ADVANCED NICU FELLOWSHIP

NEONATAL INFECTIONS/INFECTION CONTROL

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TOPICS

Infection Vs. Sepsis

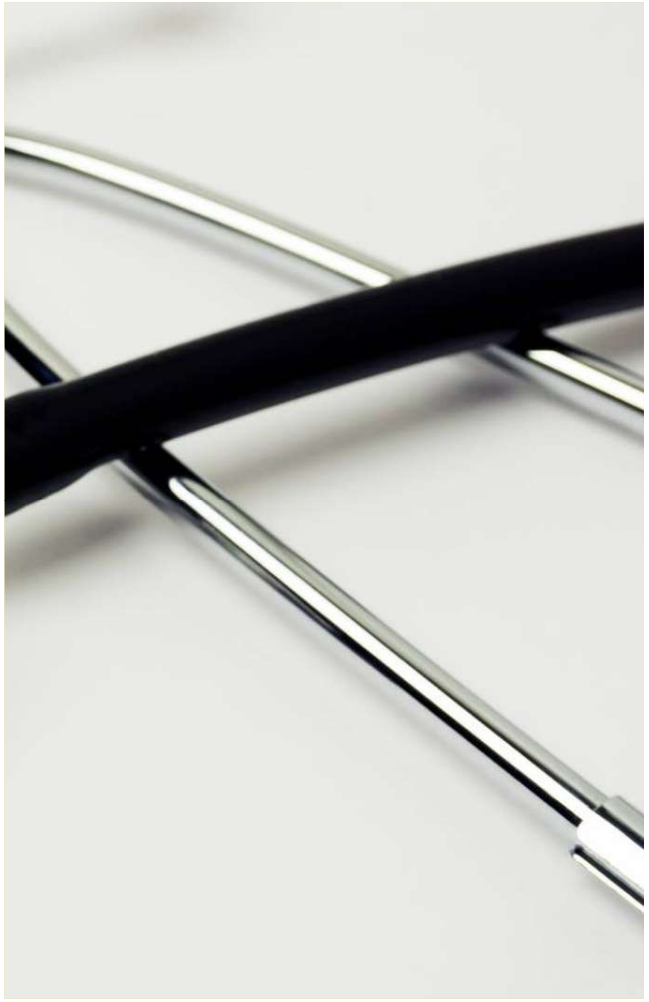
Early Onset Sepsis

Late Onset Sepsis

Interventions for prevention

Nurses Role

Escape Room



NEONATAL INFECTIONS

Prenatal:

Placenta to fetal circulatory system

Infected amniotic fluid: HSV, CMV

Vagina through cervix into the uterus

TORCH Infections

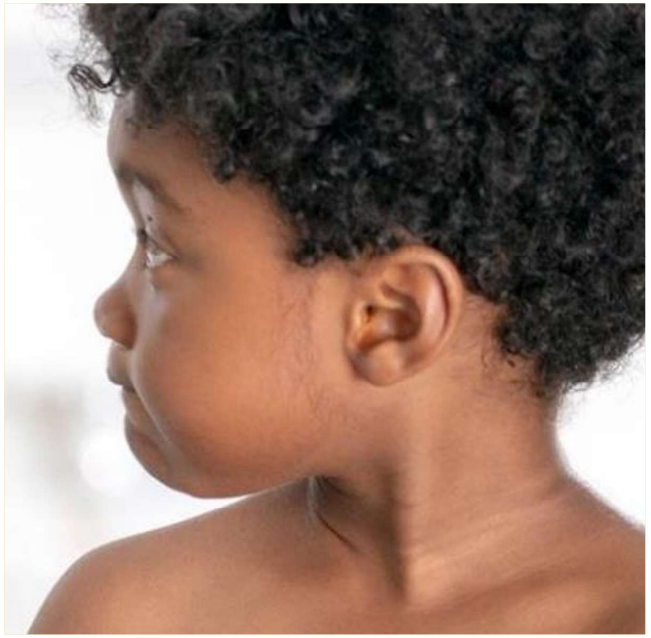
Intrapartum: (during birth)

Upper airway & GI tract generalized infections

Conjunctiva and oral local infections

Postnatally:

Resuscitation, HAI, Umbilicus



INFECTION VS. SEPSIS

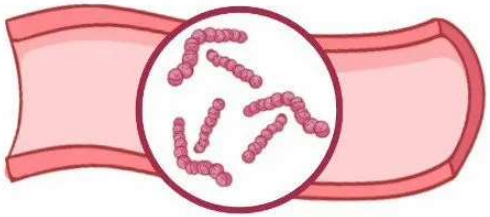
SIGNS OF INFECTION

- Respiratory – Apnea, tachypnea, retractions, nasal flaring, grunting, cyanosis, need for O2, metabolic acidosis
- Temperature – hypothermia, hyperthermia (less common), persistent fever
- GI – feeding intolerance (decreased suck strength and intake, increasing residuals) poor feeding, disinterest in feeding/weak suck, vomiting, diarrhea, abdominal distension, hypoactive bowel sounds
- Cardiovascular – tachycardia, bradycardia, hypotension, poor perfusion, increased capillary refill, mottling, decreased cardiac output, arrhythmias
- Neurologic – temperature instability (hypothermia, fever) jitteriness, bulging fontanels, irritability, sleepiness, lethargy, hypotonia, seizures, high pitched or abnormal cry
- Skin – petechiae, purpura, omphalitis, cellulitis, tissue swelling or redness

