USE of INSULIN PUMP SYSTEMS in ACUTE HOSPITALS

TARGET AUDIENCE	NHS Lanarkshire staff working in acute hospital sites, in following groups: all doctors and nursing staff
PATIENT GROUP	Patients with type 1 diabetes using insulin pump systems, with exclusion of pregnant patients who have different glucose targets

Clinical Guidelines Summary

This Guideline covers following situations:

- General points, information about insulin pump systems
- Recognising Insulin Pump use versus Continuous Glucose Monitors (CGM)
- Assessment of Diabetes patients with Insulin Pump therapy
- Safety Points
- Monitoring of patients using insulin pump system during in-patient stay
- Recognising Need for Sick Day Rules: Inpatients using Pump systems
- Pump management for elective procedures under sedation or anaesthesia

Appendices – Useful Charts and Hyperlinks to documents stored Firstport

- Assessment Type 1 diabetes Patient using Insulin Pump Appendix1
- Insulin Pump Daily Review Checklist Appendix2

  Insulin Pump Daily Review Checklist - chart for wards to order stored Firstport
- Pump management for elective procedures under sedation or anaesthesia Appendix3
- Hyperglycaemia & Sick Day Rules Hybrid Closed Loop Pump – Patient information leaflet
- Hyperglycaemia & Sick Day Rules Standalone Pump – Patient information leaflet

