  <b>CLINICAL PRACTICE GUIDELINE</b>	<b>Practice Guideline:</b>  <b>External Ventricular Drain – Set-up, Care, Maintenance, and Sampling of CSF</b>	
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**1. PURPOSE AND INTENT:** To provide guidance for set-up, care, maintenance, and sampling of cerebrospinal fluid (CSF) for an external ventricular drain (EVD).

## **2. PRACTICE OUTCOME**

- 2.1.** To provide safe and effective care for patients requiring intracranial pressure (ICP) monitoring and/or drainage of CSF via an EVD to ensure prescribed ICP goals are maintained.
- 2.2.** To minimize the risk of infection and/or other complications associated with the care and use of the EVD system and ventriculostomy site.

## **3. DEFINITIONS**


**External Ventricular Drain (EVD)** - A temporary device that diverts CSF from the ventricles of the brain to an external closed drainage system. The ordered fluid-filled EVD level controls ICP by allowing CSF to drain by means of hydrostatic pressure.

**Intracranial Pressure (ICP)** - The pressure exerted by the intracranial components of brain tissue, CSF, and the brain circulating blood volume within the cranial vault. *Normal ICP range is 0 to 15 mmHg.* Measured through a transducer system. **NOTE:** A sustained ICP greater than 20 mmHg for longer than 5 minutes is known as intracranial hypertension and requires urgent intervention.

**Cerebrospinal Fluid (CSF)** – The clear colourless liquid formed within the lateral, third, and fourth ventricles of the cerebral hemispheres by the choroid plexus.

**Cerebral Perfusion Pressure (CPP)** – The pressure necessary to maintain adequate cerebral blood flow. The brain depends on CPP for adequate metabolism and oxygen delivery. The formula to calculate CPP is mean arterial pressure (MAP) subtract ICP ( $CPP = MAP - ICP$ ). **NOTE:** An acceptable CPP ranges between 60-70 mmHg in adult patients with severe traumatic brain injury. CPP goals are individualized as per Physician/Designate order.

**Ventriculostomy** – A procedure involving the insertion of a small catheter into the ventricular system through a burr hole in the skull to provide ICP measurement, and/or allow access to CSF for drainage or sampling.

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#### 4. BACKGROUND

The placement of an EVD, is a common procedure for various neurological/neurosurgical patients. The purpose of an EVD system is that it allows ICP monitoring and/or drainage of CSF in patients with excess circulating CSF volume or obstruction of CSF re-absorption. Common indications include intracranial hemorrhage, subarachnoid hemorrhage, hydrocephalus, cerebral edema, infections including meningitis, as well as lesions or malformation.

#### 5. GUIDELINES

**5.1. The following practice guideline requires nurses with advanced knowledge and skill related to care and management of neurological patients.**

**5.2.** Ensure the sterility of the EVD system is maintained. Use aseptic technique when accessing the EVD system.

**5.3.** A Physician/Designate order is required to set the level or threshold at which CSF will be drained. This may include a maximum set amount or duration of drainage based on a goal ICP.

**5.4.** The EVD transducer stopcock should be open to the transducer OR the drain in order to either drain CSF or monitor ICP.

**5.5.** Review both EVD and ICP orders with any transfer of nursing care.


**5.6.** Only the Neurosurgery Physician/Designate may irrigate the ventriculostomy catheter/drainage system tubing towards the patient.

**5.7.** Only the Neurosurgery Physician/Designate may inject medication into the EVD system.

**5.8.** A Physician/Designate order is required for collection of CSF sample. Only the Neurosurgery Physician/Designate may obtain a CSF sample from the EVD tubing stopcock (closest to the patient catheter insertion site). Nurses may only collect CSF samples from the port below the drip chamber. (see 6.10)

**5.9.** The patient should be positioned supine, left or right side lying, ensuring the head and neck are in neutral position, aligned with the torso, to promote venous drainage. Elevate the head of bed to 30 degrees or as ordered. (see 6.3)


**5.10.** When travelling with the patient or mobilizing the patient, ensure the main system stopcock is OFF to the drip chamber in order to prevent over-drainage of CSF and related complications (i.e. collapse of the ventricles).

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**5.11.** Only the Neurosurgery Physician/Designate may remove the EVD catheter.

