PERSONAL INSULIN PUMPS IN HOSPITAL SETTINGS IN ADULTS WITH TYPE 1 DIABETES- GUIDELINES FOR HEALTH PROFESSIONALS

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PREFACE

This document is designed to assist health care professionals in caring for individuals using an insulin pump, with or without CGM, while in hospital. It Aims to provide advice regarding the continued use of insulin pumps during hospitalisation under appropriate circumstances, and provides guidance as to when their use needs to be discontinued temporarily and how this should be implemented.

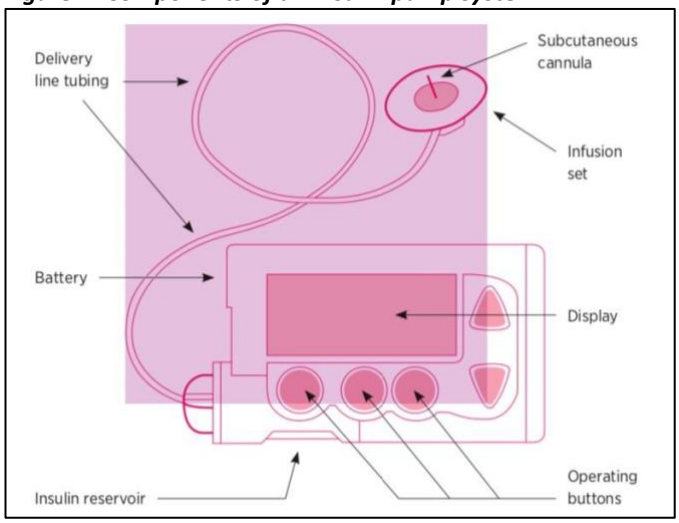
BACKGROUND

People living with diabetes who self-manage using an insulin pump, with or without continuous glucose monitoring (CGM), often prefer to continue to use these devices when admitted to hospital and are reluctant to relinquish the 'control' and reassurance which the technology provides [1]. In selected persons, the continued use of insulin pumps (and CGM) during a hospital admission can be implemented safely and may enhance inpatient glycaemic management. However, it is important to note that insulin pump settings are usually optimised for the healthy state of people with diabetes. Hospitalisation may be associated with alterations in insulin requirements associated with stress of illness where hyper and hypoglycaemia may occur with the person's usual pump settings. Additionally, there are alterations in tissue blood flow which may impact both insulin delivery and reliability of CGM, as well as changes in physical activity levels and food intake which will impact blood glucose levels [1-3]. Thus, insulin pump settings may need to be temporarily modified in response to these changed circumstances by either the user/person with diabetes or a team skilled in the management of diabetes technology.

DEVICES

Insulin pumps are small pager-sized electronic devices used predominantly by people living with type 1 diabetes (T1D) to deliver continuous subcutaneous rapid-acting insulin accurately and in a flexible manner. The insulin is delivered through an infusion set which is connected to the insulin reservoir in the pump on one end and to a subcutaneous insulin cannula on the other end (Figure 1). The cannula and insulin usually need to be changed every 3 days.

Figure 1: Components of an insulin pump system



Pumps deliver background rapid acting insulin continuously at rates which can be varied (basal insulin) and as a surge of insulin (bolus insulin) superimposed on the basal rate to address the rise in glucose levels associated with food eaten and/or to correct hyperglycaemia. Basal insulin delivery can vary to address the individual's "background" insulin requirements. In most pumps when used in conjunction with CGM basal insulin delivery is determined by automated responses to interstitial glucose levels measured in real-time (automation of insulin delivery-see below). In insulin pumps used without CGM basal insulin requirements are determined by pre-programmed insulin infusion rate settings, set in consultation with the diabetes specialist. While some insulin pumps have an automated bolus function that deliver a calculated dose to correct high glucose levels, bolus doses of insulin prior to meals, are usually calculated by bolus insulin calculators embedded in the pump and initiated by the person with diabetes. Bolus calculators utilise information regarding a person's current glucose level, their estimated sensitivity to insulin, the estimated duration of insulin action, the planned carbohydrate intake, and their personalised glucose target to calculate the dose of bolus insulin required to maintain glucose levels in a healthy range.

