

Neonatal sepsis prevention in low-resource settings

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Hosted by Paul Webber
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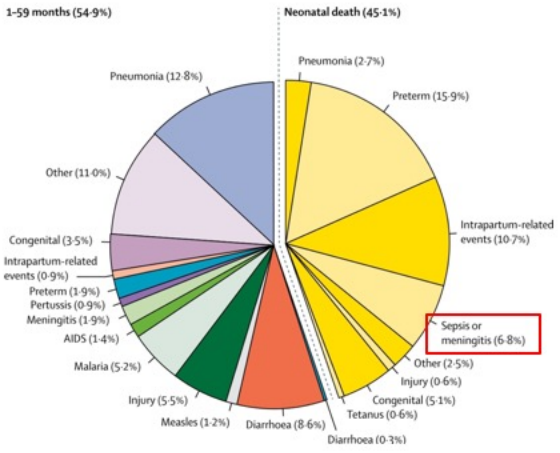
www.webbertraining.com **November 22, 2018**

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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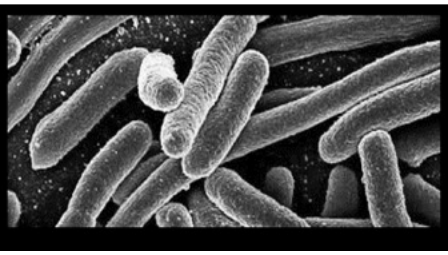
Outline

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



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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

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

Benedetta Allegranzi, Sepideh Bagheri Nejad, Christophe Combescure, Wilco Graafmans, Homa Attar, Liam Donaldson, Didier Pittet

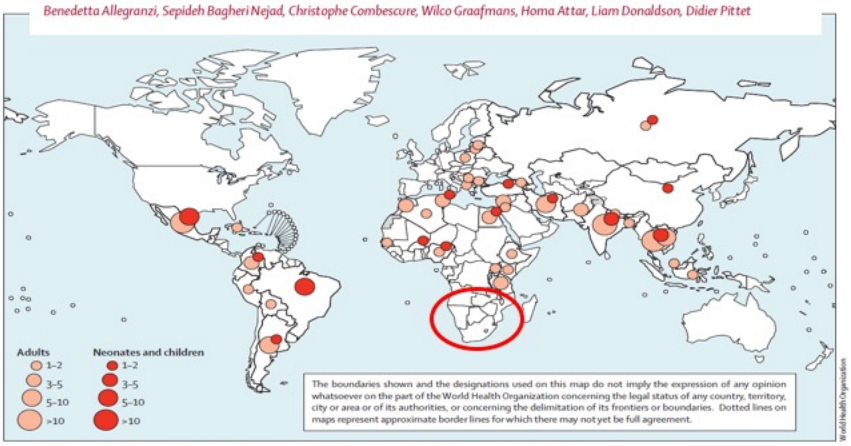

Figure 2: Number of studies reporting health-care-associated infection in developing countries, 1995–2008
Size of dots indicates number of studies. Map created with ARCView (version 9.3.1; ESRI, Redlands, CA, USA), using WHO criteria for official borders and disputed borders.

Overall HAI in neonates 3 – 20 fold greater than high-income countries

Allegranzi Lancet 2011

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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.

Hospital – acquired pneumonia (HAP)	Bloodstream infection (BSI)	Urinary tract infection (UTI)	Surgical site infection (SSI)	Device-associated infection	Others: ENT Gastro Bone/joint

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Risk factors for neonatal sepsis

	Risk factors
Early-onset sepsis	Known maternal GBS colonization Premature rupture of membranes Prolonged rupture of membranes >18 h Maternal fever or chorioamnionitis Preterm delivery Multiple pregnancies Traumatic delivery
Late-onset sepsis	Disruption of intrinsic neonatal barriers (e.g. skin) Prolonged use of an indwelling intravascular catheter Invasive procedures (e.g. endotracheal intubation) Lack of enteral feeding with breast milk Prolonged use of antibiotics (particularly broad spectrum) Necrotising enterocolitis Premature or VLBW infants

50-90% of neonatal BSI in LMIC

Cailes Early Human Development 2015

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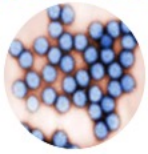
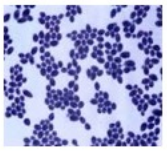
Which organisms cause neonatal unit outbreaks?

