Establishment of an external ventricular drain (EVD) best practice guideline:
*The quest for a comprehensive, universal standard for EVD care*

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EVDs and Infections

Unfortunately, patients with EVDs are prone to getting infections, and these infections can dramatically impact the patient’s hospital course, and ultimately the risk of death.

Reports indicate that Up to 45% may become infected.

- Organisms that are found most often are:
  - *Staphylococcus aureus*
  - *Propionibacterium acnes*

- CSF reports that are commonly associated with meningitis or ventriculitis are those with high protein, low glucose and high WBC.
EVD-Related Infections

• Ventriculitis, subdural empyemas and intracranial abscesses are associated with EVD placement, but did you know that
  • abdominal abscesses
  • skin infections
  • Endocarditis
  • Sepsis
  • Osteomyelitis

Can also be related to EVDs
EVD Infection Prevention

1) Standardized protocol for EVD insertion and maintenance

2) Compliance monitoring

3) Multidisciplinary effort

4) Education

Organizational Goal: Strive for a 0% infection rate.
• EVD Catheter Insertion:
  • Pre-Insertion:
    • Hair removal
    • Skin prep
    • Aseptic technique
    • Catheter Selection
    • Monitoring protocol adherence

• EVD Maintenance
• Cerebrospinal Fluid Sampling

1) Employ aseptic technique when handling EVD
2) Label EVD tubing
3) Sample CSF only from distal port
4) Obtain samples only when clinically indicated
5) Minimize EVD manipulation and length of time catheter is in place

• EVD Dressing
• Type of dressing
• Frequency of dressing change
• Personnel approved to perform dressing change

1) Use bio-occlusive dressing with biopatch™
2) Change dressing weekly or if dislodged
3) Any clinician with deemed competency performs dressing changes

1) Provide ongoing education/competency assessment for NSICU staff re: EVD care
2) Perform infection control rounds
3) Monitor rates of infection

• Education
• Surveillance

Creation of a model that guides the focus of the EVD project
Creation of a new EVD standard…

**Purpose:**
To provide consistency in the insertion, care and maintenance of intra-ventricular drainage devices across the NYULMC inpatient areas to reduce the potential risk of infection.

Use of standardized EVD checklist to ensure consistent practice.

Note: sutures are not a component of proposed practice change.
<table>
<thead>
<tr>
<th>Previous State</th>
<th>Current State</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drape for procedural site only</td>
<td>Use of a full body drape during EVD placement</td>
</tr>
<tr>
<td>Cleanse skin with alcohol prior to EVD placement</td>
<td>Clean skin with chlorhexadine prior to EVD placement</td>
</tr>
<tr>
<td>No use of antibacterial protection around insertion site</td>
<td>Use of a chlorhexidine biopatch</td>
</tr>
<tr>
<td>No monitoring of insertion practices</td>
<td>Use of a checklist during EVD insertion</td>
</tr>
<tr>
<td>Use of gauze dressing to cover EVD site</td>
<td>Use of a large bioocclusive dressing with steri-strips along the borders</td>
</tr>
<tr>
<td>Shave head to remove hair</td>
<td>Use of clippers to remove hair</td>
</tr>
</tbody>
</table>
| Flush transducer  
No priming of line | Using flush-less transducer  
Prime EVD |
| Daily CSF sampling | CSF sampling only once at initial EVD placement and then q48hours as needed for suspected infection. Do not shake vial. All CSF samples must be hand delivered to lab for immediate processing |
| Changing the collection bag when full…no standardized practice however | Changing the collection bag when 3/4 full |
| No standardized practice during repositioning, when patient coughs or vomits. | Clamping the drain for coughing, vomiting, suctioning, repositioning, or in acute pain |
| No standardized monitoring practice of EVD site  
Zero EVD with manipulation of catheter and with change of position | Nursing monitoring of the EVD site and change of dressing if indicated. Zero EVD every 4 hours and with each manipulation of catheter and change of position |
Physician should don the following attire to prevent infections during insertion:

- Cap
- Mask
- Sterile gown
- Sterile gloves

In addition, it is important to limit the # of staff in a patient’s room during insertion, and other staff should wear:

- Cap
- Mask
- Gloves
Questions: Prepping and Cleansing the head

1. Shaving or clipping?

2. Betadine or chlorhexadine?

• Cleanse head with chlorhexadine

• Clip hair with clipper
  No shaving.
PRE EVD Protocol

POST EVD Protocol
Nursing Responsibility when an EVD is placed

- Ensure that the appropriate equipment is available
- Monitor the integrity of the criteria in the new policy to ensure that aseptic technique has been maintained using the insertion checklist
- Level the EVD in relation to tragus of the ear
EVD Dressings

