



Centre for  
Perioperative Care

Academy of  
Medical Royal  
Colleges



# Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

Updated October 2023

# Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

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## Guideline review

This is version 1.0 of this guidance document, published in March 2021. Any updates made to this guidance will be reflected in the table below and included in subsequent versions.

Version	Change	Date
1.0	First publication	8 March 2021
2.0	Second publication	19 December 2022
3.0	Third publication	4 October 2023

**Date of review: March 2024**

ISBN: 978-1-900936-25-5

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Design and layout by the Royal College of Anaesthetists

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# FOREWORD

The Centre for Perioperative Care (CPOC), a cross organisational body, was established in 2019 to facilitate and promote delivery of quality perioperative care. Given this remit, CPOC is in a unique position to collate and develop, implement, and evaluate new guidelines to support delivery of perioperative care. As a consequence CPOC was commissioned by the Academy of Medical Royal Colleges (AoMRC) to build on existing work to develop a whole pathway guideline on perioperative care for people with diabetes undergoing elective and emergency surgery.

Delivering whole pathway, quality perioperative care requires multicomponent intervention, with integration across primary, secondary and social care from the moment surgery is contemplated through to full recovery. A multidisciplinary 'one team' approach is necessary to deliver each component of the pathway; shared decision making (SDM); preoperative risk assessment and optimisation of physiological status, co-morbidities and syndromes; lifestyle modification to improve both surgical and long-term health outcomes; quality, targeted postoperative care including rehabilitation; proactive discharge planning; patient and carer involvement, education and empowerment. Delivering such an approach requires accessibility to and effective use of technology, underpinned by research and implementation science.

Perioperative care for people with diabetes is particularly complex and deficiencies in current perioperative pathways for people with diabetes have been well described.<sup>1</sup> As a result, several guidelines to support clinical care have been published.<sup>2</sup> However, an implementation gap between recommended care and routine clinical practice persists. This may be a consequence of each guideline being written for specific professional groups; for example, guidelines for general practitioners focussing on community care, for preoperative assessment teams addressing immediate preoperative care or for anaesthetists describing intraoperative care.<sup>3</sup> To overcome this siloed approach, this new guideline has been coordinated by CPOC, working with patient representatives and all stakeholders involved in the care of people with diabetes undergoing surgery. Based on previous work, it aims to address gaps in currently available guidance to address the deficiencies in care identified in national reports such as the National Diabetes Inpatient Audit (NaDIA),<sup>4</sup> Getting it Right First Time (GIRFT),<sup>5</sup> and the National Confidential Enquiry into Patient Outcome and Death (NCEPOD).

As such, the scope of this guideline covers all aspects of perioperative care relevant to people with diabetes undergoing elective and emergency surgery in adult areas.<sup>†</sup> It is written for clinicians and healthcare professionals involved in delivering care throughout the surgical pathway, as well as for

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#### **†Specific perioperative consideration for children with diabetes**

There is comprehensive guidance on the management of diabetes mellitus in children and young people produced by the National Institute for Health and Care Excellence.<sup>6</sup> Within this, there are clear recommendations on management of children and young people with diabetes undergoing surgery. These include the need for involvement of the diabetes team for children and young people, as well as the requirement for specific local protocols for management of children and young people undergoing surgery. The Association of Children's Diabetes Clinicians (ACDC) has produced a guideline with opportunity to customise it for local hospital use called 'Care of children under 18 years with diabetes mellitus undergoing surgery'. This is located on both the ACDC and British society of Paediatric Endocrinology and Diabetes (BSPED) websites and endorsed by both organisations.<sup>7</sup> Where young people aged 16–18 years are managed by adult medical or surgical teams because of local arrangements, it is considered appropriate for them to be managed using local adult guidelines that the teams are familiar with, rather than using potentially unfamiliar paediatric guidelines. Where individuals aged 16–18 are managed by paediatric teams, the paediatric guidelines should be followed.

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managers and commissioners, people with diabetes and their carers. Implementation of the guideline will require collaboration between all stakeholders, an implementation strategy, workforce development with supporting education and training resource and evaluation through refinement of current national audit tools. We look forward to working with all of our collaborators to translate these recommendations into routine clinical care.



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**March 2021**

# BACKGROUND

Over 323,000 operations take place in the UK each year in people with diabetes, accounting for 15% of all operative procedures.<sup>8</sup> This group continues to have a longer length of stay and higher rates of adverse postoperative outcome compared to those without diabetes.<sup>9</sup> The 'Highs and Lows' report from NCEPOD identified many areas for improvement in perioperative diabetes care. It stressed the importance of careful planning and good communication between people with diabetes and multi-professional healthcare teams, in the complex perioperative pathway.

At present, the elective perioperative pathway usually starts with a referral from the community, followed by surgical consultation and, in most cases, preoperative assessment. A recent study highlighted that two-fifths of primary care referral letters to surgical teams do not provide any information on the status of diabetes management with less than one in ten documenting a recent HbA<sub>1c</sub>.<sup>10</sup> This issue is compounded by the lack of integrated patient record between primary and secondary care. Of those who do have a preoperative HbA<sub>1c</sub> documented, 15% reflect suboptimal management with HbA<sub>1c</sub> >69mmol/mol (8.5%).<sup>11</sup> This is despite evidence that suboptimal preoperative glycaemic management is associated with both hypoglycaemia and hyperglycaemia during and after surgery; a risk factor for infections, poor wound healing and increased length of stay.<sup>12,13</sup> Current guidelines advocate preoperative HbA<sub>1c</sub> within three months of surgery to identify those who would benefit from optimisation, but this occurs in only 35% of patients at preoperative assessment clinic.<sup>14,15</sup> People with diabetes receive variable information on the importance of diabetes in the consideration of risks and benefits of surgery, the likely impact of surgery on their diabetes and the necessary perioperative medication adjustments. In one multicentre study only half of the participants reported receiving information on perioperative diabetes management.<sup>16</sup>

Although people with diabetes do not all undergo objective or individualised assessment of severity of disease and complications, they continue to be described as 'high risk' and as such, are often denied access to day surgery.<sup>17</sup> Furthermore, people with diabetes undergoing inpatient surgery are more frequently admitted the day before surgery, with associated risks related to multiple ward moves, longer admission, a higher risk of medication errors and associated risk of adverse postoperative outcome. National guidelines advocate minimising preoperative fasting and to ensure this, people with diabetes should have surgery first on the list. In theatre and recovery, guidelines advocate regular capillary blood glucose (CBG) monitoring. The NCEPOD report showed 14% of patients did not have adequate in-theatre CBG monitoring and intraoperative hypoglycaemia occurred in 4.7%.<sup>11</sup> Furthermore, 16% of all insulin infusions were discontinued incorrectly.

In terms of ward care, the recent GIRFT programme found that people with diabetes undergoing surgery had an excess length of stay of three days. This is related, at least in part, to suboptimal inpatient diabetes management. Despite experience in self-management, many people with diabetes, particularly those on insulin, are often disempowered to self-manage in hospital.<sup>18</sup> Lack of staff knowledge frequently leads to preventable treatment errors.<sup>19</sup> NaDIA found medication errors in treatment charts of almost a third of people with diabetes and such errors were more common on surgical wards than on medical wards. Diabetes inpatient specialist nurse team (DISN) involvement reduces such errors but is not routinely available on surgical wards. Unsurprisingly, postoperative readmissions, with associated patient distress and financial cost, occur more frequently in people with diabetes.<sup>20,21</sup>

