Inclusion criteria:
- Patient with CSF shunt (e.g. ventriculoperitoneal (VP), ventriculopleural or ventriculoatrial (VA))
- Presenting with any of the following:
  - Altered Mental Status
  - Irregular respirations, bradycardia and hypertension
  - Acute focal neurological deficit
  - Vomiting
  - Headache
  - Behavior change (especially lethargy or fussiness)
  - Concern for new or increased seizure activity
  - Bulging fontanel
  - Fever
  - Swelling, redness, or drainage around shunt site
  - Abdominal pain
  - Parental concern for shunt malfunction

Triage considerations:
- ESI triage level 2
- Full set of vitals including blood pressure
- Place on continuous cardiac monitoring and document rhythm (for any patient with significant vomiting, altered mental status, or neurological deficits)
- Consider ondansetron if active vomiting
- Evaluate need for pain control
- Elevate head of bed 30°
- For patients with altered mental status, acute focal neurologic deficit, posturing, or irregular respiration, bradycardia, or hypertension
  - Order immediate STAT Stealth Head CT
  - RN to accompany patient to CT, with monitoring
Specific management by presenting complaint:

- **Altered mental status, irregular respiration, bradycardia, or hypertension, acute focal neurological deficit**
  - ED MD to evaluate STAT
  - Neurosurgery consult STAT
  - VS and continuous cardiac Monitoring
  - Establish IV access and send CBC, BMP
  - Ondansetron if necessary
  - Avoid narcotics
  - HOB 30º
  - NPO
  - STAT Stealth Head CT with RN/monitors
  - Shunt Series radiographs to be obtained only at discretion of neurosurgery

- **Emesis, headache, parental concern for shunt malfunction and/or redness, swelling or drainage at shunt site:**
  - ED MD to evaluate
  - Neurosurgery consulted after exam
  - Ondansetron and/or pain control
  - HOB 30º
  - NPO
  - Order Quick Brain MRI with RN/monitors after evaluation
  - Shunt Series radiographs to be obtained only at discretion of neurosurgery

- **Fever:**
  - ED MD to evaluate
  - Evaluate for source of infection, including:
    - Consider lab testing based on clinical evaluation (CBC, CRP, Blood cultures, UA/UC)
  - Neurosurgery consulted if no other source of infection identified or meningeal signs on exam

- **Abdominal pain with no other signs/symptoms of a shunt malfunction:**
  - ED MD to evaluate for non-shunt source of abdominal pain
  - Neurosurgery consulted if no other source for abdominal pain identified

**Imaging (goal is within 60 minutes of presentation):**

- May go to imaging off monitor if stable (no bradycardia, respiratory abnormalities, seizure, or altered mental status)
- Patients with fever or abdominal pain but no other symptoms of shunt complication may not require imaging
- Definitive imaging for all patients except isolated fever:
  - “Quick brain” MRI without sedation is first choice for stable patients
  - Order MRI head without contrast, with shunt assessment as indication
  - Stealth head CT without contrast if MRI not available within 60 minutes or patient unstable
- Consider US of abdomen if abdominal pain
Medication considerations:
- Ondansetron (Zofran) prn nausea or vomiting
  - 8-15 kg – 2 mg IV/ODT
  - 15+ kg – 4 mg IV/ODT
- Acetaminophen (Tylenol) prn pain or fever
  - 15 mg/kg PO/PR
- Morphine prn severe pain
  - 0.1 mg/kg IV; avoid in altered mental status
- Avoid NSAIDs
- If IVF indicated, use isotonic fluid (NS, D5-NS, LR); avoid hypotonic fluid

Consultations:
- Consult neurosurgery
  - Immediately for all unstable patients (altered mental status, irregular respirations, bradycardia, hypertension, acute focal neurological deficit, ongoing seizure activity)
  - After physician evaluation for other cases, only if indicated after ED assessment
- Tap of shunt to assess CSF and pressures to be completed at discretion of neurosurgery

Reassessments:
- VS with BP q1h while in ED, or as otherwise indicated by clinical status

Differential diagnosis:
- Shunt failure
- Shunt infection (usually in the first 1-3 months after placement)
- Viral illness
- Medication toxicity
- Missed medication doses (e.g. anti-epileptics)

Discharge or Admission criteria:
- General guidelines:
  - Shunt malfunction or suspected shunt malfunction: Neurosurgery to admit to OR, PICU or floor
  - Symptoms considered to be very unlikely related to shunt: Disposition to be determined by ED.

Quality measures:
- MRI or CT within 60 minutes of triage
- Return to ED for same problem within 48 hours for discharged patients
**Suspected Shunt Malfunction or Infection**

**Detailed Presentations**

- **All dispositions in consultation with Neurosurgery**
  - Recommended Disposition:
    - Shunt malfunction → OR/Neurosurgery admit
    - No shunt malfunction → Disposition per ED

**Triage**

- ED MD to evaluate
- Neurosurgery consulted after exam
- Order Quick Brain MRI with RN / monitors after evaluation

**Triage**

- ED MD to evaluate
- Neurosurgery consult STAT
- VS and continuous cardiac Monitoring
- Establish IV access
- Zofran if necessary
- HOB 30°
- NPO
- STAT Stealth Head CT with RN/monitors

**Triage**

- ED MD to evaluate
- Neurosurgery consult STAT
- Zofran and/or pain control
- HOB 30°
- NPO

**Triage**

- ED MD to evaluate
- Neurosurgery consulted if no other source of infection identified or meningeal signs on exam

**Triage**

- ED MD to evaluate
- Neurosurgery consulted if there is neurosurgical concern

**Present with:**

- Altered mental status
- Irregular respirations
- Bradycardia
- Hypertension
- Acute focal neurological deficit
- Severe dehydration secondary to emesis
- Unstable vital signs

**Present with:**

- Fever

**Present with:**

- Emesis
- Headache
- Parental concern for shunt Malfunction
- Redness, swelling or drainage at shunt site

**Present with:**

- Abdominal pain with no other S/S of shunt malfunction

**Present with:**

- None of the other criteria mentioned