Real Time-Continuous Glucose Monitoring (RT-CGM) refers to a class of devices which have been developed for ambulatory use. They utilise a sensor inserted subcutaneously that measures tissue/interstitial glucose levels every 1-5minutes and which transmits the data in real-time to a receiver or to an insulin pump to automate insulin delivery. Because RT-CGM measures interstitial glucose in real-time, these systems can provide the user with alerts for low and high glucose. There may be a slight difference between interstitial and capillary blood glucose levels, due to the lag time (usually less than 10 minutes) in equilibration between tissue fluid and blood glucose levels [4]. The sensor requires replacement after a period specified by the manufacturer and is usually inserted by the person with diabetes. The receiver may be, integrated as part of an insulin pump, or separate to the insulin pump as an application on a mobile phone, smart watch, or a dedicated receiver device. CGM devices are factory calibrated so do not require calibration with a capillary blood glucose reading. The Therapeutic Goods administration allows RT-CGM systems to be used to determine insulin dosing without a confirmatory capillary blood glucose measurement. As CGM devices are not as accurate as blood glucose monitors, capillary blood glucose checks are required for confirmation if a CGM reading does not fit the clinical situation[4, 5]. This may be particularly relevant in those situations where blood glucose levels are rapidly changing or when tissue blood flow is altered by acute illness, such as can occur in hospital.

Automated Insulin Delivery (AID) Systems: Insulin delivery and RT-CGM functions can now be embedded within a single device. These newer devices are similar in appearance to stand-alone insulin pumps, and in the absence of a sensor they can be used as such. The integration of insulin delivery with glucose sensing provides the opportunity for automated determination of insulin dosing by RT-CGM data. Computational algorithms within the insulin pump continuously and automatically adjust subcutaneous insulin delivery based upon tissue glucose readings independent of the user. Because of limitations in the speed at which subcutaneously administered insulin acts, current systems represent a hybrid of automated basal insulin delivery and user-initiated bolus dosing to address rapid changes in insulin requirements such as with meals. These are referred to as *Hybrid Closed Loop* systems as the user must still make decisions regarding bolus insulin.

1. INPATIENT PUMP USE

Recommendation

1.1 *Patients who can safely use diabetes devices should be allowed to continue using them in an inpatient setting when appropriate supervision is available.*

1.2 *All patients with diabetes using an insulin pump should be referred to the Endocrinology/Inpatient Diabetes Team on admission to hospital. If the speciality service is not available in the hospital the patient's usual endocrinologist, or credentialled diabetes educator (CDE), should be contacted to support care.*

1.3 *Because AID algorithms utilise historical data in determining responses to changing glucose levels, it is recommended that the decision to continue with AID be reviewed if insulin sensitivity and insulin requirements have not been stable (for example, use of high dose steroids, severe metabolic derangement etc). Appropriate backup settings which are used when automated insulin delivery is unavailable (e.g. conventional pump settings, such as basal insulin rates and sensitivity factors), should be programmed and optimised or a temporary basal rate implemented on the advice of the treating endocrinologist/CDE.*

1.4 *No therapies or investigations are planned which will compromise function of the device e.g. high dose paracetamol, repeated CT scans or MRIs.*

1.5 *Fingerprick glucose levels should continue to be measured as per usual hospital protocols regardless of CGM use.*

1.6 *Hypoglycaemia (BGL<4.0mmol/L) detected on CGM should always be validated with a capillary glucose level prior to treatment.*

1.7 *If there is a >2mmolL discrepancy between the CGM reading and capillary glucose reading, the capillary reading should be used for insulin bolus decisions.*

1.8 *If the CGM reading does not correlate with the clinical situation, an additional capillary glucose reading should be done.*

- It is recommended that the hospital should have access to a specialist diabetes service experienced in the care of people on pump therapy which includes capability to upload, document and review the pump data.
- The decision to continue pump therapy while an inpatient should be made in consultation with the specialist team and the person with diabetes, and should be reviewed regularly during the inpatient stay. Considerations will include the person's clinical condition, their ability to self-manage their pump which should be functioning normally with adequate personal supply of consumables including batteries, reservoirs, infusion sets (see Tables 2 and 3).
- Governance and appropriate hospital protocols regarding the use of insulin pumps should be in place. These include standard operating procedures, and documentation in the clinical history of use of the pump with the individual's consent (see appendix A).

