Continuous Subcutaneous Insulin Infusion (CSII) Pump Therapy (Adult Patient's Own Pump) in Hospital

Site Applicability

VCH and PHC - All Acute Care Inpatient and Short Stay Units

Practice Level

Basic Skill: RN, RPN, LPN

Requirements

- A provider's order is required for a patient to use their own Continuous Subcutaneous Insulin Infusion (CSII) pump while in hospital.
- Patient must be able to independently manage their own CSII pump.
- This guideline applies to any adult patient (age 17 and older) admitted using their own CSII pump to manage diabetes.
- If there is no access to a provider or Certified Diabetes Educator (CDE) who has experience with CSII pumps and patient is able to manage their own CSII pump and make adjustments to doses they may continue use until any item on the Exclusion Criteria surfaces.

Need to Know

- A consultation **should** be made to (if available at your site):
    - An on call Endocrinologist (preferred), OR an Internist who is familiar with pump therapy.
    - Inpatient Diabetes Nurse or CDE if available at your site.
    - Inpatient Registered Dietitian (RD).
    - Occupational Therapist (OT - optional), who can assist with cognitive assessment.
- A CSII pump is a small device (similar in size to a pager) which is programmed to deliver rapid acting insulin at varying rates and boluses based on the patient's own insulin pump settings and/or automated insulin delivery if using a Hybrid Closed Loop System. The insulin is infused through a very fine cannula, usually made of Teflon, or less commonly, in a steel cannula inserted under the skin. See Appendix A for examples
- There are generally two types of CSII pumps available:
    - Tubing (Medtronic, Ypsomed, Tandem) with a changeable battery in re-usable pump.
    - Non-tubing that have a pod and a personal data manager (PDM) (Omnipod) with internal battery that is disposed of with each "Pod" change (entire Pod is discarded).

- CSII pumps contain only rapid acting insulin (e.g. Humalog, Novorapid, Admelog, Trurapi, Apidra).
- The CSII pump is programmed to deliver insulin at a pre-programmed basal dose rate based on the person's insulin needs. There are two methods of delivering basal rate:
    - Programmed basal rates, which can vary based on the time of day (e.g. between 0000hr to 0300hr = 0.5 units per hour; 0300hr to 1000hr = 0.7 units per hour, etc.).
    - Hybrid Closed Loop System: Basal rates are automatically adjusted based on individual glucose response (e.g. Automode, IQ Basal). These complex algorithms adjust the basal rate in response to information relayed to the CSII pump from the Continuous Glucose Monitor (e.g. Dexcom G6, Medtronic Guardian 3).
- Current CSII pumps allows the person to take a bolus dose of insulin at meal time and/or to correct a high blood glucose. Future CSII pumps may have the ability to automatically deliver bolus doses as well.
- Most infusion sites should be changed every 3 days (every 2 days in people who are pregnant). There are some 7 day infusion sets so patient should follow company's recommended guidelines. Patient manages own infusion site and reservoir site changes.
- The CSII pump may need to be removed or covered with a lead shield in certain Medical Imaging tests. See Appendix C Medical Imaging Tests List for instructions on which tests the CSII pump needs to be removed or covered with lead apron. See:
    - Appendix D: Removing Omnipod CSII pump (no tubing).
    - Appendix E: Temporary Discontinuation of CSII pump with tubing and Resuming Operation of Medtronic, Ypsomed, Tandem CSII pump with tubing.
- If CSII pump has tubing, patient to temporarily disconnect the pump from the tubing for Medical Imaging procedures and leave pump outside the procedure room. See Appendix E: Temporary Disconnection of CSII pump with tubing.
    - Non-tubing pods need to be completely removed and a new pod inserted post procedure as exposure to x-rays and high electromagnetic interference can damage the CSII pump. See Appendix D: Removing Omnipod CSII pump.
- For patients scheduled for short operative procedures, discuss with Anesthesia whether to remove CSII pump. See Patient Initiation Of External CSII Pump Therapy.
- An interruption in insulin delivery for more than two (2) hours can lead to severe hyperglycemia and diabetic ketoacidosis (DKA). Disconnection from the CSII pump for more than one (1) hour requires the patient to have an alternative delivery for insulin (e.g. subcutaneous injection, insulin infusion).
- **Bathing:** The CSII tubing pump is waterproof, but patients often disconnect their pump at the infusion site for bathing. Non-tubing pods are fully waterproof and do not need to be removed.
- Health Care Providers (HCPs) with no training in CSII pumps (e.g. bedside clinician) at PHC and VCH are not expected to have ongoing extensive knowledge and expertise related to specific programming and operation of CSII pumps. If the patient is not able manage the CSII pump themselves, HCP may:

