

Please note, the above guidance is being updated in line with recently published 'Perioperative Care of People with Diabetes Undergoing Surgery' (CPOC) guidance. We would hence advise you to please regularly check the UKCPA [The Handbook of Perioperative Medicines \(ukcpa-periophandbook.co.uk\)](https://ukcpa-periophandbook.co.uk) for updated advice on newer medications including SGLT2i.

1. Introduction

1.1 The aim of the guideline is to improve standards of care for people with diabetes undergoing operative or investigative procedures requiring a period of starvation.

This guideline is based on the revised summary document of the national guideline published by the Joint British Diabetes Societies in March 2016 – “Management of adults with diabetes undergoing surgery and elective procedures: Improving standards”. Both the full and summary documents can be found at <https://abcd.care/joint-british-diabetes-societies-jbds-inpatient-care-group>

1.2 The national guidance has been adopted with minor local changes based on consensus opinion. The most significant deviation is our local choice of IV fluid to use alongside the variable rate IV insulin infusion.

1.3 Changes to this UHL updated guidance include

- a) Capillary blood glucose range (CBG) for patients in peri-operative period.
- b) Advice on range of variable rate intravenous insulin infusion (VRIII) rates (standard rate, reduced and increased rates)
- c) Management of hypoglycaemia specifically within the highly monitored operative period.

2. Scope

2.1 The guidelines emphasize the need for care to be patient centred at every stage and are for use to all healthcare professionals whose work brings them into contact with patients with diabetes undergoing surgery or elective procedures that require a period of fasting.

2.2 These guidelines cover all stages of the patient pathway from primary care referral to surgical outpatients, pre-operative assessment, hospital admission, surgery, post-operative care and discharge

2.3 The guidelines are primarily intended for the management of patients with diabetes referred for elective surgery. However, most of the recommendations can be applied to the patient presenting for emergency surgery with the proviso that many such patients are high risk and are likely to require an intravenous insulin infusion and care on an acute ward with possible input from critical care team.

2.4 The guidelines are not designed to be read from cover to cover. Recommendations for each stage are intended to stand alone so that individual health care professionals can identify their role in the process. The following table provides an index of the contents for quickreference.

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2.5 This Guideline is also supported by the following appendices which must be used in conjunction with the main document

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3.0 **Summary of Main Recommendations for Care (JBDS March 2016)**

3.0.1 Organisation and planning of care

- a) Careful planning, taking into account the specific needs of the patient with diabetes, is required at all stages of the patient pathway from GP referral to post-operative discharge.
- b) The patient should be involved in planning at all stages.
- c) Patients with diabetes should be identified early in the referral process to highlight the need to optimise diabetes control and prioritise them on the operating list.
- d) Early pre-operative assessment should be arranged to determine a peri-operative diabetes management strategy and to identify and optimise other comorbidities.
- e) Routine overnight admission for pre-operative management of diabetes should not be necessary in the majority of cases. The decision of when to admit a patient should be made jointly between the teams involved and there may be particular procedures where overnight admission is the preferred option.
- f) Starvation time is minimised by prioritising on the operating list.
- g) Surgical and anaesthetic principles of the Enhanced Recovery Partnership Programme should be implemented to promote earlier mobilisation with resumption of normal diet and return to usual diabetes management.
- h) Multi-modal analgesia should be combined with appropriate anti-emetics to enable an early return to normal diet and usual diabetes regimen.
- i) The patient should resume diabetes self-management as soon as possible where appropriate.
- j) A policy which includes plans for diabetes management must be in place for safe discharge.
- k) Outcomes should be audited regularly.

3.0.2 Diabetes Specialist Team

- a) A referral pathway for optimisation of diabetes control covering all stages of the patient journey is included within this document. (Appendix 1)
- b) There is an Inpatient Diabetes Specialist Nurse (DSN) service available (Mon-Fri 9am-5pm, 7 days at LRI site) to review inpatients – refer electronically via ICE (patient will be seen within 24 hours of receiving referral as long as this falls within normal working hours) or call the 'Diabetes Nurse Helpline' on x4919 (Mon – Fri 9am

– 5pm).

- c) Diabetes SpR on-call via LRI switchboard (Mon-Fri 9am-5pm).

There is no out of hours diabetes on-call team.

If advice is required out of hours please contact the Medical SpR on call via switchboard.

3.0.3 Peri-operative use of intravenous insulin

- a) The term 'variable rate intravenous insulin infusion' (VRIII) should replace the term 'sliding scale'.
- b) Patients with a planned short starvation period (no more than one missed meal in total) should be managed by modification of their usual diabetes medication, avoiding a VRIII wherever possible.
- c) Patients expected to miss more than one meal should have a VRIII. However patients on diet/lifestyle alone or once daily metformin should only be started on VRIII if CBG >12 on 2 consecutive occasions.
- d) An intravenous glucose-containing 'substrate solution' should always be given alongside VRIII.
- e) Insulin should be prescribed according to National Patient Safety Agency (NPSA) recommendations for safe use of insulin (i.e. prescribing using insulin Brand name and the word 'units' written in full if required – NOTE: UHL insulin prescription chart has "units" pre-printed and so only actual dose in numbers needs to be prescribed, e.g. '4').

3.0.4 Peri-operative blood glucose monitoring

- a) Capillary blood glucose (CBG) levels should be monitored and recorded at least hourly during the procedure and in the immediate postoperative period. CBG must be monitored hourly for the first 12 hours of any VRIII and when patients are on VRIII the CBG must be checked by a registered nurse. Hourly monitoring of CBG for patients on VRIII – to be carried out by a Registered nurse or Nursing Associate only. The Nursing Associate should escalate to the supporting Registered Nurse. HCAs should not perform CBGs on patients who are on VRIII
- b) This guidance gives clear guidelines for the management of the blood glucose when it is outside the acceptable range. Hypoglycaemia and hyperglycaemia treatment should be prescribed at the time of pre-operative assessment to enable peri-operative glucose management.
- c) The WHO surgical safety checklist bundle should be implemented.
- d) For pre-operative, anaesthetized or sedated patients treated with insulin or sulphonylureas the target blood glucose should be 6-10 mmol/L (upto 12 mmol/L may be acceptable). For awake patients on diet/lifestyle or agents which do not cause hypoglycaemia target range is 4-12mmol/L.

3.2 Surgical Outpatients – Aims and recommendations

3.2.1 Aims

- a) Arrange pre-operative assessment appointment as soon as possible after the

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decision is taken to proceed with surgery to allow time for optimisation of diabetes care.

- b) Avoid overnight pre-operative admission to hospital wherever possible. Decisions regarding timing of admission should be made by Consultant surgeon/Anaesthetist in liaison with patient and diabetes team. Day of surgery admission should be the default.

3.2.2 Recommendations

- a) Identify people with suboptimal diabetes control early in referral process to allow time to optimise diabetes control. See “UHL referral pathway for patients with diabetes undergoing elective procedure who require optimisation of diabetes management” (Appendix 1)
- b) Clear institutional plans based on British Association of Day Surgery Directory of Procedures should be in place to facilitate day of surgery admission where appropriate and prevent unnecessary overnight pre-operative admission.
- c) Patients who are likely to require admission 24 hrs prior to surgery should be identified to allow appropriate planning.
- d) Patients with diabetes should be identified and prioritised on the operating list where possible. This avoids prolonged starvation times and unnecessary use of VRIII and/or overnight stay
- e) Patients undergoing investigative or surgical procedures requiring a period of starvation should be identified and provided with written information about diabetes management if patient not attending pre-procedure / pre-assessment clinic (Appendices 8 and 9).
- f) Patients with diabetes should not be scheduled for an evening list where possible. This avoids prolonged starvation and unnecessary use of VRIII and / or overnight stay.

3.3 Pre-operative assessment – Aims and recommendations

3.3.1 Aims

- a) Ensure that glycaemic control is optimised prior to surgery, aiming for an HbA1c <8.5% if safe to do so. Note: for some patients (eg, patients on a cancer pathway) it may not be clinically appropriate to “stop the clock” and delay surgery in order to optimize diabetes control.
- b) Establish an individualised diabetes management plan, agreed with the patient, for the pre-admission and peri-operative period. Ensure co-morbidities are recognized and optimized.
- c) Ensure plans are in place to modify other treatments during the pre-admission and peri-operative period e.g. warfarin, renal replacement therapy
- d) Identify high-risk patients requiring critical care management.
- e) Ensure a management plan is in place to prevent and/or treat peri-operative hyper or hypoglycaemia. Involve the diabetes team if necessary.

3.3.2 Recommendations

- a) All patients with diabetes scheduled to undergo an elective procedure necessitating a period of starvation should attend a pre-operative assessment clinic as soon as possible.
- b) Care planning with respect to diabetes should be agreed with patient and documented.
- c) Pre-operative assessment clinic staff should:
 - i. Assess adequacy of glycaemic control. The risks of proceeding when control is suboptimal should be balanced against the urgency of the procedure
 - ii. Consider referral to the diabetes specialist team according to local referral pathway.
 - iii. Identify other co-morbidities with referral to the appropriate team for optimisation where necessary
 - iv. Plan inpatient admission including
 - Timing of admission
 - Location
 - Timing of surgery
 - Pre-admission management of medications (Appendices 1, 2, 8 & 9)
 - Availability of usual insulin (patient may need to bring if non-formulary)
 - Plans for Enhanced Recovery Partnership Programme in the context of diabetes
- d) Ensure the patient is fully consulted and engaged in the proposed plan of management
- e) Ensure the patient's usual diabetes treatment is written up on the drug chart with any necessary adjustments made (See Appendices 1 and 2).
- f) Routinely prescribe hypoglycaemia and hyperglycaemia treatment to allow prompt treatment of either condition in the patient who is unconscious or unable to cooperate.
- g) Give the patient written instructions with the changes they need to make to their medication prior to admission explicitly highlighted (Appendices 8 and 9)
- h) Ensure that patients with diabetes are not placed on an evening list. Elective evening

operating is not recommended for patients taking blood glucose lowering medication. The only exception is for patients on diet control only.