- **Bacteria**
  - *Klebsiella pneumoniae, E coli* (ESBL)
  - *Acinetobacter baumanni, 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

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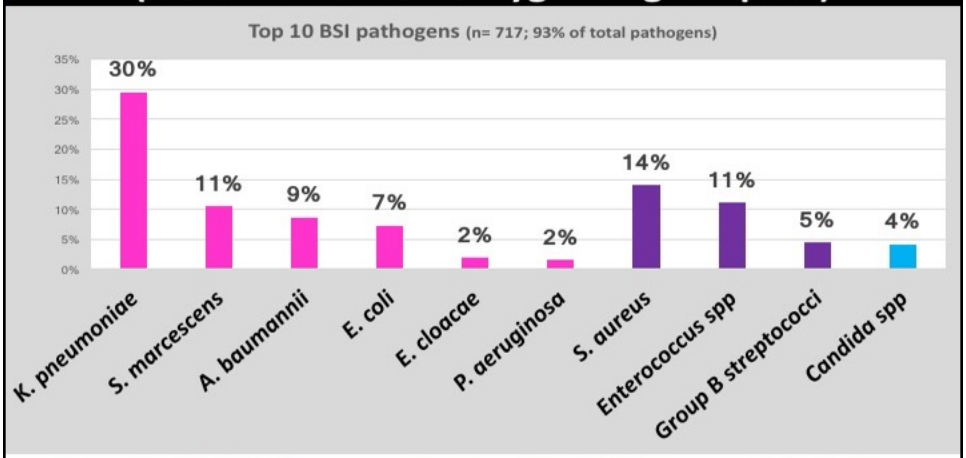
Profile of neonatal sepsis pathogens in LMIC

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



Dramowski Paeds Int Child Health 2015

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African neonatal HA-BSI rates

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

Mortality varies by study 20 – >70%

*PD = patient days

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

Promote colonisation with normal flora	Prevent colonisation with pathogens	Maintain skin integrity
Exclusive breastfeeding	Hand hygiene	Avoid/reduce adhesive use
Kangaroo mother care	Environmental cleaning	Avoid skin breaches (oral
Reduce antibiotic use	Avoid shared equipment	therapy, IV access, blood
Pre and Probiotics	Avoid re-use of devices	draws, non-invasive tests)
	Skin antisepsis: chlorhexidine	?Emollients
		?Zinc