General Points, information about insulin pump systems

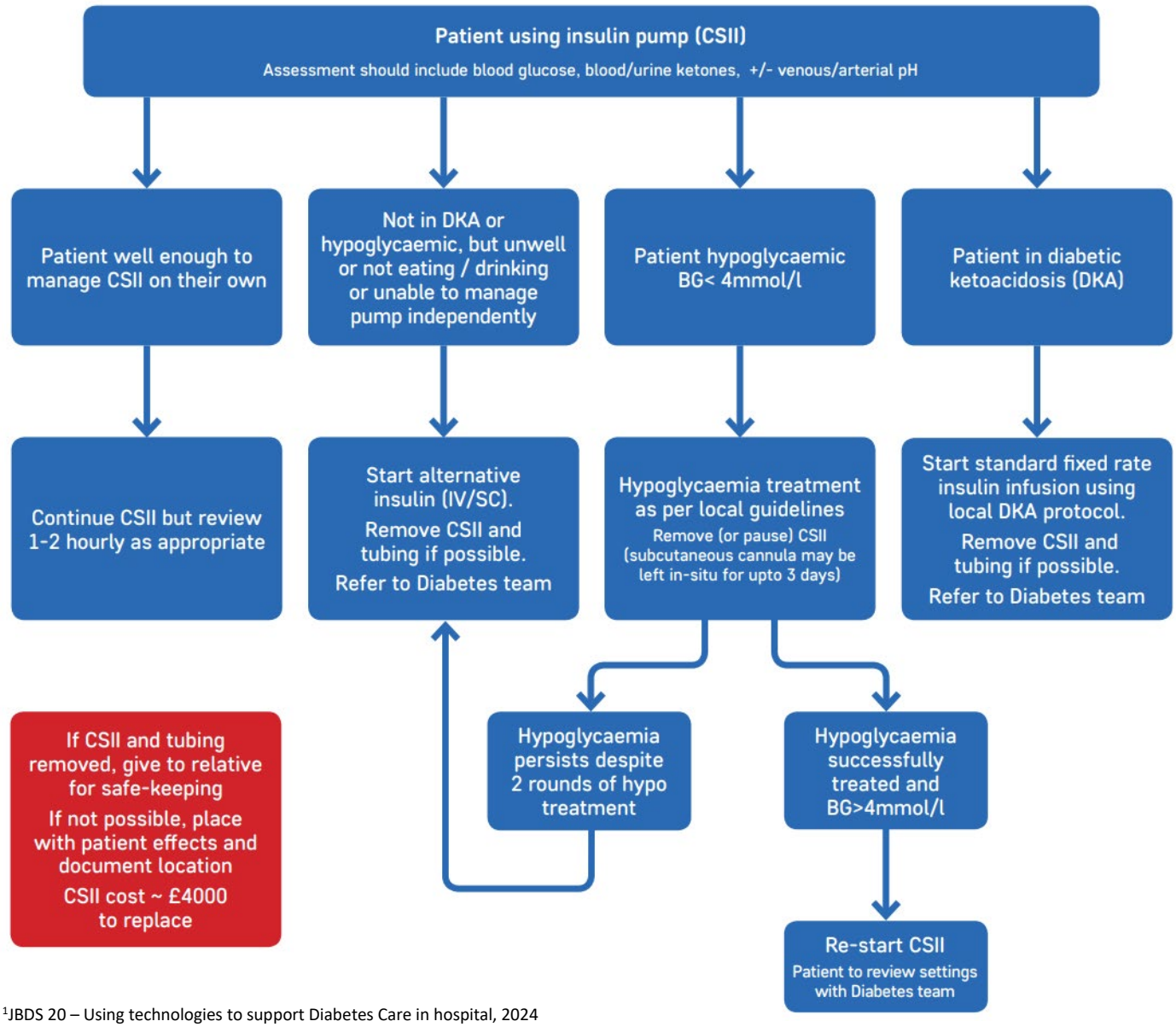
- Continuous Subcutaneous Insulin Infusion (CSII) pumps are indicated for use in type 1 diabetes and are commonly worn on abdomen or arms
- CSII pumps are battery driven devices, programmed and managed by the person with diabetes (PWD)
- CSII pumps may be 'tethered' pumps, i.e. attached to the body with thin line and cannula inserted into subcutaneous tissue or 'patch' pump no line / wires, use insulin micro pump or 'POD' applied directly to skin with subcutaneous cannula inserted at same site as 'POD' attached externally to skin e.g. Omnipod 5® system.
- CSII pumps may be 'standalone' or part of 'automated insulin delivery systems' called hybrid closed loop systems or automated insulin delivery (AID) systems.
- Rapid acting insulin (e.g. Novorapid, Humalog, Apidra) is administered continuously from the pump via an infusion set or 'POD' into the subcutaneous tissue
- The infusion set or 'POD' should be changed every three days
- All CSII pumps will have programmed basal insulin delivery through the 24 hour period. If the CSII pump is operating in hybrid closed loop system the basal insulin delivery will be automated by the pump using an algorithm guided by continuous glucose monitor (CGM) data.
- The person with diabetes (PWD) will calculate bolus insulin doses according to carbohydrate food intake. All CSII pump systems require the PWD to deliver bolus insulin for food eaten even in hybrid closed loop (AID) systems.
- The cannula delivering insulin to the subcutaneous tissue in any pump system may get dislodged or bent, disrupting insulin delivery and patients must be alert to this possibility. Cannula malfunction is detected by unexpected rapid rises in blood glucose levels often with ketones, remember '**the cannula is the weakest link in the system'**
- Patients must review glucose monitoring results every few hours, usually this is with continuous glucose monitoring (CGM), either non integrated CGM, or integrated CGM in a hybrid closed loop system.
- Ketone monitoring is essential in illness, vomiting and/or hyperglycaemia
- All people using CSII **must have access to additional insulin preparations and devices** so that multiple daily insulin dose regimens can be instigated immediately in the event of pump failure.
- Tethered insulin pumps should not be immersed in water, however patch pumps or 'PODs' are 100% waterproof.
- Patient receiving CSII pump therapy in the community are often experts in their own management. Once admitted to hospital **– LET THEM MANAGE THEIR OWN CSII PUMP.** However, in some situations this is not safe or appropriate, follow the assessment Flowchart, (see also Appendix 1).

Recognising Insulin Pumps versus Continuous Glucose Monitors (CGM)

Note: Some pumps are wireless (i.e. patch pumps) and may look similar to a CGM device. Some pumps display CGM readings on the device (ie. if working as a hybrid closed loop system) and should not be mistaken for CGM.
If in any doubt, please contact the diabetes team.

