Antimicrobial Stewardship Program in a Neonatal Intensive Care Unit: A Case Study at a Tertiary Teaching Hospital in Lebanon

 Therese Saad Rameh-Chebli, D Pharm, BCPS, BCPPS  
 Pediatric Team Leader - Pharmacy Department - AUBMC

 Dina Itani Chehab, B.S.Pharm, MPH, R.Ph.  
 Senior Attending Clinical Pharmacist - Pediatric Team - Pharmacy Department - AUBMC
“Therese Saad & Dina Itani” declare to meeting attendees that there are no financial relationships with any for-profit companies that are directly or indirectly related to the subject of this presentation.
Learning Objectives

- Describe antibiotic use in the neonatal intensive care unit (NICU)
- Review the elements and goals of an effective antimicrobial stewardship (AMS) program as it applies to the NICU
- Outline the role of the pharmacist in the AMS team in NICU
- Share the American University of Beirut Medical Center experience after implementation of AMS program in NICU
Timeline of Antibiotic versus Resistance; NICU Implications

https://www.cdc.gov/drugresistance/about.html
Problem Statement

- Antibiotics are among the most commonly prescribed medications in the neonatal intensive care unit: 43% of NICU patients
- 35% of neonates received at least one inappropriate dose due to continuation of antibiotic versus initiation
- Antimicrobial resistance responsible of about 30% of deaths from neonatal sepsis worldwide

Definitions

- Neonatal Sepsis (NS): Is defined as a clinical syndrome of bacteremia with systemic signs and symptoms of infection in the first 4 weeks of life

- Early Onset Sepsis (EOS): Sepsis occurring within 72 hours of birth, typically caused by organisms transmitted vertically from the mother to the infant before or at the time of birth. Manifests mainly as pneumonia

- Late Onset Sepsis (LOS): Sepsis occurring after 72 hours of life, caused by pathogens acquired at delivery or during the course of hospital care. Manifests as septicaemia, meningitis, osteomyelitis, arthritis and urinary tract infection

- Culture Negative Sepsis (Clinical Sepsis): Suspicion of sepsis in the event of potential other pathologic conditions with overlapping clinical presentations with negative cultures
What are Antibiotics being Prescribed For?

<table>
<thead>
<tr>
<th>Potential infection</th>
<th>Presumed infection</th>
<th>Proven infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>“At risk of sepsis”</td>
<td>“Clinical sepsis”</td>
<td>“Definite sepsis”</td>
</tr>
<tr>
<td>This category includes:</td>
<td>This category includes:</td>
<td>This category includes infections associated with positive cultures:</td>
</tr>
<tr>
<td>▪ Rule-out sepsis course</td>
<td>▪ Ventilator-associated</td>
<td>▪ Blood: CLABSI or BSI</td>
</tr>
<tr>
<td>▪ Perioperative course</td>
<td>pneumonias</td>
<td>▪ Other sterile sites: CSF, peritoneum, abscess, pleura, etc</td>
</tr>
<tr>
<td></td>
<td>▪ A Neonatal diagnosis often</td>
<td>▪ Local infections: Cellulitis, thrombophlebitis, etc</td>
</tr>
<tr>
<td></td>
<td>described as difficult to</td>
<td></td>
</tr>
<tr>
<td></td>
<td>make</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Episodes of abdominal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>dysfunction (from feeding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>intolerance to necrotizing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>enterocolitis (NEC))</td>
<td></td>
</tr>
<tr>
<td>Discontinued treatment within 4 days</td>
<td>Course lasting $\geq$ 5 days (+/- antibiotic change)</td>
<td>Treatment usually ranges between 14 to 21 days guided by cultures</td>
</tr>
</tbody>
</table>

Potential infection: Category includes infections before positive cultures. Presumed infection: Category includes infections associated with positive cultures. Proven infection: Category includes infections associated with positive cultures.
Types of Antibiotic Therapy in Neonates