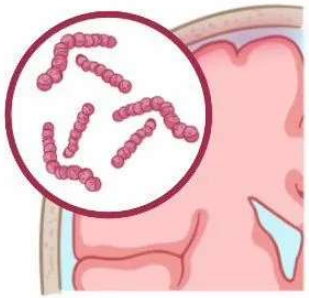
(Lowdermilk et al, 2023)

NEONATAL SEPSIS

BACTERIA in BLOOD



BACTERIAL MENINGITIS



EARLY-ONSET SEPSIS

EXPOSURE to PATHOGEN during INTRAPARTUM PERIOD

LATE-ONSET SEPSIS

PATHOGENS ACQUIRED POSTNATALLY

BIRTH

3 DAYS

1 WEEK

30 DAYS

EARLY ONSET SEPSIS

- Occurs within first 72 hours of life
- Risk factors
- Most common microorganisms
- Intrapartum antibiotics

RISK FACTORS/COMMON MICROORGANISMS

1. Accidental introduction of bacteria during invasive procedures such as vacuum assist, forceps, fetal scalp electrode
2. Prematurity & low birth weight
3. Preterm labor
4. Preterm premature rupture of membranes (PPROM)
5. Prolonged rupture of membranes >18 hours
6. Maternal GBS colonization
7. Maternal UTI
8. Maternal Illness

Bacteria

- Group B Streptococcus (GBS)
- Escherichia coli
- Listeria
- Other strains of streptococcus

Viruses

Fungi

Other pathogens

Meconium aspiration syndrome- chemical pneumonitis

LATE ONSET SEPSIS

- Occurs after 72 hours of life
- Assessment
- Risk factors
- Most common organisms

RISK FACTORS/COMMON MICROORGANISMS

1. Mother/Families
2. Hospital environment
3. Hospital personnel
4. Post delivery procedures
    a. IV
    b. Central lines
    c. ETT
    d. Thoracentesis
    e. Other invasive procedures

Bacteria

- Escherichia coli (E. Coli)
- Klebsiella
- Enterbacter
- Pseudomonas
- Listeria
- GBS

Viruses

- Herpes simplex virus
- Parainfluenza
- Many different viruses including Covid

Fungi – Candida

Other pathogens

NOSOCOMIAL INFECTION

- CDC defines as all neonatal infections acquired in the intrapartum period or during hospitalization.
- Neonatal Pneumonia
  - 1% term infants, 10% of preterm infants, up to 28% of ventilated ELBW infants in NICUs
  - Common organisms GBS and gram negative organisms (E Coli, Klebsiella, and pseudomonas)
- Central line-associated bloodstream infections (CLABSIs) are the most frequent hospital-acquired infections.
  - Dressings should be changed every 7 days, when loose, damp, or soiled.
  - Lines should be removed with signs and symptoms of infection or phlebitis
  - Presence of lines should be evaluated daily
  - Sterile line changes

(Gardner et al, 2020)

VAP- VENTILATOR ASSISTED PNEUMONIA

VAP is a nosocomial acquired infection who has been ventilated >48 hours.

1.4 to 7 episodes per 1000 ventilator days in developed countries

16-89 episodes per 1000 ventilator days in developing countries

Prevention Techniques:

Extubate as soon as possible to noninvasive support

VAP Bundle

Elevate HOB decreases risk of aspiration

Oral Cares with MBM

In – line suctioning

Do Not break the circuit

(Gardner et al, 2020)

SEPSIS MANAGEMENT

- Major cause of morbidity and mortality
- Prevention is key
- Risk of sepsis is inversely proportional to birth weight, increased sepsis with lower birth weight
- Exposure to an infectious agent activates a complete response to identify, neutralize, and eliminate the invading organism
- Neonate's immune system is immature which increases the risk of acquiring an infection.
- The younger the gestation, the higher the risk for infection and adverse outcomes

STABLE, 2024

SEPSIS MANAGMENT

Predictor	Scenario
Incidence of Early-Onset Sepsis	
Gestational age	weeks / days
Highest maternal antepartum temperature	Fahrenheit
ROM (Hours)	
Maternal GBS status	○ Negative ○ Positive ○ Unknown
Type of intrapartum antibiotics	○ Broad spectrum antibiotics > 4 hrs prior to birth ○ Broad spectrum antibiotics 2-3.9 hrs prior to birth ○ GBS specific antibiotics > 2 hrs prior to birth ○ No antibiotics or any antibiotics < 2 hrs prior to birth