- i) Venous thromboembolism risk assessment should be undertaken and documented.
- j) Patients with “at risk” feet should be identified and steps taken to assess, document and prevent pressure damage.
- k) Plan duration of stay and make preliminary discharge arrangements
- l) Ensure that admission ward staff are appraised of plans and able to activate them on the day of admission
- m) Consider the need for home support following discharge, and involve the primary care team in discharge planning.

3.3.3 Optimisation of Glycaemic Control

Decisions regarding the clinical urgency of surgery and whether surgery may be delayed pending optimisation of diabetes control should be made by the surgical team responsible for the patient.

It should also be noted that in some patients a decision will be made to proceed with surgery when HbA1c is greater than 8.5% either due to the urgency of the surgery, difficulty in optimising control below given threshold or risk of hypoglycaemia.

3.4 Hospital Admission – Aims and recommendations

3.4.1 Aims

- a) Ensure that an agreed and documented individual patient plan is communicated to all involved in the care pathway including the patient, relevant specialists (including anaesthetist, surgeon, diabetologist) and staff in all relevant clinical areas
- b) Minimise the metabolic consequences of starvation and surgical stress
- c) Maintain optimal blood glucose control throughout the admission
- d) Prevent hospital acquired foot pathology.
- e) Allow patients to self-manage their diabetes if able.

3.4.2 Recommendations

- a) Documentation for care planning with respect to diabetes should be completed by nursing staff.
- b) Provide written guidelines/information to hospital staff and patients for the modification of commonly used diabetes treatment regimens on the day prior to and day of surgery (Appendices 1, 2, 8 & 9).
- c) Identify high risk patients and make arrangements for post-operative admission to critical care if indicated.
- d) Base management on Enhanced Recovery Partnership Programme principles but omit the preoperative high carbohydrate drink in people with insulin treated diabetes.
- e) Determine the treatment pathway in advance depending on the anticipated duration of starvation. Avoid a variable rate intravenous insulin infusion (VRIII) if the starvation period is short (only one missed meal). VRIII usually required if period of starvation greater than one missed meal.
- f) Prioritise patients with diabetes to be early on the list. This reduces the starvation time

and hence the likelihood of the patient requiring a VRIII.

- g) Hartmanns solution is a suitable IV fluid for patients with diabetes undergoing surgery NOT requiring VRIII.
- h) If VRIII is required ensure that a suitable substrate fluid prescribed. 5% glucose solution with or without 0.15% potassium chloride should be used. If a patient requires VRIII for greater than 48hr or if GI electrolyte loss is a consideration then 0.9% sodium chloride may be required in addition to the substrate fluid to avoid hyponatraemia.

Note: national recommendation for preferred IV fluid to run alongside VRIII in surgical patients is 0.45% sodium chloride 5% glucose 0.15% potassium chloride however currently this fluid is not widely available.

- i) Aim for Capillary Blood Glucose (CBG) between 6-10 mmol/L but 6-12 mmol/L is acceptable. Avoid wide swings in CBG.
- j) Monitor CBG hourly peri-operatively and continue hourly post-operatively until CBG is stable or the patient is eating and drinking. CBG must be monitored hourly for the first 12 hours of any VRIII and when patients are on VRIII the CBG must be checked by a registered nurse.
- k) Monitor CBG regularly when the patient is under anaesthesia. Hypoglycaemia sometimes manifests as drowsiness, which may be wrongly attributed to sedation.
- l) Continuation of long-acting insulin analogues (Lantus[®], Abasaglar[®], Toujeo[®], Semglee[®], Levemir[®], Tresiba[®]) alongside the VRIII during the peri-operative period. Dose of long-acting insulin should be reduced by 20%.
- m) Prescribe and administer insulin safely
- n) Ensure hypoglycaemia and hyperglycaemia treatment is pre-prescribed for all patients on insulin or sulphonylureas.
- o) Involve the diabetes specialist team if blood glucose targets are not achieved.
- p) Identify high risk feet and provide pressure relief where necessary. Avoid use of anti-embolism stockings where contraindicated.
- q) Ensure that preparation for discharge is ongoing

Factors influencing the choice of perioperative diabetes management

- Duration of starvation
- Timing of surgery /procedure (a.m. or p.m.)
- Usual treatment regimen (insulin, tablets, diet)
- Diabetes control prior to admission
- Other co-morbidities
- Likelihood that the patient will be capable of self-managing their diabetes during the immediate post-operative period.

Anticipated short starvation period (only one missed meal).

Patients with HbA1c less than 8.5% who are undergoing surgery with a short starvation period should be managed according to guidance given in Appendices 1-4. The key elements required to manage the patient without pre-operative overnight admission are listed in Box 1.

Box 1

Key elements required for managing the patient without overnight pre-operative admission.

Patient factors

- Planned short starvation period (no more than one meal omitted)
- Good glycaemic control (HbA1c less than 69mmol/mol, 8.5%) - discuss with the diabetes team if the HbA1c is above this target, and it is felt that further optimisation is safely achievable.
- Patient is expected to be fit and able to resume self management of their diabetes before the anticipated time of discharge.
- Explicit verbal and written instructions are provided concerning medication adjustment and (where appropriate) pre-admission and post-discharge blood glucose monitoring.
- Patient understands and recognises the symptoms of hypoglycaemia and knows how to treat it. Advise that blood glucose levels below 4mmol/L should be treated as hypo irrespective of symptoms
- Information is provided about how to obtain advice in the event of problems with diabetes control.
- Any significant co-morbidities are managed e.g. cardiovascular, renal, autonomic neuropathy.

Institutional factors

- Agreement between the anaesthetist and the clinical team about the suitability of the proposed management plan.
- Patient is scheduled early on the procedure list.
- Adequate recovery time is available if the patient is on an afternoon list and is expected to go home the same day.
- Anaesthetic technique should minimise fasting time and the risk of post-operative nausea and vomiting.
- Capillary blood glucose should be monitored regularly to identify hypo or hyperglycaemia promptly.
- Provision for a VRIII or a dose of subcutaneous insulin if CBG is above the target range.
- Provision to admit the patient to hospital if a VRIII becomes necessary as an unplanned procedure.
- In such circumstances the patient should not be discharged until they are well enough to return to their normal regimen

3.5 Theatre and recovery – Aims and recommendations

Team work and presence of a good management plan communicated from the pre-assessment clinic are crucial. If in place then it is only necessary to review, agree, implement plan and react to excursions in CBG levels.

3.5.1 Aims

- a) Maintain good glycaemic control throughout, 6-10mmol/L (6-12mmol/L acceptable).
- b) Maintain normal electrolyte concentrations
- c) Optimise intra-operative cardiovascular and renal function
- d) Provide multi-modal analgesia with appropriate anti-emetics to enable an early return to a normal diet and usual diabetes regimen
- e) Avoid pressure damage to feet during surgery

3.5.2 Recommendations

- a) Implement the WHO surgical safety checklist bundle with target capillary blood glucose (CBG) 6-10 mmol/L (acceptable range 6-12mmol/L).
- b) Implement the agreed care plan.
- c) Avoid unnecessary use of variable rate intravenous insulin infusion (VRIII), but never stop VRIII in a patient with type 1 diabetes unless subcutaneous insulin has been given.
- d) Check the CBG prior to induction of anaesthesia
- e) Monitor the CBG regularly during the procedure (at least hourly – more frequently if readings outside the target range). CBG checks should be every 30 mins during Caesarean section.
- f) Maintain the blood glucose in the range 6–10 mmol/L where this can be safely achieved. A range of 6-12 mmol/L is acceptable.
- g) Correct a high blood glucose using additional subcutaneous insulin or by introducing a VRIII (Appendix 4).
- h) Prescribe fluid regimen as required.
- i) Document the CBG, insulin infusion rate and substrate infusion on the anaesthetic record as recommended by the Royal College of Anaesthetists and Association of Anaesthetists of Great Britain and Ireland.
- j) If patient requires VRIII do not discontinue during procedure unless in response to hypoglycaemia. In such an instance VRIII should be restarted when hypoglycaemia appropriately treated and CBG >4.0mmol/l.
- k) Ensure arrangements are in place to admit high risk patients to critical care if necessary.
- l) Implement surgical and anaesthetic principles of the Enhanced Recovery Partnership Programme to promote early return to normal diet and usual diabetes management.
- m) Use anaesthetic techniques to reduce the incidence of post-operative nausea and vomiting and promote early return to normal diet and usual diabetes management.