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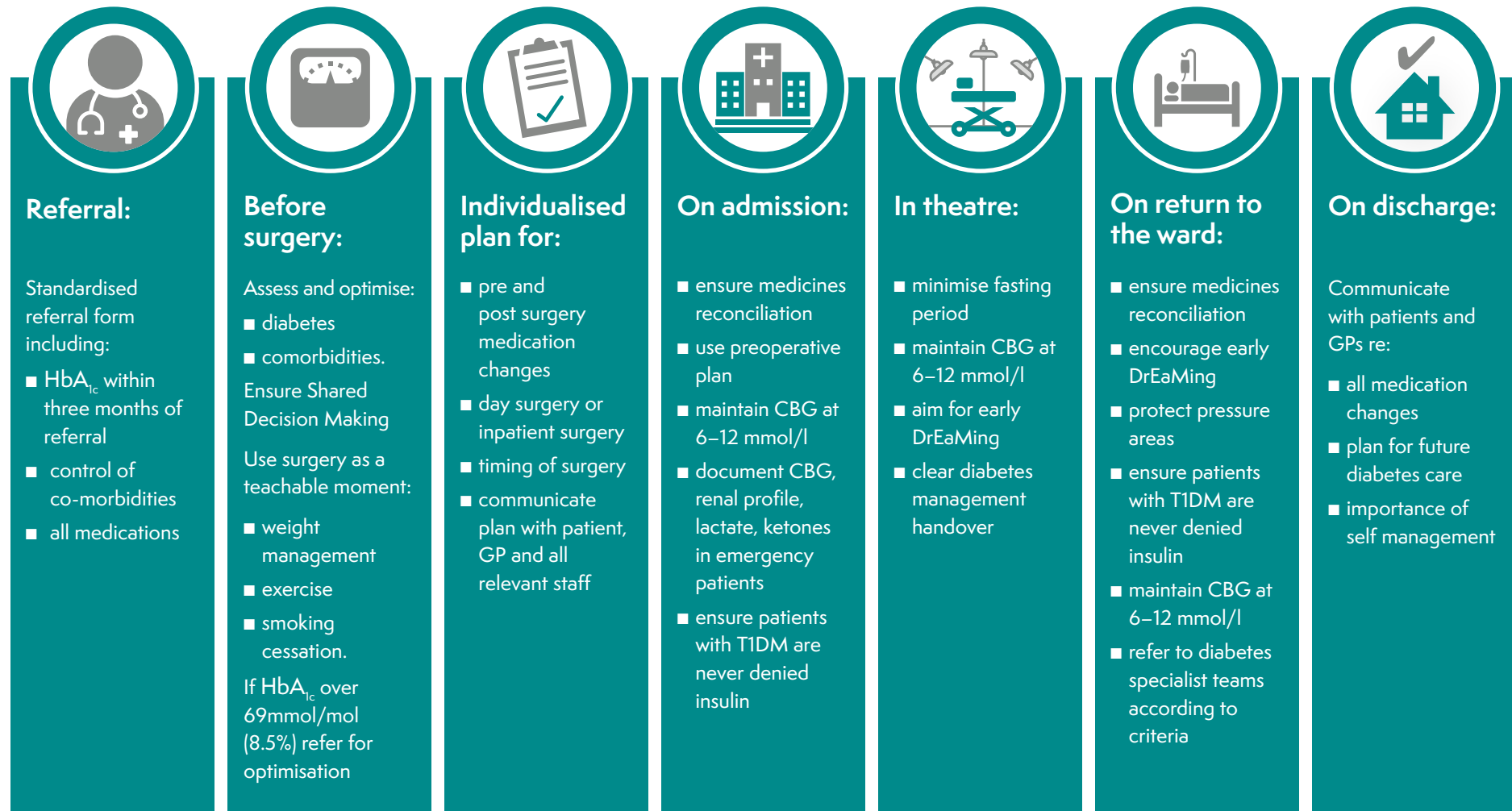
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To address these described deficiencies in perioperative care, this new guideline from CPOC provides recommendations to support delivery of quality perioperative care for people with diabetes undergoing surgery, from time of contemplation of surgery to discharge back to the community (Figure 1).

The recommendations are supported by a set of practical resources collated, with thanks, from units across the NHS, who have developed perioperative services for people with diabetes undergoing surgery.

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**Figure 1** The perioperative pathway for people with diabetes undergoing elective and emergency surgery



CBG = capillary blood glucose

Shared Decision Making = the process whereby patients and clinicians work together to make evidenced based decisions centred on patient values and preferences – including risks, benefits, alternatives and optimisation.

T1DM = Type 1 Diabetes Mellitus

DrEaMing = Drinking, Eating and Mobilising



## Recommendations for organisations

- Commissioning bodies should work collaboratively with primary, secondary, community and social care services to develop perioperative pathways for people with diabetes. They should consider commissioning preoperative holistic assessment and optimisation (including prehabilitation) services for people with diabetes and co-existing co-morbidities. The focus should be on improving both short-term perioperative outcomes and long-term health outcomes.
- All organisations involved in supporting people with diabetes through the perioperative pathway, should ensure staff have access to and complete regular training in the relevant aspects of diabetes management
- All hospitals, where surgical services are provided, should appoint a clinical lead for perioperative diabetes care. This person should be responsible for developing, implementing, and auditing policies and processes to ensure quality care for all people with diabetes undergoing surgery ([Appendix 1](#)).
- Hospitals where surgical services are provided, should appoint a specific team to co-ordinate individualised perioperative care for people with diabetes. This task should be supported by perioperative diabetes inpatient specialist nurses (DISNs) with appropriate clinical support.
- Where treatment is provided outside of NHS hospitals, a diabetes specialist team should be available to support the perioperative management of people with diabetes.
- Hospitals should have a strategy to promote and support day surgery for people with diabetes based on British Association of Day Surgery Directory of Procedures.
- Hospitals should promote use of Enhanced Recovery (ER) programmes for all surgical patients, including people with diabetes.
- Hospitals should invest in technologies to support perioperative care of people with diabetes:
  - hospitals should ensure all people with diabetes can be routinely identified on the patient administration electronic systems
  - hospitals should implement system markers and alerts for glucose levels, for example tagging of electronic medical records.
- Hospitals should ensure systems are in place to support self-management for people with diabetes; while waiting for surgery and immediately pre and post-operatively in hospital.
- Hospitals should develop pathways to allow people with diabetes to continue to use their continuous subcutaneous insulin infusions (CSII) when the anticipated fasting period is only one missed meal.
- There should be clear written information for people with diabetes about what they can do to prepare for surgery and as well as information on the care they can expect around the management of their diabetes in the perioperative period and their involvement in their care.
- The importance of the administrative and medical secretariat support should be recognised and should be actively involved in the coordination and communication of perioperative pathways (this includes recording and coding of personal information).

## Recommendations for primary care teams

Primary care referrals requesting surgical consultations for people with diabetes should include (note these may be in patient summary attached to the letter):

- type of diabetes
- main diabetes care provider (primary or secondary care)
- date of last diabetes review
- HbA<sub>1c</sub> levels within three months prior to referral
- a list of all current medications (dose/route) and medical devices used (pumps, flash monitor, continuous glucose monitoring (CGM))
- body mass index (BMI) with date of measurement if available
- latest blood pressure reading with date of measurement
- estimated glomerular filtration rate (eGFR) with date of measurement
- presence and management of co-morbidities (for example hypertension, cardiac disease, renal disease) and complications (for example foot ulceration/disease, peripheral vascular disease).

Primary care teams should:

- aim to optimise glycaemic management, aiming for an HbA<sub>1c</sub> of less than 69mmol/mol (8.5%) before referral if safe and practical
- consider referral for diabetes specialist support if the HbA<sub>1c</sub> is greater than 69mmol/mol (8.5%)
- optimise diabetes related co-morbidities (eg hypertension, cardiac disease, peripheral vascular disease) and any other comorbidities impacting on general health and wellbeing
- discuss likely impact of surgery on the person's social situation (for example work, caring responsibilities, functional independence)
- advise people with diabetes on the importance of general improvements in health:
  - exercise
  - weight management<sup>22</sup>
  - importance of good nutrition
  - smoking cessation
  - reduction in alcohol
  - psychological preparation and wellbeing

## Recommendations for staff working in surgical outpatients

Surgical teams should:

- identify people with suboptimal diabetes management (HbA<sub>1c</sub> >69mmol/mol,8.5%) and refer to a specialist team for preoperative planning and optimisation
- ensure individualised SDM through discussing the benefits, risks, and alternatives to surgery, taking the presence and impact of diabetes into consideration
- take both the urgency of the procedure and control of and management of diabetes into account to inform the timing of surgery (for example delaying surgery to optimise diabetes management)
- promote day surgery for people with diabetes, using the same principles as those used when considering day surgery for those without diabetes<sup>23</sup>
- refer all people with diabetes scheduled to undergo an elective procedure, necessitating a period of fasting to a preoperative assessment clinic as early as possible in the pathway