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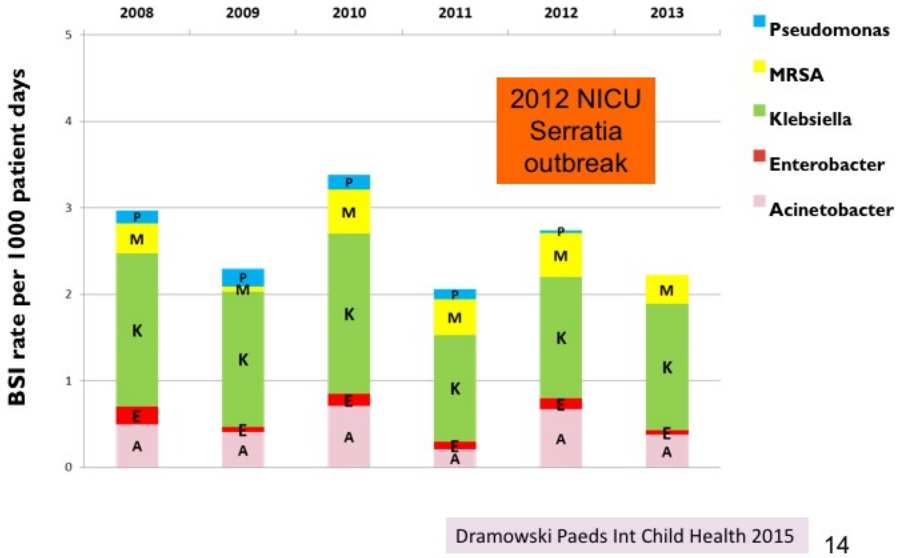
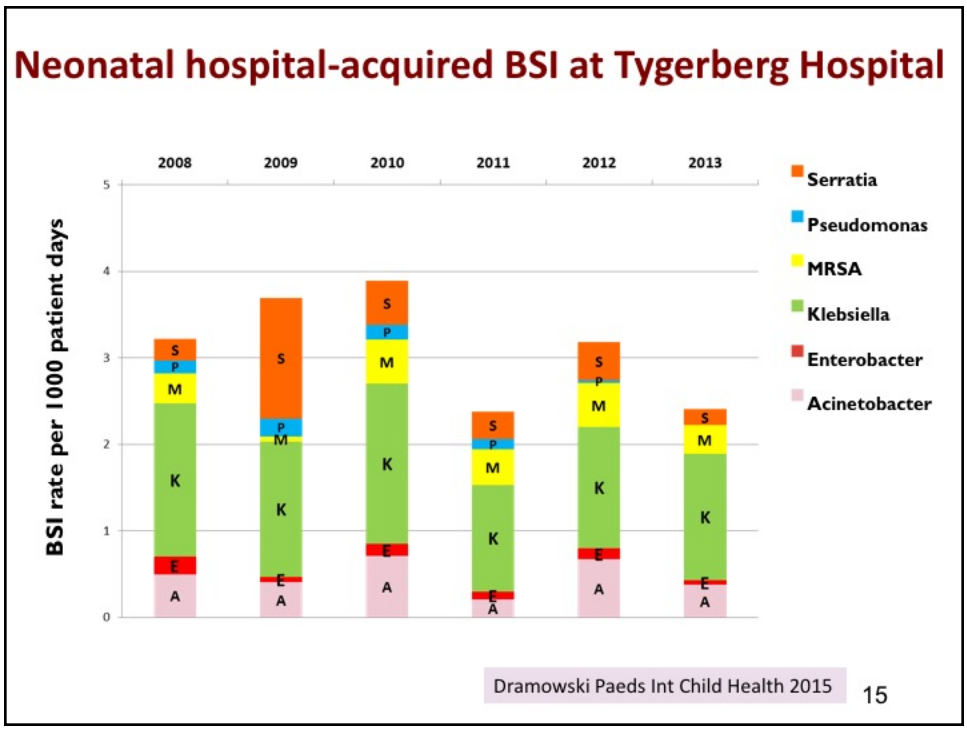
Core elements of a neonatal IPC programme

You only find what you're looking for…




Neonatal hospital-acquired BSI at Tygerberg Hospital
2008
2009
2010
2011
2012
2013
BSI rate per 1000 patient days
0
1
2
3
4
5
Serratia
Pseudomonas
MRSA
Klebsiella
Enterobacter
Acinetobacter
Dramowski Paeds Int Child Health 2015
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SINGLE USE ONLY
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Reprocessing of single use medical devices

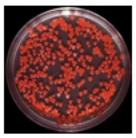
Common practice in Africa:

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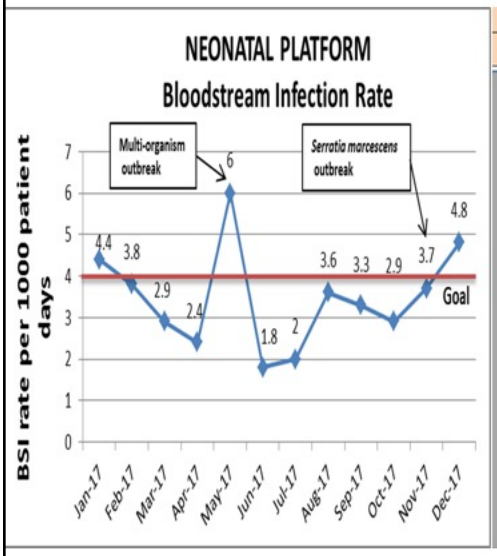
Improved neonatal HA-BSI surveillance & outbreak detection with weekly feedback