- **Empiric therapy**
  - When infection is suspected but cultures are pending

- **Definitive therapy**
  - When an organism has been identified

- **Prophylactic therapy**
  - Prevention of postoperative infection
Etiology of Infections

- Common Organisms Identified:
  - Escherichia Coli (E.coli)
  - Group B Streptococci (GBS)
  - Listeria Monocytogenes
  - Others:
    - Coagulase Negative Staphylococci (CoNS)
    - Klebsiella Pneumonia
    - Acinetobacter species
    - Pseudomonas Aeruginosa
    - Candida
Choice of Antibiotics

Early onset sepsis (GBS, E.coli)
- Ampicillin & Gentamicin
- Cefotaxime if Meningitis

Late onset sepsis (Staph Coag neg, gram negative)
- Oxacillin & Gentamicin
- Vancomycin if MRSA

NEC/Abdominal infections (Polymicrobial)
- Ampicillin/Gentamicin/Metronidazole
- Vancomycin/Meropenem

Perioperative Prophylaxis
- No standardization
- Based on surgery site

References

Antibiotic Overuse and Misuse in NICU

- One study of an advanced NICU found that 72% of infants received antibiotics, although only 5% had a culturally proven infection.

- Study from UT Southwestern NICU where prospective recording of antibiotic use was performed for 14 months where 1607 infants received antibiotics for 9165 days
  - 94% of antibiotics were empiric for “suspected infection”
  - 26% of antibiotics were continued for >5 days despite negative cultures (Reasons given were “pneumonia” and “culture negative sepsis”)

- Another study of 127 NICUs in California found rates of antibiotic use ranging from 2.4% to 97.1% of patient-days. This variability was not correlated to rates of proven infection, surgical volume, or NICU mortality.
Why Should We Limit Antibiotic Use in the NICU?

- Broad spectrum antimicrobial use in the NICU has been associated with:
  - Emergence of multi-drug resistant gram negative bacilli
  - Development of invasive candidiasis and colonization with candida

- Prolonged duration of empiric antibiotics for early onset sepsis in ELBW infants has been associated with:
  - Increased mortality
  - Increased rates of NEC
  - Late onset sepsis
Unique Challenges in Antibiotic Prescribing in NICU

Non-specific signs of sepsis and frequent occurrence of culture-negative infections “Clinical Sepsis”

Adequate blood quantities may not be feasible to obtain for culture

Treatment guidelines are often not established for infants, particularly for preterm neonates

Difficulties in dosing and therapeutic drug monitoring due to the limited pharmacokinetic and clinical studies

Efforts to Combat Antimicrobial Resistance

- 2003 CDC “Get Smart: know when ABX work” Campaign
- 2007 IDSA & SHEA guidelines
- 2012 IDSA/SHEA & PIDS
- 2015 White House NAP to combat ABX resistance
- 2016 WHO Global Action Plan
- 2017 JCI New AMS standard
- 2020 all healthcare delivery system will demonstrate AMS
Fighting Back Against Antibiotic Resistance

- Infection prevention **IS** antibiotic Stewardship!
- Tracking infection prevention data has double value
  - HAI prevention
  - Informs antibiotic stewardship programs
- Get Smart About Antibiotics prescribing
- Bacteria are constantly evolving, requiring the need for new antibiotics

https://www.cdc.gov/drugresistance/pdf/4-2013-508
What is Antibiotic Stewardship?

Antibiotic stewardship refers to a set of commitments and activities designed to “optimize the treatment of infections while reducing the adverse events associated with antibiotic use.”

Multidisciplinary team with goal ...