- An insulin pump management checklist should be completed on admission to hospital to ensure insulin pump continuation is appropriate (see Table 4)
- In an individual, in the absence of cognitive or psychiatric impairment, who can eat and is wishing and able to continue to self-manage insulin therapy with their insulin pump, continuation of insulin pump therapy is more appropriate than an intravenous insulin infusion or a multiple daily insulin injection regimen; as long as they are metabolically stable and not in DKA, HHS or critically unwell.
- While essential for AID function, pumps may be used in hospitals without CGM. The integrity of the pump insertion site (and CGM site if relevant) should be checked by the person with diabetes and nursing staff for inadvertent detachment or site inflammation at least once per nursing shift with appropriate documentation in the hospital record. The date of insulin set and CGM insertion should also be documented and replaced after an interval in accordance with the manufacturer's instructions.
- The person with diabetes, should be able to appropriately access the pump menu, bolus insulin according to their needs, modify basal rates if necessary, and perform set changes. In addition, those who wish to use CGM in conjunction with their pump should demonstrate that they are able to insert and initialise a sensor. The clinical condition of the person may change during the hospital stay; therefore, the ongoing use of an insulin pump should be reviewed regularly during the period of hospitalisation. Spare pump consumables should be available and need to be supplied by the patient.
- People with diabetes who are familiar with their pump management can often adjust insulin doses more knowledgably than inpatient staff and should be allowed to do so under supervision with all device settings adjustments documented in the patient's notes.
- If it is unlikely that the pump will be disconnected for prolonged periods on multiple occasions (e.g. for radiological investigations or for complex surgical procedures) pumps can continue to be used for short surgical procedures, although the type of infusion set (avoid metal set as risk with diathermy) and site of the insertion will need to be considered (Figure 2, Table 1).
- If the insulin pump fails after hours the endocrinology/diabetes specialist team should be contacted and an alternative mode of insulin delivery initiated urgently. Back up multiple daily injection (MDI) doses should be calculated and documented at admission in the event of pump failure after hours.
- If the insulin pump cannula is dislodged with resulting hyperglycaemia, a capillary ketone level should be checked and the person with diabetes should perform an insulin line change using their own pump consumables followed by a correction bolus and resumption of continuous insulin delivery. If ketones >1.0 mmol/L are present, then a repeat test should be performed in 2 hours and additional correction dose given if present. If ketones do not fall over time, consideration should be given to changing to multiple daily injection of subcutaneous insulin (see section 2 below).
- Whilst patients are using an insulin pump for insulin administration, supplemental insulin should not be charted as some pumps will automatically administer correction boluses in response to hyperglycaemia and additional supplemental insulin boluses may result in hypoglycaemia. All supplemental insulin is to be administered using the pump.
- If the patient has been admitted to a different hospital from their usual diabetes care provider, then contacting the usual treating endocrinology/credentialled DNE team is recommended and the endocrinologist/credentialled DNE usually responsible for the care of the patient should be notified as soon as possible.
- If the patient is admitted to a hospital without specialist endocrine or credentialled DNE services, if an appropriate plan has been provided by their usual diabetes care provider, pump therapy can be continued (see appendix B).
- Should there be concerns regarding the technical functioning of the pump the manufacturer's helpline should be contacted.

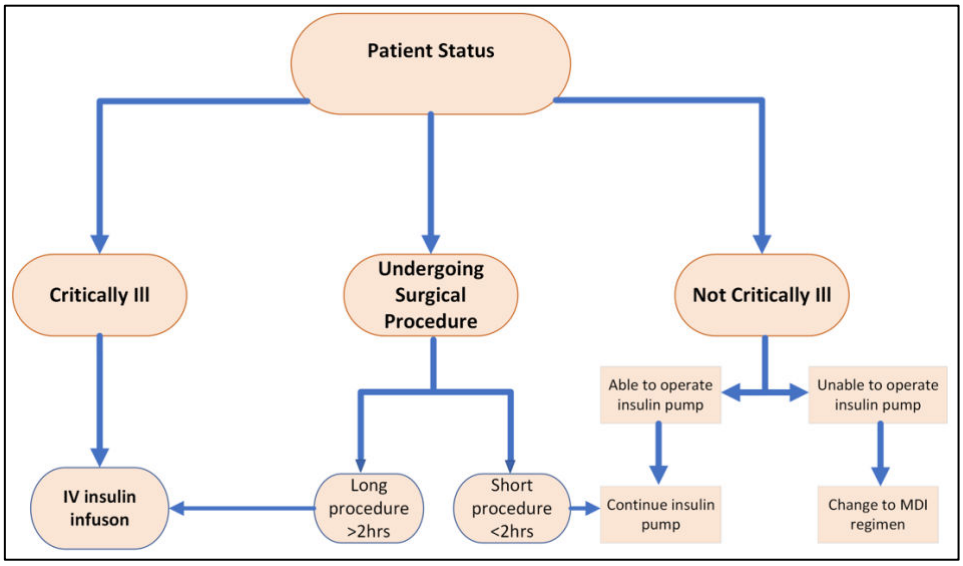


Figure 2: Management pathway for patient admitted to hospital with pump [6]