[1]JBDS 20 – Using technologies to support Diabetes Care in hospital, 2024

Assessment of Diabetes patients with Insulin Pump Therapy



[1]JBDS 20 – Using technologies to support Diabetes Care in hospital, 2024

General Points if wishing to continue CSII Pump in hospital:

- Ensure adequate supplies for CSII pump (e.g. spare batteries, infusion sets, cannula or spare PODs)
- Ensure adequate spare CGM sensors and transmitter if using integrated system
- Ask patient what their alternative insulin pen regime / MDI is and document, this, along with average Total Daily Dose (TDD) from pump in case of pump failure or struggling to self manage

- If not got spare supplies, ask a relative to bring these, **in the same day**

Safety Points:

All CSII Pumps and CGM sensors MUST be removed for any procedure using diathermy
All CSII Pumps and CGM sensors MUST be removed before MRI imaging
All CSII Pumps MUST be removed before CT imaging
Only the following CGM sensors (Libre 2 plus, Libre 3, Libre 3plus, Dexcom One+ and Dexcom G7) can be worn during CT imaging if protected by lead apron and outwith scan field. If uncertainty CGM product type remove before CT imaging.

- Patient can be disconnected for up to 1 hour from insulin pump device. If Insulin POD this needs to be replaced with new POD after any removal.
- If CGM sensor worn during CT imaging, accuracy may be effected up to 1 hour post procedure, hence capillary glucose monitoring should be used, until patient satisfied CGM accuracy
- Commence IV or administer subcutaneous insulin BEFORE disconnecting pump / CSII, unless disconnection for period less than 1 hour.
- When converting from pump / CSII to subcutaneous insulin the CSII / pump should run for one hour after subcutaneous insulin injection to reduce risk associated with insulin omission
- When converting from IV insulin infusion, the person with diabetes should prime and re-site the pump infusion cannula or POD and allow the CSII / pump and IV insulin infusion to run concurrently for one hour before IV insulin infusion is stopped to reduce risk associated with insulin omission
- Pump / CSII delivers very small doses of rapid acting insulin continuously without the need for long acting basal insulin administration thus the risk of diabetic ketoacidosis (DKA) is higher in pump users. It is important to recognise this and beware SICK DAY RULES
- 10-20 grams of quick acting carbohydrate should be available to treat hypoglycaemia, see HYPOBOX protocol in wards
- If blood glucose levels rise above 14 mmol/L, there is a risk of DKA. Blood ketones MUST be checked to guide SICK DAY management.
- If patients present to the Emergency department concerned pump malfunctioning, direct patient to discontinue insulin pump therapy and use insulin pen regime (MDI) instead. Patient should be advised to contact pump manufacturer's 24 hour technical helpline and their diabetes team the next working day.
- If a patient with an insulin pump device requires a surgical procedure they usually require conversion from CSII / pump insulin to IV insulin infusion unless an individualised plan was agreed at Pre-Assessment i.e. elective procedures[2,3]. In the context of emergency procedures surgery and acute illness will destabilise diabetes increasing the risk of diabetic ketoacidosis and hence commencing Variable Rate Insulin Infusion for the perioperative period is the safest option. Please ensure secure storage of removed insulin pump (document where e.g. locked ward controlled medications cupboard)

Patients using insulin pump system during in-patient stay

Use of CSII pump is NOT recommended in:

- Acute illness preventing self management, e.g. delirium, unconscious states, psychiatric illness
- Acute illness when haemodynamically unstable e.g. severe sepsis
- Diabetes Ketoacidosis (DKA)
- Major surgery involving a general or spinal anaesthetic
- If patients do not have sufficient consumable supplies e.g. spare infusion sets
- If patient prefers to revert to MDI (basal bolus regime) temporarily as they may feel too unwell to self manage without their usual family support

Considerations for Hybrid Closed Loop Pump Systems

- Early referral to diabetes team to assess if hybrid closed loop system should continue during in-patient stay is required, changes to automation settings may be appropriate

