

# Cerebrospinal Fluid, Care & Management of the patient with Lumbar Drainage System using the Alaris Infusion Pump

## Site Applicability

**VGH:** Neurosciences, ICU, Acute Spine Unit

**SPH:** Post-anesthetic care Unit (PACU) and High Acuity Unit (HAU)

## Practice Level

**VGH:** RN: Advanced Skill

- May be performed by RNs in Neurosciences, ICU, Acute Spine Unit and in other areas with support from Neurosciences and with approval from Patient Services Manager (PSM).

**SPH:** Critical care nurses in PACU and HAU

## Policy Statements

- Ordered by Neurosurgery or Spine Services at VGH only
- Ordered by ENT (ear, nose, throat) doctors at SPH only
- No infusions are to be administered via the Alaris infusion pump being used to drain cerebrospinal Fluid.
- Drainage set up and all pump programming requires and independent double check to be completed by two RNs

## Need to Know

**When completing lumbar drain set up, priming, flushing, CSF sample taking and bag changes strict aseptic-sterile technique must be followed.**

**NOTE:** \*\*\*nurses at SPH are not permitted to obtain CSF samples\*\*\*

## Background Information:

### Cerebral Spinal Fluid (CSF):

"Cerebrospinal fluid is the fluid that bathes the brain and spinal cord, allowing the brain to "float", thus cushioning the central nervous system from minor injury. CSF also has a role in homeostasis

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regulation, as it is able to remove toxins and metabolites.” (Tymianski, D., Sarro, A., & Green, T., Ed. 2012, pg.191). CSF is secreted from the choroid plexus of the lateral, 3rd and 4th ventricles at a rate of approximately 20 mL per hour. It is reabsorbed by the subarachnoid villi allowing for a circulating volume of between 125 to 150 mL. Under normal circumstances the volume maintained in the lateral ventricles is approximately 20 mL. Drainage of CSF can assist in maintaining normal ICP.

**Hydrocephalus:**

There are two types of hydrocephalus: Communicating and obstructive (formerly called non-communicating hydrocephalus).

Communicating hydrocephalus is a condition that occurs when there is an imbalance between production and absorption of CSF resulting in dilation of the ventricles. A lumbar drain is used to decrease pressure caused by increased volumes of CSF in the brain.

Obstructive hydrocephalus is due to an obstruction or barrier within the internal CSF pathways. A lumbar drain would not be used for obstructive hydrocephalus.

**CSF Leak:**

Early recognition and effective treatment of cerebrospinal fluid rhinorrhea and/or otorrhea is of particular importance in the prevention of meningitis or pneumocephalus. CSF leaks generally arise from congenital or acquired causes, the latter referring to traumatic or non-traumatic causes. A patient presenting with evidence of a basal skull fracture (either bruising around the eyes or behind the ear), or extensive surgical procedures involving the pituitary and skull-base regions, should be considered at significant risk for a CSF leak. Nursing care of the patient experiencing a CSF leak focuses on the identification of patients at risk for leakage, assessment for CSF leakage, and interventions aimed at reducing or managing the leakage. Treatment for CSF rhinorrhea/otorrhea includes close monitoring, a lumbar spinal subarachnoid drain and/or surgical repair, and is determined by its cause, location, and time of onset.

**Monroe Kellie Doctrine:**

The Monroe Kellie doctrine states that the skull is a rigid box that is comprised of three components; brain tissue, blood and cerebrospinal fluid. Normally the volumes of these components are in homeostasis and the pressure within the skull is constantly maintained within normal pressure limits of between 10 to 15 mmHg. An increase in volume in any one of these components must result in a decrease in one or both of the other components in order for the intracranial pressure (ICP) to remain static. Even a small increase in one component may result in a detrimental increase in ICP. Intracranial hypertension occurs when the ICP remains greater than 25 mmHg for longer than 5 minutes. Sustained increased ICP may result in global cerebral ischemia and herniation syndromes which could lead to unfavorable neurological outcome and/or death.

**Lumbar Drain with Alaris Infusion Pump:**

Two main indications for a lumbar drain are treatment of communicating hydrocephalus and traumatic CSF leaks, either from fractures or operative procedures. Having the lumbar drain in place to reduce the pressure in the intracranial and intraspinal CSF compartments allows for management of hydrocephalus as well as potential closure of the CSF leak site.