• to have the **RIGHT DRUG**
• for the **RIGHT PERSON**
• over the **RIGHT TIME FRAME**

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Clinical infectious diseases. Dellit, T. H. et al. 2007; 44(2) 159-177.
Outcomes of Antimicrobial Stewardship

- Improve patient outcomes
- Limit toxicity and ADE
- Improve rate of antibiotic susceptibilities
- Decrease infections & health care costs
- Optimize resource utilization

AMS

Strategies for Improved Antimicrobial Prescribing

- Ensure antibiotics are indicated

- Select an appropriate antibiotic with a **narrow spectrum** if possible to minimize collateral damage

- Ensure that antibiotic durations are evidence-based and take into account clinical response. Use the **shortest appropriate length of therapy**

- Remember to **re-evaluate** therapy based on culture results, laboratory data, clinical status, etc. **De-escalate** therapy, convert IV to PO, and discontinue therapy when appropriate
CDC’s Core Elements of Antibiotic Stewardship

- **Leadership Commitment**: Dedicate resources
- **Accountability**: Appoint a leader responsible for implementation
- **Drug Expertise**: Appoint a pharmacist leader
- **Actions To Improve Use**: Implement at least one recommended action
- **Tracking**: Monitor antibiotic prescribing and resistance patterns
- **Reporting**: Regular report on antibiotic use and resistance
- **Education**: Train staff, residents, and families about resistance and optimal prescribing
Where to Start....

- Get ‘Buy-in’ from NICU leadership
- Understand the ‘culture of the NICU’
- Decide on AMS interventions based on resources available
- Develop an AMS Team
- Develop metrics with clinicians
- Track progress, share data, and adjust AMS interventions accordingly
Antimicrobial Stewardship Framework

Before Rx

- Antimicrobial Formulary Restriction Order Sets
- Audits & Reports Education Guidelines
- Prescriber

After Rx

- Audit with “real-time” Feedback
  IV to PO Dose Optimization
- De-escalation Clinical Decision Support
  Rapid Testing
- Antimicrobial Rx
- Patient

ACTIVE

PASSIVE

**Antimicrobial Stewardship Team**

- **Neonatologist**
  - NICU Champion
  - Implement clinical decisions with residents and nurses

- **Infection Disease Physician**
  - Timely/appropriate Ab management
  - Prospective audits with interventions and feedback
  - Streamlining and de-escalation
  - Guidelines and Clinical Pathways

- **Clinical Pharmacist**
  - Monitor antibiotic use
  - Appropriate administration

- **Hospital Administrator**
  - Program Funding
  - Institutional Policy

- **Infection Control Professional**
  - Surveillance
  - Prevent emergence and cross-transmission of MDROs
  - Hand Hygiene

- **Nurses**
  - Education

- **Microbiologist**
  - Timely and accurate result reporting

Develop Metrics to Monitor Success

**Clinical**
- Length of stay
- Clinical cure/failure rates
- Readmission rates (30 days)
- Resistance rates
- Infection-related mortality
- *C. Difficile* infections

**Process**
- Dose optimization
- Adherence to hospital specific guidelines
- Appropriate de-escalation/streamlining
- Appropriateness of therapy
- Cultures before antibiotics

**Humanistic**
- Adverse drug events avoided
- Time to receipt of appropriate antimicrobials
- Duration of antimicrobial therapy
- IV/PO conversion rates
- Outpatient intravenous therapy rates

**Economic**
- Antimicrobial utilization (DDD or DOT or LOT)
- Hospital wide antimicrobial expenditures
- Relative consumption
- Rate of intravenous antimicrobial use
- Nonformulary agents avoided

**Outcomes**

“Pharmacist have a responsibility to take prominent roles in antimicrobial stewardship programs and participate in the infection prevention and controls programs of Health Systems”

American Society of Health-System Pharmacists
Position Statement, 2010
Common Roles and Duties of Specialist Antimicrobial Pharmacist

- Writing antimicrobial guidelines and policies
- Making anti-infective formulary decisions & Managing the implementation/introduction of new agents
- Performing multidisciplinary antibiotic review rounds & Attending ward rounds on specialities with high antibiotic use
- Attending infection control committee meetings
- Maintaining awareness of local resistance patterns/Antibiograms
- Education for all levels and specialties of staff
- Monitoring and surveillance of antimicrobial usage
- Auditing and review of antimicrobial use & Contributing to quality targets
- Antimicrobial therapeutic drug monitoring advice and guidance.
There are Two Ways Pharmacy Is Adapting to the Need for AMS

1. Lots of personnel (interventions)
2. Usually not specialty trained
   High-level interventions may not be possible
3. Continuous education of new personnel

1. Limited number of personnel
   (limited interventions)
2. Usually specialty trained
   (PGY2/3)
3. High-level interventions possible

Congratulations, you are all now doing ASP activities!!