3.6 Post-operative care – Aims and recommendations

3.6.1 Aims

- a) Ensure glycaemic control and fluid and electrolyte balance are maintained. Appropriate CBG range if patients remain on VRIII are 6-12mmol/l. If patient is awake and on usual medication then appropriate range is 4-12mmol/l (note: targets should be individualized in frail / older

- patients to avoid hypoglycaemia).
- b) Optimise pain control.
- c) Encourage an early return to normal eating and drinking, facilitating return to the usual diabetes regimen.
- d) Follow the principles of the Enhanced Recovery Partnership Programme.
- e) Avoid iatrogenic injury (drugs/diabetes management/infection/pressure damage)

3.6.2 Recommendations

- a) Refer patients to diabetes specialist team where required. Refer to Diabetes Specialist Nurse (DSN) electronically via ICE (patient will be seen within 24 hrs of receiving referral as long as this falls within normal working hours) or call the 'Diabetes Nurse Helpline' on x4919 (Mon- Fri 9am – 5pm).
- b) There is a diabetes SpR on-call via LRI switchboard (Mon-Fri 9am-5pm)
- c) Allow patients to self-manage their diabetes as soon as possible, where appropriate.
- d) Prescribe and administer insulin in line with NPSA guidance and in consultation with patient where possible.
- e) Aim for a capillary blood glucose (CBG) in the 6 -10 mmol/L range where this can be achieved safely. A range of 4-12 mmol/L is acceptable.
- f) Monitor electrolytes and fluid balance daily and prescribe appropriate fluids.
- g) Treat post-operative nausea and vomiting to promote normal feeding.
- h) If patient has required variable rate intravenous insulin infusion (VRIII) transfer back to usual treatment safely when patient eating and drinking (Appendix 7)
- i) Maintain meticulous infection control.
- j) Inspect foot and pressure areas daily.

3.7 Discharge – Aims and recommendations

Discharge planning should begin at the pre-op assessment clinic and MDT involvement is required to manage all aspects of the discharge process.

3.7.1 Aims

- a) Ensure early discharge determined by pre-agreed clinical and social discharge criteria
- b) Ensure that factors likely to delay discharge are identified at the pre-operative assessment so that any necessary arrangements are in place when the patient is medically fit for discharge
- c) Involve the diabetes team at an early stage and ensure that plans are in place for safe management of diabetes post discharge.

3.7.2 Recommendations

- a) In consultation with the patient, decide the clinical criteria that the patient must meet before discharge.
- b) Set a date and / or time of discharge as early as possible. This should include weekends.
- c) Identify whether the patient has simple or complex discharge planning needs and plan how they will be met.

- d) Involve the Diabetes Specialist Team if diabetes related delays in discharge are anticipated.
- e) Provide patient education to ensure safe management of diabetes on discharge.
- f) Discharge should not be delayed solely because of poor glucose control. The patient or carer's ability to manage the diabetes should be taken into consideration. Discuss with the Diabetes Specialist Team if necessary.
- g) Ensure effective communication with community teams, particularly if changes to the patients' preoperative diabetes treatment have been made during the hospital stay.
- h) Diabetes expertise is available to support safe discharge (Mon-Fri 9am-5pm, 7 days LRI site) Referral to Diabetes Specialist Nurse (DSN) may be made electronically via ICE (patient will be seen within 24 hours of receiving referral as long as this falls within normal working hours) or call the 'Diabetes Nurse Helpline' on x4919 (Mon – Fri 9am – 5pm).
- i) Diabetes SpR is available (Mon-Fri 9am-5pm) via switch board.

3.8 Special Circumstances

3.8.1 Continuous Subcutaneous Insulin Infusion (CSII) Pump

- a) Generally, patients on a CSII are very well educated and will be able to self-manage their diabetes appropriately if given the opportunity to do so. It is likely that they will be able to adjust their insulin rates to achieve glucose levels of between 6 and 10mmol/L.
- b) If the starvation period is short, pump therapy should be continued and patients should remain on their basal rate until they are eating and drinking normally. Regular capillary blood glucose (CBG) testing will be necessary, with electrolyte measurements if the pump is stopped for any length of time (significant hyperkalaemia may occur after discontinuation of an insulin pump). If more than one meal is to be missed the pump should be removed and a variable rate intravenous insulin infusion (VRIII) should be used. Ensure that the pump is not removed until the VRIII is set up and ready to start – never stop insulin if patient has type 1 diabetes due to risk of DKA.
- c) In patients whose pump remains on the basal rate:
 - If blood glucose cannot be maintained in the target range in the intra-operative or immediate post-operative period a VRIII should be initiated (and pump treatment discontinued) unless the patient is well enough to self-manage with bolus corrections. Bolus doses should not be given by the anaesthetist via the pump. Hypoglycaemia should be treated according to UHL Management of Hypoglycaemia in Adults with Diabetes guidance.
 - Seek advice from the diabetes specialist team.
- d) If a CSII has been continued throughout the peri-operative period, mealtime boluses should be recommenced once the patient is eating and drinking normally. The patient needs to be warned that their blood glucose may vary for a few days post-operatively and that corrections in their doses may need to be made. If the insulin pump has been discontinued and replaced with a VRIII, the CSII should be restarted (including the usual mealtime boluses) once the patient is eating and drinking and the VRIII should be discontinued 30 minutes after the first mealtime bolus.

3.8.2 Emergency Surgery

- a) There will be no opportunity for pre-admission planning.
- b) In patients treated with tablets, insulin, other injectable therapy or those known to have poor control (HbA1c is greater than 8.5% (69 mmol/mol)) a VRIII should be commenced and continued until the patient is eating and drinking. Ensure appropriate substrate fluid prescribed

alongside VRIII.

- c) In patients with Type 2 diabetes which is diet controlled the blood glucose should be closely monitored and if it is >11 mmol/L on 2 consecutive occasions a VRIII should be commenced and continued until the patient is eating and drinking.
- d) The HbA1c should be measured to assess the level of pre-admission blood glucose control as this may influence subsequent diabetes management.
- e) Early involvement of the critical care and diabetes specialist teams is recommended in the management of any high-risk surgical patient.

3.8.3 Stress Hyperglycaemia

- a) Stress hyperglycaemia may occur in people not previously known to have diabetes
- b) Stress hyperglycaemia should be treated in the same way as known diabetes during the acute episode but after recovery re-assessment is required. Those with normal blood glucose levels following surgery will need a formal oral glucose tolerance test or fasting blood glucose 6 weeks later to determine whether they have diabetes.
- c) If the blood glucose remains elevated once the acute episode has resolved the diagnosis of diabetes can be made without a formal test. Involvement of the diabetes specialist team is recommended
- d) Check HbA1c in all patients admitted with stress hyperglycaemia

4 Education and Training

- 4.1 We recommend that all healthcare professionals who prescribe, handle, prepare or administer insulin undertake all either face to face training on the safe use of insulin or undertake the relevant e-learning module available via HELM.
- 4.2 All clinical staff working in any location within UHL would be expected to seek senior advice or advice from the diabetes team if they were unsure of how to manage a patient with diabetes.

5 Monitoring and Audit Criteria

Monitoring of adherence to the guidance will be monitored by the Peri-operative Diabetes Group and the Diabetes Inpatient Safety Committee. Reporting of NaDIA-Harms and participation in the annual NaDia audit will provide benchmarked data.

Below are examples of local audit standards recommended by the Joint British Diabetes Societies.

Indicator	Standards
Access:	
Percentage of staff involved in the care of people with diabetes undergoing surgery or procedures who have received training in blood glucose measurement.	100%
Percentage of staff involved in the care of people with diabetes undergoing surgery or procedures receiving appropriate education from the Diabetes Inpatient Specialist Team.	80%
Safety, Quality, and Effectiveness During the Patient Journey:	
Percentage of primary care referrals containing all suggested information (appendix 12).	100%. Where necessary, education programmes should be instituted to engage with primary care colleagues to raise the standard of referral letters.
Percentage of patients with poorly controlled diabetes referred for pre-operative optimisation of diabetes control prior to attending pre-assessment clinic.	100%
Percentage of patients for whom a perioperative diabetes management plan is created at the pre-operative assessment clinic.	100%
Percentage of people with diabetes who are listed for elective surgery who are admitted on the day of the procedure.	90%. An exclusion for this is where other significant co-morbidity needs pre-operative optimisation.
Percentage of people with diabetes that are listed on the first third of the operating list (morning or afternoon lists).	95%
Percentage of people in whom a VRIII is established with correct configuration of the one-way and anti-siphon valves.	100%
Length of stay for patients with diabetes undergoing surgery or procedures.	No longer than 10% greater than for people without diabetes.
Percentage of people with diabetes and a condition not usually requiring a post-operative overnight stay that are operated on electively during an evening list.	0%
Percentage of patients with diabetes who receive hourly monitoring of blood glucose during their procedure, and in recovery.	100%
Percentage of time that people with diabetes have their blood glucose levels kept between 6 to 10 mmol/L (although 4 to 12 is acceptable) during their admission.	100%
Percentage of patients with evidence of poor peri-operative glycaemic control: <ul style="list-style-type: none"> - Diabetic ketoacidosis or Hyperosmolar hyperglycaemic state or Hypoglycaemia requiring 3rd party assistance 	0%
Percentage of patients where their discharge is delayed because of diabetes related problems.	0%
Institutional Accountability and Integrity:	
Percentage of patients with diabetes identified as such on hospital patient administration system.	95%
Percentage of clinical coding that identifies people with diabetes correctly.	100%
Patient and Staff Satisfaction:	
Percentage of staff who feel that they have sufficient levels of appropriate and timely support from the Diabetes Inpatient Specialist Team.	100%
Percentage of patients who express satisfaction with their patient journey, using validated tools such as the Diabetes Treatment Satisfaction Questionnaire (DTSQ) and the Diabetes Treatment Satisfaction Questionnaire for Inpatients (DTSQ-IP).	80%

6 **Legal Liability Guideline Statement**

Guidelines or Procedures issued and approved by the Trust are considered to represent best practice. Staff may only exceptionally depart from any relevant Trust guidelines or procedures and always only providing that such departure is confined to the specific needs of individual circumstances. In healthcare delivery such departure shall only be undertaken where, in the judgement of the 'responsible healthcare professional' it is fully appropriate and justifiable – such decision to be fully recorded in the patient's notes.