## **EQUIPMENT**

- Pole clamp assembly (with laser level attached)
- Designated intravenous (IV) pole
- Ventricular drainage catheter and ventricular drainage/monitoring system kit
- Pressure monitoring set (transducer system with 3-way stopcock)
- External drainage and monitoring system replacement drainage bags
- 10ml preservative-free, prefilled syringes with sterile 0.9% normal saline (NS)
- Non-toothed or padded forceps
- Sterile non-vented luer lock caps
- 70% Alcohol prep pads
- 10 mL sterile syringe for specimen collection
- Sterile CSF specimen containers
- Monitor and pressure cable

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## 6. PROCEDURES

### 6.1. PREPARATION

#### 6.2. PREPARATION OF THE EVD DRAINAGE AND MONITORING SYSTEM

#### 6.3. LEVELING THE TRANSDUCER

#### 6.4. ZEROING THE TRANSDUCER

#### 6.5. MONITORING ICP/CPP

#### 6.6. CHECKING SYSTEM PATENCY

#### 6.7. DRAINING CSF FROM THE EVD

#### 6.8. CARE OF CATHETER INSERTION SITE

#### 6.9. CHANGING OF THE CSF DRAINAGE BAG

#### 6.10. CSF SAMPLING

#### 6.11. ONGOING MONITORING, CARE, AND DOCUMENTATION

### 6.1. PREPARATION

6.1.1. Follow routine practices, and use appropriate PPE as per point of care risk assessment (PCRA).

6.1.2. Obtain Physician/Designate orders for desired ICP and CPP goals, and ventricular drainage parameters.


### 6.2. PREPARATION OF THE EVD DRAINAGE AND MONITORING SYSTEM

6.2.1. Attach the EVD pole clamp assembly to an IV pole (See Appendix for EVD system set-up).

6.2.2. Slide the EVD drip chamber onto the pole clamp assembly until the pressure line is at 0 and tighten the thumb screw.

6.2.3. Secure the **main system stopcock** to the mount on the pole clamp assembly.

6.2.4. Aseptically attach an ICP pressure monitoring set (without a continuous flush system) to the side port of the main system stopcock of the EVD system.

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6.2.5. Tighten all connections.

6.2.6. Using 10 mL preservative-free prefilled syringes with sterile 0.9 % NS, prime entire system all the way through to the drip chamber, including the ICP pressure monitoring set, ensuring system is free of air bubbles. Use aseptic technique to access the patient line stopcock injection site and turn the stopcocks as needed in order to prime the entire system.

6.2.7. Aseptically cap all ports with non-vented luer lock caps.

6.2.8. Ensure excess priming solution that has collected in the drip chamber is emptied into the EVD system drainage bag by turning the drip chamber stopcock OFF to the CSF collection port and allowing the fluid to flow into the bag.

6.2.9. Once emptied, ensure drainage bag stopcock is turned OFF to the drip chamber.

6.2.10. Turn the main system stopcock OFF to the drip chamber, and open to the pressure monitoring set.

6.2.11. Connect the primed ICP pressure monitoring set to the bedside monitor using a hemodynamic monitoring pressure cable.

6.2.12. Ensure monitoring system is appropriately labeled for ICP waveform.

6.2.13. Label the tubing “EVD” at the connection site closest to the patient, between the patient stopcock and the patient.


### 6.3. LEVELING THE TRANSDUCER

6.3.1. Level the transducer at the beginning of each shift and each time the patients position changes. This includes adjustments to the height of the bed/head of the bed.

6.3.2. Position the patient as ordered, supine, left or right side lying, and ensure the head and neck are in neutral position aligned with the torso in order to promote venous drainage. Elevate the head of bed to 30 degrees or as ordered.

6.3.3. Ensure the air bubble is centred on the laser level. Level the transducer to the foramen of Monro/external auditory meatus (tragus) using the laser (see image below). **NOTE:** When leveling, ensure to turn the main system stopcock OFF to the patient. Do not allow the laser to shine into the patient’s eyes.

6.3.3.1. **NOTE:** If leveling in the side-lying position, level the transducer to the tip of the nose.

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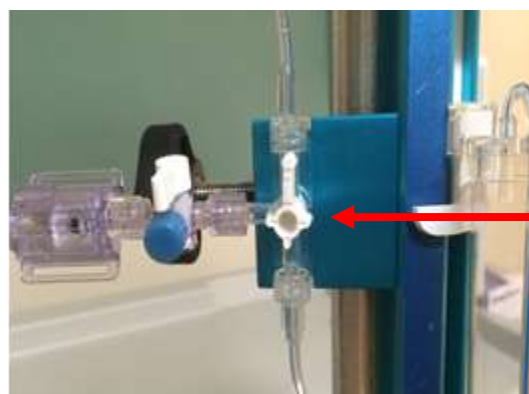


6.3.4. Adjust the drip chamber to the prescribed level.

#### 6.4. ZEROING THE TRANSDUCER


6.4.1. Zero the transducer at the beginning of each shift or as needed (i.e. if the cable becomes disconnected or if there are ICP waveform discrepancies).