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- ensure people with diabetes due for surgery are scheduled such that the period of fasting is minimised
- provide written information about perioperative diabetes management (including a medicine management plan) within the patient's surgical care pathway document.
- ensure use of ER programmes
- Make Every Contact Count; use consultation as a teachable moment and discuss lifestyle modification that is proven to have perioperative and long term benefit:
  - exercise
  - weight management
  - importance of good nutrition
  - smoking cessation
  - reduction in alcohol
  - psychological preparation

### Recommendations for staff working in preoperative assessment services

Preoperative assessment clinic staff should:

- document diagnosis, type of diabetes, usual diabetes medications, HbA<sub>1c</sub> level (within three months) and evidence of end organ damage. For example autonomic neuropathy causing postural hypotension, renal impairment increasing the risk of acute kidney injury (AKI), and/or peripheral vascular disease increasing the risk of heel or pressure ulcers, etc.
- refer to the diabetes specialist team if HbA<sub>1c</sub> >69mmol/mol (8.5%) or if on an insulin pump/CSII
- be aware of newer methods of diabetes management:
  - increasing numbers of people with Type 1 diabetes are being managed with CSII. This can be safely used in theatre provided certain criteria are met. However, the insulin pump is not licensed for use near diathermy. Therefore, SDM needs to occur if the use of the insulin pump is contemplated. This should only be performed by people knowledgeable in both SDM and the safe use of the CSII in hospital. [Practical Resource 5](#) provides details of a policy that hospitals should consider adopting to allow the safe use of the CSII in surgical patients
  - CGM/flash devices – people with diabetes may continue to use their own sensors but clinicians need to be aware of the lag shown in flash devices and the consequent need to take CBG at regular intervals during surgery to allow accurate and optimal management.
- work, where possible, with a pharmacy team to ensure medicines reconciliation prior to admission to reduce medication errors including a system for people with diabetes to report changes to their medication between their preoperative assessment and date of surgery:<sup>24</sup>
- pre-prescribe diabetes medication prior to admission. Insulin should be prescribed in accordance with NPSA recommendations for safe use of insulin
- pre-prescribe rescue treatment for looming hypoglycaemia (for example for glucose levels between 4–6mmol/l), hypoglycaemia (<4mmol/l); and hyperglycaemia (>13mmol/l). There should be a hypobox available at every point of care. For example, the admission ward, theatre, recovery ([Practical Resource 3](#)).

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- be aware that for many optimally managed people with diabetes using continuous sub-cutaneous insulin infusion and/or wearable glucose sensors, a range of 4–6mmol/l may be their normal level when they are not eating. In these cases it is important to have a discussion with the person with diabetes about the need to avoid severe hypoglycaemia and therefore the need to aim for higher levels than they are used to
- encourage the person with diabetes to bring all of their medication into hospital to ensure that they can continue to use familiar medication and to avoid omitted doses
- develop an individualised care plan, written and shared with the person with diabetes, visible to the perioperative team (including the surgeon, anaesthetist, ward team), including:
  - instructions regarding necessary changes to medication prior to admission, using hospital approved protocols ([Appendix 2](#))
  - instructions for the person with diabetes on how to seek advice if required during their admission
  - instruction for the person with diabetes on what to bring to hospital and a list of common things to consider
  - explicit documentation on whether a VRIII is required and for how long ([Appendix 3](#))
  - location of surgery (day case surgery, admission on day of surgery or prior, with rationale documented)
  - timing of surgery (ideally first on a morning list and not on an evening list)
  - documentation of expected duration of stay
  - a discharge plan including potential need for formal and informal social care, community care and primary care team.
- utilise preoperative assessment as a teachable moment for lifestyle modification to improve perioperative and long term outcomes:
  - exercise
  - weight management
  - importance of good nutrition
  - smoking cessation
  - reduction in alcohol
  - psychological preparation
- identify other co-morbidities that often coexist with or occur as a consequence of diabetes and refer to the relevant teams for optimisation where necessary

Use of preoperative carbohydrate loading is controversial. Whilst it is not recommended because of the risk of perioperative hyperglycaemia (and subsequent risks), local guidelines for people with diabetes should be developed and followed.

## Recommendations for staff delivering care during hospital admission for elective surgery

Ward staff should:

- check that any pre-prescription of medication (from preoperative assessment clinic) is consistent with medication prescribed at admission
- ensure medication is prescribed with adjustments as instructed by preoperative assessment services
- work with pharmacy teams to ensure prompt medication reconciliation
- ensure rescue medication is prescribed to allow prompt treatment of looming hypoglycaemia and hyperglycaemia
- document whether the person with diabetes will be self-managing their diabetes or whether medication will be administered by the ward team
- document an agreed plan for people with diabetes who are using continuous subcutaneous insulin infusion and those using subcutaneous sensor devices (for example the Freestyle Libre or Continuous Glucose Monitoring devices) ([Practical Resource 5](#))
- monitor CBG regularly ([Appendix 3](#)) and aim keep in the range 6–10mmol/l (up to 12mmol/l is acceptable)
- for those treated with dietary modification alone, or oral glucose lowering medications which **do not** cause hypoglycaemia for example, metformin or DPP4 inhibitors (gliptins), the Joint British Diabetes Society (JBDS) recommend an acceptable blood glucose range of 4–12mmol/l.
- in the majority of people with diabetes on glucose lowering medication (any insulin preparation and any insulin secretagogues), consider intervening at a CBG of <6.0mmol/l to prevent hypoglycaemia. This may require oral or intravenous carbohydrate. However, for many optimally managed people with diabetes using pumps and/or wearable glucose sensors, a range of 4–6mmol/l may be their normal when they are not eating. In these cases it is important to have a discussion with the person with diabetes about the need to avoid severe hypoglycaemia and therefore the need to aim for higher levels than they are used to. In these cases the decision as to whether to intervene at a blood glucose of <6mmol/l or <5mmol/l should be a joint decision ([Practical Resource 3](#))
- measure capillary blood ketones if the person with diabetes becomes unwell or has persistent hyperglycaemia (two or more consecutive BG values >13mmol/l)
- measure capillary blood ketones daily if the person with diabetes is normally on SGLT2 inhibitors (gliflozins) even if glucose concentrations are normal (as these medications can be associated with euglycaemic ketosis)
- inspect foot and pressure areas regularly and take necessary preventive action to avoid pressure injury
- ensure ER programmes are followed for all patients, including those with diabetes

### Recommendations for staff admitting people with diabetes as emergency surgical admissions

The primary aim in the management of people with diabetes presenting for emergency surgical assessment is to prevent and/or promptly diagnose metabolic derangements (hypoglycaemia, hyperglycaemia, DKA (both hyperglycaemic and euglycaemic) and hyperglycaemic hyperosmolar syndrome (HHS)).

In addition to delivering care as outlined in the recommendations for staff delivering care during elective surgery hospital admission section, staff should:

- ensure all emergency admissions of people with diabetes have glycaemic status (CBG) and metabolic status (renal profile, lactate and ketones) documented
- ensure people with Type 1 diabetes have ketone levels checked and insulin prescribed (either basal insulin or intravenous insulin infusion) (see [Practical Resource 2](#)). Failure to prescribe insulin in people with Type 1 diabetes can result in fatal diabetic ketoacidosis
- ensure SGLT 2 inhibitors are withheld,<sup>25</sup> and daily ketone levels checked throughout admission
- refer to diabetes team or physicians if there is:
  - metabolic derangement
  - recurrent or severe hypoglycaemia.
  - persistent hyperglycaemia (two or more consecutive BG values >13mmol/l or hyperglycaemia with ketone levels >1.5mmol/l).
- prioritise surgery to minimise duration of fasting
- use VRIII according to [Appendix 4](#) if the person with diabetes is fasting resulting in more than one missed meal
- use a fixed rate intravenous insulin infusion (FRIII) according to JBDS guidelines if the person with diabetes has DKA or HHS<sup>26,27</sup>
- modify the person's normal insulin if the person with diabetes will be fasting for more than one missed meal – see [Practical Resource 1.1](#)
- for any person with diabetes requiring VRIII consider the use of a reduced rate VRIII if any risk factors for hypoglycaemia present (chronic kidney disease, acute kidney injury, low body weight, low total daily dose of insulin, insulin naive)
- [Appendix 5](#) summarises the initial diabetes management of the patient admitted as a surgical emergency.