External drainage of CSF can be implemented using an Alaris infusion pump whereby the pump is utilized to control CSF drainage versus leveling the drainage bag above, at, or below the patient's zero reference point. The use of the lumbar drainage system with an Alaris infusion pump helps to regulate the drainage of CSF volume on a continuous basis. This in turn helps prevent the potential and serious complication of herniation which can occur with communicating hydrocephalus (not with a CSF leak). Also, this system allows the patient greater freedom in movement, as there is no need to keep their head in a fixed relationship to the drainage bag.

## Procedure

### A. Priming and Setting up of the Alaris Infusion Pump for use as a Lumbar Drain System

#### Equipment and Supplies

- Alaris infusion pump
- Spinal catheter (in patient)
- Sterile dressing tray
- Sterile gloves
- Mask
- Two x 10 mL NS sterile pre-filled syringes
- Positive pressure cap
- Medtronic drainage bag (see [Appendix A](#))
- Alaris Latex-Free Half Set IV Tubing (see [Appendix A](#))
- Medtronic EDM Line Assembly kit (see [Appendix A](#))
- Two TINTED 2% chlorhexidine/70% isopropyl alcohol swabs

#### Procedure

*An independent double check (IDC) by 2 nurses is required to confirm the correct set up, prior to initiation of the CSF drainage.*

1. Cleanse over-bed table with approved surface cleaner and perform hand hygiene.
2. Don mask and set up sterile dressing tray. Using aseptic technique, add to dressing tray:
  - a. Alaris Latex-Free Half set

- b. Medtronic EDM Line Assembly kit
  - c. Two Sterile 10 mL pre-filled Normal Saline syringes (paper packaging)
  - d. Positive pressure cap
  - e. Medtronic Drainage Bag
  - f. Two tinted Chlorhexidine/alcohol swabs
3. Perform hand hygiene.
4. Put on sterile gloves.
5. Attach the long end of the EDM line to the short end of the Alaris Half Set ensuring a tight fit – see [Appendix B](#).
6. Attach the long end of the Alaris Half Set (side with the roller clamp) to the Medtronic drainage bag ensuring a tight fit – see [Appendix B](#).
7. Remove the needle injection port from the EDM stopcock and attach the positive pressure cap, ensuring a tight fit - see [Appendix B](#).
8. Flush the set-up by attaching the NS filled syringes to the positive pressure cap on the stopcock. Ensure that you flush/prime the short section of the EDM line (blue striped end) as well as the rest of the line. The system only needs to be flushed past the air sensor (blue section) in the Alaris Half Set tubing (approximately 15-20 mL). Flush slowly and smoothly to decrease the amount of bubbles created in the system.
9. Ensure lines and drainage bag remain on sterile field until attached to patient's lumbar drain.
10. Maintaining aseptic technique, cleanse the white cap of the lumbar catheter with one of the tinted chlorhexidine/alcohol swabs.
11. Allow to dry for 30 to 60 seconds.
12. Repeat cleansing and drying procedure a second time with the second tinted chlorhexidine/alcohol swab.
13. Remove white cap from lumbar catheter and attach to the short end (blue striped end) of the EDM line, ensuring a tight fit.
14. Turn stopcock off to the positive pressure cap and place the Alaris tubing set into the Alaris infusion pump in the normal manner.
15. Complete labelling of the lines and pump module:
  - a. Label pump module as "CSF drain" with pink waterproof tape at the front - top of the module see - [Appendix B](#).
  - b. Cover the injection port (close to the drainage bag) with pink waterproof tape to prevent confusion with IV lines/ports – see [Appendix B](#).
  - c. Label CSF drain line pink waterproof tape as "CSF drain" in between the pump and patient – see [Appendix B](#).
16. Complete independent double check to ensure proper set up and labeling.

**Programming the pump:**

*An independent double check (IDC) by 2 nurses is required to confirm the correct programming, prior to initiation of the CSF drainage.*

1. Turn pump on and enter patient information: Select general/adult profile and enter patient's MRN
2. Press CHANNEL SELECT for the lumbar drain module, then press BASIC INFUSION.
3. Set RATE at the amount of CSF to be drawn from the patient hourly as per order.
4. Set TOTAL VOLUME TO BE INFUSED for volume of CSF to be removed over a 12-hour shift, i.e. if the rate is set at 7 mL/hr, then  $7 \text{ mL} \times 12 \text{ hours} = 84 \text{ mL}$  to be 'infused' (or drawn off) over 12 hours.
5. Complete independent double check for programming.
6. Press START for the system to begin to drain the patient's CSF at the set rate per hour.
7. Refer to the physician's orders for the patient's mobility and HOB orders.
8. Ensure that there is only one module running on the pump.