Specific Examples of NICU Stewardship

Effect of antibiotic use on antimicrobial antibiotic resistance and late-onset neonatal infections over 25 years in an Australian tertiary neonatal unit
David Carr, Elizabeth Helen Barnes, Adrienne Gordon and David Isaacs

Arch Dis Child Fetal Neonatal Ed 2017 102: F244-F250 originally published online October 13, 2016
doi: 10.1136/archdischild-2016-310905

What this study adds?
- Antibiotics were stopped safely after 2–3 days for 90% of neonates in a tertiary neonatal unit.
- The incidence of late-onset sepsis fell over time, particularly in infants born weighing <1500 g.
- Responsible antibiotic use did not prevent the emergence of resistant Gram-negative bacilli.
Neonatal Antimicrobial Stewardship Program at AUBMC

- AUBMC is a regional 365 bed academic tertiary care teaching hospital
- JCI, Magnet® accredited
- 21 beds Level IV Neonatal Intensive Care Unit (NICU) fully equipped to take care of premature newborn starting 24 weeks gestation and neonates with congenital anomalies (cardiac, metabolic and neurologic...)
- Antimicrobial Stewardship Program was implemented in June 2017
The design process for this ASP began in January 2017

Only component of an ASP that existed was formulary restriction for selected antimicrobials

A multidisciplinary team was formed: Attending neonatologist, Infectious disease attending physician, and Pediatric Clinical Pharmacy Specialist.

Review of medical literature was done to develop clinical guidelines to curtail provider-to-provider variability in prescription.

Recommendations included standard duration of treatment for EOS, LOS, clinical sepsis, and postoperative antibiotic prophylaxis 48 hours time-out.
Program Design and Implementation

- A unit-wide educational effort was launched in January 2017
- The program was officially launched on June 1, 2017
- To facilitate implementation a Pediatric Clinical Pharmacist attended daily patient care rounds
- Daily review of all prescribed antimicrobials, results of cultures and assessment of therapy was performed by ASP team members
- Timely feedback and Discussion with the clinical care team (de-escalation of therapy, shorten duration of therapy, discontinuation in the setting of negative cultures and resolution of clinical signs of infection)
ASP team met quarterly to review data, discuss feedback, address strategic issues and make modifications.

Results of this review shared with all the neonatologists during the monthly division meeting, especially deviations from the agreed guidelines.
## AUBMC Experience: AMS Core Elements

<table>
<thead>
<tr>
<th>Leadership Commitment</th>
<th>Launching in June 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accountability</td>
<td>Leader: Neonatologist</td>
</tr>
<tr>
<td>Drug Expertise</td>
<td>NICU Clinical Pharmacist</td>
</tr>
<tr>
<td></td>
<td>Pediatric Infectious disease physician</td>
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<tr>
<td>Actions</td>
<td>Guidelines developed for each specific indication for ABX use</td>
</tr>
<tr>
<td></td>
<td>“Antibiotic time out” at 48 hours</td>
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<td></td>
<td>Prospective audit + Restriction</td>
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<td></td>
<td>Dose adjustment and TDM</td>
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<tr>
<td></td>
<td>De-escalation</td>
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<tr>
<td>Tracking</td>
<td>Following up on Antibiograms and resistance patterns</td>
</tr>
<tr>
<td></td>
<td>Monitoring ABX prescribing patterns</td>
</tr>
<tr>
<td>Reporting</td>
<td>Data collected Prospectively</td>
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<tr>
<td></td>
<td>Results presented in the Neonatology division to discuss variability in pattern of ABX prescribing according to attending neonatology on service</td>
</tr>
<tr>
<td>Education</td>
<td>Meeting with physicians neonatologist</td>
</tr>
</tbody>
</table>
Guidelines and Algorithms