- Disconnect the infusion set from the infusion site for Medical Imaging tests.
- Remove infusion set completely if switching to subcutaneous or intravenous insulin pump therapy (and patient is not able to manage removal on their own).

Inclusion Criteria

CSII pumps are appropriate for inpatients who:

- Are alert and oriented to person, place and otherwise cognitively intact (consult provider or OT for assessment if needed).
- Have the physical dexterity and vision to be able to operate their own CSII pump.
- Are able to provide all their own supplies required to operate the CSII pump. Insulin can be provided by ordering the appropriate type in 10 mL vials in Cerner.
- Are able to self-manage their own CSII pump and make adjustments to doses even if there is no access to a provider or CDE.

Exclusion criteria

Do not use the patient's own CSII pump when patient is/has:

- Admitted with Diabetic Ketoacidosis (DKA).
- Admitted to critical care.
- An altered state of consciousness or any cognitive impairment (short or long-term). Consult provider or OT for assessment, as needed).
- Receiving medication that alter one's state of consciousness.
- An altered visual acuity (unable to properly read the pump screens and device buttons).
- At risk for self harm.
- A CSII pump that is not working properly (as evidence by alarms, or rising blood glucose).
- Not enough appropriate supplies for the CSII pump.

Equipment and Supplies

- The following MUST be provided by the patient:
  - CSII pump.
  - Reservoirs for the insulin.
  - Infusion sets.
  - Dressings (if needed).
  - Extra batteries for the CSII pump.
  - **Note:** If patient is unable to supply insulin, a supply (vial) may be obtained from some inpatient pharmacies. There may be instances when the inpatient pharmacy may not be able to supply the patient's specific type of insulin.
- If the patient runs out of supplies for CSII pump:

- The CSII pump may NOT be used if supplies are not available (once supplies available, can restart CSII pump under above inclusion criteria).
- The CSII pump must be removed.
- The provider must be notified that alternative insulin orders are needed.
- **Note:** None of the Diabetes Health Clinics or in-patient Diabetes Educators provide extra CSII pump supplies at any site. These are very individualized supplies and are specific to the patient's needs.

Guideline

Consults for Management of Patient's CSII Pump Therapy

- In addition to the Endocrinologist or Internist, consult the inpatient Diabetes Nurse Clinician (where available). Indicate reason for consult is "Insulin Pump Management".
- Inpatient RD provides nutritional therapy and counselling that considers the culture and nutritional preferences to achieve glycemic targets, as indicated.
- If none of these consultants are available, discuss with patient's provider whether the CSII pump should remain on. Consult provider to order insulin doses.

Patient Initiation of CSII Pump Therapy

Provider

- The consulting provider assesses the patient based on the inclusion and exclusion criteria.
- If the patient is alert and there are no contraindications to use (see Inclusion Criteria and Exclusion Criteria above), the patient may continue to use CSII pump with a provider's orders. Orders include:
  - Type of insulin to be used.
  - Basal rate(s), if applicable (not applicable in hybrid closed loop systems).
  - Dosage for bolus doses for hyperglycemia and meals (patient may use the CSII pump bolus dosage calculator which calculates bolus dose based on glucose reading, insulin sensitivity factors, correction ratios).
  - Blood glucose testing times and when the Nurse is to be notified.
  - intermittent scan continuous glucose monitor (isCGM) or real time continuous glucose monitor (rtCGM) or capillary blood glucose (CBG) and when the nurse is to be notified (e.g. CBG or CGM result QID, AC and HS).
  - Patient's individual glucose targets.
  - Patient's admission pump settings (not applicable in hybrid closed loop systems).