Table 1: Changes to pump/CGM management with different imaging studies and minor surgical procedures [6]

Pump and CGM Management with Imaging Studies and Simple Procedures	
X-ray	Pump and CGM should be covered by lead apron
CT/MRI	Pump, metal infusion sets and CGM should be removed
Ultrasound	No need to remove pump or CGM but transducer should not be pointed directly at pump
Cardiac catheterisation	Pump and CGM should be covered by lead apron
Pacemaker/automatic implantable cardioverter defibrillator (AICD) insertion	Pump and CGM should be covered by lead apron
Endoscopy	Pump and CGM can remain in place
Laser surgery	Pump and CGM can remain in place

Table 2: General recommendations for continuing insulin pump/CGM in hospital

Insulin Pump (stand-alone) OR Automated Insulin Delivery System	
Patient Related Factors	• The person with diabetes can safely take responsibility for the operation of their CGM/ Pump device. • The person with diabetes is metabolically stable. (No DKA / Hypovolaemia/Overwhelming sepsis/ Cardiac failure) • The person with diabetes provides their own devices and associated consumables.
Hospital Related	• The hospital has access to the pump and CGM upload and expertise to review the data. • Appropriate documentation and protocols, with once per nursing shift review of insertion sites and device settings. • Routine hospital protocols for monitoring finger-prick blood glucose and ketones are to be implemented. • Document date of last change of insulin reservoir and cannula set in patient's clinical record • Rapid acting Insulin used in the pump is charted on the usual medication chart • Supplemental insulin must not be charted: all correction doses of rapid acting insulin are to administered via the pump
Device Related	• The device is functioning normally with no therapies/ interventions planned that adversely impact device function. • The device will not be disconnected for prolonged periods e.g. for surgical procedures MRI and CT imaging (maximum disconnect time 2 hours) • All therapeutic interventions requiring insulin administration with the pump, should occur after confirmation with a finger-prick blood glucose reading.

Table 3: Contraindications to continuing the use of pumps (including AID systems) in hospital:

	Insulin Pump (Stand Alone)	Insulin Pump + CGM	Insulin Pump (AID)
Patient Related Factors	• Inability (patient/guardian) to self-manage insulin pump (cognitive/ physical/ psychiatric) • Severe metabolic derangement (DKA / Hypovolaemia/Overwhelming sepsis/ Cardiac failure/ICU admission) • Skin infections precluding insulin-set/ sensor insertion • Patient does not provide consent to continue with therapy		
Therapies and Interventions	• Prolonged/ Complex surgical procedures or procedures with risk for hypovolaemia (CABG, major bowel resection, significant diathermy) • Numerous radiological procedures requiring prolonged disconnection >2 hours (MRI, CT Scan, Cardiac Catheterisation)		
		• Therapies / Interventions that compromise CGM data eg. Paracetamol / hydroxyurea etc	
Hospital Related	• Absent hospital policy/ documentation • Limited staff knowledge- base/ Inability to download and review device data • No insulin pump team in the hospital		
Device Related	• Device failure/ Device out of warranty • Lack of insulin delivery consumables (batteries, reservoirs, and infusion sets)		
		• Non-availability of sensor/ transmitter/ insufficient sensor data/ unreliable sensor data	

Table 4: Insulin pump management checklist

Step 1		
Contact diabetes educator (if available at your facility)	☐No	☐Yes
Contact the patient's treating endocrinologist or local endocrinology team if available	☐No	☐Yes
Step 2 – Assessing Patient Safety *If 'Yes' to any question, discontinue the insulin pump and replace with multiple daily insulin injections or IV insulin where clinically indicated* Does the patient have any of the following:		
Impaired consciousness	☐No	☐Yes
A critical illness requiring intensive care	☐No	☐Yes
A major psychiatric disturbance or suicidal tendencies	☐No	☐Yes
Diabetic ketoacidosis	☐No	☐Yes
Lack of infusion sets, spare batteries, insulin and any other equipment required to maintain the insulin pump	☐No	☐Yes
An unwillingness to manage the pump while an inpatient	☐No	☐Yes
Any other medical circumstance deemed unsuitable by the supervising medical officer	☐No	☐Yes