Evaluation of Asymptomatic Infants < 34 weeks of gestation with risk factors for EOS

1. **Chorioamnionitis or PROM > 18 hours or IAP indicated but not adequate**
   - Blood cultures at birth CBC, CRP at 6-12 hours
   - Start antibiotics: Ampicillin/amoxicillin + gentamicin
   - Management

   - **Blood culture positive**
     - Discontinue antibiotic
     - Continue antibiotic
     - Adjust antibiotic choice and duration to organism

   - **Blood culture negative**
     - Infant well
     - Labs abnormal
     - Repeat labs q24-48 hours
     - Treat for 5-7 days
     - Shorter course may be considered if labs not far from normal or normalize rapidly

   - **Blood culture negative**
     - Infant well
     - Labs normal
     - Discontinue antibiotics within 48 hours
Guidelines and Algorithms

Evaluation of Asymptomatic Infants ≥ 34 weeks of gestation with risk factors for EOS

- Chorioamnionitis or PROM > 18 hours or IAP indicated but not adequate
- Use the early onset sepsis calculator to assess risk of sepsis

If routine care indicated:
- No further evaluation
- Observe clinically for 48 hours

If blood culture indicated:
- Blood culture and CBC, CRP at 6-72 hours

Blood culture positive:
- Do LP
- Start antibiotics

Blood culture negative:
- Infant well
- Labs abnormal
- Labs normal

Start antibiotics
- Repeat labs q24-48 hrs.
- Trial for 48 hours 5 days

Observe 48-72 hours
Evaluation of Asymptomatic Newborn ≥ 34 weeks of gestation with risk factors for EOS (cont’d)

If sepsis calculator suggest empiric antibiotics and infant is asymptomatic

Blood culture
CBC, CRP at 6-12 hours
Clinical reevaluation

Start antibiotics:
Ampicillin/amoxicillin + gentamicin

Blood culture positive
Do LP
Adjust antibiotic choice and duration to organism

Blood culture negative
Infant well
Labs abnormal

Repeat labs q24-48 hours
Treat for 48 hours - 5 days

Blood culture negative
Infant well
Labs normal

Discontinue antibiotics within 48 hours

ABX Stewardship
Evaluation of Symptomatic Newborn ≥ 34 weeks of gestation with risk factors for EOS

- If sepsis calculator suggests empiric antibiotics and infant is symptomatic or treatment is infant is symptomatic and treatment will be given regardless of calculator.

- Blood culture
  - CBC, CRP at 6-32 hours
  - Clinical reevaluation
  - If patient is ill looking or there are signs suggestive of meningitis, CSF studies and culture

- Start antibiotics: Amoxicillin/amoxicillin + gentamicin
  - If meningitis suspected consider adding cefotaxime

- Blood culture positive
  - DG LP
  - Adjust antibiotic choice and duration to organism

- Cultures negative
  - Symptoms resolved
    - Labs abnormal
      - Repeat labs q24-48 hours
      - Treat for 4 hours-5 days
    - Labs normal
      - Discontinue antibiotics within 48 hours
Guidelines and Algorithms

Evaluation and Management of Infants with risk factors for LOS

- Clinical signs of sepsis >72 hours of life
  - Document risk factors:
    - ELBW
    - Extreme prematurity
    - CVC >10 days
    - No breast milk intake
    - Delay in enteral feeds
    - Prolonged early antibiotic
  - Labs: CBC, CRP
    - Blood culture 1ml
    - Urinalysis, GS and culture
    - CSF studies, GS and culture

  - Signs and symptoms suggestive of serious infection:
    - Abnormal vital signs (hypotension, temperature instability, tachycardia)
    - Toxic looking infant
    - Significant respiratory deterioration
    - Hypoglycemia
    - Acidosis
    - Thrombocytopenia
    - Leukopenia

  - Colonized with or has history of resistant organisms
    - Yes
      - Vancomycin or oxacillin + meropenem or
      - vancomycin or oxacillin + piperacillin-tazobactam
      - vancomycin or oxacillin + ceftotaxime + gentamicin or amikacin
    - No
      - Oxacillin + amikacin
      - Or
      - Oxacillin + gentamicin + cefotaxime

  - If clinical signs resolve in less than 24 hours and cultures negative get serial labs and stop antibiotics once RDS normal
    - If clinical symptoms last more than 24 hours, treat 5-7 days even if cultures negative

  - Labs abnormal
    - Oxacillin + gentamicin

  - Labs normal with risk factors for sepsis
    - Oxacillin + gentamicin

  - Labs normal without risk factors for sepsis
    - Observe and follow cultures and serial labs

  - Stop antibiotics within 48 hours if clinical symptoms resolve in 24 hours and cultures negative
Study Design and Outcomes

- Quasi-experimental study with interrupted time series aimed at determining the impact of an ASP on antimicrobial utilization in the AUBMC NICU

- The pre-intervention period was defined as January 1, 2015, through December 31, 2016, and the stewardship period was June 1, 2017, through May 31, 2018

- Our primary outcome measure was length of therapy (LOT) per 1000 patient days (PD), compiled monthly.

- Data were collected retrospectively from the AUBMC health information system

- The aggregate sum of antimicrobial use in our NICU included any antibacterial or antifungal administered IV, IM or orally and excluded antivirals, topical, ophthalmic and nebulized antimicrobials.
Statistical Analysis

- Descriptive data for the entire NICU population admitted during the study period were compared between pre-intervention and stewardship period.

- \( \chi^2 \) test for dichotomous data and independent t test for continuous data.

- A 2 sided P value of <0.05 was considered statistically significant.

- All analysis were performed with SPSS software version 20.
## Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre-implementation (N=247), No.(%)</th>
<th>Stewardship (N=167), No.(%)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth weight, g ± SD</td>
<td>2314.5 ± 957.7</td>
<td>2489.2 ± 993.2</td>
<td>0.652</td>
</tr>
<tr>
<td>Gestational age, weeks ± SD</td>
<td>34 ± 4.5</td>
<td>34.5 ± 4.5</td>
<td>0.509</td>
</tr>
<tr>
<td>Extremely low birth weight</td>
<td>39 (16%)</td>
<td>24 (13.5%)</td>
<td>0.148</td>
</tr>
<tr>
<td>Gender</td>
<td>Male 146 (59.1%) Female 101 (40.9%)</td>
<td>Male 95 (56.9%) Female 72 (43.1%)</td>
<td>0.653</td>
</tr>
<tr>
<td>Any culture-proven bloodstream and/or cerebrospinal fluid infection</td>
<td>35 (14%)</td>
<td>26 (15.5%)</td>
<td>0.377</td>
</tr>
</tbody>
</table>
Results

- Overall antibiotic utilization decreased by 32% during the stewardship period. This decrease was not statistically significant (p=0.669)
Results

- Antibiotic utilization in EOS decreased by 34.5% during the stewardship period. This decrease was statistically significant (p=0.048)

- Antibiotic utilization in LOS decreased by 20.67% during the stewardship period. This decrease was not statistically significant (p=0.254)

- Antibiotic utilization in post-operative prophylaxis decreased by 42.48% during the stewardship period. This decrease was statistically significant (p=0.015)
Results

- Use of ampicillin decreased significantly by 33.98 LOT per 1000 PD following initiation of our ASP (P=0.012)

- Gentamycin use declined significantly by 39.82 LOT per 1000 PD following initiation of our ASP (P=0.006)

- Vancomycin, meropenem and amikacin utilization appeared to decline during the stewardship period, but the trend was not statistically significant (P=0.241, P=0.261, P=0.151)
Limitations

- LOT per 1000 PDs was used as our main outcome measure,
- DOT per 1000 PDs is most used indicator for ASP in Pediatrics
- No optimal metric has been defined

- Sample size in our study was not large enough and this might have affected the significance in our study

- Increase in rate of Out Born admissions: higher rates of infections with MDRs bacteria (36% vs 26%)
Future Interventions

- Coordinating with Obstetricians:
  - Reduce ABX exposure in perinatal period
  - Adherence to ABX prophylaxis during pregnancy

- Organizing with other NICU quality efforts
  - Prevention of preterm delivery
  - Adherence to infection prevention strategies (CLABSI Bundle...)

- Building a Research Infrastructure
  - Using EHR to obtain metrics
  - Multicenter collaborations
Key Takeaways

- **Key Takeaway #1:**
  AMS in NICU requires various considerations that differ from those in adult-focused programs
  - Challenges related to perinatal infection and non-specific clinical signs of sepsis

- **Key Takeaway #2:**
  Key targets for neonatal stewardship focus on defining the elements of diagnosis of EOS, accurate evaluation of LOS and duration of prophylaxis of surgical site infection.
Key Takeaways

- **Key Takeaway #3:**
  Neonatal pharmacy specialists have an important impact in stewardship of antimicrobials in a variety of ways.

- **Key Takeaway #4:**
  Implementation of a NICU-specific antimicrobial stewardship program is feasible and has the potential to:
  - Reduce antibiotic overuse and misuse
  - Impact neonatal morbidities and mortality in this extremely vulnerable category of patients
Question 1:

Ben is 20 days old male new born infant born at 26 week gestation. During round, RN reports to Medical Staff that baby has low grade fever, increase in the number of Apneas despite caffeine and hypo activity with some abdominal distention. Baby was on full feed with no central line. Full sepsis work up was performed and Diagnosis of sepsis likely secondary to UTI.

Which of the following statements provides the best stewardship targeted rationale for appropriate use of meropenem in this infant?

1. The patient is critically ill
2. E. coli isolates are 100% susceptible to meropenem
3. A penicillin allergy is documented in the chart
4. The patient has a history of UTI due to MDR E. coli
Test your Knowledge

Question 2:

Which one of the following best exemplifies the CDC’s core principles of AS?

1. Recommend “bottom-up” work without senior leadership awareness.
2. Require that a physician lead the team so that recommendations are taken seriously.
3. Require submission of data to the National Healthcare Safety Network (NHSN) because that is the responsible thing to do.
4. Require a pharmacist on the team to provide drug therapy expertise.
Question 3:

- Your local AS team is looking for ideas for your next project, and each discipline on the team is going to post a query to its most active organizational chat room. You are going to post to the ACCP Pediatrics PRN NICU e-mail list. Which one of the following is the most meaningful question to ask about AS?

1. What rapid detection method are you using in the microbiology laboratory?
2. What is your CLABSI rate?
3. What is your SMART aim for AS in your NICU?
4. What disciplines are represented on your AS team?
Test your Knowledge

Question 4:

Pharmacists might use clinical intervention data for AS projects. Which one of the following best describes the optimal use of clinical intervention data?

1. Best used to identify specific individuals who are non-adherent to prospective review criteria
2. May show opportunities to recommend improvements if some aspect of drug selection or dosing is not occurring as desired
3. Can be used to penalize pharmacists who fail to document interventions as directed by pharmacy managers
4. A reliable source of information on order-to-dose types of time-dependent outcomes
Special Acknowledgement

- ASP NICU team:
  - Dr. Najwa Al Zaghal, Neonatologist
  - Dr. Ramia Zakhour, ID specialist
  - Dr. Faouzi Maalouf, Neonatologist
  - Dr. Khalid Yunis, Neonatologist, Director of the Newborn Services at AUBMC
References


THANK YOU

Engage, Educate, Empower!

QUESTIONS?