6.4.2. Turn main stopcock OFF to the patient and open to the drip chamber (transducer system will be open to the air permeable membrane located at the top of the drip chamber). Do not remove the non-vented luer lock cap located on the transducer in order to zero the system (see image below).



Main system stopcock turned OFF to the patient and open to the drip chamber.

6.4.3. Adjust the drip chamber until the pressure level on the drip chamber bracket is at level 0 (see image below). **NOTE:** Ensure there is no air in the tubing from the transducer to the air-fluid interface of the drip chamber.

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6.4.4. Select “zero” on the bedside monitor and wait for the display reading to reach “0” mmHg.”

6.4.5. Adjust the drip chamber to the ordered level of drainage (e.g. ordered at 15 cm above tragus).


6.4.6. Turn the main system stopcock OFF to the drip chamber, and open to the patient and the transducer to monitor ICP waveform.

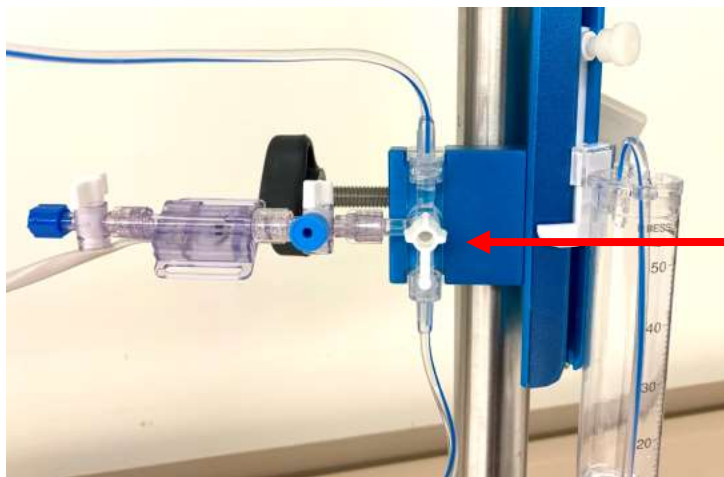
## 6.5. MONITORING ICP/ CPP

6.5.1. Ensure that the external transducer is level at the foramen of Monro/external auditory meatus (tragus).

6.5.1.1. **NOTE:** If leveling in the side-lying position, level the transducer to the tip of the nose.

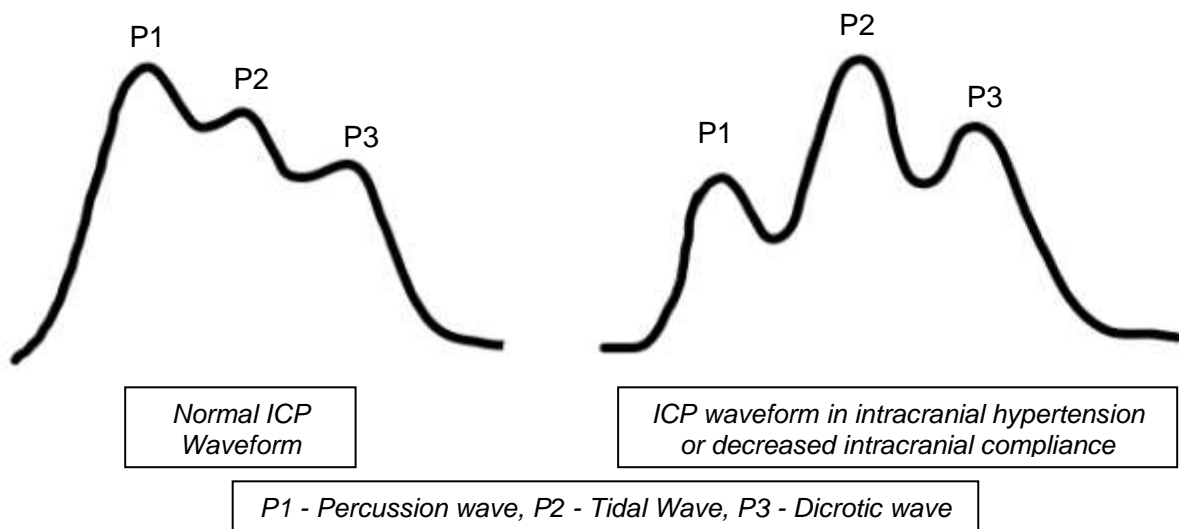
6.5.2. To view the ICP waveform on the monitor, turn the main system stopcock OFF to the drip chamber and open to the patient/transducer (see image below). **NOTE:** The EVD is unable to both monitor ICP/ CPP and drain CSF at the same time as this leads to inaccurate ICP/ CPP readings.