Prescription and Documentation of CSII Pump therapy

- On HEPMA prescribe Novorapid (or alternative analogue) CSII via insulin pump as REGULAR prescription, shows as continuous infusion for 24 hours
- On HEPMA prescribe Insulin Pump Sick Day Protocol: Novorapid flexpen (or whichever rapid insulin used by patient) 2 hourly subcutaneous doses PRN for raised Ketones > 1.5 mmol/L ONLY
- On HEPMA prescribe Insulin Pump Alternative MDI Protocol: prescriber selects within protocol the basal insulin used by patient e.g. LEVEMIR twice daily, and the rapid acting meal time insulin used by patiente.g. NOVORAPID pre meals and supper.
- Ward nursing staff will measure capillary blood glucose usually 4 times daily. More frequent monitoring is needed, 2 hourly if glucose levels are high and blood ketones level are raised.
- Patients will do additional monitoring of their glucose using their own CGM or finger glucose testing device as per diabetes self management training.
- Ward staff, as part of daily review, usually resident medical staff at ward round, should complete the **'Insulin Pump daily Review Checklist Chart'**. This is a safety tool to ensure the patient continues have equipment for pump in hospital and well enough to self manage diabetes[4]. Appendix2

Insulin Pump management for elective procedures under sedation or anaesthesia

- Target glucose for procedures 6-12 mmol/L
- Continuing pump treatment is appropriate when only one meal missed with fasting (Appendix3)
- Refer to diabetes team for assessment before procedure, e.g. higher blood glucose targets for hybrid closed loop systems, or use of pump not connected to CGM may be advised. (Appendix3)

Patients using insulin pump system during in-patient stay (cont'd)

Recognising Need for Sick Day Rules: Inpatients using Insulin Pump systems

- Blood glucose above 14 mmol/L and Ketones above 1.5 mmol/L, means Sick Day management is needed, ensure 'INSULIN PUMP – Sick Day Protocol' prescribed on HEPMA, this will permit PRN doses of rapid acting insulin e.g. NOVORAPID to be given of hyperglycaemia and Ketones.
- Sick day management is similar but there are important differences for patients using Hybrid Closed Loop pumps systems versus Insulin Pump (standalone) pump system. Please refer to the appropriate NHS Lanarkshire patient information leaflet (flowcharts) – Hybrid Closed Loop Sick Day Rules and Standalone Pump Sick Day Rules. Patients should already be aware of these guidelines and be able to follow this to manage their diabetes[5,6].
- If after 4 hours of 'sick day rules' management blood ketone levels are not significantly improved, seek medical review and switch to appropriate alternative insulin management.
- If normal total daily dose of insulin is unknown by patient and unable to access from pump, estimate total daily dose of insulin as 0.5 units / kg. Having calculated this 50% of the dose should be given as basal insulin i.e. Levemir 25% of TDD in morning and 25% of TDD in evening. The other 50% of TDD should be meal time insulin e.g. Novorapid split evenly across the 3 hospital meals.

When to Refer to Diabetes Team

Refer all In-patients using insulin pump systems in acute hospitals via the TRAK referral form to Diabetes Specialist Nurse. If unable to access TRAK referral form phone correct patient helpline answerphone:

- University Hospital Monklands: 01698 752118
- University Hospital Hairmyres: 01355 585230
- University Hospital Wishaw: 01698 366361

If patients attend the Emergency Department with insulin pump system related problems and considered safe for discharge, i.e. the patient's pump / diabetes problem has been resolved and / or there is an alternative diabetes management plan in place, please ensure the Diabetes Educator team is made aware of the patient attending the Emergency Department so that follow-up can be offered. Refer all patients discharged from ED following attendance with pump related issues via TRAK referral form to DSNs. Include in referrals:

Details: Patient Name,
CHI number,
Brief description of Pump / diabetes reason for emergency department attendance

References/Evidence

1. Joint British Diabetes Societies for Inpatient Care (JBDS-IP) Group. Using technology to support diabetes care in hospital: A guideline from the Joint British Diabetes Societies for Inpatient Care (JBDS-IP) group and Diabetes Technology Network (DTN). Joint British Diabetes Societies for Inpatient Care (JBDS-IP) Group: 2024. Version 1.0 March 2024

2. Joint British Diabetes Societies for Inpatient Care (JBDS-IP) Group. Self Management of Diabetes in hospital: A guideline from the Joint British Diabetes Societies for Inpatient Care (JBDS-IP) group and Diabetes Technology Network (DTN). Joint British Diabetes Societies for Inpatient Care (JBDS-IP) Group: 2023. Revised February 2023 https://abcd.care/sites/default/files/site_uploads/JBDS_Guidelines_Current/JBDS_04_Self_Management_Guideline_with_QR_code_February_2023.pdf

