Prevention of Device Associated Infections
in the Neonatal and Pediatric Cardiac Patient
What every nurse needs to know**.**

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Introduction:

Children with heart disease in the Pediatric Cardiac Intensive Care Unit (PCICU) are at risk for hospital-acquired infections given their complex physiologies and requirement for complex invasive procedures and supportive modalities. These guidelines will review important considerations for infection prevention specifically for ventilator associated pneumonia (VAP), catheter-associated urinary tract infections (CAUTI), and central line associated bloodstream infections (CLABSI). We will also make recommendations for antibiotic stewardship.

Introduction of the Problem:

Central venous lines, ventilators, and urinary catheters are routinely used for assessment and support of patients following cardiac surgery. However, these devices are responsible for up to 80% of hospital acquired infections. Device associated infections (VAP, CAUTI, and CLABSI) are linked with increased morbidity, mortality, length of stay, and overall hospital costs in all patients regardless of age or diagnosis. As of 2012, CAUTI was the leading device associated infection in pediatric cardiac patients followed by CLABSI, and then VAP. CAUTI are also a significant cause of secondary bloodstream infection. In 2009, the Centers of Medicare and Medicaid began to withhold reimbursement to hospitals, for the care associated with treating hospital acquired infections. Multiple studies have shown that utilizing "bundles of care" aimed at preventing these infections are more effective than singular modalities of care. A "bundle" is defined as a group of interventions that improve patient outcomes when followed by every member of the healthcare team

Critical Thinking Points for all Infection Prevention Bundles:

- Hand hygiene is the basis of all infection prevention initiatives. Perform hand hygiene:
    - Before and after contact with a patient or the patient's environment
    - Before and after manipulating an invasive device

    - Before and after wearing gloves
    - Wash hands with soap and water when visibly soiled and/or caring for a patient with *C-difficle*, Norovirus, or *Bacillus anthracis*
    - Educate healthcare personnel regarding indications for central venous line, endotracheal tube, and urinary catheter use; the proper procedures for the insertion and maintenance of these devices; and appropriate infection control measures to prevent device associated infections
- Periodically assess knowledge of and adherence to guidelines for all personnel involved in the insertion and maintenance of central venous lines, endotracheal tubes, and urinary catheters
- Create insertion checklists which empower staff to provide clinical reminders/feedback at the point of care if any of the sterile insertion practices are missed
- Develop a system of alerts or reminders to identify all patients with indwelling devices
- Assess the need for the continued use of indwelling devices on a daily basis and formulate a plan for their early removal if they cannot be discontinued
- Implement infection surveillance programs that include feedback of unit-specific infection rates, hand hygiene compliance, and indwelling device management
- Educate parents on the appropriate indications for and care of indwelling devices, the importance of hand hygiene, and encourage their participation in preventing healthcare associated infections

Prevention of Ventilator Associated Pneumonia

Critical Thinking Points:

The bundle to prevent ventilator associated pneumonia has four main components

- Elevation of Head of Bed 30 degrees or maintain the reverse Trendelenburg position for infants in isolettes or warmers. Elevating the HOB prevents aspiration of stomach contents, and prevents pooling of oral secretions in the posterior oro-pharynx
- Institute a comprehensive oral care program consisting of oral hygiene at least every 12 hours and oral care as needed:
    - Oral Hygiene: use a soft toothbrush with toothpaste, and sterile water to remove plaque from teeth, gums, and tongue. Use a gauze and sterile water to clean the gums and tongue of infants without teeth. Mechanical removal of plaque helps to prevent the colonization of microorganism in the mouth which can contaminate the lower airway.
    - Oral care: maintain moist lips and oral cavity, and the aspirate secretions from the posterior oro-pharynx prior to position change and as needed

- Drain ventilator condensate away from patient to prevent aspiration of contaminated fluid
- Assess the need for ventilation every day. Daily sedation vacations are recommended as soon as the patient is stable. Institute ventilator weaning and extubation as soon as possible

Modification of Risk Factors:

- Suctioning: Suctioning of the lower airway is a sterile procedure. Suction only as indicated for increased secretions or changes in patient status such as decreased tidal volumes or oxygen saturations, or increased work of breathing or peak inspiratory pressures. Instillation of physiologic saline is not recommended on a routine basis.
- Institute early enteral feeds: Enteral feeding supports the immune system and supports normal gastric flora, preventing the overgrowth of abnormal flora. Consider naso-jejunal feeds in patients at risk for reflux, and monitor feeding residuals to assess gastric motility and prevent gastric over-distention.
- Intubation/ re-intubation: Assure equipment used for intubation remains as sterile as possible, utilize a sterile towel for intubation equipment. Utilize other methods of respiratory support, such as nasal CPAP or high flow nasal cannula before intubation or re-intubation
- Equipment maintenance: Dispose of yankaur suction catheters every 24 hours at a minimum. Ventilator circuits should only be changed when contaminated with visible secretions, or malfunctioning.