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Main system stopcock turned OFF to the drip chamber and open to the patient for monitoring.

6.5.3. Monitor and observe waveform. Document ICP value every hour and as needed. (i.e. with changes in patient condition). **Notify provider if waveform is not pulsatile, as it may indicate the EVD is blocked or kinked.**



6.5.4. Document CPP value every hour and as needed (i.e. with changes in patient condition). **NOTE:** Manually calculate CPP if the monitor does not provide the value ( $CPP = MAP - ICP$ ).



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## 6.6. CHECKING SYSTEM PATENCY

6.6.1. Patency checks are to be performed and documented hourly.

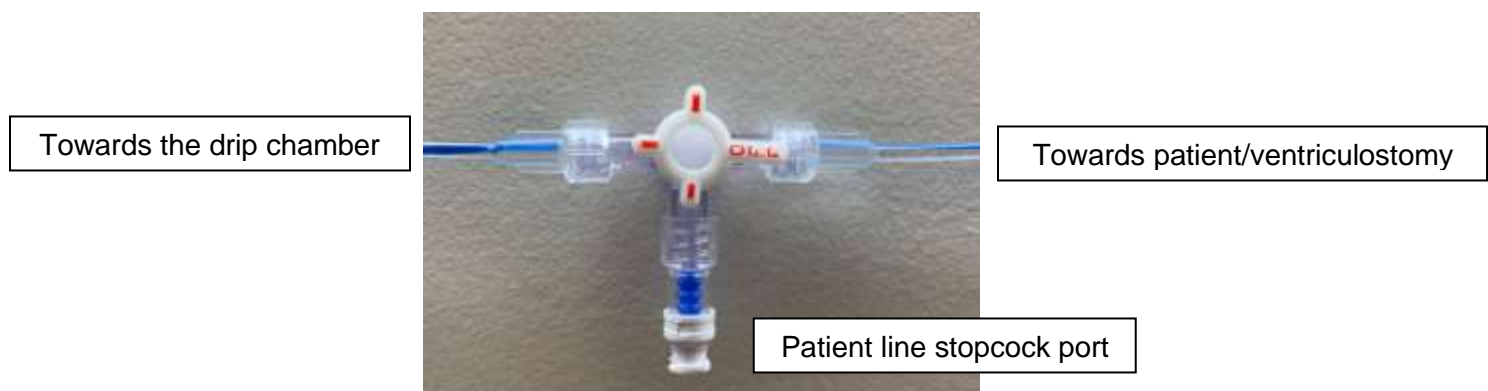
6.6.2. If drainage of CSF is noted within the hour, the system is patent.

6.6.3. If no CSF drainage is observed, check system patency by performing the following steps:

6.6.3.1. Slowly lower drip chamber below the ordered level until CSF drop(s) are observed in the drip chamber **OR** CSF is observed fluctuating/pulsating in EVD system tubing. If drainage/fluctuation of CSF is noted, the system is patent.

6.6.3.2. Return the drip chamber to the ordered level of drainage.


6.6.3.3. **NOTE:** In order to troubleshoot patency of EVD, the Nurse may irrigate towards the drip chamber at the patient line stopcock. Ensure the patient line stopcock is OFF to the patient, and open to the drip chamber. Cleanse the patient line stopcock port using two 70% alcohol prep pads for 5-15 seconds and allow to dry. Using a 10ml preservative-free prefilled syringe with sterile 0.9% NS, flush towards the drip chamber. **NEVER irrigate towards the patient/ventriculostomy catheter as this may cause harm.**



6.6.4. **If the system is deemed not patent, notify Physician/Designate/Neurosurgical team immediately.**

## 6.7. DRAINING CSF FROM THE EVD

6.7.1. Follow Physician/Designate orders for intermittent or continuous CSF drainage and ICP monitoring.

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6.7.2. Ensure the drip chamber stopcock is OFF to the drip chamber in order to prevent drainage of CSF from EVD into drainage bag.