**B. Obtaining Cerebrospinal Fluid Samples from the Alaris Infusion Pump Lumbar Drain System (VCH ONLY)**

**Obtain CSF samples as ordered. Each CSF sample requires 1 mL. If total volume of samples requires more than 3 mL obtain an additional order to ensure it is approved by the physician to remove this additional volume of CSF from the patient.**

**Equipment and Supplies**

- Dressing tray
- One 3 mL luer lock syringe
- Two or three sterile CSF collection tubes (three if protein and glucose sample to be sent with initial sample)
- Mask
- Sterile gloves
- Two tinted 2% chlorhexidine/70% isopropyl alcohol swabs

**Procedure**

1. Cleanse over-bed table with approved surface cleaner and wash hands.
2. Put the Alaris infusion pump in standby mode.
3. To allow withdrawal of CSF, turn the stopcock off to the Alaris infusion pump.
4. Don mask and set up dressing tray. Add to dressing tray:

- a. 3 mL syringe
  - b. two Chlorhexidine/alcohol swabs
5. Wash hands.
6. Don sterile gloves.
7. Cleanse positive pressure cap and surrounding area with one of the tinted Chlorhexidine/alcohol swabs.
8. Allow to dry 30 to 60 seconds.
9. Repeat cleansing and drying procedure a second time with the second Chlorhexidine/alcohol swab.
10. Attach 3 mL luer lock syringe to positive pressure cap on sample port.
11. Slowly aspirate 2 to 3 mL of cerebrospinal fluid from the positive pressure cap.
12. Return sample port and stopcock to original pre-sample settings (i.e. open to patient and to Alaris infusion pump and off to sample port).
13. Take off syringe.
14. Place the lumbar drain Alaris infusion pump to pre-existing settings by pressing the appropriate CHANNEL SELECT button and then press restore.
15. Separate CSF into separate sterile containers as required for each test; 1mL minimum for each test required.

**\*\*\* Remember – CSF must be sent via messenger / porter by the Transport Tracking System, not through the pneumatic tube system. \*\*\***

### C. Flushing the Lumbar Drain System

Flushing of the lumbar drain system may be required when there is an obstruction in the line, or air bubbles are present.

The lumbar drain system should only be flushed toward the collection bag, and never towards/into the patient.

#### Equipment and Supplies



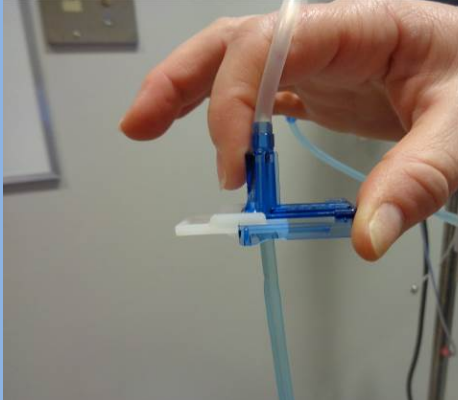

- Dressing tray
- Mask
- Sterile gloves
- Two tinted 2% chlorhexidine/70% isopropyl alcohol swabs
- Two Sterile 10 mL pre-filled Normal Saline syringes (paper packaging)

#### Procedure

1. Cleanse over-bed table with approved surface cleaner and wash hands.

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2. Put the Alaris infusion pump in standby mode and turn stopcock off to patient.
3. Open the IV pump door latch, and remove tubing from the pump.
4. Disengage clamp (see diagram below).
5. Don mask and set up dressing tray. Add to dressing tray:
  - a. two Chlorhexidine/alcohol swabs
  - b. two sterile NS syringes
6. Wash hands.
7. Don sterile gloves.
8. Cleanse positive pressure cap and surrounding area with one of the tinted Chlorhexidine/alcohol swabs.
9. Allow to dry 30 to 60 seconds.
10. Repeat cleansing and drying procedure a second time with the second Chlorhexidine/alcohol swab.
11. Attach a 10mL pre-filled NS syringe to the positive pressure cap – double check that the stopcock is turned off to the patient.
12. Flush towards the bag, slowly and smoothly to decrease the amount of bubbles created in the system.
  - a. If air bubbles are noted in the system, ensure that all air bubbles are flushed past the air sensor in the Alaris infusion pump.
13. Take off syringe.
14. Turn stop cock off to pressure cap.
15. Place the lumbar drain Alaris infusion pump to pre-existing settings by pressing the appropriate CHANNEL SELECT button and then press restore.