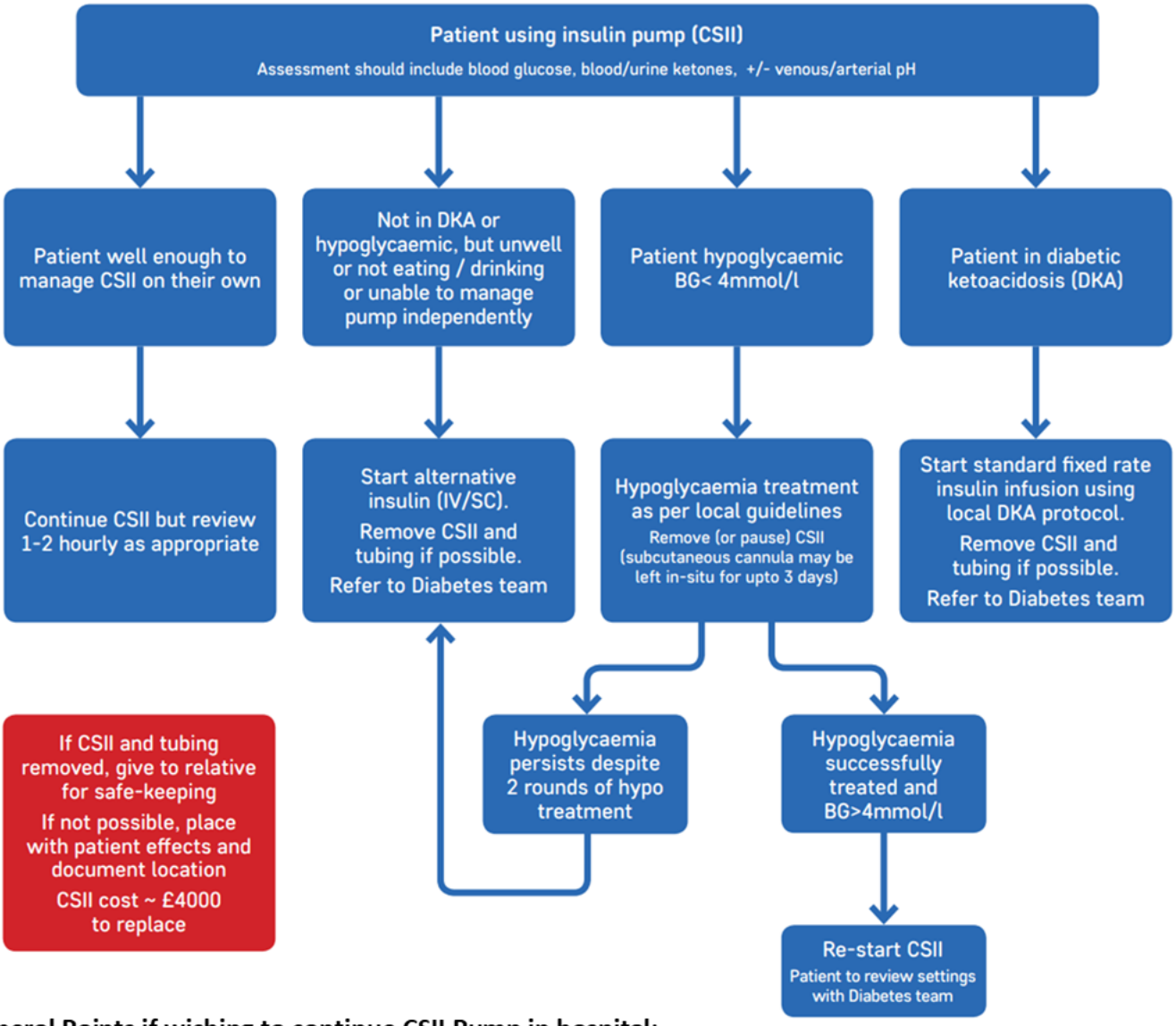
3. Centre for Perioperative Care - Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery. October 2023 https://www.cpoc.org.uk/sites/cpoc/files/documents/2024-05/CPOC-DiabetesGuideline2023.pdf