Step 3 – Assessing Patient Competency *If 'No' to any question, discontinue the insulin pump and replace with multiple daily insulin injections or IV insulin where clinical indicated*		
Can the patient (or parent or guardian) demonstrate that they can correctly operate the insulin pump	☐No	☐Yes
Can open the management menu of the device	☐No	☐Yes
Are able to adjust the basal rate	☐No	☐Yes
Are able to adjust the bolus dose (make adjustments to the program and bolus dose administration)	☐No	☐Yes
Demonstrate technical competency regarding cannula sites/how to manage infusion line obstruction/site leaks	☐No	☐Yes
The patient agrees to notify the medical staff of any changes to their insulin pump	☐No	☐Yes
Understands the pump will be discontinued if medically indicated	☐No	☐Yes

2. PUMP MALFUNCTION AND MANAGEMENT OF LINE OCCLUSION

- People with diabetes and health professionals can be alerted to a line occlusion via different mechanisms. The pump itself may sound an occlusion alarm; otherwise, line occlusion or insulin line set failure should be suspected if unexpected hyperglycaemia occurs despite correct insulin bolusing. If this occurs, follow the steps in **Table 5**.
- If the person with diabetes or their treating health professional suspects the pump has malfunctioned, they should work through a troubleshooting checklist (**Table 6)**.

***Table 5: Steps to troubleshoot unexpected hyperglycaemia** [7]*

1.	Use the pump to calculate the correction bolus dose needed or calculate using last recorded insulin sensitivity (the amount 1unit of insulin will lower blood glucose)
2.	Give the correction dose with an insulin pen
3.	Check blood ketones
4.	Replace the subcutaneous cannula and insulin reservoir
5.	Following a set change, if ketones are present at a concentration of >0.9 mmol/L, run a temporary increased basal delivery for four to six hours at 150-200% to 'catch-up' missed basal
6.	Give a second correction bolus using the insulin pump at 3-hours following the first correction bolus and retest ketones.
	• If ketones have decreased <0.9 mmol/L., cease the temporary increased basal delivery • If ketones are still >0.9 mmol/L, continue the increased temporary basal delivery and re-test ketones every 2 hours.

Table 6: Checklist for troubleshooting suspected pump malfunction

☐	Is blood glucose going up after new infusion set was inserted?
☐	Could the cannula be kinked?
☐	Is the infusion set connected to the insulin cartridge?
☐	Check tubing for air bubbles
☐	Is the infusion set connected to the infusion cartridge?
☐	Is there an insulin leak detectable? – moisture on the pump casing or at the insertion site or the smell of insulin evident
☐	Has the infusion set been changed within the last 72hours?
☐	Is the insertion site red, sore or swollen?
☐	Was a correct bolus delivered with the last meal?
☐	Is the correct basal program being used?
☐	Is the insulin used in date and been appropriately stored?

3. INPATIENT CGM USE WITH PUMP

Recommendation

3.1 *The person with diabetes, or their caregiver, is responsible for the operation of the CGM device including insertion, initialisation and calibration (if required by the manufacturer) of the sensor.*

3.2 *The person with diabetes is responsible for providing their own devices and associated consumables.*

3.3 *The person with diabetes needs to be able to respond to sensor alarms and alerts.*

3.4 *CGM devices have been validated in ambulatory settings. Limited information is available regarding use in hospitals. Therefore, all hospital protocols for monitoring capillary blood glucose and ketones are to be implemented. All therapeutic interventions for BG<4mmol/L or BG >16mmol/L should be confirmed with a capillary blood glucose reading.*

3.5 *CGM data should be reviewed by local Endocrinology/Inpatient Diabetes Team/CDE and can be used in conjunction with capillary blood glucose levels to alter glycaemic management.*

- Capillary blood glucose monitoring (and ketone monitoring) should continue according to standard hospital protocols. The use of an insulin pump incorporating CGM does not fulfil the requirements for glucose monitoring in an inpatient setting as the formal validation of the glucose readings obtained from these devices in a hospital environment has not been performed. However, where capillary and CGM blood glucose values are consistently aligned a decision may be made to use CGM values for monitoring in hospital excepting where CGM values are <4 mmol/L or >16 mmol/L when point of care testing should be resumed. See CGM guidelines (https://www.diabetessociety.com.au/ads-endorsed-resources/) for comprehensive inpatient CGM usage guidelines.
- In addition to the general recommendations above, if relevant, please refer for additional guidelines specific to pregnancy https://doi.org/10.1111/ajo.13265 [8]