7 **Supporting Documents and Key References**

- Joint British Diabetes Societies (revised March 2016) – “Management of adults with diabetes undergoing surgery and elective procedures: Improving standards”. Both the full and summary documents can be found at https://www.diabetes.org.uk/About_us/What-we-say/Specialist-care-for-children-and-adults-and-complications/Management-of-adults-with-diabetes-undergoing-surgery-and-elective-procedures-improving-standards/ .
- UHL guidance: The Hospital Management of Hypoglycaemia in Adults with Diabetes Mellitus (available on Insite or www.leicesterdiabetes.org.uk).

8 **Key Words**

Diabetes

Surgery

Surgical

Peri-operative care

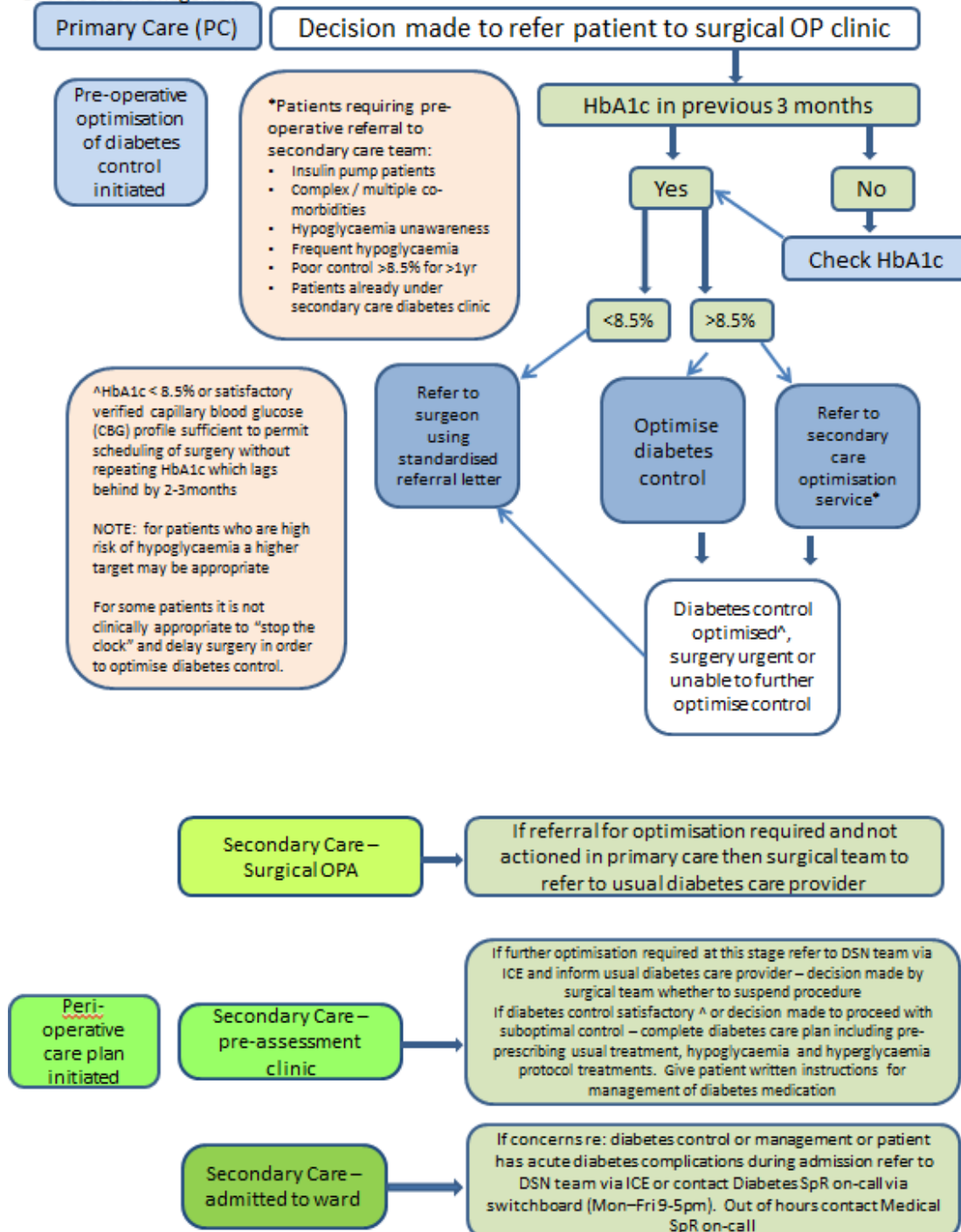
Elective procedures

DEVELOPMENT AND APPROVAL RECORD FOR THIS DOCUMENT			
Author / Lead Officer:	Dr Kath Higgins		Job Title: Diabetes Consultant
Reviewed by:	Diabetes Inpatient Safety Committee		
Approved by:	Policy and Guideline Committee		Date Approved: 20 March 2020
REVIEW RECORD			
Date	Issue Number	Reviewed By	Description Of Changes (If Any)
31/10/19	3	Kath Higgins	Amended target CBG for patients in peri-operative period to 6-12mmol/l (previously 4-12mmol/l). Management of hypoglycaemia during the operative period Updated with new insulin preparations in Appendices

Appendix One

UHL referral pathway for patients with diabetes undergoing elective procedure who require optimisation of diabetes management

UHL referral pathway for patients with diabetes undergoing elective procedure who require optimisation of diabetes management



Guideline for peri-operative adjustment of Insulin (short starvation period – no more than ONE missed meal)

Patients undergoing surgery in the morning should be eating and drinking at lunch-time.

Patients undergoing surgery in the afternoon should be eating and drinking at tea-time.

Insulin	Day prior to admission	Day of Surgery	
		Patient AM	Patient for PM surgery
Once daily (evening) (e.g. Lantus [®] , Abasaglar [®] , Toujeo [®] , Semglee [®] , Tresiba [®] or Levemir [®] Insulatard [®] , Humulin I [®] Insuman Basal [®])	Reduce dose by 20% evening prior to surgery	Check blood glucose on admission	Check blood glucose on admission
Once daily (morning) (Lantus [®] , Abasaglar [®] , Toujeo [®] , Semglee [®] , Tresiba [®] or Levemir [®] , Insulatard [®] , Humulin I [®] Insuman Basal [®])	Reduce dose by 20%	Reduce dose by 20% Check blood glucose on admission	Reduce dose by 20% Check blood glucose on admission
Twice daily (e.g. Novomix 30 [®] , Humulin M3 [®] , Humalog Mix 25 [®] , Humalog Mix 50 [®] , Insuman [®] Comb 25, Insuman [®] Comb 50, twice daily Levemir [®] , Semglee, Abasaglar or Lantus [®])	No dose change	Halve the usual morning dose. Check blood glucose on admission. Leave the evening meal dose unchanged.	Halve the usual morning dose. Check blood glucose on admission Leave the evening meal dose Unchanged.
Twice daily - separate injections of short acting and intermediate acting (e.g. animal neutral, Novorapid [®] , Humalog [®] , Humulin S [®]) Apidra [®] (e.g. animal isophane Insulatard [®] Humulin I [®] Insuman Basal [®])	No dose change	Calculate the total dose of both morning insulins and give half as intermediate acting only in the morning. Check blood glucose on admission. Leave the evening meal dose unchanged.	Calculate the total dose of both morning insulins and give half as intermediate acting only in the morning. Check blood glucose on admission Leave the evening meal dose unchanged.
Basal-bolus regime (eg, long acting insulin once or twice daily plus meal time short acting insulin)	No dose change unless patient is tightly controlled, in which case reduce dose by 20% the evening prior to surgery	Omit the morning and lunchtime short acting insulins. Keep the basal unchanged* Check blood glucose on admission	Take usual morning insulin doses. Omit lunchtime dose. Check blood glucose on admission

* If the patient requires an ongoing VRIII then the long acting background insulin should be continued but at 80% of the dose the patient usually takes when they are well. Normal insulin doses should be recommenced when the patient is eating and drinking normally.

Perioperative hyperglycaemia and hypoglycaemia: follow guidelines in Appendix 5.

Warn the patient that their blood glucose control may be erratic for a few days after the procedure.