### Recommendations for staff in theatre and recovery

Staff in theatre and recovery should:

- ensure each theatre and recovery area has immediate access to a glucose meter, ketone meter, 'hypobox', rapid acting insulin and insulin syringes
- ensure the contents of 'hypobox' are checked and if necessarily replenished daily
- implement the WHO surgical safety checklist bundle with maintenance of intraoperative blood glucose levels between 6–12mmol/l
- check CBG prior to induction of anaesthesia, monitor and record the CBG at least hourly if on insulin, or insulin secretagogues, otherwise a minimum of two hourly is recommended

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- never stop an insulin infusion in a person with Type 1 diabetes unless basal subcutaneous insulin has been given, the glucose is <10mmol/l and ketones are <0.6mmol/l
- ensure a planned approach to the use of CGM, continuous sub-cutaneous insulin infusion and closed looping systems
- ensure preventative actions to avoid and/or manage pressure areas and diabetes related foot issues
- utilise anaesthetic strategies to promote early return to usual diet and diabetes management including:
  - techniques to reduce the postoperative nausea and vomiting (PONV)
  - multi-modal analgesia combined with appropriate antiemetics.
- ensure a safe, documented handover from theatre recovery to the ward including:
  - medications given in theatre
  - CBG level on leaving the recovery area
  - plan for ward-based management of diabetes
    - the need for and duration of VRIII
    - instructions on prescription of subcutaneous insulin at least 30 minutes prior to discontinuation of VRIII to avoid ketosis due to an 'insulin gap'
  - criteria for contacting the diabetes, anaesthetic or physician teams supporting postoperative care.

### Recommendations for teams delivering postoperative ward care

Ward teams should:

- monitor and maintain CBG in target (6–12mmol/l) unless otherwise specified in care document
- monitor electrolytes and fluid balance daily and correct accordingly
- proactively treat postoperative nausea and vomiting
- promote restoration of usual diet and restoration of normal diabetes medications but note doses may need to be adapted, check the patients surgical care document and discuss with the person with diabetes
- never stop an insulin infusion in a person with Type 1 diabetes unless basal subcutaneous insulin has been given and ketones are <0.6mmol/l.
- prescribe and administer insulin in line with NPSA guidance,<sup>28</sup> in consultation with the person with diabetes wherever possible
- ensure that health care professionals prescribing and administering insulin have evidence that they are competent in these roles
- promote drinking, eating, mobilising (DrEaMing)<sup>29</sup> and provide appropriate food options (with nutritional counts) as far as practical
- support the person with diabetes to resume self-management of diabetes as soon as possible<sup>30</sup>
- inspect the person with diabetes feet and pressure areas daily as a minimum, document findings and take action to prevent and manage diabetes related foot disease and pressure areas injury.

## Recommendations for safe and effective discharge and follow up

Ensure a proactive planned approach to timely, safe and effective discharge. The ward team should ensure:

- a focus on discharge planning from time of admission
- ensure ongoing review of discharge plans throughout the admission, aiming to proactively identify and address potential barriers to discharge
- involve the diabetes specialist team if discharge delays are diabetes related (for example suboptimal diabetes management)
- ensure timely communication with all services, community, primary and social care, involved with post-discharge patient care. This is particularly important if:
  - changes have been made to diabetes medications during the hospital stay
  - there are concerns regards management of diabetes
  - there are concerns regards administration of diabetes medication
  - there has been prolonged postoperative dysglycaemia (<6 or >12mmol/l) for more than 3 days. In this case the person with diabetes should be advised to see their primary caregiver (for example GP or secondary care) and the provider should be informed.
- provision of timely (day of discharge) written discharge documentation to the person with diabetes, and GP to include:
  - sick day rules
  - details on who to contact for advice regards management of diabetes and post-surgical issues
  - changes made to diabetes medications.
- patient education to promote quality management of diabetes on discharge and long-term healthy behaviours.

## Recommendations for research

There is a need to develop studies to answer the following questions:

- does preoperative optimisation of diabetes (as measured by HbA<sub>1c</sub>) improve postoperative outcomes?
- does preoperative short-term glycaemic optimisation (as measured by CBGs or interstitial blood glucose- CGM or 'Flash Glucose' sensing) improve postoperative outcomes?
- does preventing inpatient hyperglycaemia (CBG>12mmol/l) reduce postoperative complications?
- does a dedicated perioperative pathway for people with diabetes improve postoperative outcomes?
- what interventions reduce the incidence of inpatient postoperative complications related to:
  - hospital acquired DKA in hospital
  - hospital acquired hypoglycaemia in hospital
  - hospital acquired hyperglycaemia in hospital
  - medication errors in hospital.
- Does preoperative administration of carbohydrate to people with diabetes make a difference to postoperative outcomes?



## Recommendations for people with diabetes and their carers and the staff engaging with them

People who have diabetes and who are having surgery should be encouraged and supported to:

- ask questions about the proposed surgery, including the benefits, risks and alternatives of the proposed surgery
- communicate what is important to them in their life and talk about this to the healthcare team.
- improve control of diabetes (aiming for HbA<sub>1c</sub> <8.5% or less depending on individualised assessment)
- bring a list of medication to all healthcare related appointments
- discuss how they normally manage their diabetes, including usual injection sites, medication timings, susceptibility to hypoglycaemia and ask about whether and how this may need to change during the surgical episode
- discuss what will be the recommended blood glucose range while in hospital and how this may differ from the range that they use at home.
- bring enough diabetes related medication and supplies for the duration of their admission
- prepare for surgery. (Research shows these approaches can reduce the risk of complication by up to 80%):<sup>31</sup>
  - stop smoking
  - exercise every day, starting with a walk
  - ensure good nutrition
  - aim for good weight management before surgery
  - reduce alcohol consumption in accordance with government guidelines (<14 units per week)
  - prepare psychologically for surgery
  - make necessary adjustment to their responsibilities (work and caring) and homes, so that the discharge from hospital can happen as smoothly as possible

## Glossary and abbreviations index

CBG – Capillary blood glucose

CGM – Continuous glucose monitors

CSII – Continuous subcutaneous insulin infusion

DISN – Diabetes Inpatient Specialist Nurse

DKA – Diabetic ketoacidosis

DPP4 inhibitor – Dipeptidyl Peptidase-4 Inhibitors

FRIII – Fixed rate intravenous insulin infusion

GLP 1 agonist – glucagon-like peptide 1 receptor agonist

HHS – hyperosmolar hyperglycaemic state

MDI – Multiple daily injections

SDM – Shared Decision Making

SGLT2 inhibitor – sodium-glucose cotransporter 2 inhibitor

VRIII – Variable rate intravenous insulin infusion

# PRACTICAL RESOURCES

## 1 Perioperative management of medications for diabetes

### 1.1 Guideline for perioperative adjustment of insulin

This guideline is an updated version to the appendices 1 and 8 found in the [Joint British Diabetes Society guideline: Management of adults with diabetes undergoing surgery and elective procedures: Improving standards](#) (March 2016).

Insulin products are classified according to their duration of action and it is important to understand the type of insulin and the regimen that the person with diabetes is on in relation to the advice to be given perioperatively.

Due to the potential for insulin preparations to change, this table is for guidance only and reference should be made to the [UKCPA Handbook of Perioperative Medicines](#) for up-to-date information.

## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
<b>Long acting insulin</b>	<b>Once daily long acting (morning)</b>	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
	<b>Once daily long acting (lunchtime)</b>	As above (or merge the cells)	Give 80% of dose	Restart insulin at normal dose when eating and drinking starts	Restart insulin at normal dose when eating and drinking starts
	<b>Once daily long acting (evening)</b>	As above (or merge the cells)	Give 80% of dose	No dose adjustment necessary	No dose adjustment necessary
	<b>Twice daily (long acting insulin)</b>	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

Guideline for Perioperative Care for People with Diabetes Mellitus  
Undergoing Elective and Emergency Surgery

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
Premixed insulin prepared by manufacturers	<b>Twice daily (premixed insulin)</b>	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 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
	<b>Three times per day (premixed insulin)</b>	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

## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
Self-mixed insulin prepared by patient/carer	<b>Twice daily (two different types of insulin combined by the person with diabetes into one injection)</b>	Short acting: Actrapid® Apidra® Fiasp® Humalog® Humulin S® Hypurin® Porcine Neutral Insuman Rapid® Lyumjev® NovoRapid® Trurapi® 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

## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

	Insulins	Example medications	Day prior to admission	Patient for am surgery	Patient for pm surgery
Short acting insulin	<b>Short acting insulin with meals (two to four doses a day)</b>	Actrapid Apidra® Fiasp® Humalog® Humulin S® Hypurin® Porcine Neutral Insuman Rapid® Lyumjev® NovoRapid® Trurapi®	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
<b>Resume taking usual insulin the morning after surgery (procedure). However, blood glucose levels may be higher than usual for a day or so.</b>					
Variable rate intravenous insulin infusions	<p>Dose of long-acting insulin should be 80%</p> <p>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</p> <p>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</p>				

## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

### 1.2 Guideline for perioperative adjustment of non-insulin diabetes medication before surgery

This guideline is an updated version to the appendices 2 and 8 found in the [Joint British Diabetes Society guideline: Management of adults with diabetes undergoing surgery and elective procedures: Improving standards](#) (March 2016).