Frequency of dressing change

• Only change if soiled or dislodged
• No criteria exist for interval changing

When you need to change a dressing: Use of products

• Cleanse with chlorhexadine
• Reapply a Biopatch™ and bio-occlusive dressing
• Remember to retain old dressing for neurosurgery to examine
Sampling CSF

Use port that is most distal to patient

Changing Practice…

• Sample only when there is a clinical suspicion of an infection

• NOT daily or as per routine

• MD or RN can draw CSF sample
Duration of catheter placement

No strict criteria exist for catheter placement

- However, the EVD catheter should remain intact only as long as is clinically indicated in order to prevent infection

Catheter tracking

- Units will now be tracking how many days a catheter remains intact.
- Unit rounds ensure all are adhering to the new protocol
EVD Set Up

Level EVD at the Tragus of the ear
<table>
<thead>
<tr>
<th></th>
<th>MR# Pt Name:</th>
<th>MR# Pt Name:</th>
<th>MR# Pt Name:</th>
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<tbody>
<tr>
<td><strong>FALLS:</strong></td>
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<tr>
<td>Falls Band</td>
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<td>Y/N ___/1</td>
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<tr>
<td>Patient Education</td>
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<td>Patient Environment</td>
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<td>Y/N ___/1</td>
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<tr>
<td>Call bell within reach</td>
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<td>Y/N ___/1</td>
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<td>Toileting awareness</td>
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<td>Reason CVC is still needed</td>
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<td>Dressing C/D/I</td>
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<td>Y/N ___/1</td>
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<tr>
<td>Date of dressing</td>
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<td>Y/N ___/1</td>
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<tr>
<td>Date back check valve changed</td>
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<td>Curos Cap in place</td>
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<td><strong>CAUTI:</strong></td>
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<tr>
<td>Reason Foley is still needed</td>
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<tr>
<td>Date of insertion on the bag</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<tr>
<td>Bag is below bladder and off of the floor</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<tr>
<td>Catheter secure</td>
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<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<tr>
<td>Meatal Care done Q12</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<tr>
<td>Collection bag emptied appropriately</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<td><strong>EVD:</strong></td>
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<tr>
<td>Dressing: Change only when soiled or dislodged (save for Neurosurgery to assess)</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
</tr>
<tr>
<td>Drainage bag &lt; ½ full</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<tr>
<td>Tubing secure/ leak free</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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<td>Y/N ___/1</td>
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<tr>
<td>CSF samples drawn only as indicated</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
<td>Y/N ___/1</td>
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</tbody>
</table>

- EVD added to safety compliance monitor

**Safety Compliance Monitor Unit:** 12 West

**Date**_______________                **Time**______________  **Rounding Team**______________
Other specific items of EVD care

Your patient with an EVD needs a CT scan. What do you do with the EVD?

Turn off the CSF flow at the stopcock (on the white plate) and at the more proximal stopcock and go to CT with the patient!

Your patient is draining into EVD bag consistently. At what point do you need to change the bag?

When bag is 3/4 full
Creation of an EVD Insertion Checklist

Available within the electronic health record!

<table>
<thead>
<tr>
<th>Critical Steps</th>
<th>Yes</th>
<th>Yes with Reminder</th>
<th>No - Complete PNN Report</th>
<th>N/A</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before procedure</strong></td>
<td></td>
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</tr>
<tr>
<td>Informed consent obtained &amp; placed in chart</td>
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<tr>
<td>o As per standard protocol</td>
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<td>o Consenting party absent, 2 physician consent obtained</td>
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<tr>
<td>Time out pause and confirm completed</td>
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<td>o Correct patient</td>
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<td>o Correct procedure</td>
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<tr>
<td>o Correct site and side</td>
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<tr>
<td>o Correct patient position</td>
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<tr>
<td>o Availability of correct equipment</td>
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<tr>
<td>o Antibiotic administered</td>
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<tr>
<td>Everyone in the room performed hand hygiene</td>
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<tr>
<td>Operator/staff in close proximity to patient</td>
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<tr>
<td><strong>During Procedure</strong></td>
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<tr>
<td>Hair clipped around the site</td>
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<tr>
<td>Skin debrided with alcohol</td>
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<tr>
<td>Site is prep with Chloraprep</td>
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<tr>
<td>Sterile gloves changed between prep and procedure</td>
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</tr>
<tr>
<td>Patient is covered with full sterile drape</td>
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<tr>
<td>Catheter sutured with at least 3 sutures</td>
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<tr>
<td>Benzoin tincture applied and skin is allowed to fully dry</td>
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<tr>
<td>Bipatch of the skin opening</td>
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<tr>
<td>Full tegaderm placed and edges secured with steri-strips</td>
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<tr>
<td>Full gauze head wrap applied</td>
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<tr>
<td><strong>After procedure</strong></td>
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<tr>
<td>EVD tubing labeled</td>
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<tr>
<td>CSF sample obtained by practitioner and sent immediately</td>
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</tbody>
</table>