There may be new medications that have been approved for use that are not on this list, for advice what adjustments are required in these cases please contact the Diabetes Specialist Team

Guideline for peri-operative adjustment of non-insulin medication
(short starvation period – no more than ONE missed meal)

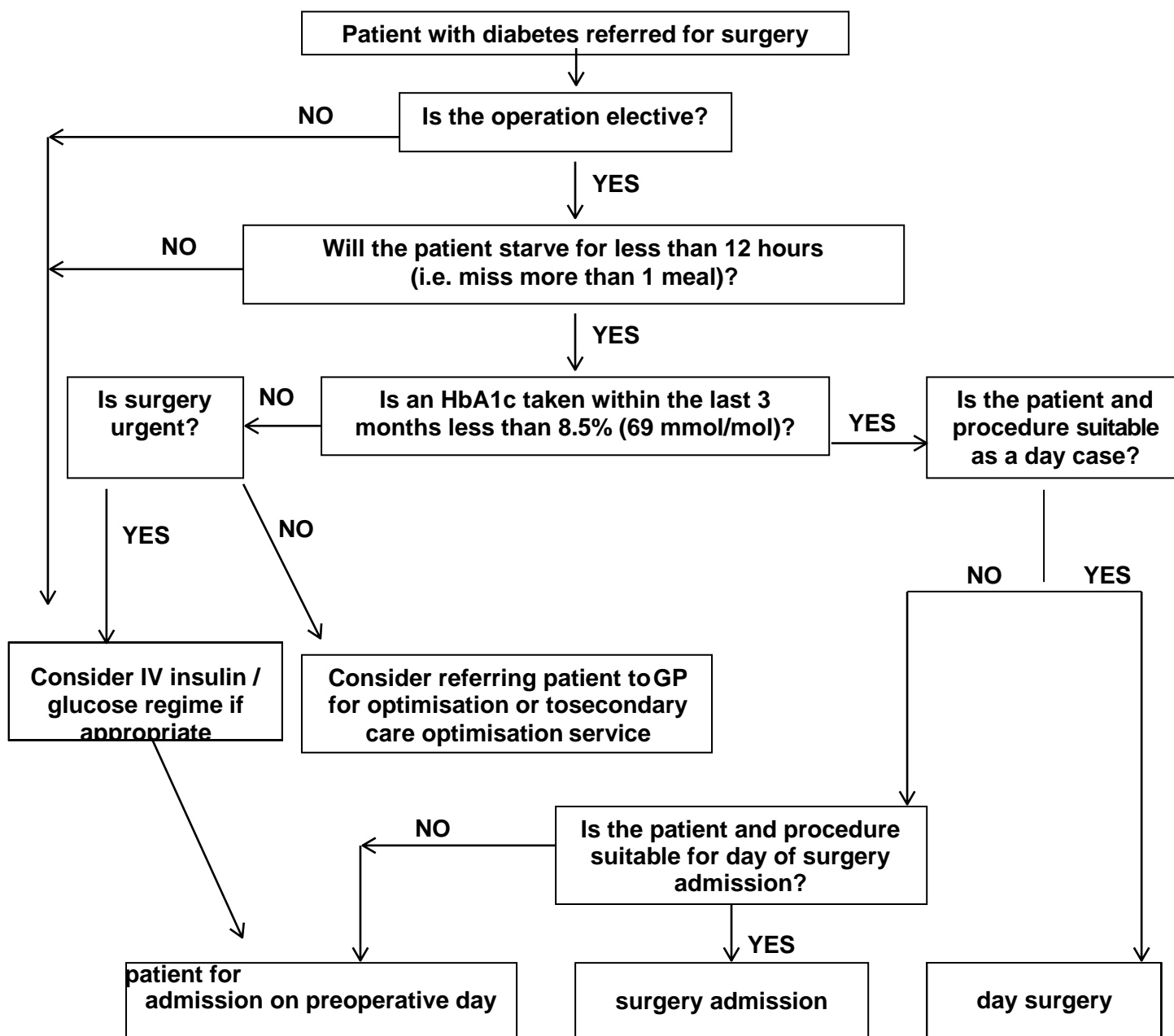
Tablets	Day prior to admission	Day of Surgery	
		Patient for AM surgery	Patient for PM surgery
Acarbose	Take as normal	Omit morning dose if NBM Recommence when eating and drinking	Give morning dose if eating Recommence when eating and drinking
Meglitinide (repaglinide or nateglinide)	Take as normal	Omit morning dose if NBM Recommence when eating and drinking	Give morning dose if eating Omit lunch time dose Recommence when eating and drinking
Metformin eGFR above 60 ml/min/1.73m² and procedure not requiring use of contrast media*	Take as normal *If patient is likely to have IV contrast media then stop 48 hrs prior to procedure. Restart 48 hours following procedure when eGFR is back to baseline	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, omit lunchtime dose
Metformin eGFR 35-60 ml/min/1.73m²	Take as normal unless patient is to have contrast media, in which case stop 48 hours before surgery	Omit on day of surgery Recommence when eating and drinking and if eGFR is back to baseline	Omit on day of surgery Recommence when eating and drinking and if eGFR is back to baseline
Sulphonylurea (Glibenclamide, Gliclazide, Glipizide, Glimepiride etc.)	Take as normal	Omit on morning of surgery. Recommence when eating and drinking.	Omit on day of surgery Recommence when eating and drinking
Pioglitazone	Take as normal	Take as normal	Take as normal
DPP IV inhibitor (e.g. Sitagliptin, Vildagliptin, Saxagliptin, alogliptin, linagliptin)	Take as normal	Take as normal	Take as normal
GLP-1 analogue (e.g. Exenatide, Liraglutide, lixisenatide, Semaglutide dulaglutide, albiglutide)	Take as normal	Take as normal	Take as normal

SGLT-2 inhibitors (eg,dapagliflozin, canagliflozin, empagliflozin)	Take as normal	Omit on day of surgery Recommence when eating and drinking	Omit on day of surgery Recommence when eating and drinking
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There may be new medications that have been approved for use that are not on this list, for advice what adjustments are required in these cases please contact the Diabetes Specialist Team

If a patient requires VRIII then stop all non-insulin medication pending review. Re-start when VRIII no longer required (note: depending on eGFR). If unable to re-start oral medication refer to Diabetes team for review.

- All Patients with diet controlled diabetes are suitable for day case surgery if the procedure itself is suitable for day surgery and all other criteria are fulfilled.
- Patients with diabetes controlled by oral or injected medication are suitable for day case surgery if:
 - They fulfil all day case criteria
 - They can be scheduled early on a morning or afternoon list (ensures adequate recovery time.)
 - See the algorithm below for guidance.
 - Give patients instructions for adjusting their dose of tablets or insulin (patient instruction leaflet (Appendix 8&9).
- Note: this is a guide – there will be cases where the surgical team or anaesthetist may wish to admit 24 hrs before rather than on day of surgery. If it is unclear whether the patient suitable for day case surgery discuss with Consultant surgeon and anaesthetist. Liaison with Diabetes Specialist Team may be necessary.**
- Algorithm for Assessing the Suitability of patients with diabetes for daysurgery**



1. Introduction

- a) These guidelines are for the management of well-controlled patients (HbA1c less than 8.5% [69mmol/mol]) undergoing surgery with a **short starvation period**.
- b) Medication should be managed as in Appendix 1 or 2, depending on usual treatment.
- c) Patients who are not well controlled but in whom surgery cannot be postponed or with a starvation time of more than one missed meal should have a variable rate intravenous insulin infusion (VRIII).
- d) Monitor capillary blood glucose on admission and hourly during the day of surgery. Aim for blood glucose level 6-10 mmol/L; 6-12 mmol/L is acceptable.

2. Management of hyperglycaemia

2.1 Blood glucose greater than 12 mmol/L either pre or postsurgery

- a) Check capillary ketone levels using an appropriate bedside monitor if available. If not available check urine ketones.
- b) If capillary blood ketones are greater than 3 mmol/L or urinary ketones > ++ cancel surgery, assess for Diabetic Ketoacidosis (DKA), follow DKA guidelines if DKA confirmed and contact the diabetes specialist team or the on call medical team for advice.

2.2 Pre-operative hyperglycaemia: (blood glucose greater than 12 mmol/L with blood ketones less than 3 mmol/L or urine ketones <+++).

- a) **Type 1 diabetes:** give subcutaneous rapid acting analogue insulin (i.e. Novorapid®, Humalog® or Apidra®). Assume that 1 unit will drop the blood glucose by 3 mmol/L. Recheck blood glucose 1 hour later to ensure it is falling. If surgery cannot be delayed commence VRIII.
- b) **Type 2 diabetes:** give 0.1 units/Kg (eg, 7 units for 70kg patient) of subcutaneous rapid acting analogue insulin, and recheck blood glucose 1 hour later to ensure it is falling. If surgery cannot be delayed or the response is inadequate, commence VRIII.

2.3 Post-operative hyperglycaemia (blood glucose greater than 12 mmol/L with blood ketones less than 3 mmol/L or urine ketones <+++).

Manage post-op hyperglycaemia according to the UHL Hyperglycaemia Decision support tool Trust Reference B27/2019 <http://insitetogether.xuhl-tr.nhs.uk/pag/pagdocuments/Hyperglycaemia%20in%20Adult%20Inpatients%20with%20Diabetes%20-%20including%20Decision%20Support%20Tool%20UHL%20Guideline.pdf>

In well patients if hyperglycaemia persists despite 2 doses of PRN Novorapid then consider introducing VRIII and consider cause of hyperglycaemia (eg, sepsis, steroids, etc).

3. Management of Hypoglycaemia and Hypoglycaemia Risk for patients in the peri-operative period

- a) In fasted patients consider the risk of hypoglycaemia (capillary blood glucose (CBG) less than 4.0mmol/l) and aim to avoid episodes of hypoglycaemia.
- b) **NB** patients on diet alone are not at risk of hypoglycaemia and are excluded from the guideline below:
- c) If CBG is 4-6 mmol/L and the patient has symptoms of hypoglycaemia: Consider giving 50-100mls of 10% dextrose as a stat IV bolus and repeat the CBG after 10-15 minutes.