Due to the potential for diabetes to change this table is for guidance only and reference should be made to the [UKCPA Handbook of Perioperative Medicines](#) for up-to-date information.

Diabetes medication	Day prior to admission	Timing of surgery	
		Patient for am surgery	Patient for pm surgery
<b>Acarbose</b>	Take as normal	Omit morning dose if not eating	Give morning dose if eating
<b>Meglitinide</b> (repaglinide or nateglinide)	Take as normal	Omit morning dose if not eating	Give morning dose if eating
<b>Metformin</b> (AND eGFR >60 ml/min/1.73m <sup>2</sup> OR procedure not requiring use of contrast media <sup>**</sup> )	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
<b>Sulphonylurea</b> (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
<b>Pioglitazone</b>	Take as normal	Take as normal	Take as normal
<b>DPP4 inhibitor</b> (eg sitagliptin, vildagliptin, saxagliptin, alogliptin, linagliptin)	Take as normal	Take as normal	Take as normal
<b>GLP-1 Receptor Agonist</b> (eg exenatide, liraglutide, lixisenatide, dulaglutide, semaglutide) Daily/Weekly administration	Take as normal	Take as normal	Take as normal <sup>***</sup>
<b>SGLT-2 inhibitors</b> (eg dapagliflozin, canagliflozin, empagliflozin, ertugliflozin)	Omit on day before surgery	Omit on day of surgery	Omit on day of surgery

<sup>\*\*</sup>If contrast medium is to be used and eGFR less than 60ml/min/1.73m<sup>2</sup>, metformin should be omitted on the day of the procedure and for the following 48 hours.

<sup>\*\*\*</sup>The American Society of Anaesthesiologists have released advice stating that GLP1 agonists should be withheld prior to surgery to [reduce the risk of pulmonary aspiration](#). It is the considered opinion of the expert committee advising CPOC that these drugs should be continued to maintain peri-operative glycaemic control, however prudent precautions should be undertaken to avoid pulmonary aspiration. These include regional anaesthesia or intubation using a modified rapid sequence induction using the ramped position.

## SGLT-2 Inhibitors

Serious, life-threatening, and fatal cases of diabetic ketoacidosis (DKA) have been reported rarely in people with diabetes taking an SGLT-2 inhibitor. The presentation can be atypical, with people with diabetes having only moderately elevated blood glucose levels.<sup>32</sup> Risk factors for DKA in people with diabetes taking an SGLT-2 inhibitor include conditions leading to a restricted food/fluid intake. This includes people with diabetes who are required to follow a reduced calorie diet prior to their surgical procedure, such as in bariatric surgery or those who require bowel preparation preoperatively. For these cases, a longer period of treatment cessation may be necessary and, in general, should coincide with the reduced food intake. Trusts/Health Boards should ensure that they have clear guidance in place for these cases so that peoples treatment can be appropriately managed.

In addition, current guidance suggests that SGLT-2 treatment should be interrupted in people with diabetes who have been hospitalised for major surgery or acute serious illness.<sup>33,34</sup> Ketone levels should be monitored, preferably in blood rather than urine. Treatment may be restarted once ketone levels are normal and the person with diabetes condition has stabilised, and normal oral intake is established. This approach has recently been questioned.<sup>35</sup> However, until further data is available, the recommendation to stop SGLT2 inhibitors preoperatively remains in place.

Please regularly check the [UKCPA Handbook of Perioperative Medicines](#) for updated advice.

## 2 Suggested scales for variable rate intravenous insulin infusion

### Aim

The aim of the VRIII is to achieve and maintain glucose levels within the target range of 6–10mmol/l, although up to 12mmol/l may be acceptable. This is done by infusing a constant rate of glucose containing fluid as substrate while infusing insulin at a variable rate.

### Principles

- There is no one fit for all.
- The VRIII is the preferred method of managing the surgical patient's serum glucose in the following circumstances:
  - people with Type 1 or 2 diabetes undergoing surgery with a fasting period with more than one missed meal
  - people with Type 1 diabetes undergoing surgery who have not received background insulin.
  - people with suboptimal diabetes management as defined as an HbA<sub>1c</sub> >69mmol/mol (>8.5%)
  - most people with diabetes requiring emergency surgery.
  - people with persistent hyperglycaemia (CBG >12mmol/l) in the perioperative period in the context of acute decompensation.
- If the person with diabetes is already on a long acting insulin analogue (eg Levemir®, Lantus® or Tresiba®) these should be continued at 80% of the usual dose.
- Insulin requirements often vary with weight.
- Initial insulin infusion rate should be determined by the bedside capillary blood glucose (CBG) measurement.
- Hourly bedside CBG measurement should be taken to ensure that the intravenous insulin infusion rate is correct – initially for the first 12 hours or as locally agreed.



## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

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- If the blood glucose remains over 12mmol/l for three consecutive readings and is not dropping by 3mmol/l/hr or more the rate of insulin infusion should be increased.
- If the blood glucose is <6mmol/l stop VRIII and manage low blood sugar. Recheck CBG and restart VRIII within 20 minutes irrespective of whether the person with diabetes has symptoms. However, if the person with diabetes has continued on their long acting background insulin, then their VRIII can be switched off, but the regular CBG measurements need to continue.

### Administration

- Some institutions use prefilled syringes and where available, these should be used according to local policies.
- Make up a 50ml syringe with 50 units of Soluble Human Insulin (eg Human Actrapid®) with 49.5ml of 0.9% sodium chloride solution.

### Fluids to run alongside the VRIII

- To ensure a steady supply of substrate and to ensure the recommended daily allowance for sodium is met, it is recommended that 5% dextrose in 0.45% saline and 0.15%/0.3% potassium chloride should always be run alongside the VRIII at a rate to meet the patient's fluid maintenance requirements.
- It is acknowledged that not all surgical wards and theatres will have access to this solution. In these circumstances 4% glucose in 0.18% saline and 0.15%/0.3% potassium chloride can be used instead. However, daily assessment of serum electrolytes is mandatory and resultant hyponatraemia must be treated appropriately.
- The practice of alternating 5% glucose with 0.9% saline according to serum glucose is not recommended.
- To prevent hypoglycaemia, the substrate solution containing glucose must never be discontinued inadvertently, especially during transfers.
- The rate of fluid replacement must be set to deliver the hourly fluid requirements of the individual person with diabetes and should not be altered thereafter without senior advice.
- Some people with diabetes will require additional concurrent crystalloid (via a second infusion line).

### Cautions

- 1 Do not infuse insulin without substrate unless in ITU/HDU/CCU setting.**
- 2 Measure CBG hourly to avoid hypoglycaemia and hyperglycaemia.**
- 3 Ensure the administration of basal insulin to prevent hyperglycaemia and ketosis on cessation.**
- 4 In people with Type 1 DM, the VRIII must never be stopped until alternative subcutaneous insulin has been administered in the previous 30 minutes.**
- 5 Ensure RDA of sodium is met to prevent hyponatraemia and measure electrolytes daily.**

## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

Glucose (mmol/l)	Insulin rates (ml/h) Start on standard scale unless otherwise indicated			Customised Scale	Customised Scale
	<b>Reduced Rate Scale</b>  For use in insulin sensitive people with diabetes (frail older, renal patients or those who usually need less than 24 units per day)	Standard Scale (First choice in most cases)	<b>Increased Rate Scale</b>  For use Insulin resistant people with diabetes– (Patients using > 100 units per day preadmission or with BMI > 35 kg/m <sup>2</sup> )		
<b>NB</b> If patient is on basal insulin, continue basal insulin.					
< 6.0	0*	0*	0*		
6.1 to 8.0	0.5	1	2		
8.1 to 11.0	1	2	4		
11.1 to 15.0	2	4	6		
15.1 to 20.0	3	5	7		
20.1 to 28.0	4	6	8		
28.1 or more	6	8	10		

\*Treat Hypoglycaemia **and restart IV insulin within 20 minutes**. The half-life of intravenous insulin is very short (seven to eight minutes) and restarting the VR111 promptly minimises the risk of ketoacidosis.