NYU Langone Medical Center
**Neurosurgical Externalized Drain Fact Sheet**

**Prevent INFECTION:** Refer to EVD Protocol prior to insertion

<table>
<thead>
<tr>
<th>Lumbar Drain</th>
<th>Externalized Shunt</th>
<th>Ventricular Drain (Refer to EVD protocol)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cause</td>
<td>CSF leak, NPH</td>
<td>Subarachnoid hemorrhage, obstructive hydrocephalus, increased ICP, trauma</td>
</tr>
<tr>
<td>Management*</td>
<td>Titrate for specific amount</td>
<td>Place at specific height in relation to level of Tragus</td>
</tr>
<tr>
<td>Parameters</td>
<td>None</td>
<td>ICP&lt;20</td>
</tr>
<tr>
<td>CSF Studies</td>
<td>Following placement &amp; as clinically indicated</td>
<td>Sampling: To be drawn by MD/RN/PA</td>
</tr>
</tbody>
</table>

*Most common management listed here, but always check MD orders.

Hourly: 1) Neuro-assessment (every hour: EVD; Lumbar drain, VP shunt as per MD order), 2) Record mL CSF in buretrol and empty into the collection bag & document on EVD flowsheet, 3) Educate patient &/or family regarding catheter care &/intra-thecal medications and document in patient education section.

**Priming Drainage System (RN/MD)**

- MD: Primes drainage system prior to connecting to catheter. Use sterile technique. Check that all fittings are tightened
- Turn the pressure transducer stopcock to "open" to the patient line and "open" to the Pressure transducer
- Remove sterile red cap from the pressure transducer and end cap at the catheter connection. Attach 10mL syringe, filled with preservative-free normal saline, to the transducer stopcock port and prime tubing of the patient line to the catheter connection.
- Replace sterile end cap once patient line is primed. Re-orient the stopcock "off" to the patient line.

- Tubing allowing 2 - 3ml of preservative free normal saline to cc graduated burette.
- Turn the stopcock proximal to the drainage bag "open" to drain preservative-free normal saline into the drainage bag.
- Remove 10ml syringe into the drainage bag. Remove 10ml syr sterile end cap.
- Do not fully drain out tube between burette and drainage bag can result in an in an air lock that delays draining.
- RN: Takes a transducer from the A-line setup and flushes using mL preservative-free normal saline flush
- Remove sterile red cap from pressure transducer stopcock. Ati
- Turn pressure transducer stopcock to 'open' to the patient line pressure transducer (UP) [turn stopcock attached to white plat wave appears on monitor]

**Zeroing:**
Re-level the EVD system each time the patient moves.
The system must be zeroed to atmospheric pressure & with the tragus e with any change in patient position or transport & after system manipul sample collection), & when troubleshooting or there is suspected malf *Level the transducer to the tragus using a laser level.
- Turn the main stopcock (attached to the white plate) "off" to t
- Open transducer stopcock to air (turn to the right) and remove
- Zero ICP on cardiac monitor.
- Return all stopcocks to the original open position to allow for (*Assure drain is at ordered level (at the tragus for EVD). If EVD is not zer
- ICP reading can be up to +/- 2mmHg from the true ICP.

**TROUBLESHOOTING:**

If there is no wave or CSF drainage: a) Ensure tubing is secure and not le kinks in tubing, c) Check that all stopcocks are open, d) Drop drain down fluctuation in tubing and drainage. If no fluctuation in tubing: contact ne tubing becomes disconnected: a) Turn stopcock to off position b) Se</code>

**RED FLAGS:**
- Change in VS , HA, Nausea, Vomiting
- Change in CSF drainage (color, clarity)
- Leakage at insertion site or tubing

**TRANSPORT:**
Nursing Competency

Department of Nursing Education

NYU Langone Medical Center

COMPETENCY CHECKLIST
External CSF Drainage System

<table>
<thead>
<tr>
<th>NAME</th>
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</table>

<table>
<thead>
<tr>
<th>Method</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Observation (actual)</td>
<td>New Scope of Practice</td>
</tr>
<tr>
<td>Direct Observation (simulated)</td>
<td>Patient Satisfaction</td>
</tr>
<tr>
<td>Testing (written/oral)</td>
<td>Regulatory</td>
</tr>
<tr>
<td>Documentation Review</td>
<td>Safety</td>
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<tr>
<td>Performance Improvement Data</td>
<td>Quality Related</td>
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<td>Inservice</td>
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<table>
<thead>
<tr>
<th>SKILL SET:</th>
<th>Technical Skill</th>
<th>Interpersonal Skill</th>
<th>Critical Thinking</th>
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COMPETENCY STATEMENT: Carries out NYULMC procedure for operating the external CSF drainage system.
EVD Procedure - Nursing