Risk per 1000/births	
EOS Risk @ Birth	

EOS Risk after Clinical Exam	Risk per 1000/births	Clinical Recommendation	Vitals
Well Appearing			
Equivocal			
Clinical Illness			

Classification of Infant's Clinical Presentation Clinical Illness Equivocal Well Appearing

Low risk: <0.65
Medium risk: 0.65-1.54
High risk: >1.54

Signs/Symptoms are subtle

Changes in vital signs

Hypoglycemia

Temperature instability

Changes in bevaior

Obtain blood cultures and start antibiotics (Ampicillin & Gentamicin) within the first 60 minutes of life.

EOS calculator is used for infant greater than 34 weeks gestation

https://neonatalsepsiscalculator.kaiserpermanente.org

ORDERS.....

Cultures: blood, urine, CSF

Skin/wound swabs

CBC

CRP

Blood gas, lactate

Blood sugar

XRay

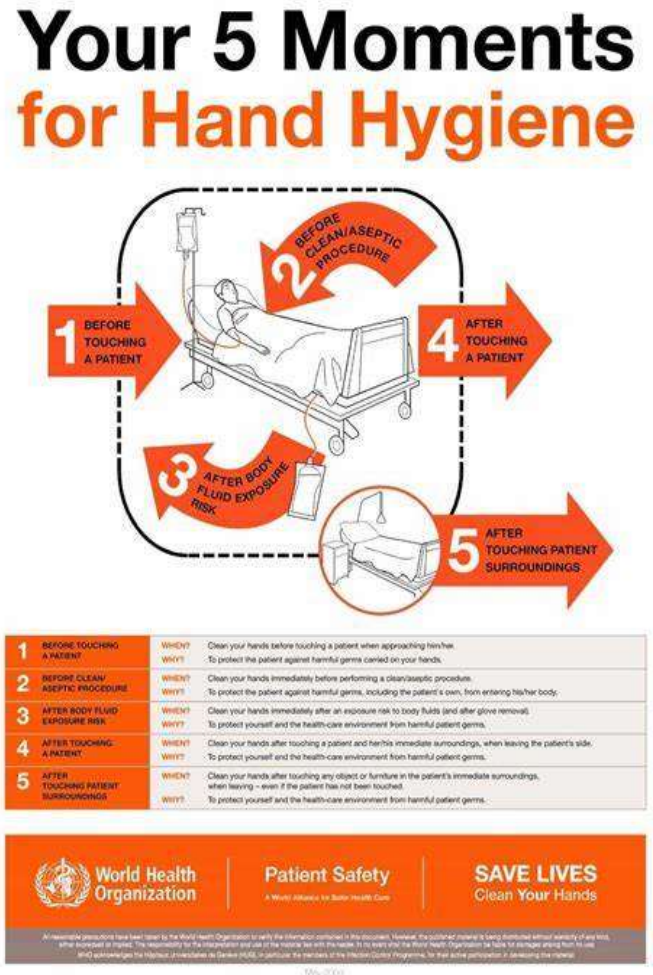
NPO?

Antibiotics?

WASH YOUR HANDS!

- Hand sanitizer vs Soap and Water
- Walk in room, before touch patient, after touch patient, when leave the room.

WHO RECOMMENDS….



HOW TO WEAR A PROCEDURE/SURGICAL MASK:

Correct Usage:

1.Secure procedure/surgical mask over both nose and mouth

Incorrect Usage:

1.Do Not have your mask hang from your ear when not in use

2.Do Not pull mask under your nose

3.Do Not pull mask under your chin

4.Do Not have mask on your arm/elbow when not in use

Discard mask after each use

CREATING A HEALING ENVIRONMENT

Keeping space clean

Top half of bed – CLEAN

Bottom half – DIRTY

CDC SCRUB THE HUB PROTOCOL

Steps for scrubbing the hub:

