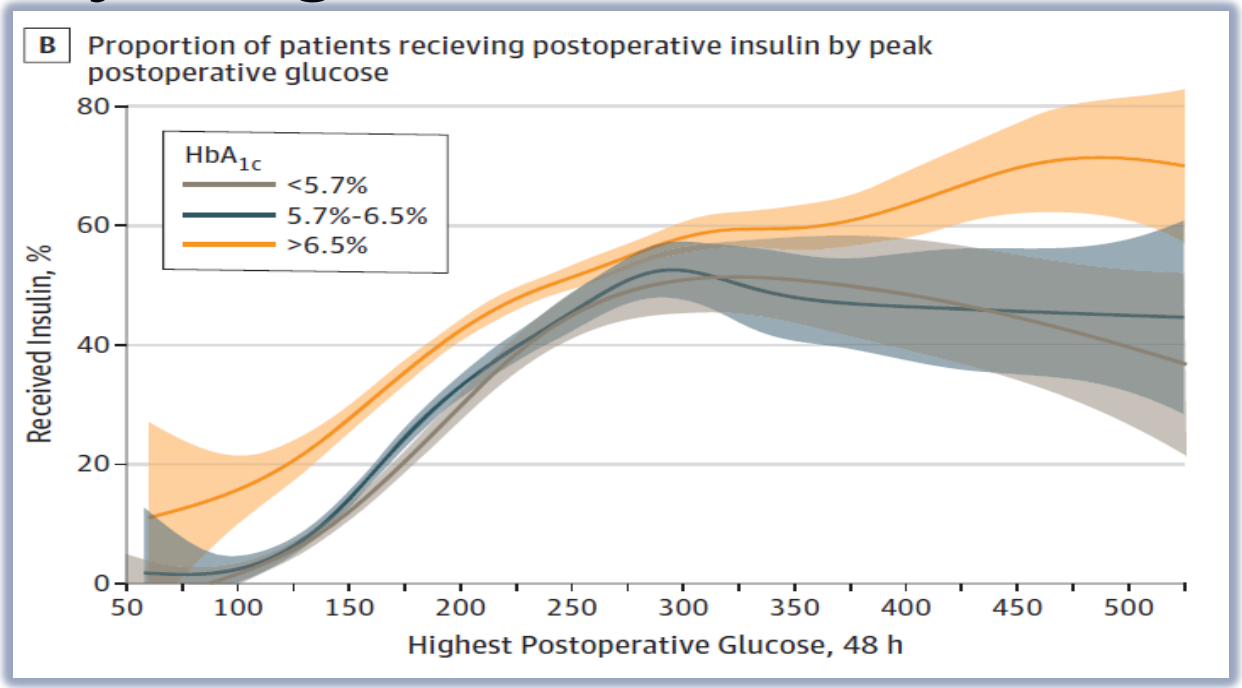
Kwon S et al Ann Surgery 2013;257(1):8-14

