Neonatal Sepsis Prevention in Low-Resource Settings
Dr. Angela Dramowski, Stellenbosch University, South Africa
A Webber Training Teleclass

Neonatal sepsis prevention in low-resource settings

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Hosted by Paul Webber
paul@webbertraining.com

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Background

- Global decline in under 5 childhood mortality rates
- BUT limited progress in neonatal mortality reduction
- Nearly 50% of under 5 deaths now occur in newborns

Severe bacterial infection affects:
- 7 million neonates
- 750 000 deaths
- >90% in LMIC

In South Africa, hospital-acquired infection is 2nd most prevalent avoidable factor in neonatal deaths.
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Outline

• Summarise the epidemiology of neonatal sepsis in low-middle income countries (LMIC)
• Discuss current and new strategies for neonatal sepsis prevention

Why are neonates vulnerable to HAI?

Immature immunity (innate, acquired, vaccine-derived)
Many invasive procedures
Prolonged length of stay
Exposure to broad-spectrum antibiotics
Rapidly colonised with antibiotic-resistant bacteria
Many caregivers, more handling, incontinence
Overcrowding, congregate settings
Also vulnerable to introduction of respiratory and gastrointestinal viruses, maternal TB exposures

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Challenges to Neonatal IPC in Africa

Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis

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Bloodstream infections are the predominant type of hospital-acquired infection (HAI) in neonates. Prevention of HA-BSI should be the focus of neonatal IP programmes.

<table>
<thead>
<tr>
<th>Hospital-acquired pneumonia (HAP)</th>
<th>Bloodstream infection (BSI)</th>
<th>Urinary tract infection (UTI)</th>
<th>Surgical site infection (SSI)</th>
<th>Device-associated infection</th>
<th>Others: ENT (Gastro) Bone/joint</th>
</tr>
</thead>
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Risk factors for neonatal sepsis

<table>
<thead>
<tr>
<th>Risk factors</th>
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<tbody>
<tr>
<td>Early-onset sepsis</td>
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<tr>
<td>Late-onset sepsis</td>
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</table>

50-90% of neonatal BSI in LMIC

Cailes Early Human Development 2015
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Which organisms cause neonatal unit outbreaks?

- **Bacteria**
  - *Klebsiella pneumoniae*, *E. coli* (ESBL)
  - *Acinetobacter baumannii*, *Pseudomonas aeruginosa*
  - *Staphylococcus aureus* incl. MRSA
  - Emerging pathogens: *Serratia marcescens*

- **Viruses**
  - Rotavirus, Norovirus
  - RSV, parainfluenza, influenza

- **Fungi**
  - mostly *Candida spp*

Occasionally: TB, HIV, Hepatitis B, PJP

Risk factors: low birth weight, broad spectrum antibiotics, central lines, TPN

Profile of neonatal sepsis pathogens in LMIC

Gram negative pathogens predominate
(neonatal HA-BSI at Tygerberg Hospital)

Top 10 BSI pathogens (n=717; 93% of total pathogens)

- K. pneumoniae: 30%
- S. marcescens: 11%
- A. baumannii: 9%
- E. coli: 7%
- E. cloacae: 2%
- P. aeruginosa: 2%
- S. aureus: 14%
- Enterococcus spp: 11%
- Group B streptococci: 5%
- Candida spp: 4%

Gram negatives (65%)
Gram positives (31%)
Fungi (4%)

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African neonatal HA-BSI rates

Neonatal HA-BSI:

- Moulainine (Morocco) 18 / 1000 PD*
- Gadallah (Egypt) 14 / 1000 PD
- Ballot (S. Africa) 14 / 1000 PD
- Spicer (S. Africa) 7 / 1000 PD
- Dramowski (S. Africa) 4 / 1000 PD

Mortality varies by study 20 – >70%

*PD = patient days

Principles of neonatal sepsis prevention: targets for intervention in hospital settings

<table>
<thead>
<tr>
<th>Promote colonisation with normal flora</th>
<th>Prevent colonisation with pathogens</th>
<th>Maintain skin integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exclusive breastfeeding</td>
<td>Hand hygiene</td>
<td>Avoid/reduce adhesive use</td>
</tr>
<tr>
<td>Kangaroo mother care</td>
<td>Environmental cleaning</td>
<td>Avoid skin breaches (oral therapy, IV access, blood draws, non-invasive tests)</td>
</tr>
<tr>
<td>Reduce antibiotic use</td>
<td>Avoid shared equipment</td>
<td>?Emollients</td>
</tr>
<tr>
<td>Pre and Probiotics</td>
<td>Avoid re-use of devices</td>
<td>?Zinc</td>
</tr>
<tr>
<td></td>
<td>Skin antisepsis: chlorhexidine</td>
<td></td>
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</tbody>
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Core elements of a neonatal IPC programme

- HAI surveillance & outbreaks
- Hand hygiene and PPE usage
- Catheter care
- Environmental & equipment cleaning
- Breastfeeding and KMC
- Maintenance of skin integrity
- Safe preparation of feeds
- Behaviour change & institutional climate

You only find what you’re looking for...

2012 NICU Serratia outbreak

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Neonatal hospital-acquired BSI at Tygerberg Hospital

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Reprocessing of single use medical devices

Common practice in Africa:
Recycling/re-use of single use items
Lack of training in decontamination & sterilization

Potential for outbreaks
e.g. *Serratia marcescens* in NICU
source = reprocessed (disposable) ventilator tubing

Challenges in Africa:
Can re-use ever be safe?
Ageing infrastructure
All staff need training in disinfection & cleaning

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Improved neonatal HA-BSI surveillance & outbreak detection with weekly feedback

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Improved neonatal HA-BSI surveillance & outbreak detection with weekly feedback

YOU CANNOT MANAGE WHAT YOU CANNOT MEASURE.

Neonatal HA-BSI surveillance assists with antimicrobial stewardship

OVERALL % susceptible in vitro

<table>
<thead>
<tr>
<th>Combination</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEN+AMIK</td>
<td>68</td>
</tr>
<tr>
<td>PIPTAZ+AMIK</td>
<td>78</td>
</tr>
<tr>
<td>MERO</td>
<td>75</td>
</tr>
<tr>
<td>MERO+AMIK</td>
<td>80</td>
</tr>
<tr>
<td>MERO+VANCO</td>
<td>86</td>
</tr>
</tbody>
</table>

HA-BSI episodes (n = 717)
Syndromic isolation: proactive vs reactive

Empiric use of transmission-based precautions on first signs/symptoms of infection
- e.g. rash for HSV, loose stools for rotavirus, RDS for RSV

Take appropriate specimens and de-isolate if negative

Assumes a sufficient number of isolation beds and staffing

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Surveillance of device-associated infections PICU/NICU

CLABSI bundle programme: a recipe for success

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Tygerberg Hospital: CLABSI programmes

First public sector NICU CLABSI programme (2012)
First public sector neonatal ward CLABSI bundle (2017)
Driven largely by one neonatal and one IPC nurse practitioner
Supported by Paeds ID service and Neonatal Consultant

Need for improved care of peripheral IV lines

• Poor line care (central and peripheral)
• Multi-dose vials with limited use of claves
• Very limited implementation of catheter bundles
• High rates of needlestick injury

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Environmental cleaning contributes to safer care

Table 1: Persistence of clinically relevant bacteria on dry inanimate surfaces.

<table>
<thead>
<tr>
<th>Type of bacteria</th>
<th>Duration of persistence (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acinetobacter spp.</td>
<td>3 days to 5 months</td>
</tr>
<tr>
<td>Bordetella pertussis</td>
<td>3 – 5 days</td>
</tr>
<tr>
<td>Campylobacter jejuni</td>
<td>up to 6 days</td>
</tr>
<tr>
<td>Clostridium difficile (spores)</td>
<td>5 months</td>
</tr>
<tr>
<td>Chlamydia pneumonia, C. trachomatis</td>
<td>≤ 30 hours</td>
</tr>
<tr>
<td>Chlamydia psittaci</td>
<td>15 days</td>
</tr>
<tr>
<td>Corynebacterium diphtheriae</td>
<td>7 days – 6 months</td>
</tr>
<tr>
<td>Corynebacterium pseudotuberculosis</td>
<td>1–8 days</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>1.5 hours – 16 months</td>
</tr>
<tr>
<td>Enterococcus spp. including VRE and VSE</td>
<td>5 days – 4 months</td>
</tr>
<tr>
<td>Haemophilus influenzae</td>
<td>12 days</td>
</tr>
<tr>
<td>Helicobacter pylori</td>
<td>≤ 90 minutes</td>
</tr>
<tr>
<td>Klebsiella spp.</td>
<td>2 hrs to &gt; 30 months</td>
</tr>
<tr>
<td>Legionella spp.</td>
<td>1 day – months</td>
</tr>
<tr>
<td>Mycobacterium bovis</td>
<td>&gt; 2 months</td>
</tr>
<tr>
<td>Mycobacterium tuberculosis</td>
<td>1 day – 4 months</td>
</tr>
<tr>
<td>Nisseria genomosporale</td>
<td>1 – 2 days</td>
</tr>
<tr>
<td>Proteus vulgaris</td>
<td>1 – 2 days</td>
</tr>
<tr>
<td>Pseudomonas aeruginosa</td>
<td>6 hours – 16 months; on dry floor: 5 weeks</td>
</tr>
<tr>
<td>Serratia marcescans</td>
<td>6 hours – 4 weeks</td>
</tr>
<tr>
<td>Serratia plymoflaviana</td>
<td>10 days – 42 years</td>
</tr>
<tr>
<td>Salmonella spp.</td>
<td>1 day</td>
</tr>
<tr>
<td>Staphylococcus aureus, including MRSA</td>
<td>3 days – 2 months; on dry floor: 5 weeks</td>
</tr>
<tr>
<td>Streptococcus pneumonia</td>
<td>2 days – 5 months</td>
</tr>
<tr>
<td>Streptococcus pyogenes</td>
<td>7 days – 7 months</td>
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<tr>
<td>Vibrio cholera</td>
<td>1 – 20 days</td>
</tr>
<tr>
<td></td>
<td>2 days – 6.5 months</td>
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<tr>
<td></td>
<td>1 – 7 days</td>
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</tbody>
</table>

Kramer BMC ID 2006

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Cleaning of incubators and basinettes

Daily cleaning of frequently-touched equipment

Employed carers to help clean equipment

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Replaced mattress covers and bedside lockers

Removed hand washbasins from NICU

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Reuse of equipment e.g. oxygen saturation probes

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Improvements in management of EBM and EBM containers / utensils

Infant feeds as a risk factor for HAI

Lack of standardized protocols & training
Ageing and poorly maintained equipment
Regular EBM exposures: non-maternal HIV

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Kangaroo Mother Care for infection prevention

Increased breastfeeding
Increased colonization by maternal flora
Less invasive procedures
Improved growth
Enhanced skin barrier function
Earlier hospital discharge

Reduced nosocomial infection rate and severity

NB. Screening of mothers on neonatal wards for pulmonary TB

Hand hygiene: it’s no joke!

“Sounds like an obsessive-compulsive disorder. Normal people don’t spend that much time washing their hands.”

Hand hygiene awareness and handrub availability

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Personal protective equipment

Core elements of a neonatal IPC programme

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Maintenance of skin integrity
- Medical adhesive-related skin damage (MARSi)
- Moisture-associated skin damage (MASD)
- Medical device-related pressure injuries (MD-PrIs)

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Skin antisepsis: chlorhexidine gluconate (CHG) bathing

10 US PICU, RCT crossover with 4947 admissions
Reduced BSI rates in 10 US PICU (3.2 vs 4.9 / 1000 days)
Reduced CLABSI rates
Driven by reduction in gram positive BSI
Few CHG skin reactions 1/1000 days

RCT of Indian neonates (70 per arm)
0.25% CHG vs saline solution wipes daily
Blood cultures + skin swabs D1, D3, D7
BSI rate 3.5 vs 6.9% (NS)
Gram negative predominance

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Risk factors for HAI in Africa: weak health systems

- Weak or non-existent IC programs
- Severe shortage of IC practitioners
- Lack of patient safety culture / awareness of HAI
- No requirement for surveillance & reporting of HAI

Neonatal staff as a potential source of infection

- Minimal training in IC (undergraduate & in-service)
- Limited knowledge of HAI and IPC principles
- Understaffing, high turnover, use of agency staff
- Additional functions eg portering, cleaning
- Presenteeism
- Minimal uptake of available vaccinations
- Lack of accountability and IC champions

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Neonatal HAI prevention in LMIC

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Opportunities</th>
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<tbody>
<tr>
<td>Lack of neonatal HA-BSI/HAI data</td>
<td>Growing pool of IPC-trained HCW</td>
</tr>
<tr>
<td>Lack of IPC training &amp; practitioners</td>
<td>Increasing laboratory capacity</td>
</tr>
<tr>
<td>Understaffing / Overcrowding</td>
<td>Political will</td>
</tr>
<tr>
<td>Lack of isolation facilities</td>
<td>Quality improvement initiatives</td>
</tr>
<tr>
<td>Aging infrastructure/equipment</td>
<td>Motivated neonatal staff</td>
</tr>
<tr>
<td>Lack of HCW accountability</td>
<td>Antimicrobial stewardship/IPC alliance</td>
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Acknowledgements

Sr Marina Aucamp (UIPC)
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DECOLONISATION TO REDUCE MULTI-DRUG RESISTANT PATHOGENS IN HEALTHCARE: WHO, WHAT, WHERE, WHEN, AND WHY?
November 26, 2018
Speaker: Professor Susan Huang, Professor and Hospital Epidemiologist, University of California Irvine School of Medicine
Live broadcast sponsored by Clinell (www.clinell.com)

(FREE Teleclass – Broadcast live from the Healthcare Infection Society conference)
SPORICIDES AND HOW TO TEST THEM
November 27, 2018
Speaker: Professor Jean-Yves Maillard, Professor of Pharmaceutical Microbiology, Cardiff University
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INFECTION DISEASE HIGHLIGHTS AND LOWLIGHTS IN 2018, AND WHAT TO EXPECT IN 2019
December 6, 2018
Speaker: Dr. Larry Madoff, ProMED Editor, Director, Division of Epidemiology and Immunization, Massachusetts Dept. of Public Health

(South Pacific Teleclass)
CONTROL OF CARBAPENEMASE-PRODUCING ENTEROBACTERIACEA IN AN ENDEMIC SETTING: DO CLASSICAL IPC METHODS WORK FOR NEW AGE
December 12, 2018

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