<b>IV Set Inside of Alaris pump</b>		<b>Engaged Clamp</b>	
<b>Press on blue upper tab</b>		<b>Disengaged Clamp</b>	

#### D. Changing the System Collection Bag

***Change the collection bag when it is approximately 2/3 full (approximately 300 – 400mL), or as a troubleshooting measure as outlined in the complications section.***

##### Equipment and Supplies

- Dressing tray
- New sterile Collection Bag
- Mask
- Sterile gloves
- Two tinted 2% chlorhexidine/70% isopropyl alcohol swabs
- Red dead-end

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**Procedure**

1. Cleanse over-bed table with approved surface cleaner and wash hands.
2. Put the Alaris–IV pump in standby mode and turn stopcock off to patient.
3. Don mask and set up dressing tray. Add to dressing try:
  - a. the sterile collection bag
  - b. two Chlorhexidine/alcohol swabs
4. Wash hands.
5. Don sterile gloves.
6. Using one of the Chlorhexidine/alcohol swabs, cleanse the connection port where the Alaris half set is connected to the bag.
7. Allow to dry 30 to 60 seconds.
8. Repeat cleansing and drying procedure a second time with the second Chlorhexidine/alcohol swab.
9. Disconnect collection bag, place red dead-ender on open port of the full drainage bag.
10. Connect new collection bag to lumbar drain.
11. Turn stopcock back to original position (off to sample port).
12. Place the lumbar drain Alaris infusion pump to pre-existing settings by pressing CHANNEL SELECT button on the pump module and then press restore.
13. Discard sealed collection bag in the approved Blood and Body Fluids (biohazard) container on unit.

## POTENTIAL COMPLICATIONS

Unexpected Outcomes	Interventions
<b>Localized infection</b> related to the presence of an invasive lumbar spinal subarachnoid drain.	<ul style="list-style-type: none"> <li>Assess the insertion site Q4H, note any drainage from site or redness at site and notify physician.</li> <li>Note the characteristics of the CSF (color and clarity Q4H) and notify physician immediately if it changes e.g. cloudy, increase in blood, etc.</li> <li>Observe for signs of neck stiffness, photophobia, increased temperature, change in vital signs and level of consciousness (LOC).</li> <li>Monitor lab results for CSF and report to physician if elevated WBC with high portion of neutrophils, low CSF glucose, high CSF protein, or positive gram stain and culture.</li> <li>When emptying or changing the drainage bag, flushing the system or obtaining CSF specimens ensure that strict aseptic technique is maintained.</li> <li>Ensure the system remains secure Q4H: <ul style="list-style-type: none"> <li>intact catheter site</li> <li>coiled catheter tubing stabilized on back with large clear occlusive dressing.</li> </ul> </li> </ul>
<b>Headache/Clinical deterioration</b> related to excessive drainage of CSF from the spinal subarachnoid system due to: <ul style="list-style-type: none"> <li>malfunctioning of the system</li> <li>drainage rate too high for patient</li> </ul>	<ul style="list-style-type: none"> <li>Inform physician of significant headache, nausea, and vomiting, irritability, change in level of consciousness (LOC) and/or electrolyte imbalance.</li> <li>Inform physician if new blood in the lumbar drain system.</li> <li>Record drainage volume every hour.</li> <li>Adjust Alaris infusion pump rate or clamp drainage system as per physician's order.</li> <li>Ensure a closed functioning system, i.e. secured connections throughout, and secured anchoring of tubing, remembering to clamp system prior to removing from Alaris infusion Pump.</li> <li>Assess insertion site / dressing for CSF leak.</li> </ul>
<b>System Occlusion</b> As indicated by: <ul style="list-style-type: none"> <li>"Occluded Fluid Side" Alarm</li> <li>"Occluded Patient Side" Alarm</li> </ul>	<ul style="list-style-type: none"> <li><b>Occluded Fluid Side Alarm</b> <ul style="list-style-type: none"> <li>Indicates a blockage occurring between the patient and the pump.</li> </ul> </li> <li><b>Occluded Patient Side Alarm</b> <ul style="list-style-type: none"> <li>Indicates a blockage occurring between the pump and the drainage bag.</li> </ul> </li> </ul>