Nurse

- The nurse is responsible for communicating CSII plan of care to patient (see below).
- The nurse asks the patient if they have the ability to test own glucose levels using either:

- Blood glucose meter compatible with patient's own CSII pump (some pumps require a specific blood glucose meter to be used). In this case, the patient will test own CBG using own blood glucose meter.
- rtCGM (e.g. Dexcom G6, Medtronic Guardian 3).
- isCGM (e.g. Freestyle Libre 2).

If patient does not have supplies for devices mentioned above, provider writes orders to revert to hospital glucose meter.

- If patient using own CBG meter or CGM, a venous blood glucose should be sent to the lab on admission to confirm accuracy. Home device should be within 20% of the venous blood sample
- The nurse notifies the patient of any venous blood glucose test results. Patient adjusts CSII pump settings according to provider's orders.
- If the patient has two (2) consecutive glucose readings greater than 14 mmol/L (Diabetes Canada recommendations) 4 hours apart, discuss with provider need to send blood for ketones stat. **Note**: CST Cerner PowerPlan for Hyperglycemia states threshold greater than 20 mmol/L. It is suggested to follow Diabetes Canada recommendations of greater than 14 mmol/L.
- Approved infusion sites for insulin pumps are: abdomen, upper buttocks, hips, upper arms, upper thighs. These include Medtronic, Tandem and Omnipod and Ypsomed insulin pumps. See Appendix G: Approved sites for Continuous Glucose Monitors.

Patient

- Patient reports any glucose results taken from a home CBG or CGM device each time result obtained.
- Patient may use own CSII pump for insulin delivery. Patient programs the basal rate(s) and bolus dosages in the pump per provider's orders.
- If using a hybrid closed loop CSII pump/continuous glucose monitor system, patient programs bolus dosages only, as CSII pump adjusts basal rates according to patient's fluctuating glucose levels. The patient may use the CSII pump bolus calculators to deliver bolus dose appropriate for their individual needs.
- Patient is responsible for rotating the infusion site (or pod), changing the infusion set or pod and filling a new reservoir with insulin at least every three (3) days (every two [2] days if pregnant).
  - **Note**: Some infusion sites are approved for a seven-day wear time. Follow the individual company's recommended change intervals.
- The infusion site will need to be changed more frequently than two (2) to three (3) days (or longer if approved) if:
  - There are signs of site infection (e.g. redness, swelling, heat, pain).
  - There is bleeding at the site or blood is backing up in the tubing.
  - There is a "No Delivery" alarm in the pump.
  - The patient has two (2) consecutive glucose readings greater than 14 mmol/L (Diabetes Canada recommendations), four (4) hours apart. See above instructions under "Nurse" for direction. Hyperglycemia may be an indication of infusion set or pump failure.

- There is the smell of insulin or it is wet around the infusion site.

- The patient changes the infusion site and reports to the nurse:
  - Reason(s) the infusion set was changed:
    - Routine infusion set change.
    - Signs of infection (e.g., redness, swelling, heat, pain).
    - Bleeding at the site or blood backing up in the tubing.
    - There is a "No Delivery" alarm in the pump.
    - The patient has two (2) consecutive glucose readings greater than 14 mmol/L, 4 hours apart and patient is concerned that the pump is not delivering insulin.
    - Insulin via CSII has been stopped.
    - There is the smell of insulin or it is wet around the infusion site.

Reasons to stop a CSII pump

- Nurse contacts the provider to assess for CSII pump therapy discontinuation if the patient:
  - Is admitted with diabetic ketoacidosis (DKA).
  - Is admitted or transferred to a critical care unit/higher level of care.
  - Has an altered state of consciousness and/or behaviour that impacts the ability to self-manage the CSII pump.
  - Has onset of altered visual acuity (unable to properly read the pump screens and device buttons).
  - Is not able to physically push buttons on CSII pump.
  - Is assessed as being at risk for self-harm.
  - Does not have a pump that is operating properly.
  - Does not have the appropriate supplies for the CSII pump.
- If CSII pump is discontinued, provider is to provide alternative insulin orders.