1.Wash hands

2.Put on clean or sterile gloves

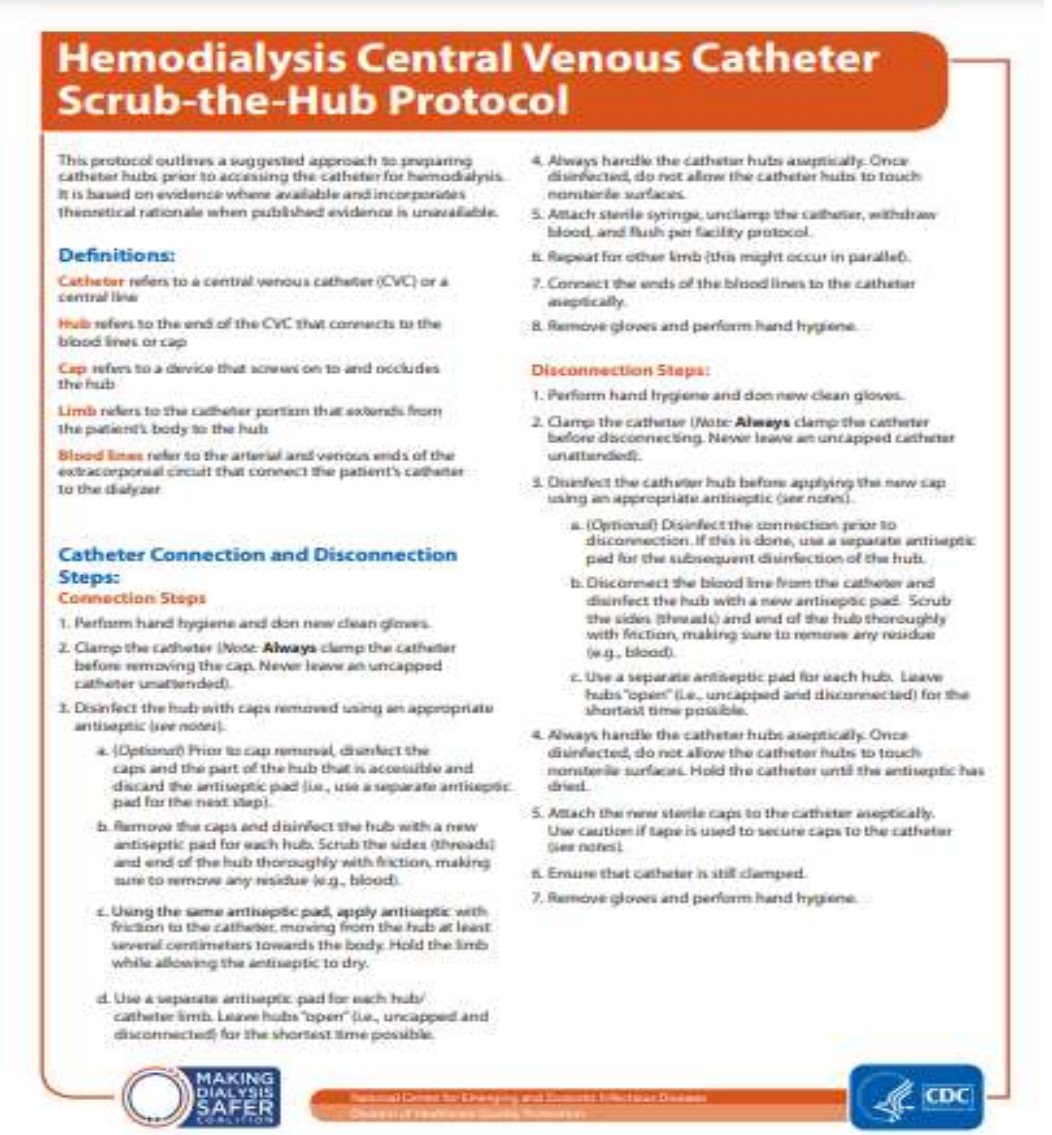
3.Use an antiseptic like 70% alcohol or chlorhexidine with alcohol

4.Scrub the hub in a twisting motion for at least five seconds

5.Let the hub dry without touching anything

6.Use sterile devices to access the injection port or stopcock

7.Take off gloves and wash hands again



Hemodialysis Central Venous Catheter Scrub-the-Hub Protocol

This protocol outlines a suggested approach to preparing catheter hubs prior to accessing the catheter for hemodialysis. It is based on evidence where available and incorporates theoretical rationale when published evidence is unavailable.

Definitions:

Catheter refers to a central venous catheter (CVC) or a central line

Hub refers to the end of the CVC that connects to the blood lines or cap

Cap refers to a device that screws on to and occludes the hub

Limb refers to the catheter portion that extends from the patient's body to the hub

Blood lines refer to the arterial and venous ends of the extracorporeal circuit that connect the patient's catheter to the dialyzer

Catheter Connection and Disconnection Steps:

Connection Steps

1. Perform hand hygiene and don new clean gloves.
2. Clamp the catheter (*Note:* **Always** clamp the catheter before removing the cap. Never leave an uncapped catheter unattended).
3. Disinfect the hub with caps removed using an appropriate antiseptic (*see notes*).
   a. (Optional) Prior to cap removal, disinfect the caps and the part of the hub that is accessible and discard the antiseptic pad (i.e., use a separate antiseptic pad for the next step).
   b. Remove the caps and disinfect the hub with a new antiseptic pad for each hub. Scrub the sides (threads) and end of the hub thoroughly with friction, making sure to remove any residue (e.g., blood).
   c. Using the same antiseptic pad, apply antiseptic with friction to the catheter, moving from the hub at least several centimeters towards the body. Hold the limb while allowing the antiseptic to dry.
   d. Use a separate antiseptic pad for each hub/catheter limb. Leave hubs "open" (i.e., uncapped and disconnected) for the shortest time possible.
4. Always handle the catheter hubs aseptically. Once disinfected, do not allow the catheter hubs to touch nonsterile surfaces.
5. Attach sterile syringe, unclamp the catheter, withdraw blood, and flush per facility protocol.
6. Repeat for other limb (this might occur in parallel).
7. Connect the ends of the blood lines to the catheter aseptically.
8. Remove gloves and perform hand hygiene.