	<ul style="list-style-type: none"> <li>• Ensure all pieces of the tubing are connected correctly as per diagram, making sure that connections are secured tightly.</li> <li>• Ensure roller clamp on tubing is open.</li> <li>• Un-kinking tubing and/or catheter.</li> <li>• Ensure proper direction of stopcock.</li> <li>• Assess lumbar drain site and ensure it is insitu.</li> <li>• Flush the lumbar drain as per <b>Section C: Flushing the Lumbar Drain System</b> as per page 7 of this document.</li> <li>• Change drainage bag as per <b>Section D: Changing the System Collection Bag</b> as per page 7 of this document.</li> <li>• If above interventions unsuccessful, call physician.</li> </ul>
<b>Dressing not intact</b> <b>Dressing edges peeling</b>	<ul style="list-style-type: none"> <li>• <b>Physicians only will remove and replace the lumbar drain dressing.</b></li> <li>• Nursing may reinforce the dressing with a clear occlusive dressing.</li> </ul>

## Documentation

### VGH:

Document CSF drain output on 24h fluid balance record

Document drainage set up with independent double check in nurse's notes

Document rate changes with independent double check in the 24h fluid balance record

### SPH:

As per:

- [PACU: Post Anesthesia Patient in Phase I \(B-00-13-10018\)](#)
- [High Acuity Unit Admission/Post Anesthesia Care Unit Overnight Stay \(B-00-13-10105\)](#)

## Related Documents

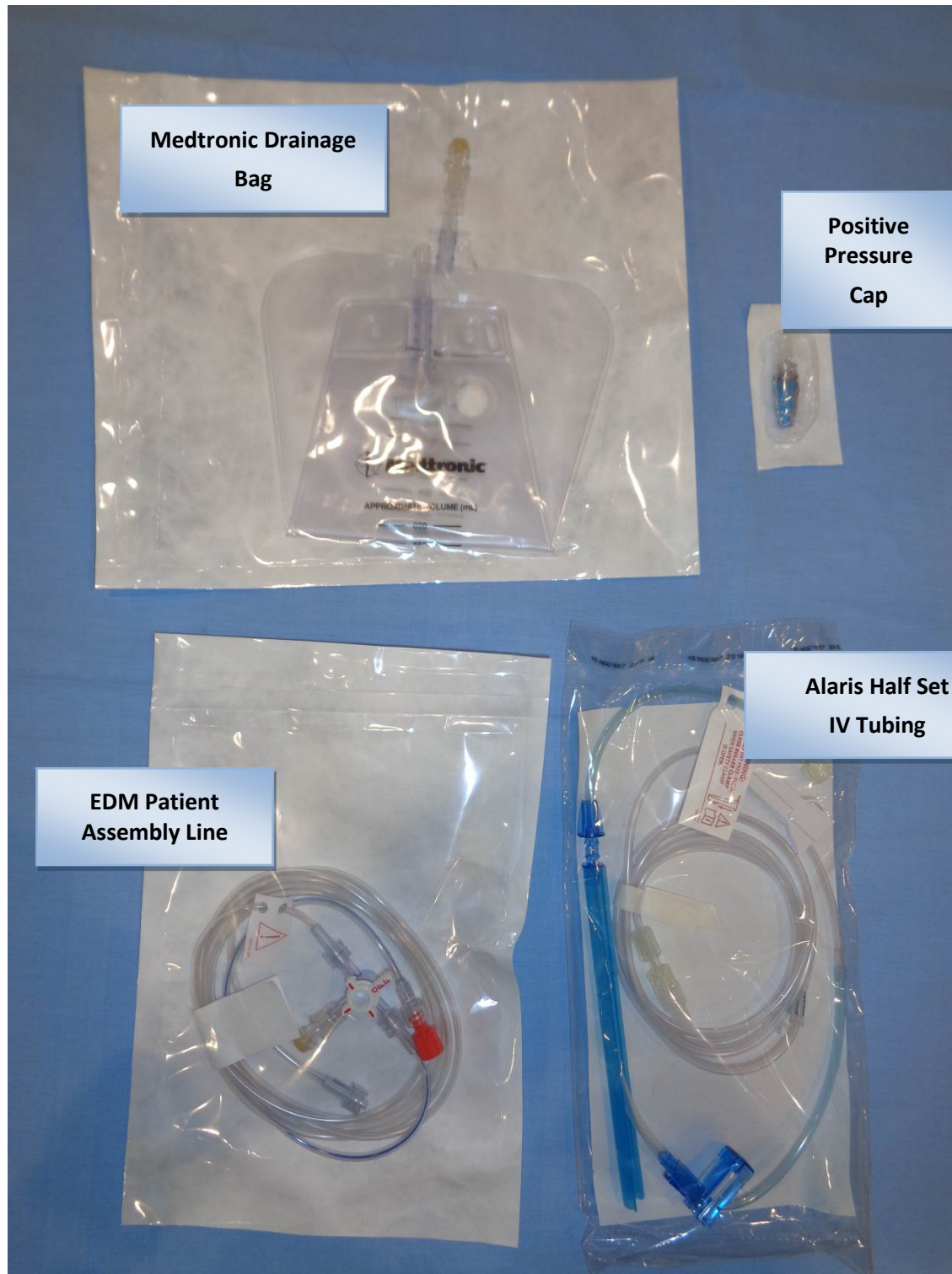
- C-350: [Cerebrospinal Fluid: Leak](#)
- PPO (VGH): LUMBAR CEREBROSPINAL FLUID MANAGEMENT using ALARIS INFUSION PUMP