Bloodstream Infections on the Neonatal Platform

Patient	Date of Specimen	Microbe	Ward related to infection	Type of infection	Isolation Precautions
	30/05/2017	Serratia marcescens IBL	I3	BSI	Contact
	27/05/2017	Enterococcus faecalis; Enterococcus faecium	A9 NICU	BSI	Contact
	29/05/2017	MRSA	G2	BSI	Contact
	25/05/2017	MRSA	G2	BSI	Contact
	23/05/2017	MRSA	G1	BSI	Contact
	20/05/2017	Klebsiella pneumoniae (CRE); MRSA	G1/A9 NICU	CLABSI	Contact
	21/05/2017	MRSA	G2	BSI	Contact
	17/05/2017	Serratia marcescens IBL	I3	BSI	Contact
	15 & 16/05/2017	Acinetobacter baumannii MDR (2 strains)	A9 NICU	BSI	Contact
	10, 16 & 18/05/2017	Serratia marcescens IBL	A9 NICU	BSI	Contact
	17/05/2017	Acinetobacter baumannii MDR (S to colistin only), Enterococcus faecium	A9 NICU	BSI secondary to jejenal atresia and repeat bowel surgery	Contact
	16/05/2017	Klebsiella pneumoniae; Enterobacter cloacae IBL	A9 NICU	BSI secondary to gastroschisis	Standard

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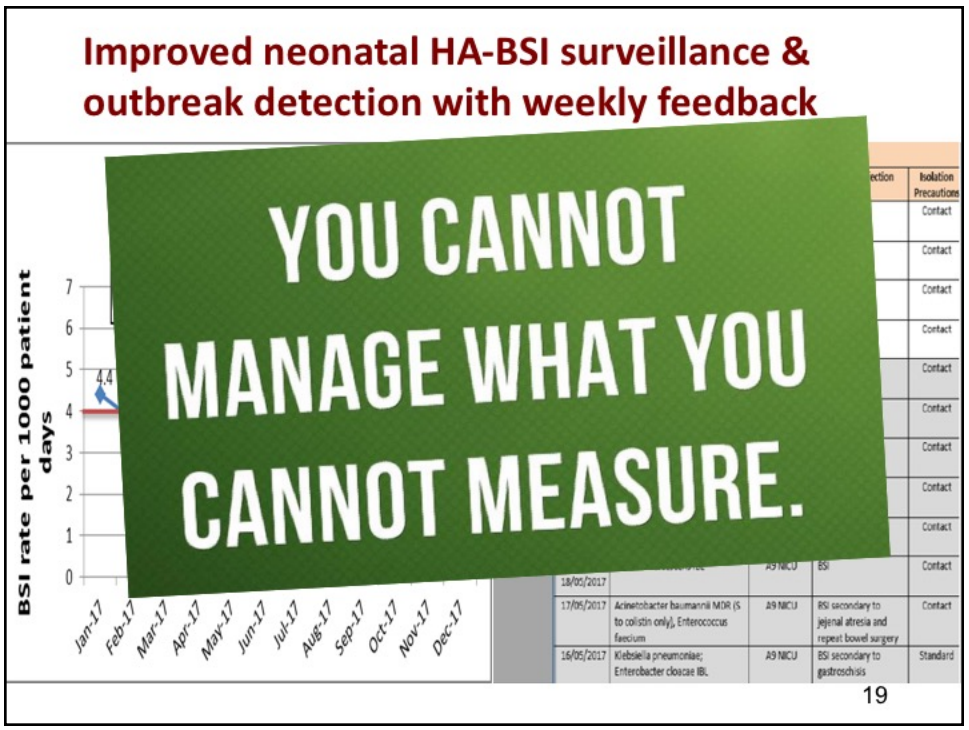
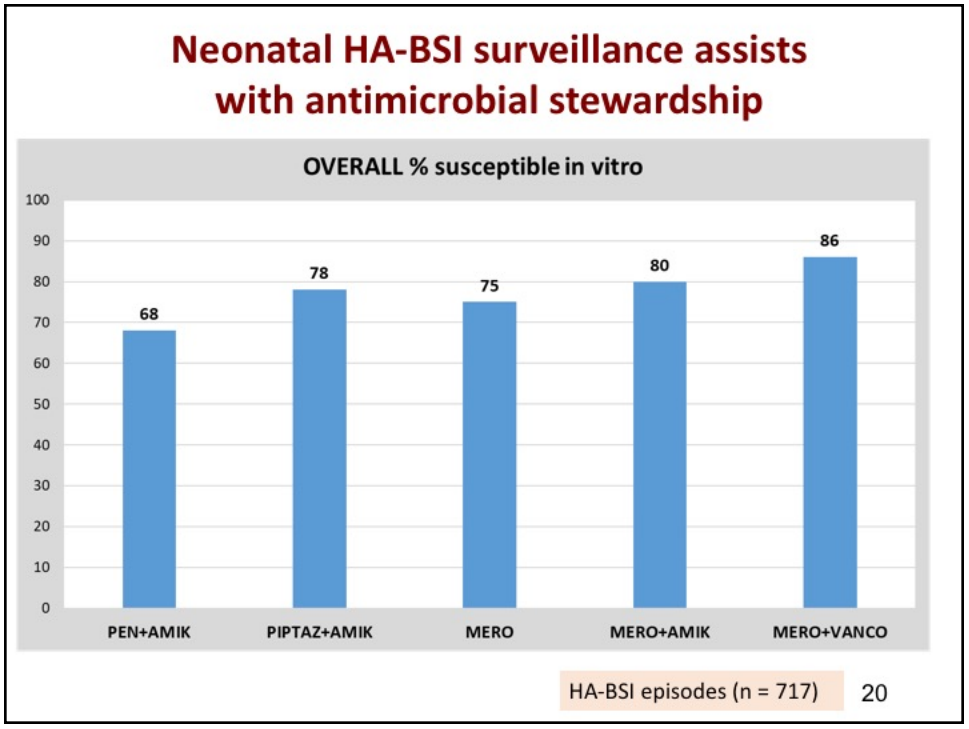