4. Optimising Glycaemic Control in people with type 1 diabetes (SIGN170) 2024 https://rightdecisions.scot.nhs.uk/optimising-glycaemic-control-in-people-with-type-1-diabetes-sign-170/glucose-lowering-and-glucose-monitoring-technologies/

5. Griffin TP, Gallen G,Hartnell S, et al. UK's Association of BritishClinical Diabetologist's Diabetes TechnologyNetwork (ABCD-DTN): Best practice guide for hybrid closed-loop therapy. Diabet Med.2023;40:e15078. doi:10.1111/dme.15078

6. Hybrid Closed Loop (HCL) System Information Leaflet; https://abcd.care/dtn/resource/current/hybrid-closed-loop-hcl-system-information-leaflet

Assessment of Diabetes patients with Insulin Pump Therapy Chart



General Points if wishing to continue CSII Pump in hospital:

1. Ensure adequate supplies for CSII pump (e.g. spare batteries, infusion sets (i.e. reservoirs, lines & cannulae, or spare PODs)
2. Ensure adequate spare CGM sensors and transmitter if using integrated system
3. Ask patient what their alternative insulin pen regime / MDI is and document, this, along with average Total Daily Dose (TDD) from pump in case of pump failure or struggling to self manage

If not got spare supplies, ask a relative to bring these, **in the same day**

All CSII Pumps and CGM sensors MUST be removed for any procedure using diathermy
All CSII Pumps and CGM sensors MUST be removed before MRI imaging
All CSII Pumps MUST be removed before CT imaging
Only the following CGM sensors (Libre 2 plus, Libre 3, Libre 3plus, Dexcom One+ and Dexcom G7) can be worn during CT imaging if protected by lead apron and outwith scan field. If uncertainty CGM product type remove before CT imaging.

Insulin Pump Daily Review Checklist (page1)

CHI no .....
First name ..... DOB ...../...../.....
Last name ..... Sex: M F
Address .....
.....
.....
or attach addressograph label here

☐ Hairmyres ☐ Monklands ☐ Wishaw
Ward: .....

Insulin Pump Daily Review Checklist

Date commenced: ...../...../.....

If answering 'NO' to any questions below this should trigger discussion to review insulin pump treatment and temporarily convert to alternative MDI (basal bolus insulin) regime or DKA protocol if persisting blood ketones >1.5 mmol/L.

Date:								
Time:								
Questions	**Yes No**	**Yes No**	**Yes No**	**Yes No**	**Yes No**	**Yes No**	**Yes No**	**Yes No**
1. The patient is willling and able to continue insulin pump treatment today?	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
2. The patient's clinical condition is stable enough for the patient to self manage diabetes?	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
3. The patient's blood glucose levels are running generally less than 14 mmol/L?	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
4. The patient has tested for ketones when blood glucose levels were greater than 14 mmol/L?	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
5. The blood ketone levels are below 1.5 mmol/L?	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
6. The patient has sufficient supplies to continue with insulin pump (i.e. spare batteries, lines, reservoirs and infusion sets, blood glucose and ketone monitoring equipment?)	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
The doctor/MINTS/HECT nurse completing this record to initial completed column and record page number. **Initials:**								
Pager:								

NMAHP.INSCHK.23_24913.L

Lead Author	**Dr Liz McIntyre**	**Date approved**	**September 2025**
Version	**9**	**Review Date**	**September 2028**

Insulin Pump Daily Review Checklist (page 2)

CHI no .....
First name ..... DOB ...../...../.....
Last name ..... Sex: M F
Address .....
.....
.....
or attach addressograph label here