4. GLUCOCORTICOID EXPOSURE IN HOSPITAL

Recommendation

4.1 *Insulin pump therapy can continue following steroid administration to safely maintain normoglycaemia.*

4.2 *There will be an increase in insulin requirements which may vary between individuals by 20% to 100% and is dependent on glucocorticoid dose and potency.*

4.3 *Local specialist Endocrinology/Diabetes Team should be involved in insulin dosing management*

- Steroid induced hyperglycaemia is common in the hospital setting. People on insulin pump therapy can continue to use the pump following steroid administration to safely maintain BGL in the 'healthy/target' range of 5.0 - 10.0mmol/L.
- At least 10-30% increase in insulin dose is usually required to maintain normoglycaemia; however, the degree of increase is widely variable and therefore adjustments to pump settings should be individually determined.
- Adjustments to insulin delivery can be achieved by altering the settings of the pump such as strengthening correction boluses or carbohydrate ratios and increasing temporary basal rates.
- AID systems will automatically respond to hyperglycaemia by increasing basal insulin delivery and deliver correction boluses. However, if insulin requirements increase rapidly and very substantially some systems will exit automated insulin delivery, whilst others will respond but may not avert hyperglycaemia. All AID devices will require carbohydrate ratios to be strengthened.
- Steroids have varying relative potencies and duration of actions (Table 4).

Table 4: Glucocorticoid potency and duration of action[9]

Glucocorticoid	Expected onset of hyperglycaemia (hours)	Equivalent Doses	Duration of action (hours)
Hydrocortisone	4–8	25 mg	8
Prednisolone	4–8	5 mg	16–36
Methylprednisolone	4–8	4 mg	18–40
Dexamethasone	4–8	0.75 mg	36–54
Betamethasone	4–8	0.75 mg	36–54

5. INSULIN PUMPS IN DIALYSIS PATIENTS

- Diabetes with concurrent end stage kidney disease and dialysis (both peritoneal and hemodialysis) can cause increased glycaemic variability and contribute to suboptimal glycaemic outcomes.
- Whilst there is limited evidence for the use of AID in dialysis patients, the existing literature all points towards improved glycaemia without increased incidence of hypoglycaemia[10, 11].
- The more flexible nature of insulin delivery in AID systems appears to better accommodate the glucose fluctuations that occur with both peritoneal and haemodialysis.
- As such, we would recommend the continuation of use of AID systems in people when commencing dialysis and consideration of commencement of AID systems if feasible.
- CGM systems are less accurate on haemodialysis days and therefore increased finger-prick blood glucose levels should be assessed on these days[12-14].

6. RECOMMENCEMENT OF INSULIN PUMP THERAPY IN HOSPITAL

Recommendation

6.1 *Persons with diabetes should be able to recommence insulin delivery via their personal insulin pump whilst in hospital when all criteria for inpatient pump use are met.*

6.2 *Insulin settings should be re-reviewed prior to recommencing the insulin pump.*

- Ensure that all criteria are met for inpatient pump use prior to recommencing insulin delivery with the patient's pump (Table 5).
- Review pre-programmed basal rates and bolus calculator settings prior to recommencing insulin pump relative to documented insulin requirements during hospitalisation.
- A new infusion set and sensor should be inserted and delivery by pump should be recommenced, in the morning, with adequate overlap of at least 2 hours with the prior insulin regimen (subcutaneous or intravenous) in order to avoid ketosis.
- If intermediate or long-acting insulin is on board, a reduced temporary basal rate or higher temporary target may need to be utilised for a few hours prior to resuming pre-programmed basal rates.
- For devices integrating the pump with CGM, alarms, Low Glucose Suspend or Predicted Low Glucose Suspend functions may be implemented immediately.
- If disconnected for a prolonged period of time, some AID systems may require a warm-up period of up to two days prior to AID activation.

Table 5- Considerations for recommencing insulin pump

All Pumps	
Patient Related Factors	• All criteria for inpatient pump use are met (Table 2)
Device Related	• AID systems may require a warm-up period of up to two days prior to AID activation (if disconnected for a prolonged period of time) • Review pre-programmed basal rate and bolus calculator settings to ensure requirements have not changed. • Insert new infusion set and sensor. • Schedule recommencement in the morning where possible. • Ensure overlap of at least 2 hours with the prior insulin treatment regimen in order to avoid ketosis, • Alarms, Low Glucose Suspend or Predicted Low Glucose Suspend functions may be implemented immediately for devices integrating the pump with CGM.