### 3 Prevention of hypoglycaemia and treatment for 'looming' hypoglycaemia and hypoglycaemia

- Hypoglycaemia is defined as a CBG <4mmol/l and is associated with death.
- Looming hypoglycaemia is defined as a CBG in the region of 4–6mmol/l in a person with diabetes on glucose lowering medication.
- Glucose lowering medications include all insulin preparations and insulin secretagogues for example sulphonylureas and meglitinides.
- It is now recognised that aiming for tight glycaemic management (CBG 4–6mmol/l) in unwell people with diabetes, especially if the person is on medication that actively lowers blood glucose, may cause hypoglycaemia. Consequently, a CBG less than 6mmol/l in a person with diabetes on glucose lowering medication should be managed.
- If a person with diabetes is nil by mouth IV glucose and buccal hypostop® are the preferred treatments.

## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

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### a Adults with hypoglycaemia (CBG <4.0mmol/l) who are conscious, orientated and able to swallow

1 Give 15–20g quick acting carbohydrate of the person with diabetes choice where possible. Some examples are:

- five to seven Dextrosol® tablets (or four to five Glucotabs®)
- one bottle (60ml) Glucojuice®
- 150–200ml pure fruit juice for example orange
- three to four heaped teaspoons of sugar dissolved in water
- 150–200ml of 10% glucose over 15 minutes.

**NB** People with diabetes following a low potassium diet (due to chronic kidney disease) should not use orange juice to treat hypoglycaemia due to its potassium content.

**NB** Sugar dissolved in water is not an effective treatment for people with diabetes taking acarbose as it prevents the breakdown of sucrose to glucose. It should only be considered if no other treatment options are readily available.

2 If a person with diabetes is nil by mouth IV glucose and Oral Gel preparation are the preferred treatments.

3 Repeat capillary blood glucose measurement 10–15 minutes later. If it is still less than 4mmol/l, repeat step one (no more than three treatments in total).

4 If a person with diabetes has hypoglycaemia or looming hypoglycaemia after 30–45 minutes or three cycles, **contact the ward doctor**. Consider:

- 1mg of glucagon IM (may be less effective in people with diabetes prescribed sulfonylurea therapy, under the influence of alcohol, with liver disease, women who are pregnant or people with diabetes with recent episode of hypoglycaemia or prolonged fasting)
- 150–200ml of 10% glucose over 15 minutes (for example 600–800ml/h). Care should be taken with infusion pump settings if larger volume bags are used to ensure that the whole bag is not inadvertently administered. Volume should be determined by clinical circumstances.

5 Once the person with diabetes has recovered, offer a long-acting carbohydrate of the person's choice where possible (except if nil by mouth), taking into consideration any specific dietary requirements. Examples include:

- two biscuits
- one slice of bread/toast
- 200–300ml glass of milk (not soya or other forms of alternative milk, for example almond or coconut)
- normal meal if due (must contain carbohydrate).

**NB** People with diabetes given glucagon require a larger portion of long-acting carbohydrate to replenish glycogen stores (double the suggested amount above) although nausea associated with glucagon injections may be an issue.

**DO NOT omit insulin injection if due.** (However, insulin regimen review may be required).

6 People with diabetes who self-manage their insulin pumps (CSII) may not need a long-acting carbohydrate but should take initial treatment as outlined and adjust their pump settings appropriately. Many people with diabetes will have a locally devised hypoglycaemia protocol that should be checked to ensure that it remains appropriate for use in the inpatient setting.

## Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

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- 7 If the hypoglycaemia was due to sulfonylurea or long-acting insulin therapy then be aware that the risk of hypoglycaemia may persist for up to 24–36 hours following the last dose, especially if there is concurrent renal impairment.
- 8 Document event in patient's notes. Ensure regular capillary blood glucose monitoring is continued for at least 24 to 48 hours. Ask the person with diabetes to continue this at home if they are to be discharged. Give hypoglycaemia education or refer to local Diabetes Inpatient Team.
- 9 If on VRIII adjust the scale accordingly ([see Practical Resource 2](#)) and ensure that the glucose containing solution is being administered at a constant rate.

### **b Adults with CBG >4 and <6mmol/l who are on glucose lowering medication (insulin and insulin secretagogues) consider managing looming hypoglycemia by combination of:**

- adjusting insulin
- administration of glucose
- snack if not nil by mouth (aiming for 15g of carbohydrate, eg one slice of toast)

## 4 Rescue treatment for perioperative hyperglycaemia

Surgery is a stressful event, and hyperglycaemia is common. Data demonstrates that a CBG >10mmol/l is associated with harm. However, it is also recognised that excess insulin treatment is also associated with harm. Therefore, for pragmatic reasons, it is suggested that whilst CBGs up to 10mmol/l are preferred. Treatment should occur once the CBG >12mmol/l.

### **Key causes of perioperative hyperglycaemia (CBG >12mmol/l)**

- 1 Hospital acquired Diabetic Ketoacidosis (DKA).
- 2 Hyperosmolar Hyperglycaemic State (HHS).
- 3 Stress hyperglycaemia.
- 4 Insufficient medication for example omission of insulin, disconnection/blockage of CSII.
- 5 Sepsis/infection.

### **Management of perioperative hyperglycaemia (CBG >12mmol/l)**

- 1 Rule out hospital acquired DKA. Perform capillary ketones if the person with diabetes is unwell or if the CBG >13mmol/l:
  - a if ketones >3mmol/l, treat for DKA as per local policy
  - b identify and remedy cause of hyperglycaemia
  - c ensure basal insulin is given as per local policy.
- 2 Rule out HHS. HHS is characterised by profound hypovolaemia, hyperglycaemia and osmolality >320 mOsm/kg or more. If evidence of HHS, treat as per local policy or [use national guidelines](#).
- 3 If on CSII refer to CSII guidelines.
- 4 If no evidence of DKA or HHS, consider correction dose of subcutaneous rapid acting analogue insulin.
- 5 If recurrent hyperglycaemia, consider need for variable rate intravenous insulin infusion if fasting or for dose adjustment of medication or commencement of insulin.

## Insulin correction doses

- Always administer with a dedicated insulin syringe (seek expert advice if person with diabetes is on an insulin pump).
- Always write 'units'.
- Administer 2–6 units depending on the criteria below.

## Insulin correction doses for people with Type 1 diabetes

- Give subcutaneous rapid acting analogue insulin. Assume that one unit will drop blood glucose by 3mmol/l, but wherever possible take advice from the person with diabetes about the amount of insulin normally required to correct a high blood glucose.
- Recheck the blood glucose one hour later to ensure it is falling.
- Repeat the subcutaneous insulin dose after two hours if the blood glucose is still above 12mmol/l. In this situation the insulin dose selected should take into account the response to the initial dose. Consider increasing the dose if the response is inadequate. Recheck the blood glucose after one hour. If it is not falling consider introducing VRIII.

## Insulin correction doses for people with Type 2 diabetes

- Give 0.1 units/kg of subcutaneous rapid acting analogue insulin and recheck blood glucose one hour later to ensure it is falling.
- Repeat the subcutaneous insulin after two hours if the blood glucose is still above 12mmol/l.
- In this situation the insulin dose selected should take into account the response to the initial dose. Consider doubling the dose if the response is inadequate, but note the risk of hypoglycaemia with stacking of insulin in fasted cases
- Repeat the blood glucose after 60-90 minutes. If it is not falling consider introducing VRIII.

## 5 A clinical guideline that facilitates the perioperative use of continuous subcutaneous insulin infusion

### Introduction

In 2008 the National Institute for Health and Care Excellence (NICE) recommended the use of continuous subcutaneous insulin infusions (CSII) in people with Type 1 diabetes mellitus. This was provided that attempts to achieve target glycosylated haemoglobin (HbA<sub>1c</sub>) concentrations with multiple daily injections (MDIs), despite attending structured education, were not reached, with the person experiencing frequent or disabling hypoglycaemia, or if HbA<sub>1c</sub> remained at 69mmol/mol (8.5%) or above.