How to remove CSII pump

- **For Omnipod CSII pump (pump with no tubing):** The patient (nurse may assist if needed) is to remove the pod from their skin. See Appendix C: Removing Omnipod CSII pump (no tubing). Pod is single use and cannot be reinserted.
- Nurse ensures CSII pump is stored in a locked, secure location or given to family or caregiver for safekeeping. Document on appropriate Valuables Record (PowerForm) in Cerner or paper form.
- **For Medtronic, Ypsomed and Tandem CSII pump (pumps with tubing):** Patient disconnects the infusion set from the pump**.** See Appendix E: Temporary Discontinuation of CSII pump with tubing.
- Nurse documents discontinuation of CSII pump and rationale for discontinuation in a narrative note.

Temporary Discontinuation of CSII Pump

Refer to Appendix C: Removing Omnipod CSII pump (no tubing) and Appendix E: Temporary Discontinuation of CSII pump with tubing.

There are times when the CSII pump needs to be temporarily discontinued to protect the pump from high frequency energy of certain tests. See Appendix B: Medical Imaging Tests List.

- Instructions for temporary discontinuation of the CSII pump for less than one (1) hour, such as during shower/bath or any procedure where the CSII pump might get wet (some pumps are not reliably waterproof or patient prefers not to take a risk) include:
    - Patient suspends and disconnects CSII pump from infusion set. See Appendix E: Temporary Discontinuation of CSII pump with tubing for steps.
    - Infusion set remains attached to patient's skin.
    - When the procedure or shower/bath is complete, the patient may reconnect the CSII pump to the infusion set and resume CSII pump therapy. See Appendix E: Resuming Operation of Medtronic, Ypsomed, Tandem CSII pump.
    - Nurse documents the time the CSII pump was suspended and resumed in the MAR.
- **Note:** Patient can continue to wear pod pump, as it is waterproof.
- **Note:** Infusion sets are all waterproof, so there is no need to remove from patient's skin.
- For temporary discontinuation from the CSII pump for more than one (1) hour, such as any test listed in Appendix B: Medical Imaging Tests:
    - Contact provider for alternative insulin orders.
    - Temporarily disconnect the CSII pump from the patient. Can leave infusion set in situ (must remove entire pod, as they are one unit).
- Patient can reconnect CSII pump and insulin therapy can be restarted after the procedure as per original provider's orders with previously prescribed insulin settings unless changed by provider.

Troubleshooting:

Appendix F: Troubleshooting for unexplained hyperglycemia.

Documentation

Each shift, the Nurse documents the following in Cerner PowerChart or site-specific documentation tools:

- Type of insulin in CSII.
- Bolus doses given by patient: See Appendix H.
- CSII pump is working.
- Times CSII pump was suspended and restarted.
- Site appearance.
- Endocrinologist and/or in patient Diabetes Nurse consult entered in Cerner (where applicable).
- CBG or CGM results (in iView narrative note).

- Reasons the infusion set was changed:
  - Routine infusion set change.
  - Signs of infection (e.g., redness, swelling, heat, pain).
  - Bleeding at the site or blood backing up in the tubing.
  - There is a "No Delivery" alarm in the pump.
  - The patient has two (2) consecutive glucose readings greater than 14 mmol/L, 4 hours apart**.** If so, send blood to check for ketones and the patient is concerned the pump is not delivering insulin.
  - Insulin via CSII has been stopped.
  - There is the smell of insulin or it is wet around the infusion site.
- Time when provider was informed and information provided to them.
- Cerner documentation:
  - In iView under "adult lines – devices," add the subcutaneous catheter. Document site assessment and other infusion related activities here.
  - Add a note in the Situational Awareness and Planning stating that patient is managing own insulin infusion (subcutaneous) with own pump.

Patient and Family Education

- Explain processes of pump management in hospital to patient and family.
- Patient is expected to provide all supplies for own insulin pump, as the hospital does not carry the supplies.
- Patient is expected to manage own insulin pump independently and to work collaboratively with provider regarding insulin dosing regimen.
- Patient is responsible for immediately notifying the Nurse if insulin pump is malfunctioning.
- Patient may be asked to remove insulin pump in certain circumstances (e.g. medical imaging, going to the operating room, or if patient too unwell to manage pump independently) and revert to subcutaneous or IV infusion of insulin to control blood glucose.