<u>Customer Service Numbers:</u>

AMSL : 1300 851 056

Medtronic: 1800 668 670

Ypsomed : 1800 447 042

Roche : 1800 251 816

Abbott for Flash Glucose Monitoring: 1800 801 478

GLOSSARY

CORRECTION BOLUS – Increase in insulin dose given as a bolus dose to correct raised BGLs – usually calculated according to insulin sensitivity and the degree that the blood glucose level is above the programmed target.

ALARM- An audible beep or vibration with a message to inform the pump user that the pump is no longer delivering insulin. Alarms require immediate action.

ALERT- An audible beep or vibration with a message to inform the pump user of a situation that may require attention.

AUTOMATED INSULIN DELIVERY / CLOSED LOOP- A system which uses CGM data and an insulin pump to automatically regulate a user's glucose levels. The AID system provides adequate insulin infusion without patient input.

HYBRID CLOSED LOOP - The Hybrid Closed Loop (HCL) pump is any insulin pump with the capability of delivering variable (automated) basal insulin by using an algorithm and real-time CGM sensor glucose trends. Bolus doses will still need to be administered by the patient or care-giver.

OPEN LOOP- a system that provides continuous blood glucose readings which are transmitted to an insulin pump. The patient needs to adjust insulin delivery in response to the blood glucose levels.

Commonly used settings:

ACTIVE INSULIN - Bolus insulin that has been delivered by the pump and is still working to lower blood glucose levels in the body.

ACTIVE INSULIN ADJUSTMENT- The amount of insulin that is subtracted from BG correction bolus to account for the active insulin that is tracked as being present in the body.

ACTIVE INSULIN TIME - A bolus setting that allows setting the length of time that bolus insulin is tracked as active insulin.

INSULIN TO CARBOHYDRATE RATIO – Determines the amount of insulin required to cover the quantity of carbohydrate to be eaten. Calculations may be based on grams or 'exchanges' (15 g serves) of CHO.

INSULIN SENSITIVITY (CORRECTION) FACTOR - The individualised amount by which one unit of insulin is expected to lower a person's blood glucose level over the following few hours. The insulin sensitivity factor is used to calculate correction bolus amounts.

BLOOD GLUCOSE TARGET -The glucose level used in calculation of correction bolus insulin- NOT the glucose range within which the person's glucose levels should be maintained

Glossary: Medtronic specific

AUTOMODE SMART GUARD: Auto Mode is an insulin delivery feature that automatically controls basal insulin delivery to regulate blood glucose (BG) levels to a target sensor glucose (SG) value.

MANUAL MODE: Manual Mode refers to system functions other than Auto Mode. In other words, if Auto Mode is not functioning, the system is in Manual Mode.

LOW GLUCOSE SUSPEND or SUSPEND ON LOW - A feature that suspends insulin delivery when the sensor glucose value reaches or falls below the programmed low limit.

PREDICTIVE LOW GLUCOSE SUSPEND or SUSPEND BEFORE LOW- A feature that suspends insulin delivery when the sensor predicts sensor glucose value is approaching the programmed low limit

BOLUS WIZARD- A feature that uses the individualised Bolus Wizard settings to calculate an estimated bolus amount based on the BG values and amount of carbohydrates that are entered. These settings include Insulin Carbohydrate Ratio, Insulin Sensitivity Factor, BG Target Range, and Active Insulin Time.

Glossary: AMSL Tandem pump specific

BASAL IQ: Basal IQ is a predictive low-glucose suspend algorithm that can be installed on Tandem's t-SlimX2 insulin pumps. It utilizes the sensor values from an integrated Dexcom G6 sensor to help reduce the frequency and duration of a hypoglycaemic event (low blood glucose). It reduces hypoglycaemia by suspending insulin delivery when a low glucose level is predicted. It does not increase basal rates or correct high blood glucose levels.

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APPENDIX A

Inpatient Insulin Pump User Agreement Facility:	(Affix identification label here or complete if E-Form) URN: Family name: Given name(s):

User agreement for continued use of insulin pump whilst hospitalised

This document outlines the current guidelines regarding Insulin Pump with or without Continuous Glucose Monitoring (CGM) use in hospital.

Insulin pump users must agree to the below.