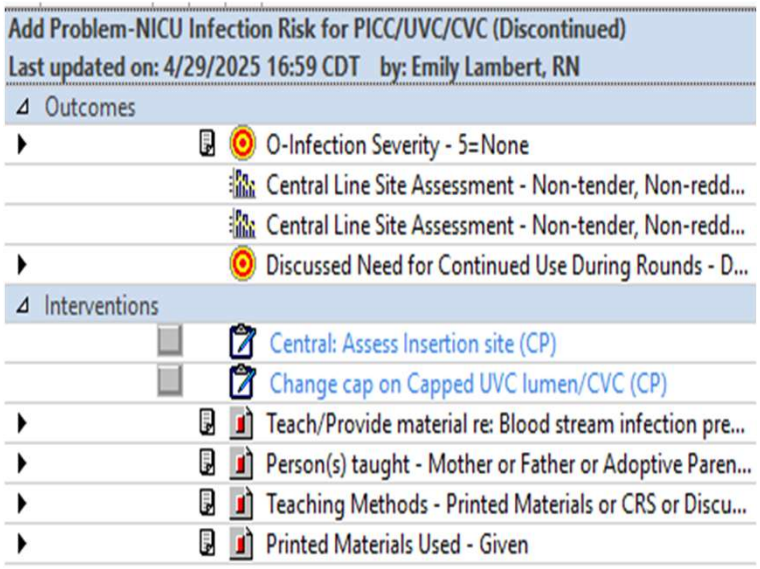
Disconnection Steps:

1. Perform hand hygiene and don new clean gloves.
2. Clamp the catheter (*Note:* **Always** clamp the catheter before disconnecting. Never leave an uncapped catheter unattended).
3. Disinfect the catheter hub before applying the new cap using an appropriate antiseptic (*see notes*).
   a. (Optional) Disinfect the connection prior to disconnection. If this is done, use a separate antiseptic pad for the subsequent disinfection of the hub.
   b. Disconnect the blood line from the catheter and disinfect the hub with a new antiseptic pad. Scrub the sides (threads) and end of the hub thoroughly with friction, making sure to remove any residue (e.g., blood).
   c. Use a separate antiseptic pad for each hub. Leave hubs "open" (i.e., uncapped and disconnected) for the shortest time possible.
4. Always handle the catheter hubs aseptically. Once disinfected, do not allow the catheter hubs to touch nonsterile surfaces. Hold the catheter until the antiseptic has dried.
5. Attach the new sterile caps to the catheter aseptically. Use caution if tape is used to secure caps to the catheter (*see notes*).
6. Ensure that catheter is still clamped.
7. Remove gloves and perform hand hygiene.

MAKING DIALYSIS SAFER COALITION

CDC

CENTRAL LINE BUNDLE



METHODIST HEALTH SYSTEM

METHODIST WOMEN'S HOSPITAL

NICU

TITLE:	IV tubing and cap changes: Peripheral, Arterial, UVC, PICC & Central lines
ORIGINATION DATE:	2/11
REVIEWED DATE:	2/13, 9/14, 11/14, 11/17, 7/19, 7/22
REVISED DATE:	5/20, 4/24
PURPOSE:	To establish a guideline for consistent care when changing IV tubing to decrease the risk of infection.

POLICY:

IV tubing will be changed every 72 hours or every 24 hours with TPN and/or lipids and with IV solution changes.

IV tubing for continuous drip medications will be changed every 72 hours or every 24 hours if piggybacked into TPN and/or lipids at the same time as the carrying IV solution

Needleless access caps will be changed every Monday and Thursday or when: residual blood or debris is noted; the cap is removed for any reason, prior to drawing a blood sample for blood culture, or upon contamination, including a cracked or leaking cap.

Alcohol-impregnated port protectors (AIPP) will be placed on the IV tubing needleless connector port below the filter and on any capped line needleless connector port on UVC, PICC and Central lines. AIPP should be changed at least every 7 days. The only exception to this is on the connector port on the t-connector directly attached to the PICC line, as this is considered part of the PICC line and is not to be accessed, therefore will not have an AIPP placed on it.

All IV tubing will be labeled with start date/hr and discard date/hr and RN initials.

High alert medications and its IV tubing will be labeled.

Intravenous fluids with dextrose concentration greater than 12.5% will be administered into a central line (UVC, PICC or Central line catheter).