NYU Hospitals Center
Department of Neurosciences
Departmental Process Standard
Date: 2-3-15

PROCEDURE FOR: Set up and maintenance of the External Cerebrospinal Fluid Drainage and Monitoring System

PURPOSE(S): To ensure appropriate set up and maintenance of the External Cerebrospinal Fluid Drainage and Monitoring System

SUPPORTIVE DATA:
1. External Ventricular Drain (EVD) is a closed sterile system that is placed in the lateral ventricle to drain cerebrospinal fluid (CSF). Ventricular catheter is placed by neurosurgeons/neurosurgery residents under sterile conditions. The catheter is then connected to the External CSF Drainage and Monitoring System.
2. EVD facilitate therapeutic CSF drainage and is the gold standard for intracranial pressure (ICP) measurement.

NYUMC Externalized Ventricular Drain Protocol and Procedures

Procedures: EVD insertion, Sampling CSF, Intrathecal medications, EVD troubleshooting, EVD weaning, EVD removal

EVD INSERTION:
Pre-procedural Preparation:
1. EVDs may only be placed by neurosurgery residents with appropriate credentialing, or under the direct observation of a neurosurgeon who has appropriate credentialing.
2. Informed written or telephonic consent must be obtained per standard hospital policy. In the emergent setting without a consenting party, 2-physician consent must be performed by the performing/observing neurosurgeon and another attending physician.
3. A detailed medication history should be obtained focusing on the use of:
   a. Platelet inhibitors (aspirin, clopidogrel, dipyridamole)
   b. Vitamin K antagonists (warfarin)
   c. Thrombin inhibitors (argatroban, dabigatran)
   d. Xa Inhibitors (heparin, LMWH, fondaparinux, rivaroxaban, apixaban)
4. Obtain a coagulation profile and CBC to ensure the following goals are met: INR < 1.5, PTT < 40, platelets > 100,000.
Establishment of an external ventricular drain (EVD) best practice guideline: The quest for a comprehensive, universal standard for EVD care

Problem: External ventricular drains (EVDs) are devices commonly used in neurocritical care. Despite a high risk of ventriculostomy-related infection (upward of 45%), many hospitals including NYULMC lack strict protocols for EVD placement and maintenance. Additionally, EVD infections are typically not tracked with the same diligence as central line related bloodstream infections or catheter related urinary tract infections.

Project goal: To achieve a 0% ventriculostomy-related infection rate

Team members and roles:
Team Leader: Ariane Lewis, MD, Neurocritical Care
Irina Dynkevich, RN, SSN, 12 West; Fabio Frisoli, MD, Neurosurgery; John Golfinos, MD, Neurosurgery; Millie Hepburn, RN, Nurse Educator, Neurosciences; Nancy Jones, RN, NM 12 West; Aaron Lord, MD, Neurocritical Care; Donato Pacione, MD, Neurosurgery; Michael Phillips, MD, Infection Control; Marina Spektor, RN, SSN, 12 West; Jeffrey Wisoff, MD, Neurosurgery

Interventions:
- Development of MD and RN protocols for EVD insertion, care and maintenance
- Initiation of change in frequency of cerebrospinal fluid (CSF) sampling from EVDs
- Acquisition of antibiotic coated EVD catheters
- Creation of an EVD placement checklist
- Creation of an EVD audit log
- Establishment of a definition of ventriculostomy-related infection
- Facilitation of a method for Infection Control to track ventriculostomy-related infections

Baseline Data:
- 57 EVDs 1/1/13-7/1/14: 7 excluded (6 due to CSF infection before EVD placement & 1 with a positive CSF culture made comfort care before determining if it was an infection or a contaminant)
- 379 EVD days
- 414 CSF cultures
- 9 patients (18%) with positive CSF cultures

Lessons learned:
- It is necessary to be transparent regarding practice shortcomings and determine aspects of care that require modification.
- Institutions that develop a meticulous standardized protocol for EVD insertion, maintenance and management have reported reduction in frequency of infection.
- Vigilant and consistent monitoring is integral to success.
- Specific aspects of EVD insertion and maintenance have dramatic influence on EVD related infection rates.
- Improvements in infection rates must be organized by multidisciplinary teams.
- Frequent education and reeducation sessions about EVD maintenance and infection prevention promotes understanding of risk factors for infection and compliance with protocols.

Next steps: Implement the protocol then monitor rates of infection

Project Contacts:
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Progress to date: Nursing and Physician education and protocol implementation underway in Spring 2015
EVD workgroup:

This project was driven by Research and Recommendations by:

- NeuroSurgery ICU Nurses
- Pediatric ICU Nurses
- Neurointensivists
- Neurosurgeons
- Pediatric Neurologists
Thank you for keeping our neuroscience patients safe and free from infection!