CSII delivers a continuous supply of subcutaneous fast acting insulin (for example Apidra®, Novorapid®, Humalog®, Lyumjev®, Fiasp®, Trurapi®) via an insulin pump, and at meal times, the person with diabetes delivers a bolus of insulin according to the meal eaten, via the insulin pump or an app. These devices can be used alongside self-monitored blood glucose, continuous glucose monitors (CGM) or flash glucose monitoring (for example FreeStyle Libre®). CGM assesses subcutaneous interstitial glucose concentrations, and, as this lags behind capillary blood glucose (CBG) by ~15 minutes, CGM is not currently advocated for sole use in sedated/anaesthetised surgical patients in procedures due to last longer than 60 minutes. Instead CBG readings should be relied on.

About 15% of people with Type 1 diabetes manage their diabetes with CSII.

## Rationale for this guidance

The use of CSII lends itself to the safe management of the surgical patient with diabetes undergoing a short fasting period (ie no more than one missed meal). However, the manufacturers of these devices state that the CSII should not be used in the presence of diathermy or imaging devices. This advice is based on perceived rather than actual risk. Thus, the manufacturers of the pumps recommend that all people with diabetes with a CSII undergoing surgery or imaging should be converted either to MDI or onto the variable rate intravenous insulin infusion (VRIII) which is invasive and, if inappropriately managed, can predispose to hypoglycaemia or diabetic ketoacidosis (DKA).

The purpose of this guideline is to facilitate the perioperative use of CSII in people with diabetes who meet agreed criteria and who wish to continue the use of their CSII having been fully informed of the risks and the alternatives through the process of SDM.

This guideline has been developed jointly by anaesthetists and diabetologists who share a wish to improve the perioperative care of people with diabetes undergoing surgical procedures. This guideline supplements the Association of British Clinical Diabetologists Diabetes Technology Network UK Best Practice guideline series and is specifically for the person with diabetes on a CSII undergoing surgical procedures.

## Shared Decision Making and the use of CSII

SDM is an essential part of healthcare delivery, and the management of blood sugars during surgery is no different. The Academy of Medical Royal Colleges and Choosing Wisely UK recommend the following four questions should be used to make better decisions together:

- 1 what are the **B**enefits?
- 2 what are the **R**isks?
- 3 what are the **A**lternatives?
- 4 what if I do **N**othing? (with the acronym of BRAN)

BRAN lends itself to the SDM process of perioperative glycaemic management for the person on a CSII.

## Benefits of CSII

- Avoidance of VRIII with its intrinsic dangers.
- Risk of hospital acquired DKA caused by transition issues to and from VRIII are eliminated.
- Risks of electrolyte and fluid abnormalities that are associated with the use of the VRIII are eliminated.
- Risk of hospital acquired hypoglycaemia that is associated with use of VRIII are eliminated.
- Avoidance of changing to and from MDI during the perioperative period.
- Avoidance of individually calculated dose of long-acting insulin analogue with risk of omission and miscalculated dose eliminated.
- Person with diabetes has familiarity and can more easily continue self-management of diabetes.
- Facilitates day surgery with its intrinsic benefits.

# Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

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## Risks

- Failure of pump and/or cannula.
- Manufacturers do not advocate that pumps to be used near diathermy/X-ray machines.
- Not easily titratable by clinical teams who are not familiar with CSII, to counter the glycaemic variability that occurs during major surgery.
- Anaesthetist may not be familiar with CSII and possible alarms.
- No basal insulin so rapid ketogenesis in the fasted person with diabetes in case of failure/disconnection/occlusion (people are safely able to remove CSII for 30 minutes to allow bathing and swimming). This risk is mitigated by regular CBG testing and by putting in place IV lines whilst the person with diabetes is unconscious/sedated.

## Alternatives to CSII

- VRIII.
- MDI.
- Individually calculated dose of long-acting insulin analogue.

## Nothing

- Harm from hospital acquired DKA and is not a viable option.

## Requisites for safe perioperative use of CSII (all conditions must be met)

- The person with diabetes should be seen preoperatively by a registered health care practitioner who is knowledgeable about the perioperative use of CSII. A shared decision making process (using the BRAN principles advocated by Choosing Wisely) should occur to determine their preference for the use of the CSII
- Documentation of discussions and decisions made with the person with diabetes.
- Multidisciplinary agreement that continued use of CSII is appropriate.
- Provision to issue patient information leaflet.
- Ability to communicate with medical teams.
- Short fasting period (for example no more than one missed meal).
- Elective or expedited surgery.
- Optimal preoperative HbA<sub>1c</sub> <69mmol/mol (8.5%).
- Ability to site pump away from the site of proposed surgery.
- Ability to avoid positioning the insulin pump between the earthing plate and the diathermy.
- Use of a Teflon® cannula and not a steel cannula.
- Sufficient Teflon® consumables.
- Ability to monitor CBG regularly (i.e every 60 minutes) and to monitor capillary blood ketones.
- Ability to replace CSII with a VRIII if necessary.

## Practicalities in preoperative clinic

- Gain consent and ensure a shared decision making process undertaken regards the perioperative use of CSII.
- Document decision along with the SDM discussion.
- Ask the person with diabetes to monitor their CBG hourly on the day of surgery and aim to keep their glucose levels between 6–10mmol/l from day of admission.
- If the person with diabetes usually wakes up in the mornings with a CBG <6mmol/l, ask them to reduce the infusion rate to 80% of their normal rate at bedtime.
- If the person with diabetes usually gets CBG's less than 6mmol/l during the day, inform the person with diabetes to reduce basal to 80% of normal on awakening on the day of surgery.
- Inform the person with diabetes on where to site their cannula and pump on the day of admission/ on arrival in hospital.
- Inform the person with diabetes to use a Teflon® cannula set on the day of surgery.
- The Teflon® cannula needs to be observable and accessible during their time in theatre, and not near the operative field. The upper arm is generally a good place for abdominal and lower limb surgery, whilst the thigh is generally a good place for head, neck and upper limb surgery.
- The pump needs to be positioned so that it can be observed to ensure correct functioning and must not be in between the diathermy plate and the diathermy.
- Ask the person with diabetes to bring in sufficient consumables.

## On admission

- Check CBG is in the range of 6–10mmol/l.
- Check correct siting of Teflon® cannula (upper arm for lower body surgery and thigh for upper body). The person with diabetes can move it to the desired place once in hospital.
- Check that cannula is Teflon®.
- Ensure the anaesthetist is happy for the perioperative use of CSII and is happy with the position of the Teflon® cannula.
- The person with diabetes to demonstrate the following to the clinical team
- How to assess correct functioning of the pump.
- How to safely detach the cannula if needed.
- If these criteria cannot be met, consider VRIII.

## In theatre

- Check CBG every 30–60 minutes and that it is in target range 6–10mmol/l (6–12mmol/l is acceptable).
- Position pump away from diathermy, and is not between diathermy and earthing plate, and ensure that it and the cannula site is visible and accessible.
- Check correct connection and functioning of pump (DKA will occur swiftly if it is disconnected).
- If these criteria cannot be met, a VRIII should be started.
- Check and record CBG every 30–60 mins.
- If the glucose rises above 12mmol/l consider pump failure as a cause (NB the pump will not necessarily alarm in this instance), check ketones, start VRIII and remove pump cannula.
- Store the pump carefully, ensuring it is labelled with the person with diabetes' details. Give the pump to the recovery staff to give back to the person with diabetes.



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### In recovery

- Check CBG is in target range 6–10mmol/l (6–12mmol/l is acceptable).
- Check correct connection and functioning of pump (DKA will occur swiftly if disconnection occurs).
- If these criteria cannot be met, consider a VRIII.
- Check and record CBG every 60 minutes.
- Aim to get person with diabetes eating and drinking once able to safely self-manage the insulin pump.
- Make sure that when the person with diabetes is going back to the ward the pump goes with them, if it has been disconnected at any time.