Never run an IV set up that has been running in a peripheral site into any central line.

Sterile IV tubing change is a two person procedure to ensure the process is completed in a sterile manner, as outlined.

STERILE LINE CHANGES

PROCEDURE:
IV TUBING CHANGE
This procedure is a two person procedure; one clean and one sterile person

1. Perform hand hygiene
2. Gather IV supplies and mayo stand and bring into room
3. Hang "Sterile Procedure" sign on infant's room door and close the door
4. Clean top of the mayo stand with germicidal wipes and allow to dry (allow contact time per manufacture). Gather IV fluids and any medication syringes to be changed
5. Together the clean and sterile person check and scan all fluids and any medication syringes to be hung
6. Perform hand hygiene
7. The clean person dons mask and clean gloves, sterile person dons mask and sterile gloves
8. Using aseptic technique, clean person opens the sterile drape package and the sterile person removes the drape and places it on top of the mayo stand.
9. Using aseptic technique, clean person opens the sterile supply packages to be used and drops them on the sterile drape
10. Sterile person assembles all tubing using all required components without contamination of the sterile field
11. The clean person holds the IV fluid bag while the sterile person spikes the bag and primes the tubing. If an extension set is to be used, at this point do not prime the pigtail(s) if a medication is to be connected to that port
12. If any fluid/medication syringes with attached tubing need to be piggybacked into the main line, the sterile person holds the connecting port on the main line tubing while the clean person connects the syringe tubing to it. The clean person will prime all piggybacked medication through the pigtail it is connected to
13. The clean person cleanses the connection site with an alcohol wipe using a vigorous friction rub for 15 second and allows to dry.
14. The clean person clamps the line near the connection site and disconnects the tubing. If residual blood or debris is noted, uses an alcohol wipe to scrub the catheter hub, making sure not touch the opening of the catheter, for 15 seconds and allow to dry
15. The sterile person securely attaches the new tubing to the catheter hub without contamination. If there is a need to displace air in the catheter hub, the sterile person may drip some mainline fluid into the catheter hub or the clean person may use a pre-filled saline syringe to accomplish this
16. The clean or sterile person places an IV tubing expiration label on the IV tubing:
    a. For a bag – just below the drip chamber
    b. For syringe – just below the syringe

17. The clean or sterile person places high alert labels as needed (Refer to labeling of high alert medications and high alert medication IV tubing section below):
    a. On front of IV bag/syringe being careful not to cover up any information
    b. Just below the IV tubing expiration label
    c. For a bag – at the end of the IV tubing near the injection port closet to the infant
    d. For a syringe – at the end of the IV extension tubing near the IV connection site closest to the infant
18. The clean or sterile person changes out all fluids and any medication syringes, appropriately programs pumps, begins infusions and then unclamps the line(s)
19. An AIPP will be placed on the IV tubing needleless connector port below the filter and on any capped line needleless connector port on a UVC, PICC and Central line. The only exception to this is on the connector port on the t-connector directly attached to the PICC line, as this is considered part of the PICC line and is not to be accessed, therefore will not have an AIPP placed on it.
20. Perform hand hygiene after glove removal

HANGING NEW FLUIDS/MEDICATIONS WITHOUT CHANGING THE IV TUBING

1. Cleanse the connection site with an alcohol wipe using a vigorous friction rub for 15 seconds and allow to dry
2. Clamp the tubing nearest to the connection site and disconnect the IV fluid bag/syringe. Securely attach the tubing to the IV fluid bag/syringe without contamination and unclamp tubing. If needed, displace any air in the syringe tubing with the new fluid prior to connecting the new syringe

LABELING OF HIGH ALERT MEDICATIONS AND HIGH ALERT MEDICATION IV TUBING

The appropriate colored high alert label set will be attached to the bag/syringe by the pharmacy for the following medications:

- Alteplase Infusion – Red label
- Chemotherapy – Black label
- Heparin (> 2 units/mL) – Red label
- Insulin – Red label
- Magnesium Sulfate – Purple label
- Potassium > 40 meq/L – Red label
- Sodium Chloride (> 0.9% concentration) – Red label

The person administering the high alert medication is responsible for placing the labels on the IV tubing.
A blank red high alert label set will be located with the IV supplies. The person administering a high alert medication is responsible for writing the name of the medication on the labels and applying them on the bag/syringe and its IV tubing on the following medications:

- Analgesia/Sedation (Morphine, Fentanyl, Midazolam, Lorazepam).
- Vasopressor infusions (Dopamine, Dobutamine, Epinephrine, Vasopressin).
- Calcium
- Digoxin

A green high alert IV Nutrition label set will be located with the IV supplies. The person administering TPN is responsible for labeling the TPN bag and its IV tubing.

A white blank label set will be located with the IV supplies for use with non-high alert medications and its IV tubing. These labels can be placed at the discretion of the person administering the medication.