- d) If CBG is less than 4 mmol/L; give 75-100 mls of 20% glucose (ie 300-400 ml/hr using an infusion pump) and repeat the blood glucose after 10-15 minutes. Treat hypoglycaemia according to UHL guidance: Trust Reference B41/2011 Hypoglycaemia in Adults with Diabetes UHL Guideline

<http://insitetogether.xuhl-tr.nhs.uk/pag/pagdocuments/Hypoglycaemia%20in%20Adults%20with%20Diabetes%20UHL%20Guideline.pdf>

- e) If VRIII is stopped in response to hypoglycaemia **recommence as soon as the blood glucose rises above 5 mmol/L**. Rate of IV insulin infusion may require review / reduction if patient on VRIII is treated for hypoglycaemia.
- f) Persistent hypoglycaemia should be referred to the Diabetics Specialist Team or the on-call medical team.
- g) Increase frequency of blood glucose monitoring until normoglycaemia achieved and then revert to monitoring blood glucose hourly until the patient is eating and drinking.

NOTE: this guidance (management of hypoglycaemia) is at slight variance with the standard management of hypoglycaemia. This is to provide individualized care during the highly monitored peri-operative period.

1. Aim

The aim of the variable rate intravenous insulin infusion (VRIII) is to achieve and maintain normoglycaemia (ideally, blood glucose levels between 6-10 mmol/L, up to 12 mmol/L is acceptable).

Do you want the phrases below made into sentence layout, ie Patient with Type 1 diabetes undergoing surgery with a starvation period greater than 1 missed meal. Do you want the bullet points below that look like red Os, turned into letters or numbers?

2. Principles

a) There is no one fit for all.

The VRIII is the preferred method of controlling the surgical patient's serum glucose in the following circumstances:

- o Patient with Type 1 diabetes undergoing surgery with a starvation period greater than 1 missed meal.
 - o Patient with Type 1 diabetes undergoing surgery who has not received background insulin
 - o Patient with Type 2 diabetes undergoing surgery with a starvation period greater than 1 missed meal and develops hyperglycaemia (CBG >12mmol/L)
 - o Patients with an HbA_{1c} >8.5%
 - o Most patients with diabetes requiring emergency surgery
- b) If the patient is already on a long acting insulin analogue (e.g. Levemir[®], Lantus[®], Abasaglar[®], Toujeo[®], Semglee[®], Tresiba[®]) these should be continued at 80% of the usual dose.
- c) Patients who are heavier or are known to be insulin resistant often require more insulin per hour.
- d) Initial insulin infusion rate should be determined by the bedside capillary blood glucose (CBG) measurement.
- e) Hourly bedside CBG measurement should be taken for at least the first 12 hours to ensure that the intravenous insulin infusion rate is correct. Only reduce to 2 hourly if patient and CBG are stable.
- f) If the blood glucose remains over 12 mmol/L for 3 consecutive readings and is not dropping by at least 3 mmol/L/hr the rate of insulin infusion should be increased.
- g) If the blood glucose is less than 4.0 mmol/L, the insulin infusion should be stopped, the low blood glucose should be treated as UHL guideline (The Hospital Management of Hypoglycaemia in Adults with Diabetes Mellitus – <http://insitetogether.xuhl-tr.nhs.uk/pag/pagdocuments/Hypoglycaemia%20in%20Adults%20with%20Diabetes%20UHL%20Guideline.pdf>) Trust Reference B41/2011.
- h) The insulin infusion should be re-started as soon as CBG greater than 4.0mmol/L with review of prescribed rate which may need reducing.
- i) **Note: the half life of intravenous insulin is 3-5 mins and in patients with Type 1 diabetes there is a risk of developing Diabetic Ketoacidosis (DKA) if there is delay in restarting VRIII.**

3. Indication for VRIII

- a) Patients anticipated to have a long starvation period (i.e. 2 or more missed meals)
- b) Decompensated or poorly controlled diabetes.

4. Administration

- a) Make up a 50 ml syringe with 50 units of Soluble Human Insulin (e.g. Human Actrapid®) with 49.5 mls of 0.9% sodium chloride solution. (N.B. Some clinical areas stock the ready-made 50 unit Soluble Human Insulin in 50ml 0.9% sodium chloride solution syringes – in which case these may be used instead).
- b) The initial iv fluid to be co-administered with the VRIII is 5% glucose (with or without 0.15% potassium chloride). This should be given via an infusion pump.

Note: national recommendation is 0.45% sodium chloride 5% glucose 0.15% potassium chloride however currently this fluid is not widely available, hence the recommendation to use 5% glucose (with or without 0.15% potassium chloride) routinely within UHL. An alternative would be Dextrose saline (0.18% saline with 4% glucose) see Appendix 6.

To prevent hypoglycaemia, the substrate solution containing glucose must never be discontinued inadvertently especially during transfers.

To prevent in-hospital DKA (patients with type 1 diabetes) or avoidable hyperglycaemia VRIII should never be discontinued inadvertently, especially during transfers.

NOTE: The practice of alternating 5% glucose with 0.9% saline according to serum glucose is not recommended.

Delivery of substrate solution and intravenous insulin must be via a single cannula with an appropriate Y connector with one-way and anti-syphon valves.

Serum electrolytes which must be measured daily.

- c) The rate of fluid replacement must be set to deliver the hourly fluid requirements of the individual patient.
- f) Additional concurrent crystalloid (via a second infusion line) may be required according to the specific needs of the patient and given surgical procedure. Consideration of sodium requirements / loss is important. This is a particularly important consideration in patients who have been on an IV insulin infusion with 5% glucose substrate for greater than 48hrs in order to avoid hyponatraemia. Ideally the post-operative sodium intake should not exceed 200 mmol/day. Hartmann's solution is acceptable alongside substrate as is 0.9% sodium chloride.

Caution:

- 1) Do not infuse insulin without substrate unless in ITU/HDU setting.
- 2) Measure CBG hourly to avoid hypoglycaemia and hyperglycaemia
- 3) Ensure the administration of background insulin to prevent hyperglycaemia and ketosis on cessation (See Appendix 7)
- 4) In patients with type 1 DM, the VRIII must never be taken down until alternative subcutaneous insulin has been administered in the previous 30minutes.
- 5) Ensure RDA of sodium is met to prevent hyponatraemia and measure electrolytes daily.

5. Rate of insulin infusion – variable rate intravenous insulin infusion

Suggested scales for insulin infusion rate

Glucose (mmol/l)	Insulin infusion rate (ml/hr)				
	Start on standard infusion rate unless otherwise indicated				
	Reduced rate for insulin sensitive patients eg, <24 units per day	Standard rate (first choice in most patients)	Increased rate (for insulin resistant patients eg, > 100 units per day)	Customised scale	Customised scale
N.B. if a patient is on basal subcutaneous insulin – continue this alongside the VRIII –					

Diabetes Patients Undergoing Surgery UHL Guideline

V3 approved by Policy and Guideline Committee on 20 March 2020 Trust Ref: B3/2013

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for peri-operative patient reduce dose of basal insulin by 20%					
<4.0	0*	0*	0*		
4.1 – 8.0	0.5	1	2		
8.1 – 12.0	1	2	4		
12.1 – 16.0	2	4	6		
16.1 – 20.0	3	5	7		
20.1 – 24.0	4	6	8		
>24.1	6	8	10		

*treat hypoglycaemia and once CBG >4.0mmol/l restart iv insulin within 20 minutes. The half-life of insulin is very short and restarting the VRIII promptly minimises the risk of ketosis. Consider if patient requires reduced rate insulin infusion or increase in substrate infusion to 10% dextrose

Hypoglycaemia during VRIII should be treated according to Hypoglycaemia guidance. NOTE: if patients are nil by mouth they will require treatment with intravenous glucose according to guidance.

If increased doses of insulin are consistently being required or if patients are persistently developing hypoglycaemia advice should be sought from the Diabetes Specialist Team.

Hourly monitoring of CBG for patients on VRIII – to be carried out by a Registered nurse or Nursing Associate only. The Nursing Associate should escalate to the supporting Registered Nurse. HCAs should not perform CBGs on patients who are on VRIII

6. Setting up a variable rate intravenous insulin infusion

- a) Intravenous fluid must be administered using a volumetric infusion pump.
- b) Delivery of the substrate solution and the VRIII must be via a single cannula **with appropriate one-way and anti-siphon valves**.
- c) Set the fluid replacement rate to deliver the hourly fluid requirements of the individual patient
- d) Insulin must be administered via a syringe pump.
- e) Insulin should not be administered without substrate except on senior advice in an ITU/HDU setting.
- f) Insulin must be infused at a variable rate to keep the blood glucose 6-10 mmol/L (acceptable range 4-12 mmol/L).
- g) Continue the substrate solution and VRIII intra-operatively and post-operatively until the patient is eating and drinking and back on their usual glucose lowering medication.
- h) Additional fluid therapy may be required according to the specific needs of the patient for a given surgical procedure. Hartmann's solution is acceptable alongside substrate as is 0.9% sodium chloride. Ideally the post-operative sodium intake should not exceed 200mmol/day.
- i) If the insulin and substrate solution are disconnected from the patient new solutions and new giving sets should be used to reduce the risk of nosocomial infection.