Improved neonatal HA-BSI surveillance & outbreak detection with weekly feedback
YOU CANNOT MANAGE WHAT YOU CANNOT MEASURE.
BSI rate per 1000 patient days
Jan-17
Feb-17
Mar-17
Apr-17
May-17
Jun-17
Jul-17
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Isolation Precautions
Contact
18/05/2017
17/05/2017
Acinetobacter baumannii MDR (S to colistin only), Enterococcus faecium
A9 NICU
BSI secondary to jejenal atresia and repeat bowel surgery
16/05/2017
Klebsiella pneumoniae; Enterobacter cloacae IBL
BSI secondary to gastroschisis
Standard
19


Neonatal HA-BSI surveillance assists with antimicrobial stewardship
OVERALL % susceptible in vitro
68
78
75
80
86
PEN+AMIK
PIPTAZ+AMIK
MERO
MERO+AMIK
MERO+VANCO
HA-BSI episodes (n = 717)
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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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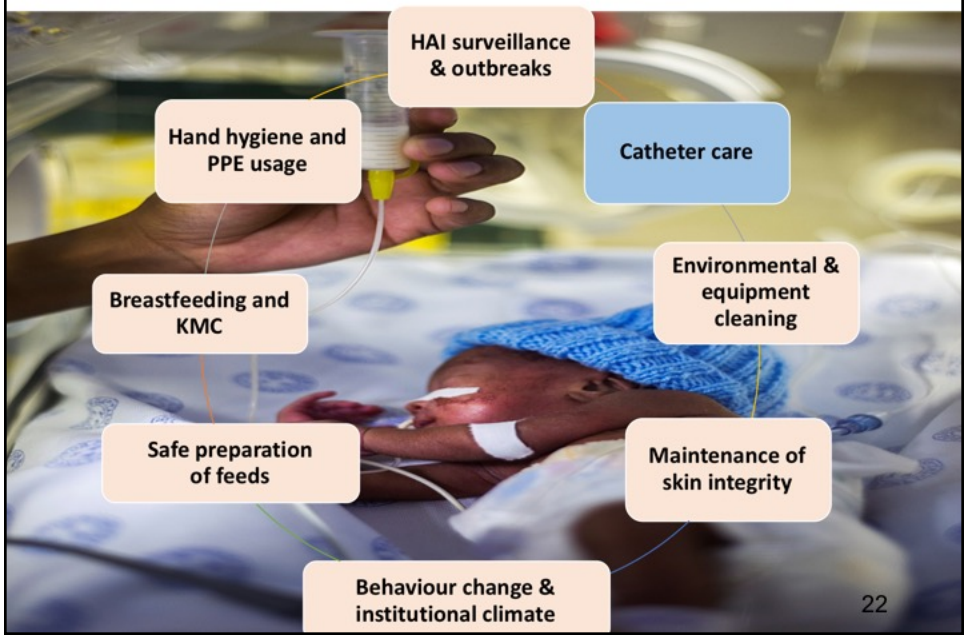
Core elements of a neonatal IPC programme