Label examples:

High alert medication specific

High alert blank

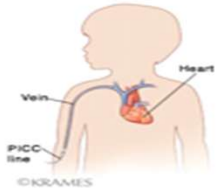
Non-High alert blank

PATIENT EDUCATION

Methodist Health System

Central Line Infections in the NICU

In the hospital, your baby may have a small, soft tube, called a catheter placed in a large vein. This is a central line (also called a venous catheter). It's often used when medications or nutrition need to be given over a period of weeks or months. But central lines come with a risk of infection. This sheet tells you more about central line infections, what hospitals are doing to prevent them, and how they are treated if one occurs.



Types of central lines:

- **Umbilical line**: This line is placed into the artery and/or vein in the umbilical cord. An umbilical artery catheter (UAC) is used for drawing blood for laboratory tests and for monitoring blood pressure. An umbilical venous catheter (UVC) is used to give IV medications or fluids.

Peripherally inserted central catheter (PICC): This line is placed in a large vein in the arm, scalp or leg. It's then threaded through the vein until the tip sits in the large vein just above the heart. It can also extend into the heart.

Tunneled catheter: This line is tunneled through the soft tissue under the skin before it enters a vein. It has a small cuff that helps hold the catheter in place.

Subclavian line: This line is placed through the skin directly into the subclavian vein, which runs behind the collarbone.

Internal jugular line: This line is placed into the internal jugular vein (a large vein in the neck).

- **Femoral line**: This line is placed in a large vein in the groin

Types of infections

A central line provides a direct path into the bloodstream. This gives germs a pathway for entry into the body. Germs can get into the catheter site or into the bloodstream. Often, the germs that cause a central line infection come from one's own skin. There are 2 possible types of infection:

- **Local infection**. This can occur where the central line enters the body. Symptoms include redness, pain, swelling or drainage at or near the entry site or along the path of the catheter.
- **Systemic infection**. This can occur if germs get into the bloodstream. A bloodstream infection can make your baby very ill and can even be fatal. Symptoms can include change in behavior and vital signs.

Risk factors for infection

Anyone who has a central line can get an infection. This risk is higher for those who:

- Are in the intensive care unit.
- Have an immature immune system or serious illness.
- Have the line in for an extended time.
- Have a central line in the neck or groin.

How central line infections are treated

Treatment depends on the type of catheter, how severe the infection is, and your baby's overall health. The doctor will prescribe antibiotics to fight the infection. The line may also need to be removed.

What hospitals do to prevent infection

Hospitals have a plan to reduce central line infections. This plan includes:

- Using good hand hygiene. Hospital staff clean their hands before and after touching the line. They use soap and water or an alcohol-based hand cleaner containing at least 60 percent alcohol.
- Using sterile practices during placement. The healthcare worker who places the line wears germ free (sterile) clothing including a long-sleeved and gloves. They also wear a mask. Before the line is placed, the baby's skin is cleaned with an antiseptic solution. During placement, the baby is fully covered with a sterile drape (a large, sterile sheet) except for the spot where the line is placed. After placement, the site where the line enters the body is covered with a sterile dressing unless it is a UAC and UVC line.
- Choosing a lower-risk vein. Whenever possible, the line is placed in a vein that has a lower risk of infection.
- Checking for infection: The line site is checked routinely for signs and symptoms of infection. It is removed as soon as it is no longer needed.

What parents/families can do to prevent infection

- Use good hand hygiene. Wash your own hands often with soap and water, and use alcohol-based hand sanitizer as directed.
- Make sure healthcare staff clean their hands. They should use soap and water or an alcohol-based hand sanitizer before and after checking the line. Don't be afraid to remind them.
- Do not touch the line. Even when your hands are clean, try not to touch the catheter or dressing.
- Talk to a healthcare worker if you have any concerns related to the catheter, catheter site or catheter dressing.

To protect the central line from germs, it's very important to wash your hands often and clean them well.

Follow the steps below for cleansing your hands with soap and water:

- Wet your hands.
- Apply enough soap to cover the entire surface of your hands, including your fingers.
- Rub your hands together briskly for at least 15 seconds. Make sure to rub the front and back of each hand up to the wrist, your fingers, fingernails, between fingers and each thumb.
- Rinse your hands with warm water.
- Dry your hands completely with a new, unused paper towel.
- Use the paper towel to turn off the faucet, then throw it away. If you're in a bathroom, also use a paper towel to open the door instead of touching the handle.