6.7.3. Adjust the height of the drip chamber as ordered (refer to 6.3).

6.7.4. Turn main system stopcock OFF to the transducer and allow CSF to drain into drip chamber. **NOTE: Do not leave EVD unattended when draining.** Close monitoring is required when the EVD system is open to avoid excessive CSF drainage beyond Physician/Designate order which can lead to collapse of the ventricles.

6.7.5. Once draining is complete, return main system stopcock OFF to drip chamber, and open to the transducer.

6.7.6. Assess the color, clarity, and amount of CSF drainage. **Notify Physician/Designate if drainage is cloudy, bloody, or exceeds ordered amount. (Cloudy CSF drainage may indicate presence of infection. Blood in CSF drainage may indicate intracranial bleeding).**

6.7.7. Open drip chamber stopcock to drain CSF into drainage bag.

6.7.8. Close stopcock to EVD drainage bag.

## 6.8. CARE OF CATHETER INSERTION SITE

6.8.1. Assess insertion site, including sutures and surgical site. **Notify Physician/Designate if any CSF drainage or signs and symptoms of infection are present at insertion site (i.e. foul odour, purulent drainage, increased pain at site, etc.).**


6.8.2. An EVD catheter does not require a dressing over the insertion site. If a dressing is in place for significant drainage at the catheter insertion site, change dressing using aseptic technique as ordered by the Physician/Designate and as clinically indicated.

## 6.9. CHANGING OF THE CSF DRAINAGE BAG

6.9.1. Change the CSF drainage bag when it is  $\frac{3}{4}$  full.

6.9.2. Obtain a single use sterile CSF drainage bag.

6.9.3. Ensure the drip chamber stopcock is positioned OFF to the drip chamber.

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6.9.4. Cleanse CSF drainage bag connection site with two 70% alcohol prep pads for 5-15 seconds and allow solution to dry.

6.9.5. Disconnect the used drainage bag from the system. Aseptically connect the new drainage bag to the system.

6.9.6. Discard used drainage bag and contents into appropriate biohazard waste receptacle.

## 6.10. CSF SAMPLING

6.10.1. **Nurses may only take CSF samples from the port below the drip chamber.**

6.10.2. Physician/Designate order is required, including frequency of sampling and type of test.

6.10.3. Ensure the drip chamber stopcock is OFF to the drainage bag and the main system stopcock is OFF to the transducer and open to drain, to allow sufficient CSF sample collection in drip chamber. **NOTE:** CSF sample size will depend on ordered test. Refer to site-specific Lab Information Manual for guidance.

6.10.4. Once sufficient CSF sample is collected in the drip chamber, ensure the main system stopcock is turned OFF to the drip chamber. Monitor the patient for ICP changes while main system stopcock is OFF to the drip chamber.

6.10.5. Cleanse the CSF collection port located beneath the drip chamber using two 70% alcohol prep pads for 5-15 seconds and allow to dry.


6.10.6. Aseptically attach a sterile 10mL luer lock syringe to the CSF collection port below the drip chamber. Close drip chamber stopcock OFF to drainage bag and slowly withdraw CSF sample from the drip chamber.

6.10.7. Once sample is collected in the syringe, turn the drip chamber stopcock OFF to the drip chamber and remove the syringe.

6.10.8. Return the main system stopcock to its ordered position (continuous ICP monitoring or open to drain continuously).

6.10.9. Transfer the CSF from the syringe to the specimen container using aseptic technique.

6.10.10. In the presence of the patient, label the specimen with correct identifiers. Place specimen in specimen bag with requisition(s) and send immediately to appropriate lab following site specific protocol for transport. **NOTE:** Document

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aspirated CSF sample volume in appropriate record/flowsheet to ensure accurate fluid volume status is reflected.

## 6.11. ON-GOING MONITORING, CARE, AND DOCUMENTATION


6.11.1. Document in unit specific documentation records, such as Adult Intensive Care Flow Sheet/Primary Patient Supplemental Care Record/Adult PACU Patient Record/Electronic Patient Record; and/or neurological assessment records, intake and output records, and IPN.

6.11.2. Monitor/assess/document the following minimum q1h or as ordered:

- Neurological status/assessment
- Vital signs
- ICP and CPP readings (refer to 6.5). **Notify Physician/Designate of any gradual or sudden change in ICP/CPP not within ordered parameters.**
- Amount, colour, and clarity of CSF drainage. **NOTE:** Specific parameters will be ordered for CSF drainage amount.
- Patency of EVD system (refer to 6.6)
- Prescribed drip chamber height and landmark for leveling as ordered (e.g. 5cm above the tragus).