Special considerations:

- Newborns and infants are at risk for developing oral aversion. Use soft suction catheters as opposed to yankaur suction catheters. Perform oral care when sedated if possible
- Avoid the use of products such as hydrogen peroxide and saline due to bitter taste
- Several outbreaks of infection have been linked to the use of over the counter mouthwash in intubated patients.
- Oral intubation allows for the drainage of the sinuses in older patients
- At this time, no recommendations can be made for the use of specific oral antiseptics in intubated pediatric and neonatal patients. The use of oral antibiotics has not been shown to be efficacious

Prevention of Catheter Associated Urinary Tract Infections

Critical Thinking Points:

The bundle to prevent catheter associated urinary tract infections has two main components: insertion and maintenance

Insertion bundle

- Insert catheters only for appropriate indications
    - Hemodynamically unstable patient with need for close monitoring of output
    - Medically complex patients with need for strict I&O (ie DI, DKA etc)
    - Chemically paralyzed or deeply sedated patient who are unable to void spontaneously
    - Patient with wound/ breakdown in sacral/genital area
    - Patient with physical obstruction of bladder
    - Patients at end of life for comfort
- Insert catheters using aseptic technique and sterile equipment

Maintenance bundle

- Maintain a closed drainage system
- Maintain unobstructed flow of urine
- Maintain level of urinary catheter bag below the hips

Modification of Risk Factors

- Duration of catheterization is the leading risk factor for CAUTI
- Provide devices, supplies, and techniques that allow alternatives to indwelling catheters (e.g., condom catheters, penis pouches, bladder scanners, incontinence products)
- Utilize a prepackaged kit or insertion cart or tray to assure all items needed for sterile urinary catheter insertion are available
- Develop guidelines and protocols for nurse-directed removal of urinary catheters
- Develop protocols for management of urinary retention, such as nurse directed use of bladder ultrasound and intermittent catheterization as appropriate

Special considerations

- Patients in renal failure do not need urinary catheters. Utilize bladder scanner and straight catheterization to assess urine output as indicated
- Secure urinary catheter appropriately to decrease urethral trauma
- Use as small as a catheter as possible to minimize urethral damage

Prevention of Central Line Associated Blood Stream Infections

Critical Thinking Points:

The bundle to prevent central line associated bloodstream infections has three main components: insertion, maintenance: dressing changes, and maintenance: equipment and access

Insertion bundle:

- Utilize maximum sterile barriers (gloves, gown, mask, patient drape) during central venous line insertion
- For all children > 2 months, disinfect skin with a > 0.5% chlorhexidine gluconate antisepsis, scrub the insertion site for 30 seconds for all areas, except the groin and internal jugular, which should be scrubbed for 2 minutes, and followed by 30 to 60 seconds of air drying
- If there is contraindication to chlorhexidine, or for infants <2 months, 70% alcohol, tincture of iodine or iodophor can be used. Allow product to fully dry on skin before insertion

Maintenance bundle: Dressing changes

- Use chlorhexidine gluconate antisepsis to disinfect central line sites for dressing changes, (30-sec scrub, 30-sec dry for dry areas, 2 minutes for the groin area
- Use either gauze or sterile, transparent, semi permeable dressing to cover the catheter site.
- Replace the gauze dressings every 2 days, and transparent dressings every 7 days, unless they are soiled, damp or loosened.
- Monitor the catheter sites visually during dressing changes or by palpation through an intact dressing regularly. Encourage patients to report any changes or discomfort in their catheter.

Maintenance: Line care and line access

- Replace administration sets including secondary sets and add on devices, no more frequently than at 96-hour interval, but at least every 7 days.
- Replace administration sets used to administer blood, blood products, or lipids every 24 hours.
- Replace pressure monitoring components (transducers, tubing, flush device and flush solution) at 96 -hour interval
- Change caps or other needleless connectors no more frequently than every 72 hours or according to manufacturers' recommendation.
- Minimize contamination risk by scrubbing the central line access ports with the appropriate antiseptic (chlorhexidine gluconate, povidine iodine, an iodophor, or 70% alcohol), and accessing the port only with sterile devices.