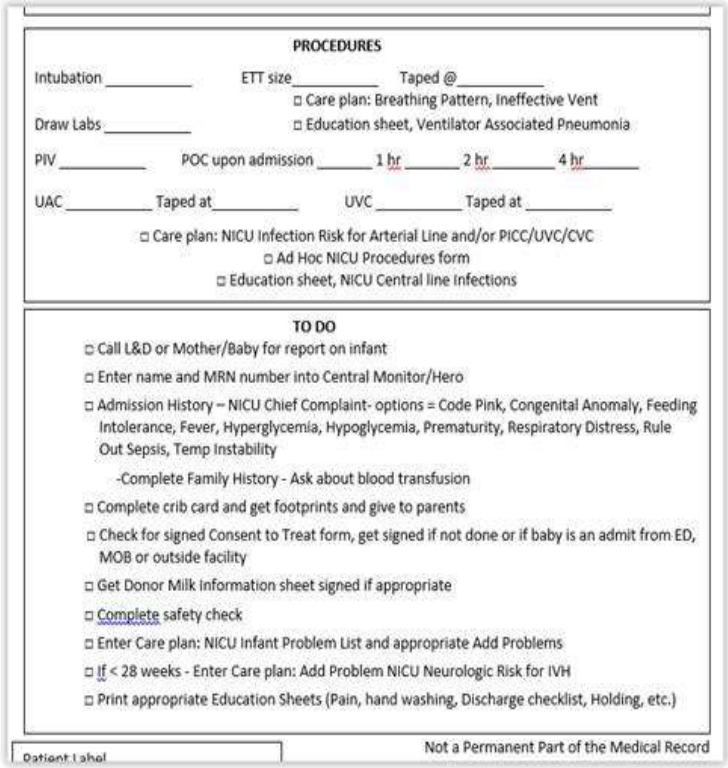
(Ctrl)

PATIENT EDUCATION

- Joint Commission mandates specific patient education that needs to be completed and document in the electronic medical record.
- All infants that are intubated or have a central line need to have specific teaching sheets added to the patient chart, specific care plan added to chart, education reviewed with family, and documented as appropriate. Please carefully review the information below for guidelines on the required patient education.

- Central Line Placement (UVC, PICC, Surgically placed Central Venous Catheter):
- Care Plan -- NICU Infection Risk for PICC/UVC/CVC
- Patient Education -- **NICU Central Line Infections**

- When any of these procedures are completed follow these steps:
  - · Document procedure, Time out, and add appropriate dynamic group (for the line placements)
  - · Add the appropriate care plan (listed above)
  - · Add and print specific patient education for family
  - · Review print education with family
  - · Document teaching completion/follow-up in appropriate Care Plan.



PROCEDURES

Intubation _____ ETT size_____ Taped @_____

□ Care plan: Breathing Pattern, Ineffective Vent

Draw Labs _____ □ Education sheet, Ventilator Associated Pneumonia

PIV _____ POC upon admission _____ 1 hr _____ 2 hr _____ 4 hr _____

UAC _____ Taped at_____ UVC _____ Taped at _____

□ Care plan: NICU Infection Risk for Arterial Line and/or PICC/UVC/CVC

□ Ad Hoc NICU Procedures form

□ Education sheet, NICU Central line Infections

TO DO

□ Call L&D or Mother/Baby for report on infant

□ Enter name and MRN number into Central Monitor/Hero

□ Admission History – NICU Chief Complaint- options = Code Pink, Congenital Anomaly, Feeding Intolerance, Fever, Hyperglycemia, Hypoglycemia, Prematurity, Respiratory Distress, Rule Out Sepsis, Temp Instability

-Complete Family History - Ask about blood transfusion

□ Complete crib card and get footprints and give to parents

□ Check for signed Consent to Treat form, get signed if not done or if baby is an admit from ED, MOB or outside facility

□ Get Donor Milk Information sheet signed if appropriate

□ Complete safety check

□ Enter Care plan: NICU Infant Problem List and appropriate Add Problems

□ If < 28 weeks - Enter Care plan: Add Problem NICU Neurologic Risk for IVH

□ Print appropriate Education Sheets (Pain, hand washing, Discharge checklist, Holding, etc.)

Patient Label

Not a Permanent Part of the Medical Record

EMOTIONAL SUPPORT

- Having a sick baby can be very scary for parents.
- Provide parents with emotional support.
- Assess support system and offer to contact them for the parents.
- Offer education in a timely manner. Do not overwhelm.
- Utilize resources – NNPs, Social Work, Attending RN, Developmental Specialist, Feeding Specialist, Cuddlers, etc

WELCOME TO ESCAPE THE NEONATAL EMERGENCY: SAVE THE PATIENT!

- **Escape Room Instructions:**
- • You will have 30 minutes to “escape” the neonatal emergency and save the patient.
- • The instructor will be present but will be unable to talk to you.
- • Use the Participant Guide to help solve the clues.
- • If you ask the instructor for help, you will lose a minute of your time!
- • One participant will be selected as the team leader by the instructor.
- • The timer will start once you open the START envelope.
- • Be respectful of the equipment in the room.
- • Do not force any equipment or locks open.
- • Do one puzzle at a time to facilitate collaboration and knowledge acquisition (no peeking; no jumping ahead).
- • Read all clues out loud, so all team members can hear and participate.
- • Work as a team.
- • Have fun!

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THANK YOU

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