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Definitions

Basal rate: CSII pumps deliver small amounts of insulin in a continuous fashion (to mimic the natural action of a working pancreas). This continuous background insulin is measured in units/h. Rates are variable, differ between individuals, and differ across a 24-hour period for the same individual. **Only rapid acting insulin is used in the pump.**

Bolus dose: the amount of insulin given for a meal or snack. The patient determines the dose based on the estimated amount of carbohydrates they will eat for that meal/snack and calculates the dose in collaboration with the patient's healthcare team. This is also called, "Insulin to Carbohydrate Ratio (ICR)" (e.g., ICR 1:10 = 1 unit of insulin for every 10 g carbohydrate).

Continuous Glucose Monitoring (CGM): There are two major types of CGM (real time CGM (rtCGM) or intermittent scan CGM/Flash (isCGM). Health Canada approved devices available without a prescription. These devices provide real-time measurements of glucose levels, with glucose levels displayed at one (1) to five (5) minute intervals. Dexcom G6 and Medtronic Guardian 3 are the two systems available in Canada.

Continuous subcutaneous insulin infusion (CSII) pump: a device to provide administration of insulin under the skin continuously with an infusion pump connected to a flexible filament or in less common cases, a needle (e.g., Sure-T) inserted beneath the epidermis.

Hybrid Closed Loop System: pump is integrated with CGM. This technology is rapidly growing and changing. The artificial intelligence algorithms use the data from CG to automatically adjust basal insulin

without the user's action. The user determines bolus insulin. Some manufacturers have Health Canada approved devices.

Personal Diabetes Manager (PDM): the Omnipod DASH insulin management system is made up of the wearable and tubeless pump, which delivers the insulin (called the pod), and the remote controller is called the Personal Diabetes Manager.

Appendices

Appendix A: Examples of Continuous Subcutaneous Insulin Infusion (CSII) Pumps.

Appendix B: Continuous Glucose Monitors.

Appendix C: Medical Imaging Tests List.

Appendix D: Removing Omnipod CSII pump (no tubing).

Appendix E: Temporary Disconnection of CSII pump with tubing and Resuming Operation of Medtronic, Ypsomed, Tandem CSII pump with tubing.

Appendix F: Troubleshooting for unexplained hyperglycemia.

Appendix G: for approved sites for continuous glucose monitors (isCGM and rtCGM).

Appendix H: documenting of bolus doses in MAR

Appendix A: Examples of Continuous Subcutaneous Insulin Infusion (CSII) Pumps

CSII Pumps with Tubing

Medtronic CSII pump and infusion set	
Ypsomed CSII pump and infusion set	
Tandem CSII pump and infusion set	

CSII pumps with no tubing

Omnipod CSII pump and pod	

Appendix B: Continuous Glucose Monitors

Real Time Continuous Glucose Monitors (rtCGM)

Dexcom G6	Medtronic Guardian 3
	

Example of Intermittent Scan Continuous Glucose Monitor (isCGM)

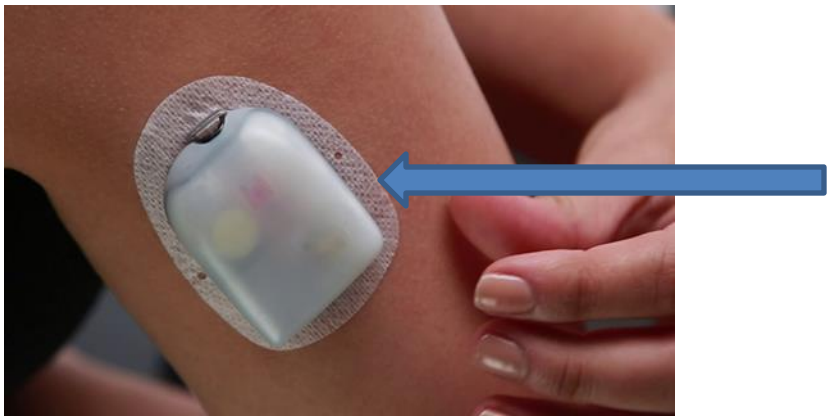
Freestyle Libre/Libre 2	

Appendix C: Medical Imaging Tests List

Criteria for when a CSII pump may need to be removed prior to a Medical Imaging test:

Medical Imaging Tests List
Suspend the CSII pump and patient disconnects and locks pump outside testing room for the following tests (for pumps with tubing): **Note: if wearing an Omnipod pump, entire pod must be removed at the infusion site. The Personal Diabetes Manager (PDM) is placed outside the testing area.** **If wearing an infusion set with metal cannula, must remove entire insertion device.** **Remove insulin pump for the following tests:** • MRI • CT Scan • Nuclear Medicine-SPECT-CT • Bone Density Whole Body Bone Composition • Bone Density (lumbar spine, hips, forearms), Consult Bone Density Department before scheduling procedure to assess location of rtCGM and determine if device should be removed or if it can remain on and lead shielding completely covering device applied) **Insulin pump can remain on and lead shielding that completely covers the device must be worn during procedures which use lower doses of ionizing radiation (remove if test site directly over Omnipod insulin pump. Can leave infusion sets on pumps using tubing system):** • x-ray: stationary, including mobile imaging and mammography • body x-ray/fluoroscopy (any department using fluoroscopy, including the large mobile c-arms and the mini mobile c-arms) E.g. operating rooms, interventional radiology, cath Lab, electrophysiology lab, barium x-rays, urinary x-rays, arthrography, spinal blocks, endoscopy, colonoscopy, bronchoscopy • electrophysiology (pacemaker/automated implantable cardioverter defibrillator (AICD) placement or reprogram) • bone density lumbar spine, hips, forearms (see directions in section above) **Insulin pump can remain on and no lead shielding required:** • surgeries, procedures and scope without ionizing radiation • ECG / EEG • laser surgery • ultrasound • nuclear medicine with NO CT for attenuation correction or diagnostic

Appendix D: Removing Omnipod CSII pump (no tubing)



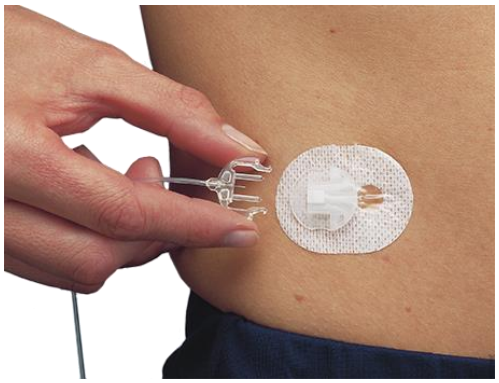
Peel up tape around outside of pod and pull pod away from skin.

There is a flexible filament under the skin, not a needle so can pull in any direction

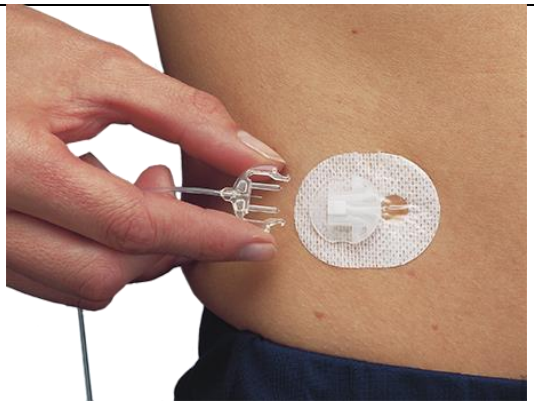
A new pod must be filled with insulin and reinserted once patient is ready to resume using CSII pump. The pods are not reusable. Patient will be responsible for inserting new pod and setting up. Patient will either have a Personal Diabetes Manager (PDM) or the pod will link to their cell phone (Omnipod DASH).

Appendix E: Temporary Disconnection of CSII pump with tubing

Removing Medtronic, Tandem, Ypsomed CSII pump

Pinch clips on each side of infusion set with your thumb and forefinger. Pull away from infusion set. Place tubing clip inside a 4x4 sterile gauze pad or sterile bandage package to keep clean. Patient can temporarily suspend CSII pump so insulin flow is stopped.	