Probably



Jones CE et al JAMA Surg 2017;152(11):1031-1038

The Highest Pre-op HbA1c Were Most Likely to go onto Insulin Post-op

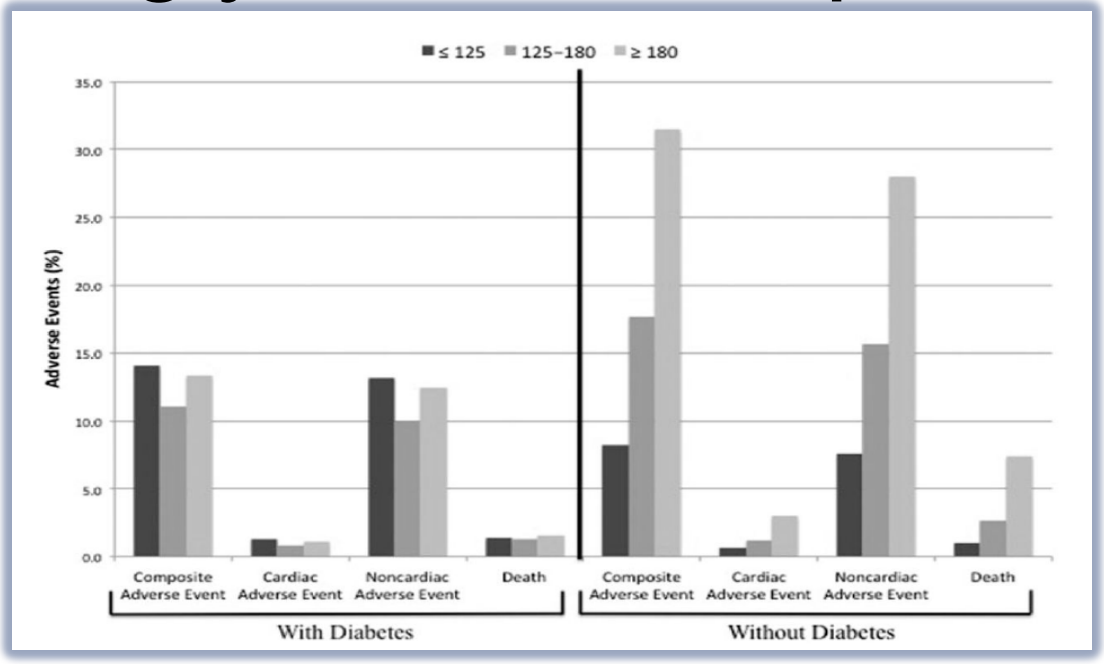


Jones CE et al JAMA Surg 2017;152(11):1031-1038

There is a Trend Emerging

- Data from the 2010-2012 Surgical Care and Outcomes Assessment Programme across 55 hospitals in the US
- 40,836 patients, of whom 19% had DM, and of whom 47% had a peri-operative BG test
- Those who had not been identified as having diabetes or those who developed post-operative hyperglycaemia had the worst outcomes

Hyperglycaemia in Previously Normoglycaemic People is Bad



Composite endpoint = readmission; ITU; falls; any infection; debridement; AKI; re-operation

Kotagal M et al Annals of Surgery 2015;261(1):97-103

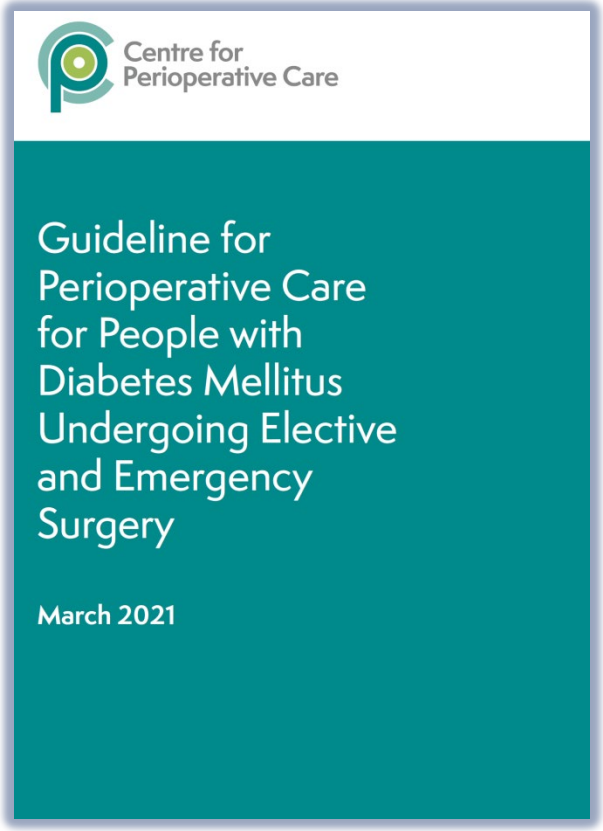
Recent UK Biobank Data

- 467,898 people in biobank, of whom 26,653 had an operation within 1 year of an HbA_{1c}
- 30 day post op complications and 90 day mortality