6.11.3. Monitor/assess/document condition of catheter insertion site and/or dressing changes if applicable.

6.11.4. Once the EVD is removed, ensure to continue to monitor neurological status/assessment, vital signs, and drainage at the removal site per Physician/Designate order. **NOTE: Only the Neurosurgery Physician/Designate may remove the EVD catheter.**

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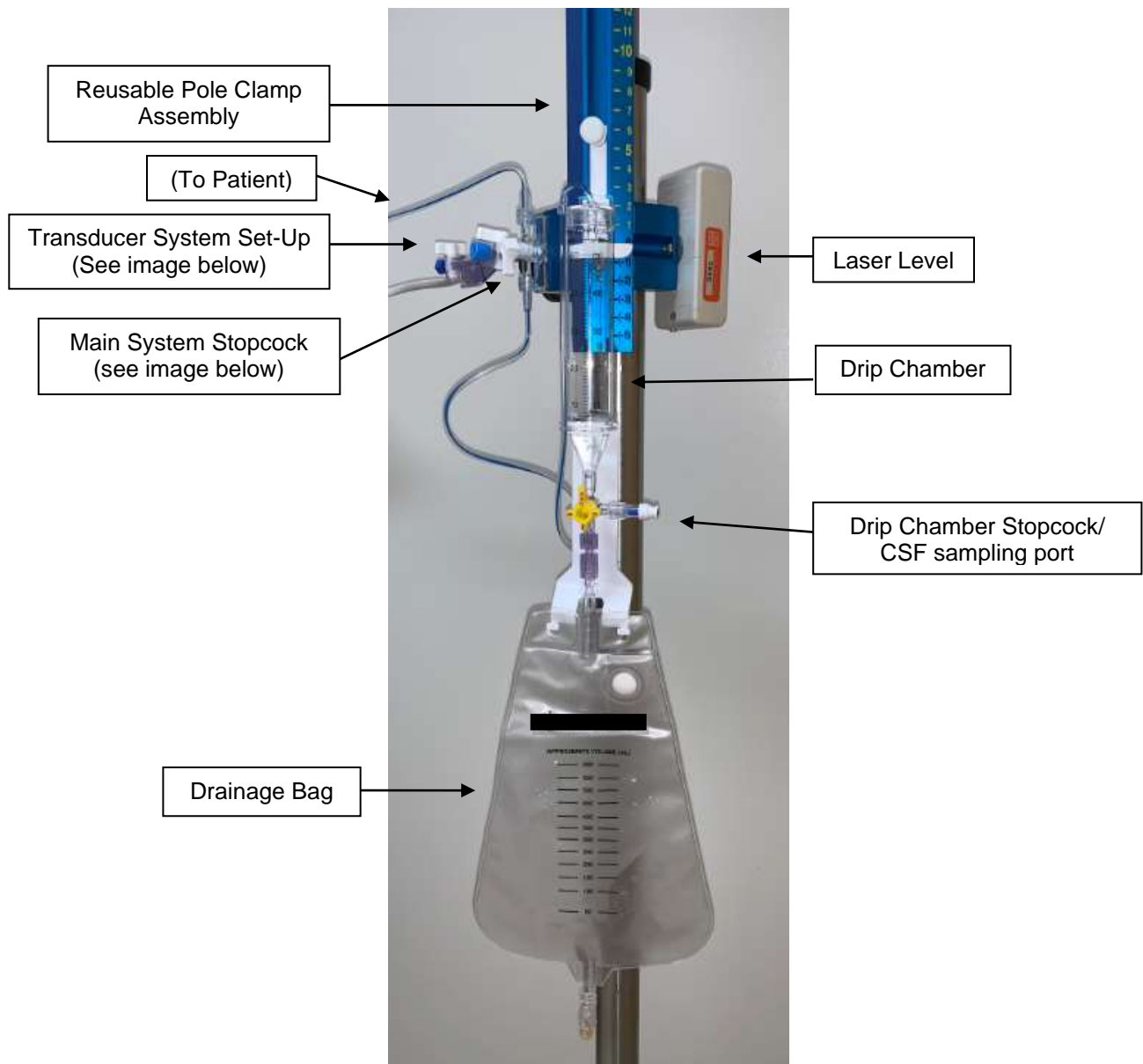
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## Appendix: EVD System Set-Up and Pressure Monitoring Set-Up



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