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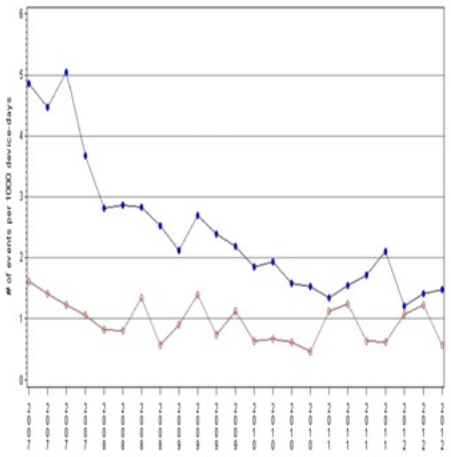
Surveillance of device-associated infections PICU/NICU



Patrick Pediatrics 2014

Rates of CLABSI and VAP in NICUs, January 2007 to September 2012. CLABSI: 2615 events; 5 006 125 patient days; 1 222 393 line days.

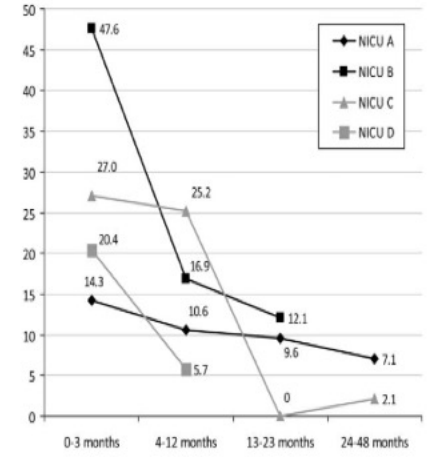


FIGURE 1. Evolution of central line–associated bloodstream infection rates in each neonatal intensive care unit (NICU).

Rosenthal ICHE 2013

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CLABSI bundle programme: a recipe for success

Hand hygiene

Maximal barrier precautions

Chlorhexidine skin antisepsis

Catheter site selection

Daily review of line necessity

Sterile access

Line securement

Sterile dressings

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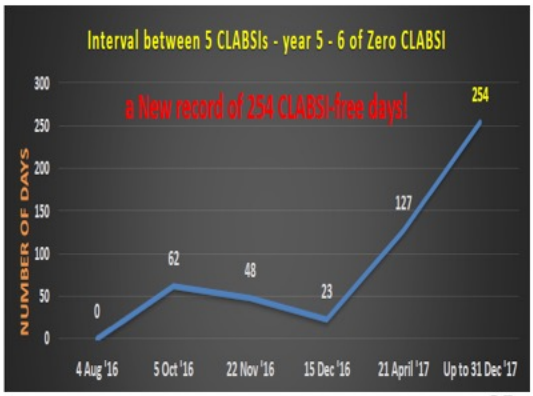
Tygerberg Hospital: CLABSI programmes

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



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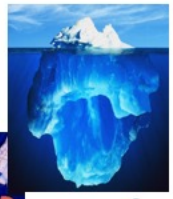
Need for improved care of peripheral IV lines