	Age- and sex-adjusted OR [95% CI]	Adjusted for total effect OR [95% CI]	Adjusted for direct effect OR [95% CI]
n = 23,255 No diagnosis of diabetes $HbA_{1c} < 42$ mmol.mol^{-1}	reference	reference	reference
n = 1,305 No diagnosis of diabetes $HbA_{1c} \geq 42$ mmol.mol^{-1}	1.49 [1.10–2.01]; p = 0.01	1.43 [1.02–2.02]; p = 0.04	1.37 [0.97–1.93]; p = 0.07
n = 2,093 Prevalent diabetes	2.21 [1.80–2.72]; p < 0.0001	2.00 [1.53–2.54]; p < 0.0001	1.79 [1.37–2.31]; p < 0.0001

Lam S et al Anaesthesia 2022;77:659-667

Practical Advice?



https://cpoc.org.uk/guidelines-resources-guidelines-resources/guideline-diabetes

Non-Insulin Agents

Diabetes medication	Day prior to admission	Timing of surgery	
		Patient for am surgery	Patient for pm surgery
Acarbose	Take as normal	Omit morning dose if not eating	Give morning dose if eating
Meglitinide (repaglinide or nateglinide)	Take as normal	Omit morning dose if not eating	Give morning dose if eating
Metformin (AND eGFR >60 ml/min/1.73m^2 OR procedure not requiring use of contrast media**)	Take as normal	If taken once or twice a day – take as normal If taken three times per day, omit lunchtime dose	If taken once or twice a day – take as normal If taken three times per day, do not take lunchtime dose
Sulphonylurea (eg glibenclamide, gliclazide, glipizide, glimiperide)	Take as normal	Omit on morning of surgery If taken twice daily, take evening dose if eating	Do not take on day of surgery
Pioglitazone	Take as normal	Take as normal	Take as normal
DPP4 inhibitor (eg sitagliptin, vildagliptin, saxagliptin, alogliptin, linagliptin)	Take as normal	Take as normal	Take as normal
GLP-1 Receptor Agonist (eg exenatide, liraglutide, lixisenatide, dulaglutide, semaglutide) Daily/Weekly administration	Take as normal	Take as normal	Take as normal
SGLT-2 inhibitors (eg dapagliflozin, canagliflozin, empagliflozin, ertugliflozin)	Omit on day before surgery	Omit on day of surgery	Omit on day of surgery

https://cpoc.org.uk/guidelines-resources-guidelines-resources/guideline-diabetes

Insulin

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
Long acting insulin	**Once daily long acting (morning)**	Abasaglar® Humulin I® Insulatard® Insuman Basal® Lantus® Levemir® Semglee® Tresiba® Toujeo® Xultophy®	No dose adjustment necessary	Give 80% of dose and blood glucose to be checked on admission	Give 80% of dose and blood glucose to be checked on admission
	Once daily long acting (lunchtime)	As above	Give 80% of dose	Restart insulin at normal dose when eating and drinking starts	Restart insulin at normal dose when eating and drinking starts
	Once daily long acting (evening)	As above	Give 80% of dose	No dose adjustment necessary	No dose adjustment necessary
	Twice daily (long acting insulin)	As above	Morning dose will need to stay the same evening dose will need to be 80%	Morning dose will need to be 80% and blood glucose to be checked on admission The evening dose will remain unchanged	Morning dose will need to be 80% and blood glucose to be checked on admission The evening dose will remain unchanged