Resuming Operation of Medtronic, Ypsomed, Tandem CSII pump with tubing

Pinch clips on each side of infusion set with your thumb and forefinger. Line up clips with infusion set and push to connect. Patient to resume insulin delivery.	

Appendix F: Trouble shooting for unexplained hyperglycemia

If glucose results are outside the acceptable range, it may be necessary to reassess CSII pump function or the patient's ability to self-manage the CSII pump. Patients knowledgeable in problem solving approaches, which can include:

- Checking infusion site and tubing for any kinks, blockages.
- Checking for the smell of insulin or it is wet around the infusion site.
- Assessing for signs of infection (e.g redness, swelling, heat, pain).
- Checking for bleeding at the site or blood backing up in the tubing.
- Checking pump for "no delivery" alarm.
- Checking if pump is suspended.
- May need to use new vial of insulin and reload reservoir.
- If patient has two (2) consecutive glucose readings greater than 14 mmol/L, patient removes infusion set/pod and provides insulin via subcutaneous injection. See Equipment and supplies on p.3. Call provider for subcutaneous insulin orders. Consider checking for urine or blood ketones.

Patient may reinsert new infusion set/pod if hyperglycemia resolves and patient demonstrates self-management of CSII pump.

Appendix G: approved sites for rtCGM and isCGM devices

Continuous Glucose Monitor	Type	Approved sites
Dexcom G6	rtCGM	• **18 years and older:** abdomen and back of upper arm • **2 to 17 years:** abdomen, back of upper arm, upper buttocks
Medtronic Guardian 3	rtCGM	• **7 to 13 years:** abdomen and upper buttocks • **14 years and older:** abdomen and back of upper arm
Freestyle Libre2	isCGM	• **4 years and older:** back of upper arm

Appendix H: documenting bolus doses given by patient

Bolus doses given by the patient must be recorded in the MAR. Document under “non-formulary medication alert”

See: Cerner Help topic for more details

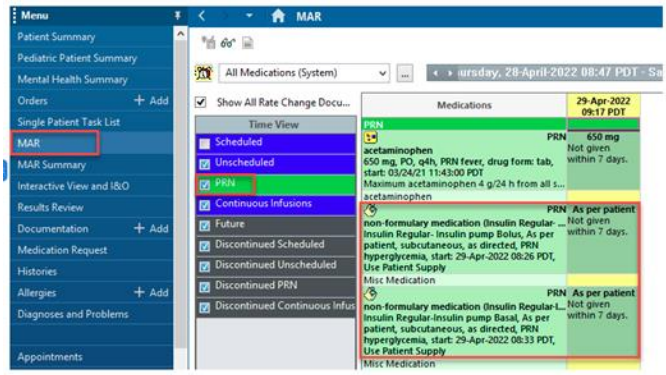
Order and Documentation of Insulin Pump Use

Patients who use an insulin pump to manage their diabetes may qualify to do so while in hospital. Providers are responsible for ordering this into CST Cerner using non formulary medication orders. Nurses are responsible for documenting self-administered medications (i.e. insulin) on the MAR.

Provider Steps - Order the Bolus / Basal doses

Nursing Documentation Steps

The nurse is responsible for documenting all self-administered medication (i.e. insulin) on the **MAR**



1. From within the patient chart, after reviewing the **MAR** navigate to **Medication Administration** window (MAW).

A **Warning** displays for the freetext dose

First Released Date:	08-NOV-2023	
Posted Date:	08-NOV-2023	
Last Revised:	08-NOV-2023	
Last Reviewed:	08-NOV-2023	
Review Due By:	08-NOV-2026	
Approved By: *(committee or position)*	PHC	VCH
	PHC Professional Practice Standards Committee	VCH: (Regional DST Endorsement - 2nd Reading) Health Authority & Area Specific Interprofessional Advisory Council Chairs (HA/AIAC) Operations Directors Professional Practice Directors Final Sign Off: Vice President, Professional Practice & Chief Clinical Information Officer, VCH
Owners: *(optional)*	PHC	VCH
	Diabetes Clinical Nurse Specialist, Medicine, Vancouver, Acute care, PHC	