### On the ward

- Check CBG is in target range 6–10mmol/l (6–12mmol/l is acceptable).
- Check the person with diabetes is satisfied with pump function and glucose management
- Move cannula to desired location (assist the person with diabetes to do this if needed).
- Inform the person with diabetes to check CBG more regularly for next two to three days.

# Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery

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## APPENDIX 1

# Roles and responsibilities of clinical lead for perioperative diabetes care in hospitals

Each hospital should appoint a clinical lead for perioperative diabetes care.<sup>1</sup>

The clinical lead should:

- establish and lead a multidisciplinary team including at minimum: a patient representative, diabetes specialist, anaesthetist, surgeon, geriatrician, nurse, pharmacist, allied health professional, preoperative assessment team member, community representation (general practitioner, community diabetes team member) and manager from perioperative services
- work with the MDT to develop and disseminate local policies and procedures for perioperative management of people with diabetes to include those listed below
- establish a local quality improvement programme based on these recommendations, linking with listing datasets (NADIA, PQIP) and report the outcomes regularly to the board.

The clinical lead should ensure the following policies, procedures and guidelines (supported through training resources) are available and accessible to, and implemented by, all healthcare professionals involved in the care of people with diabetes undergoing surgery:

- a policy outlining day surgery in people with diabetes (noting diabetes is not a reason to deny ambulatory surgery)
- a policy promoting admission on day of surgery in people with diabetes (noting diabetes specific pre-admission should be avoided)
- establishment of ER Programmes in people with diabetes (noting same principles for people with diabetes as those without diabetes)
- indications for involvement of the diabetes multidisciplinary team, including diabetes specialist nurse
- identification of high-risk people with diabetes, including those with Type 1 diabetes and emergency admissions, to ensure individualised care plans are proactively instituted
- a guideline on perioperative management of diabetes medication
- a guideline on indications for and use of variable rate intravenous insulin infusion
- a guideline on perioperative management of patients on continuous subcutaneous insulin infusions/pump therapy and/or with continuous and flash glucose monitoring devices
- a policy to support reduction of the risk of medication errors (including timely medicine reconciliation)
- a policy describing strategies to reduce the risk of and harm related to hospital acquired hypoglycaemia and hospital acquired diabetic keto-acidosis (DKA)
- a strategy to avoid late cancellation of surgery and to ensure a root cause analysis of late cancellations in people with diabetes
- a policy to support safe and effective discharge from hospital, communicating with community services.

The clinical lead and MDT should ensure consistent availability of monitoring equipment and appropriate medications.

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- All areas including every theatre to have immediate access to glucose meters
- All clinical areas to have access to ketone meters
- All places in the hospital where people with diabetes are managed should have access to treatment for hypoglycaemia, looming hypoglycaemia and hyperglycaemia. This includes access to insulin syringes and vials of rapid acting insulin analogue preparation and 20% glucose.

The clinical lead and MDT should work with people with diabetes to:

- co-design, co-develop and disseminate patient information leaflets to include:
- what people with diabetes can expect during surgery in relation to diabetes management
- what medication changes and target levels are necessary preoperatively
- importance of and practical advice on preoperative and postoperative lifestyle modification
- promotion of patient self-management of diabetes during admission with signposting to supportive services (see [JBDS. Self management of diabetes in hospital](#))

## APPENDIX 2

# Factors to consider in the perioperative management of people with diabetes

- 1 Type of diabetes:
  - Type 1 DM
  - Type 2 DM and insulin dependent (+/-non-insulin glucose lowering medication)
  - Type 2 DM and on non-insulin glucose lowering medication
  - diet-managed type 2DM.
- 2 Long term management of diabetes ( $HbA_{1c} < 8.5\%$  or  $>8.5\%$ ).
- 3 Urgency of procedure:
  - immediate
  - urgent
  - expedited.
- 4 Degree of metabolic derangement on presentation:
  - recurrent or severe hypoglycaemia
  - persistent hyperglycaemia (two or more consecutive BG values  $>13\text{mmol/l}$  or hyperglycaemia with ketone levels  $>1.5\text{mmol/l}$ )
  - DKA
  - HHS.
- 5 Anticipated period of total fasting (from last meal to next meal):
  - $>$  one missed meal
  - only one missed meal in total.

## APPENDIX 3

### Perioperative blood glucose target zones

- Ensure that the patient's blood glucose is maintained in the target zone (6–10mmol/l with up to 12mmol/l may be acceptable).
- The lowest acceptable CBG of 6.0mmol/l is especially important for those who are treated with glucose lowering medications (ie insulin or the insulin secretagogues).
- In the **awake** patient, lower blood glucose values down to 4mmol/l are often safe and do not require IV glucose or other rescue treatment provided they have not received any glucose lowering medication (ie insulin or the insulin secretagogues) (see [Practical Resource 3](#)).
- For most surgical patients capillary blood glucose monitoring is preferred as it is easily obtainable and reflects arterial blood glucose.
- Where continuous glucose monitoring data is available, the glucose trends can help inform diabetes management decisions alongside CBG results.
- In the sedated/unconscious/unwell patient continuous glucose monitoring should never be relied upon. This is because it lags behind blood glucose.
- If the blood sample is obtained from an arterial or venous line, good practice dictates ensuring there is no glucose in the arterial line (NPSA alert and AAGBI arterial line sampling).
- Blood sugars should be monitored at the very least at these frequencies:
  - on the VRIII: hourly and especially if sedated/ anaesthetised
  - hourly if on subcutaneous insulin and on day of surgery
  - minimum of three to four times a day if on subcutaneous insulin and not fasted
  - minimum of twice a day if only on non-insulin diabetes medication
  - minimum of once a day if diet and CBG < 10mmol/l.

\*\*Frequency will need to be increased if dysglycaemia occurs\*\*

## APPENDIX 4

### Indications and use of VRIII

Indications:

- people with diabetes on insulin and the anticipated/actual fasting period > one missed meal
- people with diabetes with recurrent hyperglycaemia (CBG > 12mmol/l). Safe use:
- **to reduce the risk of hospital acquired DKA, never** discontinue a VRIII in a patient with T1DM unless basal insulin administered
- every hospital to have its own guideline for correct establishment and discontinuation
- continue basal insulin at 80% of usual dose alongside the VRIII (this aids transition off the VRIII)
- monitor CBG hourly when on VRIII and especially when sedated/anaesthetised
- maintain CBG in target zone of 6–10mmol/l
- measure capillary ketones if there are delays in establishment/issues in discontinuation and the CBG > 13mmol/l
- run a solution containing glucose, sodium and potassium alongside the VRIII at a rate to meet the routine maintenance requirements
- monitor serum electrolytes daily.



## APPENDIX 5

### Initial diabetes management of the patient admitted as a surgical emergency

Type of diabetes	Type 1 DM	Type 2 DM and insulin dependent (+/-non-insulin glucose lowering medication)	Type 2 DM and on non-insulin anti-diabetes medication	Diet Managed type 2DM
Metabolic state				
Normoglycaemia (CBG <10 mmol/l) and no metabolic derangement	Modification if $\leq 1$ missed meal VRIII if $\geq 1$ missed meal	Modification if $\leq 1$ missed meal VRIII if $\geq 1$ missed meal	Modification and monitor CBG at least twice daily	Monitor CBG at least daily
Hyperglycaemia (CBG >10mmol/l)	VRIII	VRIII	VRIII	VRIII
Diabetic ketoacidosis* Be aware: mixed HHS and DKA can occur	FRIII	FRII	FRIII	FRIII
Hyperosmolar hyperglycaemic state (HHS)**	FRIII	FRIII	FRIII	FRIII
Important notes	Do not omit insulin Check CBGs regularly Check ketones if CBG >13 mmol/l Continue basal insulin at 80% of normal dose If prolonged fasting: 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	Continue basal insulin at 80% of normal dose If prolonged fasting, 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 If on SGLT 2 inhibitors: stop them and check ketones daily Hold metformin if AKI and/or eGFR <30	If on SGLT 2 inhibitors: stop them and check ketones daily. Stop metformin if renal impairment	May require no specific intervention

Diabetic ketoacidosis (DKA) \* = presence of diabetes with Ketones >3.0mmol/l and venous pH<7.3.

Hyperosmolar hyperglycaemic state (HHS)\*\* = Glucose >30mmol/l and bicarbonate >15mmol/l, and pH >7.3, and osmolality >320 mOsm/kg

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Information correct as at October 2023