Solution	Advantages	Disadvantages
0.45% saline with 5% glucose with 0.15% potassium chloride at 83 -125 ml/hr with a continuous VRIII	<ul style="list-style-type: none"> Constant supply of substrate Meets daily sodium and potassium requirements Safety profile of regimen demonstrated in the paediatric diabetic population. 	<ul style="list-style-type: none"> Not widely available Hypotonic solution in vivo with reference to plasma and may still predispose to hyponatraemia May exceed daily requirements of sodium
0.9% saline with 5% glucose with 0.15% potassium chloride at 83 -125 ml/hr with a continuous VRIII	<ul style="list-style-type: none"> Constant supply of substrate Meets sodium and potassium requirements Safety profile of regimen demonstrated in the paediatric diabetic population 	<ul style="list-style-type: none"> Not widely available Will exceed daily sodium chloride requirement and predispose to oedema and hyperchloraemic metabolic acidosis
0.18% saline with 4% glucose (Dextrose-Saline) with 0.15% potassium chloride at 83 -125 ml/hr with a continuous VRIII	<ul style="list-style-type: none"> Constant supply of substrate Meets daily sodium and potassium requirements Widely available 	<ul style="list-style-type: none"> Associated with hyponatraemia. Use in children has been curtailed by the NPSA Hypotonic solution in vivo with reference to plasma
5-10% glucose with 0.15% potassium chloride at 125 ml/hr with a continuous VRIII	<ul style="list-style-type: none"> Constant supply of substrate Widely available 	<ul style="list-style-type: none"> Does not provide any sodium Associated with hyponatraemia
5-10% glucose with 0.15% potassium chloride at 125 ml/hr with additional 0.9% saline at a variable rate to correct the hyponatraemia and a continuous VRIII	<ul style="list-style-type: none"> Constant supply of substrate Widely available 	<ul style="list-style-type: none"> Requires 3 infusion pumps (1 for the glucose, 1 for the saline and 1 for the insulin) May need multiple venous access leading to difficulties in obtaining blood samples and venous access May lead to fluid overload
10% glucose with 0.15% potassium chloride at 60 ml/hr with additional 0.9% saline at 60 ml/hr with a continuous VRIII	<ul style="list-style-type: none"> Constant supply of substrate Widely available 	<ul style="list-style-type: none"> Needs 3 infusion pumps (1 for the glucose, 1 for the saline and 1 for the insulin) May need multiple venous access leading to difficulties obtaining blood samples and venous access
10% glucose with 0.15% potassium chloride at 100ml/hr if CBG less than 15mmol/L with a continuous VRIII 0.9% saline with 0.15% KCl at 100 ml/hr if CBG more than 15mmol/L with a continuous VRIII		<ul style="list-style-type: none"> Erratic supply of substrate Unpredictable administration of sodium Increased nursing workload and difficulties in maintaining accurate fluid balance charts with constant changes of fluid bags according to CBG
500mls 10% glucose and 0.15% KCl with 5 units insulin if CBG less than 6 mmol/L 500mls 10% glucose and 0.15%KCl with 10 units insulin if CBG 6-10 mmol/L 500mls 10% glucose and 0.15%KCl with 15 units insulin if CBG 10-20 mmol/L 500mls 10% glucose and 0.15% KCl with 20 units insulin if CBG more than 20 mmol/L All administered at 100-125 ml/hr and with additional 0.9% saline to treat established hyponatraemia	<ul style="list-style-type: none"> Intrinsically safe as substrate and insulin are co-administered Evidence to support its use 	<ul style="list-style-type: none"> Increased nursing workload and difficulties in maintaining accurate fluid balance charts with constant changes of fluid bags according to CBG Hyponatraemia is a recognised complication. May lead to fluid overload with the co-administration of additional 0.9% saline.

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Hartmann's Solution	<ul style="list-style-type: none"> • Causes minimal metabolic and electrolyte disturbance • Provided the blood sugars are controlled and stable without the use of a VRIII, Hartmann's solution can be safely used as 	<ul style="list-style-type: none"> • Probably has insufficient calories to provide a safe substrate solution when given alone with a continuous infusion of insulin • Has insufficient potassium to run alongside a continuous insulin infusion
	the sole fluid in all patients with diabetes.	<ul style="list-style-type: none"> • Continuous use over several days will lead to salt retention as well as hypokalaemia.

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1. Restarting Oral Hypoglycaemic Medication

- a) Recommence oral hypoglycaemic agents at pre-operative doses once the patient is ready to eat and drink.
- b) Be prepared to withhold or reduce sulphonylureas if the food intake is likely to be reduced. Likewise insulin doses may need reducing if food intake reduced.
- c) Metformin should only be recommenced if the eGFR is greater than 45 ml/min/1.73m² or back to baseline.

2. Restarting subcutaneous insulin for patients already established on insulin

- a) Conversion to subcutaneous insulin should be delayed until the patient is able to eat and drink without nausea or vomiting.
- b) Restart the normal pre-surgical regimen. Be prepared to adjust the doses because the insulin requirement may change as a result of post-operative stress, infection or altered food intake.
- c) Consult the Diabetes Specialist Team if the blood glucose levels are consistently outside the acceptable range (4-12 mmol/L) despite attempts to optimise or if a change in diabetes management is required.
- d) The transition from intravenous to subcutaneous insulin should take place when the next meal related subcutaneous insulin dose is due e.g. with breakfast or lunch.

3. For the patient on basal bolus insulin

- a) For patients in whom a long acting insulin analogue such as Lantus®, Abasaglar®, Semglee®, Toujeo®, Tresiba® or Levemir® has been continued there should be an overlap between the VRIII and the first injection of fast acting insulin.
- b) The fast acting insulin should be injected subcutaneously with the meal and the intravenous insulin and fluids discontinued 30 to 60 minutes later.
- c) **If the basal insulin was stopped in error, the insulin infusion should be continued until some form of background insulin has been given. If the basal insulin is normally taken once daily in the evening and the intention is to convert to subcutaneous insulin in the morning, give half the usual daily dose of basal insulin in the morning, give fast acting insulin with either breakfast or lunch, discontinue VRIII 30-60 mins following injection of mealtime fast acting insulin and continue usual insulin regime thereafter. Check glucose levels regularly during this transition phase.**
- d) Contact the Diabetes Team (DSNs) for advice electronically via ICE (patient will be seen within 24 hours of receiving referral as long as this falls within normal working hours) or call the 'Diabetes Nurse Helpline' on x4919 (Mon- Fri 9am – 5pm). Diabetes SpR via switchboard (Mon – Fri 9am – 5pm).

4. For the patient on a twice daily fixed-mix regimen

The insulin should be re-introduced before breakfast or before the evening meal ideally. If the intention is to stop VRIII at lunchtime then give half usual morning dose at lunchtime and stop VRIII 30-60mins following lunchtime insulin injection. The VRIII should be maintained for 30 to 60 minutes after the subcutaneous insulin has been given.

5. For the patient on a continuous subcutaneous insulin infusion (CSII, 'pump')

- a) If the CSII has been continued at basal rate then VRIII should be continued until the meal time bolus given at which time the VRIII may be discontinued.
- b) If CSII was stopped during the peri-operative period then CSII should be recommenced at the patient's normal basal rate once able to eat and drink. The VRIII should be continued until the next meal bolus has been given at which point VRIII may be discontinued. Do not recommence the CSII at bedtime.

6. Calculating subcutaneous insulin dose in insulinaïve patients

(NB these are guidelines only and advice should be sought from the diabetes specialist team).

a) Estimated Total Daily Dose (TDD) of insulin

- this estimate is based on several factors, including the patient's sensitivity to insulin, degree of glycaemic control, insulin resistance, weight, and age.
- Calculate the average hourly insulin dose by totalling the last 6 hours doses on the chart and dividing by 6 e.g. 12 units divide by 6 = 2 units/hour.
- This should then be multiplied by a factor of 20 (not 24 because of the risk of hypoglycaemia with the first dose) to get the total daily dose (TDD) insulin e.g. ~40units.

b) Calculating a basal bolus (QDS) Regimen

- Give approximately 50% of the TDD with the evening meal in the form of long acting insulin and divide the remaining dose to be given as rapid acting equally between pre-breakfast, pre-lunch and pre-evening meal.
- When converting VRIII to basal bolus regime this is ideally undertaken at breakfast or lunchtime. It should only be switched over at the evening meal if monitoring can be guaranteed. Do not convert to a subcutaneous regimen at bed time.

c) It is important that basal insulin is given before the insulin infusion is taken down.

d) See section 3 for transfer from the VRIII to basal bolusinsulin.

	Pre-breakfast	Pre-lunch	Pre-evening meal	Bedtime
Rapid acting insulin, e.g. Apidra [®] / Humalog [®] / NovoRapid [®]	6 units	6 units	6 units	
Long acting insulin, e.g. Lantus [®] , Abasaglar [®] , Toujeo [®] , Tresiba [®] , Semglee [®] , Levemir [®]				18 units

e) Calculating a Twice Daily (BD) Regimen

If a twice daily pre-mixed insulin regimen is to be used, two thirds of the total daily dose should be given at breakfast, with the remaining third given with the evening meal.

Patient instruction leaflet for people with diabetes controlled with tablets or by injections of GLP-1 agonists – Bydureon[®], Byetta[®] (exenatide), Victoza[®] (liraglutide), Ozempic[®] (Semaglutide), Lyxumia[®] (lixisenatide), Trulicity[®] (dulaglutide)

Before your operation or procedure

Please follow the instruction in the table below marked “What to do with your medication before surgery”

If your operation is on a morning or “all day” list.

- Food and drink until 2am morning before surgery. From 2am – 6am water only.

If your operation is in the afternoon.

- Food and drink until 7am on day of surgery. From 7am – 11am water only.
- When you travel to and from the hospital for your operation carry some glucose tablets or a sugary drink.

If you have any symptoms of a low blood sugar such as sweating, dizziness, blurred vision or shaking please test your blood sugar if you are able to do so. If it is less than 4 mmol/L take 4 glucose tablets or 150 mls of the sugary drink (this is the same as half a standard sized can of non-diet cola). Please tell staff at the hospital that you have done this because it is possible that your surgery may have to be rearranged for another day.