For ongoing insulin pump use in hospital, it is essential that the user has capacity to manage the pump and associated CGM (if applicable) independently including the following tasks:

- Self-insertion of new sensors if applicable
- Identification of when fingerstick blood glucose levels are required for CGM calibration
- Able to change insulin reservoir and cannula independently
- Able to deliver insulin for corrections and meals as required
- Able to work through basic troubleshooting steps in event of unexpected high blood glucose or pump failure
- User must agree to notify medical staff of any changes to their insulin pump

To allow safe use of insulin pumps, users will require:

- Access to usual smart phone / glucose reader device used for review of CGM and pump data or for pump bolus delivery
- All supplies required for insulin pump and CGM to be provided by the user

Capillary glucose testing is still required:

- At routine times for people with diabetes in hospital (minimum pre-meals and pre-bed)

In specific clinical situations, CGM readings are known to be less accurate and clinical staff may request to perform additional fingerstick readings for more accurate assessment of your blood glucose levels. These situations include, but are not limited to:

- Hypoglycaemia (CGM measure <4mmol/L)
- Rapid fluid shifts (eg. Dialysis)
- Rapid glucose changes (eg. diabetic ketoacidosis)
- Critical illness
- Surgery
- Medications which may affect CGM accuracy

In specific clinical situations, it may not be safe to continue wearing an insulin pump and associated CGM and clinical staff may request removal of the CGM device. These include but are not limited to

- Medical imaging (CT and MRI)
- Surgery where insulin cannula or CGM is located within surgical field
- Surgery where diathermy is required or long procedures more than 2-hours
- Direct current cardioversion
- During management of diabetic ketoacidosis

The health care professional (HCP) has explained my responsibilities for the ongoing wear and use of my insulin pump and associated CGM whilst I am an inpatient, and I agree to the above.

Patient/carer name: ..... Signature:.....

HCP name:..... Signature:.....

HCP Designation:..... Date:.....

APPENDIX B

Inpatient Insulin Pump Advice for Patients and Doctors

Name: _____ DOB_____

Diagnosis: _____

Contact details of usual public hospital OR private endocrinologist:

Current Insulin Pump: _____

Insulin used:_____

Target BG: _____

In the event of pump failure, back-up MDI (insulin) doses are as follows:

Long-Acting (Basal) Insulin dose: _____time_____

Short Actng (Bolus) Insulin doses: _____times_____

Or other: _____

Fasting and Surgical Plan (delete if not applicable)

Should be first on procedure list whenever possible

Give insulin via pump as per usual settings the evening and night before surgery

☐ Morning procedure Fasted from _____hours	☐ Afternoon procedure Fasted from _____hours
<u>Morning of procedure:</u> • Basal Rate %: _____ from ____:_____hrs • Glucose Target: _____mmol/L from ____:_____hrs • Check BGL hourly and maintain BG between 5-11mmol/L	<u>Morning of procedure</u>: • Basal Rate %: _____ from ____:_____hrs • Glucose Target: _____mmol/L from ____:____hrs • Check BGL hourly and maintain BG between 5-11mmol/L

- If procedure expected to be >2-hours or significant diathermy is anticipated, pump should be discontinued just prior to procedure and an IV insulin/glucose infusion commenced – insulin infusion rate to commence at _____units per hour
- If procedure expected to be <2-hours in duration, pump can be continued with settings below

<u>During procedure:</u>

- Basal rate %: _____
- Glucose Target: _____mmol/L

Continue to check BGL hourly

<u>After procedure:</u>

- If pump was continued during procedure correction bolus to be given by pump at end of procedure if BG >10 mmol/L once patient is awake and able to give correction
- If pump was continued during procedure, resume usual bolus dose rapid acting insulin with next meal via the pump
- If on IV insulin/glucose infusion, transitioned back to insulin pump once patient is capable of resuming adequate oral intake with two hours overlap with insulin dextrose infusion

Imaging Procedures (delete if not applicable)

X-ray/CT	Pump and CGM should be covered by lead apron
MRI	Pump, metal infusion set and CGM should be removed. Infusion set and CGM to be re-inserted after MRI.
Ultrasound	No need to remove pump or CGM but transducer should not be pointed directly at pump
Cardiac catheterisation	Pump and CGM should be covered by lead apron
Pacemaker/automatic implantable cardioverter defibrillator (AICD) insertion	Pump and CGM should be covered by lead apron
Endoscopy	Pump and CGM can remain in place
Laser surgery	Pump and CGM can remain in place

Glucocorticoids (delete if not applicable - note glucocorticoids are often given by the anaesthetist to prevent postoperative nausea/vomiting so a plan should be documented in case this occurs)

Name of glucocorticoid: _____

Dose: _____

Duration of course: _____

Changes to pump settings:

- Basal rates: _____
- Insulin-carbohydrate ratio: _____
- Insulin sensitivity factor: _____