https://cpoc.org.uk/guidelines-resources-guidelines-resources/guideline-diabetes

Insulin

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
Premixed insulin prepared by manufacturers	**Twice daily (premixed insulin)**	Humulin M3® Humalog Mix 25® Humalog Mix 50® Hypurin Porcine 30/70 Mix®) Insuman Comb 15® Insuman Comb 25® Insuman Comb 50® Novomix 30®	No dose adjustment necessary	Halve usual morning dose. Blood glucose to be checked on admission Resume usual l insulin with evening meal if eating a normal meal. If eating a half/small meal give half usual dose. If not eating give basal only component of the usual mixed insulin	Halve usual morning dose. Blood glucose to be checked on admission Resume usual insulin with evening meal if eating a normal meal. If eating a half/small meal give half usual dose. If not eating give basal only component of the usual mixed insulin
	Three times per day (premixed insulin)	As above	No dose adjustment necessary	Halve usual morning dose. Blood glucose to be checked on admission Omit lunchtime dose Resume normal insulin with evening meal if eating a normal meal. If eating a half/ small meal give half usual dose. If not eating give basal only component of the usual mixed insulin	Halve usual morning dose. Blood glucose will be checked on admission Omit lunchtime dose Resume normal insulin with evening meal if eating a normal meal. If eating a half/ small meal give half usual dose. If not eating give basal only component of the usual mixed insulin

https://cpoc.org.uk/guidelines-resources-guidelines-resources/guideline-diabetes

Insulin

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
Self-mixed insulin prepared by patient/carer	**Twice daily (two different types of insulin combined by the person with diabetes into one injection)**	Short acting: Actrapid® Apidra® Fiasp® Humalog® Humulin S® Hypurin® Porcine Neutral Insuman Rapid® Lyumjev® NovoRapid® AND intermediate acting: Humulin I® Hypurin® Porcine Isophane Insulatard®	No dose adjustment necessary	Calculate the total dose of both morning insulins and give half of this total dose as intermediate acting insulin only, in the morning Blood glucose to be checked on admission Resume usual insulin with evening meal if eating a normal meal. If eating a half/ small meal give half usual dose. If not eating give basal only component of the usual mixed insulin	Calculate the total dose of both morning insulins and give half of this total dose as intermediate acting insulin only, in the morning Blood glucose to be checked on admission Resume usual insulin with evening meal if eating a normal meal. If eating a half/ small meal give half usual dose. If not eating give basal only component of the usual mixed insulin

https://cpoc.org.uk/guidelines-resources-guidelines-resources/guideline-diabetes

Insulin

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
Short acting insulin	**Short acting insulin with meals (two to four doses a day)**	Actrapid Apidra® Fiasp® Humalog® Humulin S® Hypurin® Porcine Neutral Insuman Rapid® Lyumjev® NovoRapid®	No dose adjustment necessary	Omit morning dose if no breakfast is eaten Blood glucose to be checked on admission Omit lunchtime dose if not eating and drinking normally Resume normal insulin with evening meal if eating a normal meal. If eating a half/ small meal give half usual dose. If not eating give basal only component of the usual mixed insulin	Take your usual morning insulin dose with your breakfast Omit lunchtime dose if not eating Blood glucose to be checked on admission Resume normal insulin with evening meal if eating a normal meal. If eating a half/ small meal give half usual dose. If not eating give basal only component of the usual mixed insulin
Resume taking usual insulin the morning after surgery (procedure). However, blood glucose levels may be higher than usual for a day or so.					
Variable rate intravenous insulin infusions	Dose of long-acting insulin should be 80% Short acting, Intermediate and Pre-mixed Insulins should be discontinued and replaced by a long-acting basal insulin at a dose of 0.2 units per kilogram A return to the person's usual diabetes management should be made once they are eating and drinking normally. Adjustments may need to be made to insulin dose(s) as insulin requirements may change in the postoperative period – blood glucose levels should be monitored and advice sought from the specialist diabetes team if necessary				

https://cpoc.org.uk/guidelines-resources-guidelines-resources/guideline-diabetes

In Summary

- Diabetes and hyperglycaemia in people undergoing surgery is common
- Hyperglycaemia is associated with harm
- There are many practical guidelines available
- There is emerging evidence of benefit, try to aim for glucose concentrations of 6.0-10.0mmol/l (108-180mg/dl) where it is safe to do so

Preparing People with Diabetes for Surgery

www.norfolkdiabetes.com

ketan.dhatariya@nnuh.nhs.uk

@ketandhatariya