- After your operation you will be offered food and drink when you feel able to eat. If you are eating and drinking normally you should resume taking your normal tablets. However, your blood glucose levels may be higher than usual for a day or so.
- When you get home, if you feel nauseated or vomit and are unable to eat, please refer to the sick day rules leaflet.
- If you do not improve quickly and usually attend the hospital for diabetes care please telephone the Diabetes Team on 0116 258 4919 during office hours Monday – Friday. Outside these hours please contact your GP practice or out of hours service.
- If you usually see your GP about your diabetes please phone your GP practice.

Remember to bring with you to hospital:

- Glucose tablets or a sugary drink.
- Blood glucose testing equipment (if you usually monitor your blood glucose).
- The tablets you usually take for your diabetes.

Instructions for taking your diabetes medication before your operation (assessing nurse to complete):

What to do with your medication before the surgery

Tablets	Day prior to admission	Day of Surgery	
		Patient for AM surgery	Patient for PM surgery
Acarbose	Take as normal	Omit morning dose if you have been told to fast from midnight Recommence when eating and drinking	Take morning dose if eating breakfast. Do not take lunchtime dose Recommence when eating and drinking
Meglitinide (repaglinide or nateglinide)	Take as normal	Omit morning dose if you have been told to fast from midnight Recommence when eating and drinking	Take morning dose if eating Do not take lunchtime dose Recommence when eating and drinking
Metformin eGFR above 60 ml/min/1.73m² and procedure not requiring use of contrast media*	Take as normal *If patient is likely to have IV contrast media then stop 48 hrs prior to procedure. Restart 48 hrs following procedure when eGFR is back to baseline	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, omit lunchtime dose
Metformin eGFR 35-60 ml/min/1.73m²	Take as normal unless patient is to have contrast media, in which case stop 48 hours before surgery	Omit on day of surgery Recommence when eating and drinking and if eGFR is back to baseline	Omit on day of surgery Recommence when eating and drinking and if eGFR is back to baseline
Sulphonylurea (Glibenclamide, Gliclazide, Glipizide, Glimepiride etc.)	Take as normal	Omit on morning of surgery. Recommence when eating and drinking.	Omit on day of surgery Recommence when eating and drinking
Pioglitazone	Take as normal	Take as normal	Take as normal
DPP IV inhibitor (e.g. Sitagliptin, Vildagliptin, Saxagliptin, alogliptin, linagliptin)	Take as normal	Take as normal	Take as normal
GLP-1 analogue (e.g. Exenatide, Liraglutide, lixisenatide, dulaglutide, albiglutide, Semaglutide)	Take as normal	Take as normal	Take as normal
SGLT-2 inhibitors (eg, dapagliflozin, canagliflozin, empagliflozin)	Take as normal	Omit on day of surgery Recommence when eating and drinking	Omit on day of surgery Recommence when eating and drinking

Other Notes:

Patient instruction leaflet for people with insulin (or insulin and tablet) controlled diabetes undergoing surgery or a procedure requiring a period of starvation

Before your operation (or procedure)

Please follow the instruction in the table below marked “What to do with your insulin before surgery (or procedure).”

If your operation is on a morning or “all day” list.

- Food and drink until 2am morning before surgery. From 2am – 6am water only.

If your operation is in the afternoon.

- Food and drink until 7am on day of surgery. From 7am – 11am water only.
- When you travel to and from the hospital for your operation carry some glucose tablets or a sugary drink.

If you have any symptoms of a low blood sugar such as sweating, dizziness, blurred vision or shaking please test your blood sugar if you are able to do so. If it is less than 4 mmol/L take 4 glucose tablets or 150 mls of the sugary drink (this is the same as half a standard sized can of non-diet cola). Please tell staff at the hospital that you have done this because it is possible that your surgery may have to be rearranged for another day.

- After your operation (procedure) your blood sugar will be checked and additional insulin given if necessary.
- After your operation (procedure) you will be offered food and drink when you feel able to eat. If you are eating and drinking normally you should resume taking your normal insulin (and tablets). However, your blood glucose levels may be higher than usual for a day or so.
- When you get home, if you feel nauseated or vomit and are unable to eat, please refer to the sick day rules leaflet.
- If you do not improve quickly and usually attend the hospital for diabetes care please telephone the Diabetes Team on 0116 258 4919 during office hours Monday – Friday. Outside these hours please contact your GP practice or out of hours service.
- If you usually see your GP about your diabetes please phone your GP practice.

Remember to bring with you to hospital:

- Glucose tablets or sugary drink.
- Blood glucose testing equipment you usually use.
- Insulin (and tablets) you usually take for your diabetes.

Instructions for taking insulin before your operation (assessing nurse to complete):

What to do with your insulin before surgery (procedure)

Insulins	Day prior to admission	Patient for AM surgery	Patient for PM surgery
Once daily (evening) (e.g. Lantus [®] , Abasaglar [®] , Toujeo [®] , Tresiba [®] , Semglee [®] or Levemir [®] . Insulatard [®] , Humulin I [®] Insuman	Reduce dose by 20% evening prior to surgery	Check blood glucose on arrival at hospital	Check blood glucose on arrival at hospital
Once daily (morning) (Lantus [®] , Abasaglar [®] , Toujeo [®] , Semglee [®] , Tresiba [®] or Levemir [®] . Insulatard [®] , Humulin I [®] Insuman Basal [®])	Reduce dose by 20%	Reduce dose by 20% Check blood glucose on arrival at hospital	Reduce dose by 20% Check blood glucose on arrival at hospital
Twice daily (e.g. Novomix 30 [®] , Humulin M3 [®] Humalog Mix 25 [®] , Humalog Mix 50 [®] , In- suman [®] Comb 25, In- suman [®] Comb 50, twice daily Levemir [®] or Abasaglar [®] , Semglee [®] or Lantus [®])	No dose change	Halve the usual morning dose. Check blood glucose on arrival at hospital. Leave the evening meal dose unchanged	Halve the usual morning dose. Check blood glucose on arrival at hospital. Leave the evening meal dose unchanged
3, 4 or 5 injections daily	No dose change unless patient is tightly controlled, in which case reduce dose by 20% the evening prior to surgery	Omit the morning and lunchtime short acting insulins. Keep the basal unchanged Check blood glucose on admission	Take usual morning insulin doses. Omit lunchtime dose. Check blood glucose on admission

You should resume taking your normal insulin regime the morning after surgery (procedure). However, your blood glucose may be higher than usual for a day or so.

Other Notes:

1. Upper GI endoscopy / Bronchoscopy

Follow guidelines for surgery as in leaflets in appendix Eight

2. Colonoscopy (procedure requiring bowel preparation)

2.1 Day before procedure / day of bowel preparation

Insulin treated patients

- a) Follow the advice provided about low residue food.
- b) Take the bowel preparation as instructed.
- c) Take additional clear fluid, and sugary drinks such as Lucozade[®] or clear fruit juice to maintain the blood glucose levels.
- d) Test your blood glucose levels before administering insulin.
- e) Take half the usual dose of short acting (Novorapid[®]/Humalog[®]/Apidra[®]/Actrapid[®]/Humulin S[®]) or mixed insulin (Novomix 30[®]/Humulin M3[®]/Humalog Mix 25[®]).
- f) Take the usual dose of long-acting insulin (Lantus[®], Abasaglar[®], Toujeo[®], Tresiba[®], Semglee[®], Levemir[®]).

Non insulin treated patients

- a) Omit any diabetes tablets

2.2 Day of procedure: insulin treated or non insulin treated patients

Follow the guidelines in the patient information leaflet for the day of surgery (procedure) (Appendix 8).

1. What should I do if I am unwell?

- a) **NEVER** stop taking your insulin or tablets – illness usually increases your body's need for insulin.
- b) **TEST** your blood glucose level every 2 hours, day and night.
- c) If you have Type 1 diabetes **TEST** your urine for ketones every time you go to the toilet or your blood ketones every 2 hours if you have the equipment to do this.
- d) **DRINK** at least 100mls water/sugar free fluid every hour – you must drink at least 2.5 litres per day during illness (approx. 5 pints!).
- e) **REST** and avoid strenuous exercise as this may increase your blood glucose level during illness.
- f) **EAT** as normally as you can. If you cannot eat or if you have a smaller appetite than normal, replace solid food during illness, with one of the following:
 - 400mls milk
 - 200ml carton fruit juice
 - 150-200ml non-diet fizzy drink
 - 1 scoop ice cream

2. When should I seek urgent help?

- a) **CONTINUOUS** diarrhoea and vomiting, and/or high fever.
- b) **UNABLE** to keep down food for 4 hours or more.
- c) **HIGH** blood glucose levels with symptoms of illness (above 15 mmol/L - you may need more insulin).
- d) **KETONES** at ++2 or +++3 in your urine or 1.5 mmol/L blood ketones or more. (You may need more insulin).

Within normal working hours you may contact the person who normally looks after your diabetes immediately or your GP.

OUTSIDE NORMAL WORKING HOURS consult the local out of hours service or go to your local hospital A&E department.

- a) Take your insulin or other medication as advised.
- b) Monitor your blood glucose if you have the equipment to do so – 4 times per day if possible. You should test more frequently if you are unwell, nauseated or vomiting.
- c) Your blood glucose may be higher than usual. This is not a concern if you are feeling well.
- d) If you are feeling unwell (particularly if vomiting and unable to take food or medication) contact your usual diabetes team/GP surgery.

Tel:

- e) If outside normal working hours contact the out of hours service

Tel: