Infection prevention for hospitalized children and neonates in Africa

Presenter: Dr. Angela Dramowski
Affiliation: Stellenbosch University, South Africa
Infection Control Africa Network (ICAN)
Specialty: Paediatric Infectious Diseases
Disclosures: I have nothing to disclose.
Teleclass objectives

1. Review data on the burden of paediatric & neonatal HAI and outbreaks in Africa

2. Describe specific IPC challenges encountered in African paediatric & neonatal settings

3. Share HAI/IPC case studies from South African paediatric & neonatal settings

A population vulnerable to HAI

Immature immunity (innate, acquired and vaccine-derived)

Rapidly colonised with antibiotic-resistant bacteria

Unique behaviours and incontinence

Many caregivers, more handling

Predominance of respiratory and gastrointestinal viruses

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What’s different about infection prevention in Africa?

- Limited investment in facilities
- Hospital environment
- Lack of basic, functional equipment e.g. sinks, soap, PPE
- Overcrowding
- Malnutrition
- Susceptible patient population
- Factors contributing to HCAI risk in SSA
- Limited investigation into achievable/affordable interventions
- Scarcity of national antimicrobial/infection control guidelines/policies
- National healthcare infrastructure
- Huge community-acquired infection burden
- Competing priorities
- Lack of nosocomial infection & resistance surveillance

Figure 2. Risk factors contributing to healthcare-associated infection (HCAI) in sub-Saharan Africa (SSA). HIV, human immunodeficiency virus; PPE, personal protective equipment.

Rothe J Hosp Infect 2013
2011 Report on the burden of HAI: neonates

Neonatal infection rates in developing countries 3-20x higher than in industrialized countries

HAI cause 4-56% of deaths in the neonatal period (majority in SS Africa and SE Asia)

HAI rates in neonatal ICUs are very high with predominance of HA-bloodstream infections and device-associated infections.

VAP and CR-BSI densities were particularly high
VAP = 109 - 143 episodes / 1000 ventilator-days
CR-BSI = 21 - 600 episodes / 1000 catheter-days.

High rates of AMR infections:
- 70% of neonatal BSI not susceptible to an empiric regimen of ampicillin and gentamicin.

African neonatal unit HAI outbreaks

Hospitalized neonates are vulnerable to infection, with pathogen exposures occurring in utero, intrapartum, and postnatally.

African neonatal units are at high risk of outbreaks owing to overcrowding, understaffing, and shared equipment.

High income neonatal unit experience 10 outbreaks/year;

Burden of neonatal unit outbreaks in Africa is unknown.
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<table>
<thead>
<tr>
<th>Tygerberg hospital neonatal unit</th>
<th>African neonatal units</th>
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</thead>
<tbody>
<tr>
<td>- 130 neonatal beds</td>
<td></td>
</tr>
<tr>
<td>- 6000 deliveries per year</td>
<td></td>
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<tr>
<td>- 37% low birth weight rate.</td>
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</table>

Pathogens, outbreak size, mortality, outbreak source, control measures

<table>
<thead>
<tr>
<th>Tygerberg hospital neonatal unit</th>
<th>African neonatal units</th>
</tr>
</thead>
<tbody>
<tr>
<td>13 outbreaks over 8 years</td>
<td>20 outbreaks over 20 years</td>
</tr>
<tr>
<td>148 babies</td>
<td>524 babies</td>
</tr>
<tr>
<td>(11 deaths; 7% mortality)</td>
<td>(177 deaths; 34% mortality)</td>
</tr>
<tr>
<td>Viruses: rotavirus, influenza, measles</td>
<td>50% of outbreaks were caused by ESBL-producing</td>
</tr>
<tr>
<td>MDR bacteria: <em>S. marcescens</em>, <em>A. baumannii</em>, <em>MRSA</em>, <em>VRE</em></td>
<td><em>K. pneumoniae</em>.</td>
</tr>
</tbody>
</table>

Source seldom identified; most outbreaks had breaches in IP practices. Outbreaks contained with: stringent transmission-based precautions, staff/parent education, and changes to clinical practices.
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Paediatric HAI prevalence in US, UK = 3-4%

Burden of endemic health-care-associated infection in developing countries: systematic review and meta-analysis
Benedetta Allegranzi, Sepideh Baghi Nejad, Christophe Combescure, Wilco Graafmans, Homa Attar, Liam Donaldson, Didier Pittet

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HAI point prevalence studies in Africa:
- HAI prevalence 10 – 19%
- Profile of paediatric infections differs
- HAP, BSI and UTI predominate
- Less focus on device-associated infections
- Very limited evidence base – more research needed!

<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>
</table>

Hospital-acquired bloodstream infections (BSI)

Paediatric HA-BSI:
- Aiken (Kenya) 1.0 / 1000 patient days (PD)
- Dramowski (S. Africa) 1.6 / 1000 PD

Neonatal HA-BSI:
- Maoulainine (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
- Landre-Peigne (Senegal) 3 / 1000 PD

Mortality varies by study 20 – >70%

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

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

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>K. pneumoniae</td>
<td>30</td>
</tr>
<tr>
<td>S. marcescens</td>
<td>11</td>
</tr>
<tr>
<td>A. baumannii</td>
<td>9</td>
</tr>
<tr>
<td>E. coli</td>
<td>7</td>
</tr>
<tr>
<td>E. cloacae</td>
<td>2</td>
</tr>
<tr>
<td>P. aeruginosa</td>
<td>2</td>
</tr>
<tr>
<td>S. aureus</td>
<td>14</td>
</tr>
<tr>
<td>Enterococcus spp</td>
<td>11</td>
</tr>
<tr>
<td>Group B streptococci</td>
<td>5</td>
</tr>
<tr>
<td>Candida spp</td>
<td>4</td>
</tr>
</tbody>
</table>

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

Profile of paediatric bloodstream infection (n = 864)

Demographics
- Median age 7 months
- 14% HIV-infected
- 20% Mortality
- 47% Hospital-acquired BSI

Predictors of mortality
- HIV-infection
- HA-BSI
- Gram-negative BSI
- Fungal BSI
- BSI in PICU

Predictors of AM resistance
- Younger age (infants)
- HIV-infection
- HA-BSI
- Gram-negative BSI

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Device-associated infections in LMIC countries

Figure 4.3: Incidence of overall healthcare-associated infection and device-associated infection in high-risk patients in low- and middle-income countries, 1996-2010.

- HCAI = healthcare-associated infections
- CRBSI = catheter-related bloodstream infection
- CR-UTI = catheter-related urinary tract infection
- VAP = ventilator-associated pneumonia

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Device-associated HAI at Tygerberg hospital paediatric ICU

Comparison of device-associated infection rates in PICU

<table>
<thead>
<tr>
<th></th>
<th>Ventilator-associated pneumonia</th>
<th>Central line-associated bloodstream infection</th>
<th>Catheter-associated urinary tract infection</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>0.7</td>
<td>1.0</td>
<td>3.5</td>
</tr>
<tr>
<td>LMIC</td>
<td>6.0</td>
<td>8.1</td>
<td>4.1</td>
</tr>
<tr>
<td>Tygerberg</td>
<td>15.9</td>
<td>12.9</td>
<td>16.0</td>
</tr>
</tbody>
</table>

Burden, spectrum, and impact of healthcare-associated infection at a South African children’s hospital

Ward G10
(1 May-31 October 2014)
admission episodes >= 48hrs
(n = 296)

Wards G7, G4 and PICU
(1 May-31 October 2015)
admission episodes >= 48hrs
(n = 1051)

Total admission episodes >= 48hrs (n = 1347)

Patient demographics
Admissions history
Laboratory investigations
Antimicrobial prescriptions
Information on any HAI event/s

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Tygerberg paediatric HAI prevalence vs European CDC

4.2% (95%CI: 3.9-4.5%)
726 children with 820 healthcare-associated infections

24.1% (95%CI 21.9-26.5%)
296 children with 417 healthcare-associated infections

Walter Zingg, Susan Hopkins, Angéle Gayet-Ageron, Mike Sharland
32nd ESPID Conference, 2014, Dublin

HAI burden and spectrum (n = 417 events)

24% HAI prevalence (95%CI 22-27%)
296 children with 417 healthcare-associated infections

Hospital-acquired pneumonia

Presumed HAI

Urinary tract infection

HA-bloodstream infection

Surgical site infection

75%

Skin and soft tissue

Device-associated infection

Other: ENT, bone, gastrointestinal

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Clinical predictors of HAI (n = 296 children)

- HIV status
  - infected
  - exposed
- Any PICU stay
- Transfer in
- Severe malnutrition
- Co-morbidities
- Indwelling device/s

Outcome and impact of HAI (n = 296 children)

- Crude mortality (7% vs 1%)
- Death at 4 days from onset
- HA pneumonia
  - Adenovirus (5)
  - RSV (3)
  - Influenza (2)
- HA bloodstream infections
  - *K. pneumoniae* (3)
  - Other gram negatives (5)
  - Candida spp (2)
- Re-hospitalisation (21% vs 8%)
- Prolonged hospitalization when compared to 3 ward- and age-matched controls

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### Health system impact

<table>
<thead>
<tr>
<th>Direct costs*</th>
<th>Hospitalization days</th>
<th>Antimicrobial use</th>
<th>Laboratory investigations</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAP, BSI, UTI, SSI = R5.6 million</td>
<td>2275 excess days</td>
<td>2365 excess Rx days</td>
<td>3575 excess tests</td>
</tr>
</tbody>
</table>

Extrapolation to all TCH wards annually = R60 million

- **Overcrowding**
- **Inability to admit**
- **Pathogen reservoir**

95% of HAI events = new antimicrobial/s prescription

61% carbapenems

*Cost calculation = # HAI events x median excess stay x unit cost per patient day (fixed + variable costs: laboratory, radiology, pharmacy)*
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Table 1 Paediatric isolation room utilization

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discrete patient isolation episodes</td>
<td>335</td>
<td>100</td>
</tr>
<tr>
<td>Median patient age (months)</td>
<td>17</td>
<td>-</td>
</tr>
<tr>
<td>Median stay in isolation room (days)</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Indication for isolation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Infection control (IPC) purposes</td>
<td>200</td>
<td>78</td>
</tr>
<tr>
<td>- Nursing care</td>
<td>46</td>
<td>14</td>
</tr>
<tr>
<td>- Palliation/privacy</td>
<td>13</td>
<td>4</td>
</tr>
<tr>
<td>- Other</td>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>Transmission-based precautions applied</td>
<td>260</td>
<td>100</td>
</tr>
<tr>
<td>- Airborne precautions</td>
<td>136</td>
<td>52</td>
</tr>
<tr>
<td>- Droplet precautions</td>
<td>57</td>
<td>22</td>
</tr>
<tr>
<td>- Contact precautions</td>
<td>67</td>
<td>26</td>
</tr>
<tr>
<td>Mean</td>
<td>2172/3294</td>
<td>Minimum 225/40</td>
</tr>
<tr>
<td>Minimum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolation room occupancy rate</td>
<td>(66 %)</td>
<td>(42 %)</td>
</tr>
</tbody>
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Proportional utilization of isolation bed-days

- Occupied: 2172
- Missed: 2054
- Delayed: 51
- Inappropriate bed-days: 171

*missed isolation = laboratory identification of pathogens requiring isolation but patient not isolated

Projected bed demand exceeds availability

Projected occupancy if syndromic isolation were implemented

*syndromic isolation = empiric use of patient isolation based on symptoms & signs, prior to laboratory confirmation

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Challenges to HAI prevention in children and neonates

<table>
<thead>
<tr>
<th>National healthcare factors</th>
<th>The healthcare environment</th>
<th>Patient factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competing health priorities</td>
<td>Overcrowding</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>High burden of community-acquired infections</td>
<td>High patient to staff ratios</td>
<td>HIV-exposure and-infection</td>
</tr>
<tr>
<td>Few resources for IPC implementation</td>
<td>Lack of IPC provisions</td>
<td>Prematurity</td>
</tr>
<tr>
<td>Lack of HAI surveillance</td>
<td>Lack of isolation facilities</td>
<td>Chronic diseases</td>
</tr>
<tr>
<td>Lack of IPC policies</td>
<td>Ageing infrastructure</td>
<td></td>
</tr>
<tr>
<td>Lack of HCW IPC training</td>
<td>Poor environmental cleaning</td>
<td></td>
</tr>
<tr>
<td>Lack of HAI research</td>
<td>Re-use and sharing of devices and equipment</td>
<td></td>
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<tr>
<td></td>
<td>Lack of a culture of patient safety</td>
<td></td>
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What is known about paediatric and neonatal HAI in Africa

A framework for paediatric HAI prevention

- Policies & guidelines
- HAI surveillance & research
- Education & training
- Provisions & infrastructure
- Patient safety climate

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Call for Submission of Abstracts and Registration
Abstract submissions close 28 February 2018
Early bird registration closes 7 May 2018
Late registration closes 25 June 2018

7th ICAN Congress 2018
Infection Control Africa Network
8 – 11 July 2018
Century City Conference Centre
Cape Town | South Africa
www.icancongress.org

www.webbertraining.com/schedule1.php
November 9, 2017
CLEANING THE GREY ZONES OF HOSPITALS: LESSONS FROM A COMMUNITY-BASED TEACHING HOSPITAL
Speaker: Prof. Makeda Semret, McGill University, Montreal

November 13, 2017
(FREE ... WHO Teleclass)
FACING THE THREAT OF CARBAPENEM-RESISTANT ORGANISM SPREAD: THE NEW WHO INFECTION PREVENTION AND CONTROL GUIDELINES
Speaker: Professor Lindsay Grayson, University of Melbourne, Australia
Sponsored by the World Health Organization Infection Control Global Unit
(www.who.int/infection-prevention/en/)

November 20, 2017
(FREE South Pacific Teleclass - Broadcast live from the 2017 ACIPC conference)
EVIDENCE CHALLENGES IN INFECTION PREVENTION AND CONTROL
Speaker: Prof. Frank Bowden, Dr. Chong Ong, Emily Larson, and Prof. Allen Cheng
Broadcast live from the 2017 conference of the Australasian College of Infection Prevention and Control

November 21, 2017
(European Teleclass)
The Role of Rapid Diagnostics in Preventing Healthcare Infection

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