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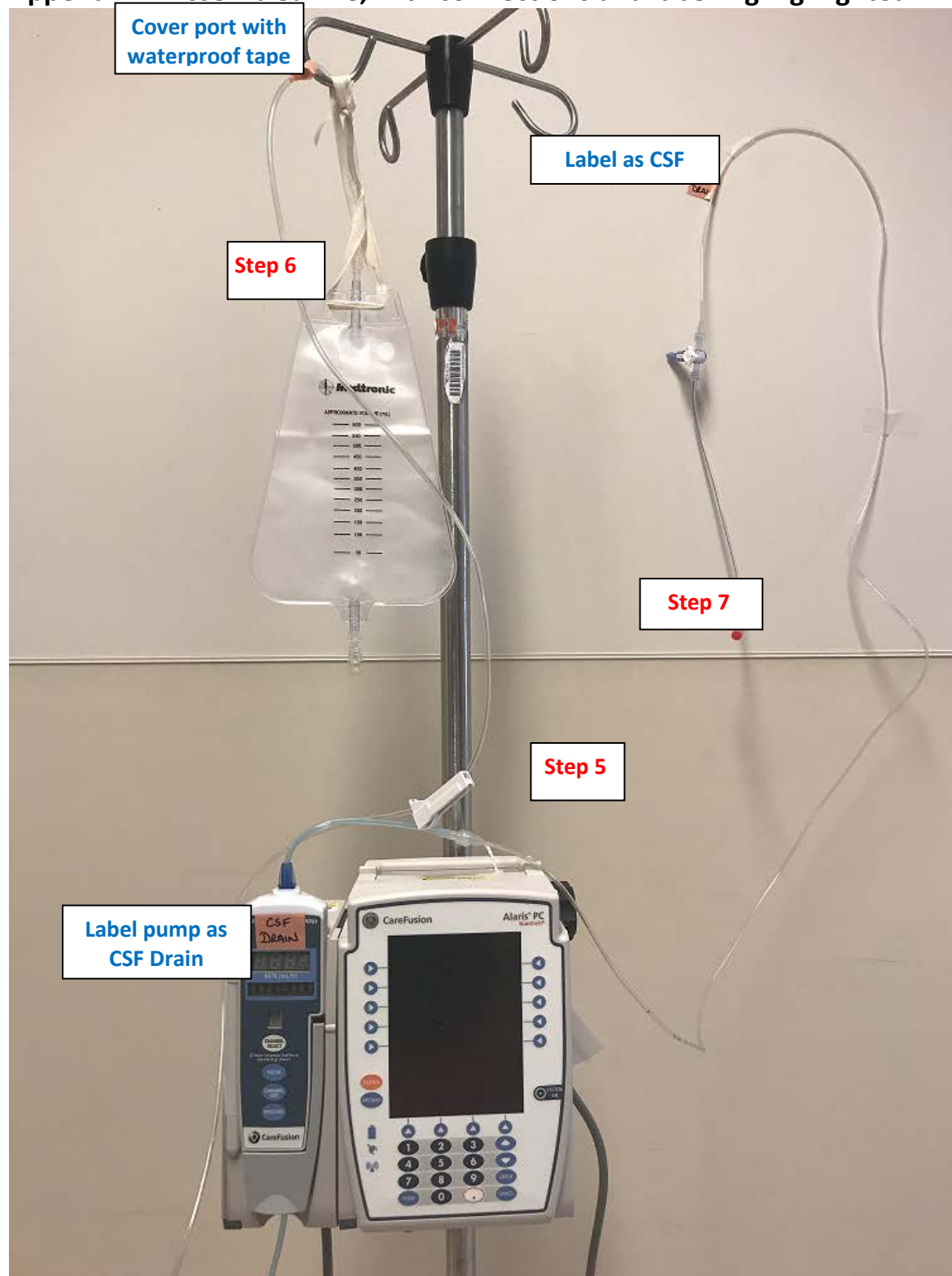
Gribbons, B., Burmister, M., Buzikievich, S., Ho, D., Hawley, S., Rose, E., & Fekete, M. (2019). Failure Modes and Effects Analysis: Off-Label Use of Alaris Infusion Pump for Cerebrospinal Fluid Subarachnoid Drainage. *Canadian Biological and Medical Engineering Conference (CMBEC42)*. Ottawa.