Calculation of Alternative Basal Bolus (MDI) Regime for Insulin Pump Patients

1. Record the last 2 days total daily insulin administered by pump device:
   [ ] + [ ] = [ ] ÷ 2 = [A] i.e. Average Pump Total Daily Dose (TDD)
2. Calculate 20% of the Average Pump TDD = ([A] x 20) ÷ 100 = [B]
3. Add value [A] + [B] = [C] = MDI regime starting TDD
4. 50% of the MDI regime starting TDD should be given as basal insulin e.g. LEVEMIR and 50% of the MDI regime starting TDD should be given as mealtime insulin e.g. NOVORAPID or HUMALOG.
5. The basal insulin for MDI regime should be given split again 50:50 at 8am and 10pm e.g. if the MDI regime starting TDD is 48 units, 24 units should be basal insulin and of this 12 units should be given at 8am and 12 units at 10pm. Basal insulin will be LEVEMIR flexpen for most patients.
6. A starting guide for mealtime doses on MDI regime using e.g. HUMALOG Kwikpen or NOVORAPID flexpen insulin would be to calculate 50% of the MDI regime starting TDD, then divide the number into 3 equal mealtime doses, e.g. using the example if the MDI regime starting TDD is 48 units, 24 units should be mealtime insulin and this means 8 units before each meal. Skilled insulin pump patients should be allowed to alter such prescribed meal time doses depending on glucose levels at mealtimes and food eaten. Nursing staff should be supported to record actual dose taken by patient.

Insulin for Alternative MDI Regime and Starting Doses

Date: ...../...../.....

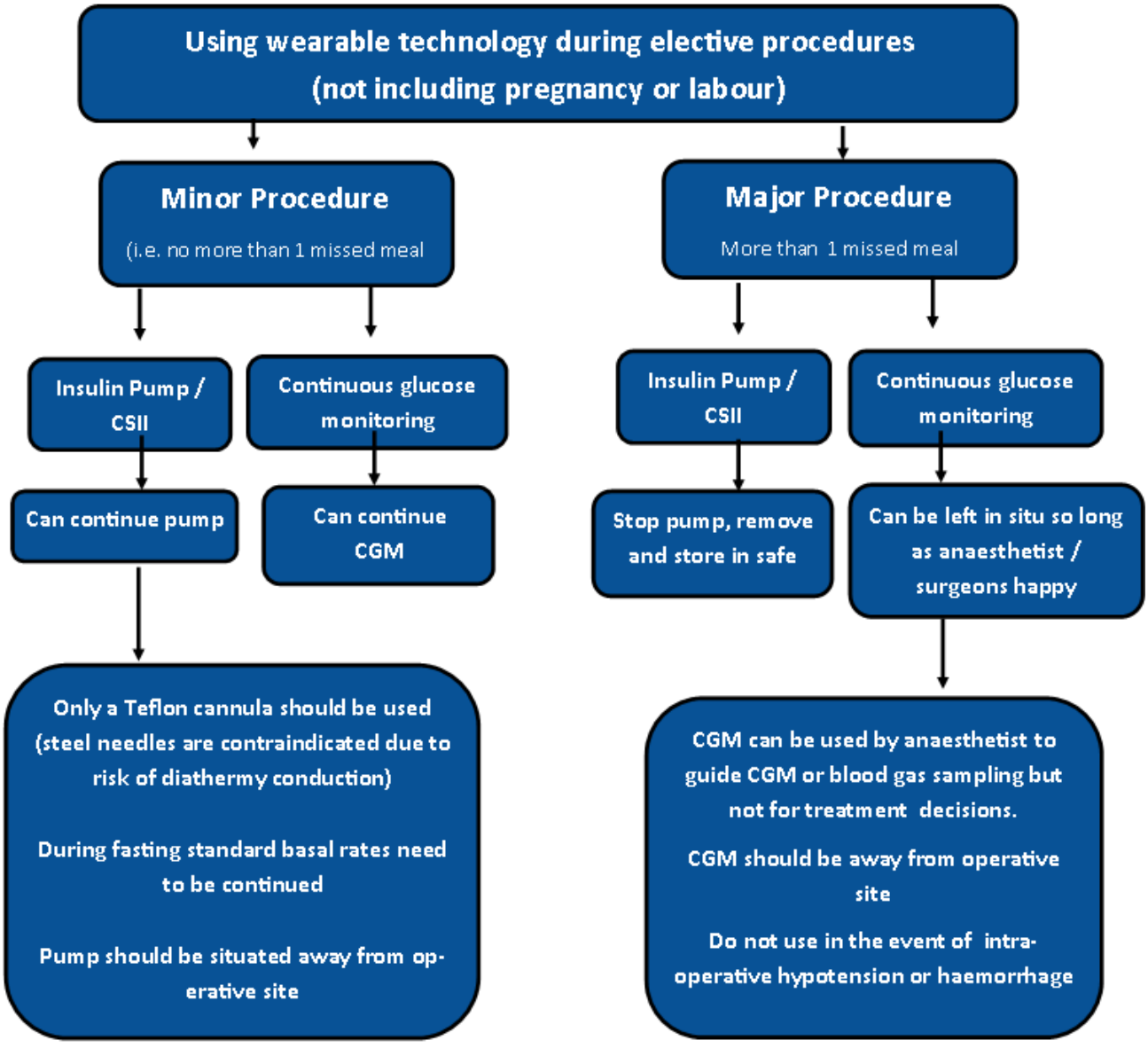
	Name	Device	Dose	Administration Times	
Basal Insulin			units	8am	10pm