Modification of Risk factors:

- Utilize a prepackaged kit or insertion cart or tray to assure all items needed for sterile line insertion are available
- Do not use topical antibiotic ointment or creams on the insertion site, as this will lead to fungal overgrowth
- Use gauze dressing if the patient is diaphoretic or site is bleeding

- Use a suture less securement device to secure central venous line
- When adherence to aseptic technique during central line insertion cannot be ensured, (pre-hospital, code situations), replace the catheter within 48 hours as soon as possible.
- Use a chlorhexidine- impregnated sponge dressing in patients older than 2 months of age if the CLABSI rate has not been substantially reduced.
- Consider introduction of antibiotic impregnated central venous catheters if CLABSI infection rates do not improve after introduction and reliable implementation of infection prevention initiatives
- A daily bath with Chlorhexidine wipes, in patients over 2 months of age with a central venous line, has been shown to decrease CLABSI rates
- Use a split septum valve when a needless system is used due to increased risk of infection with mechanical valve.? Should this state positive pressure valve?
- Minimize central line entries by using peripheral IVs, transitioning medications from parenteral to enteral as soon as possible, and minimizing blood draws

Special Considerations

- Iodine containing products are readily absorbed by pre-term and some term infants. It is recommended that 70% alcohol be used for skin disinfection in this population
- The use of Chlorhexidine in patients under 2 months of age as an antiseptic agent is widespread in U.S. hospitals. The potential for skin irritation and systemic absorption of Chlorexidine exists, and the benefit of CLABSI reduction versus the risk of chlorhexidine must be considered in this age group.

Antimicrobial Stewardship Program

Introduction to the Problem:

Antibiotics are amongst the most common therapies used for pediatric patients in acute care hospitals and have contributed to rising health care costs. Moreover, there is mounting recognition that inappropriate antibiotic use has led to the emergence of antibiotic resistance as well as an increase in morbidity and mortality. Therefore, Antimicrobial Stewardship Programs (ASPs) are being promoted as a means to limit antimicrobial resistance and improve quality of care. In 2007, the guidelines for institutional ASPs by the Infectious Diseases Society of America (IDSA) highlighted the need for evaluation of ASPs in pediatric specialty settings.

Critical Thinking Points:

The primary goal of ASPs is to optimize clinical outcomes while minimizing unintended consequences of antibiotics such as toxicity, development of pathogenic organisms, and antibiotic resistance. A secondary goal of ASPs is to decrease health care costs without

comprising the quality of care. Lastly, ASPs can standardize clinical practices, monitor prescription patterns and optimize antimicrobial use.

Elements of an Antimicrobial Stewardship Program:

- Prospective audit with intervention and feedback by way of an infectious disease physician or a clinical pharmacist with infectious disease training can result in reduced inappropriate use of antimicrobials and identify valuable information on current practice.
- Formulary restriction and preauthorization requirements for specific agents may lead to reduction in antimicrobial use and cost; however, controlling antimicrobial agents is less clear on the long-term benefits on resistance.
- Education is the fundamental foundation of ASPs; however, integration of active intervention is the only effective strategy to effect antimicrobial prescribing practices.
- The use of existing guidelines and clinical pathways in the literature has facilitated the development of evidence-based guideline which includes local microbiology and resistance patterns to improve antimicrobial decision-making. Furthermore, the standardization of practices has improved patient outcomes, reduced medical errors, and unnecessary health care costs.
- Utilization of culture and susceptibilities to determine the correct drug has been determined to be useful unlike the use of antimicrobial cycling which hasn't shown a significant reduction in resistance.
- Critically-ill patients experienced improved clinical outcomes and less resistance when broad-spectrum empirical therapy was employed for serious infections. However, there is insufficient data to support routine use of combination therapy to prevent emergence of resistance.
- A considerable cost saving measure is the de-escalation of antimicrobials once culture results become available by eliminating the use of redundant therapy to a more targeted therap.
- An important step in the antimicrobial program is the optimization of dosing for individual patient characteristics, causative organism and site of infection, pharmacokinetic and pharmacodynamics characteristics. Likewise, ASPs need to account for pediatric prescribing patterns.
- A beneficial component is the conversion of parenteral to oral therapy when the patient's clinical status improves for antimicrobials with excellent bioavailability, can reduce length of hospital stay and hospital care costs.
- Computer surveillance can improve antimicrobial decisions by incorporation of patient-specific microbiology cultures and susceptibilities, hepatic and renal function, drug-drug interactions,

allergies, and cost. Furthermore, computer surveillance can foster good stewardship by identification of antimicrobial resistance patterns, and prevent adverse drug events.

- A critical element of an antimicrobial stewardship program is the clinical microbiology laboratory by providing patient-specific cultures and susceptibilities in order for clinicians to customize a patient's antimicrobial management.
- The impact of the ASPs needs to have a dedicated process to measure and quantify the impact and outcomes of the ASPs.

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