## Appendix A – Lumbar Drain Components



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## Appendix B: Assembled line, with connections and labelling highlighted



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## Appendix C – L Monitoring Guidelines SPH PACU and HAU

A MINIMUM 2 HOUR PACU STAY IS REQUIRED PRIOR TO TRANSFER TO HAU		
Assessment – Patient and CSF Drainage System	Frequency	
	PACU	HAU
Neuro <ul style="list-style-type: none"><li>GCS</li><li>Vision</li><li>Headache</li><li>Signs of meningeal irritation (photophobia, nuchal rigidity, headache, irritability)</li></ul>	q 1 h	q 4 h
Infection <ul style="list-style-type: none"><li>Temperature</li></ul>	q 1h	q 4 h
<ul style="list-style-type: none"><li>Insertion site</li></ul>	q 4 h	
CSF Drainage <ul style="list-style-type: none"><li>Amount (i.e. Is the amount in the bag consistent with the flow rate?)</li><li>Clarity</li><li>Color</li></ul>	q 1 h	
Note: If Intrathecal fluorescein is added to the CSF in the operating room the CSF will be yellow-green for up to 36 hours postoperatively		
Drainage System  IV Pump: <ul style="list-style-type: none"><li>Drainage bag is fastened to IV pole, above IV pump</li><li>Ensure all connections are secured</li><li>Correct flow rate, as per physician</li></ul> Straight Drainage: <ul style="list-style-type: none"><li>Drain is secured at level ordered</li></ul>	q 1 h	
NOTE: IF patient condition changes, increase frequency of assessments as needed		

Monitoring Post Lumbar Drain Removal	
Assessment	Frequency
Insertion Site - Leakage at site, redness	As ordered
Vital Signs	
Postdural puncture headache	



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<b>Approved By:</b> <i>(committee or position)</i>	<b>VCH</b>  <b>Endorsed by</b> (Regional SharePoint 2 <sup>nd</sup> Reading) Health Authority Profession Specific Advisory Council Chairs (HAPSAC)  Health Authority & Area Specific Interprofessional Advisory Council Chairs (HA / AIAC) VCH Operations Directors VCH Professional Practice Directors  <b>Final Sign-Off &amp; Approved for Posting by</b> Vice President Professional Practice and Chief Clinical Information Officer, VCH
<b>Owners:</b> <i>(optional)</i>	<b>VCH</b>  <b>DST Developer Lead(s):</b> Clinical Nurse Educator, Neuroscience Program, VGH Clinical Nurse Educator, Neuroscience Program VGH  <b>Development Team:</b> Clinical Nurse Educator, Spine Program, VGH

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Revision April 20, 2018 (updated equipment and new pictures added)

Revision May 3, 2019 (updated pictures and incorporated recommendations from FMEA)

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