	Name	Device	Dose	Administration Times			
Meal Time Insulin			units				

Pump management for elective procedures under sedation or general anaesthesia

Important points:

1. Aim glucose 6 – 12 mmol/L, avoidance of hypoglycaemia important
2. Ensure pre-operative review by diabetes team, for perioperative use insulin pumps
3. Ensure the pump site is away from the site of proposed surgery
4. If diathermy required, pump and CGM sensor manufacturers do not recommend use
5. Monitor capillary glucose levels every 30 – 60 minutes



Further guidelines and checklists can be found in the Appendix and UK Centre for Perioperative care https://cpoc.org.uk/guidelines/

[1]JBDS 20 – Using technologies to support Diabetes Care in hospital, 2024

1. Governance information for Guidance document

Lead Author(s):	Dr Liz McIntyre
Endorsing Body:	NHS Lanarkshire ADTC
Version Number:	9
Approval date	17.09.2025
Review Date:	17.09.2028
Responsible Person (if different from lead author)	

CONSULTATION AND DISTRIBUTION RECORD	
Contributing Author / Authors	Carol McNair – lead insulin pump nurse
Consultation Process / Stakeholders:	E-mail circulation of draft guideline and feedback from Diabetes Technologies MDT 28.2.25 – 7.3.28 including: Dr L Clark, E McCabe – UHH; Dr Sandeep, L Wilson, L Doran - UHM, Dr M Chong, A Innes – UHW Dr D Slack (IMT3 trainee) and his discussion ward 12 resident
Distribution	All Acute hospital wards / emergency departments

CHANGE RECORD

Date	Lead Author	Change	Version No.
7.03.25	Dr L McIntyre		1

31.03.25	Dr L McIntyre	Added explanation of terminology – 'POD' Further Appendices – recognition of pump devices	2
1.04.25	Dr L McIntyre	Advise MRI & CT compatibility, updated UK specific licensing rules versus US, FDA update	3
5.05.25	Dr L McIntyre	Updated HEPMA prescribing text – advise Claire Anderson (lead medical pharmacist, UHM) who will kindly link with HEPMA team	4
5.05.25	Dr L McIntyre	Added Appendix documents into body of guideline as advised ADTC, but please note as some pdf blurring of text when trying to paste and resize doc. Hence original Appendix doc. attached for details. Plan would be this document hosted as one document on RDS. Appendix 4&5 are patient leaflets and Appendix 2 is a NHSL chart, Firstport Clinical Records library	5
04.08.25	Dr L McIntyre	Improved Appendix 3 - redrawn	6
21.08.25	Dr L McIntyre	Added appendix 2 and marked sample	7
27.08.25	Dr L McIntyre	Hyperlinks for Appendix 4 & 5 following feedback	8
28.08.25	Dr L McIntyre	HEPMA links reviewed and wording within document adjusted, paragraphs: 1. Prescription and Documentation of CSII Pump therapy and 2. Recognising Need for Sick Day Rules: Inpatients using Insulin Pump systems	9

2.You can include additional appendices with complimentary information that doesn't fit into the main text of your guideline, but is crucial and supports its understanding.

e.g. supporting documents for implementation of guideline, patient information, specific monitoring requirements for secondary and primary care clinicians, dosing regimen/considerations according to weight and/or creatinine clearance