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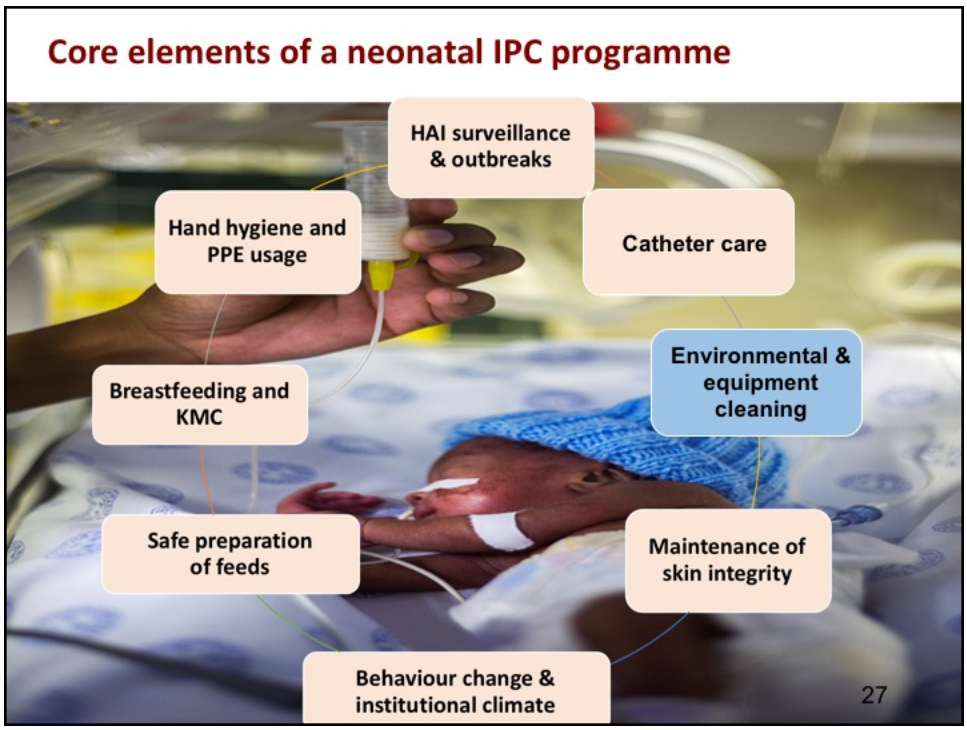
Core elements of a neonatal IPC programme
HAI surveillance & outbreaks
Hand hygiene and PPE usage
Catheter care
Environmental & equipment cleaning
Breastfeeding and KMC
Safe preparation of feeds
Maintenance of skin integrity
Behaviour change & institutional climate
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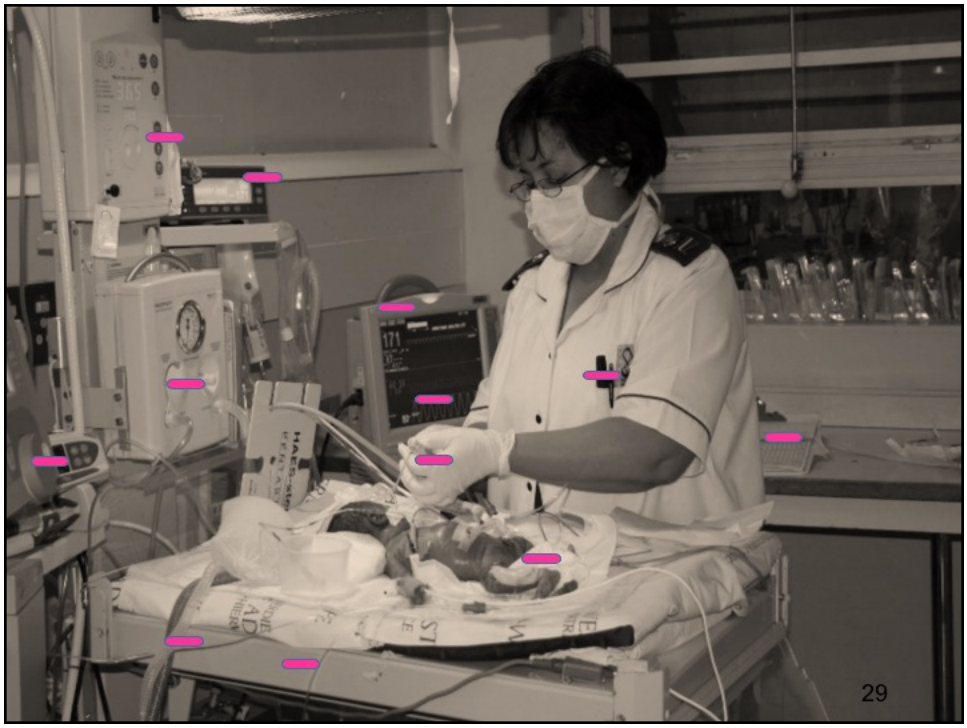
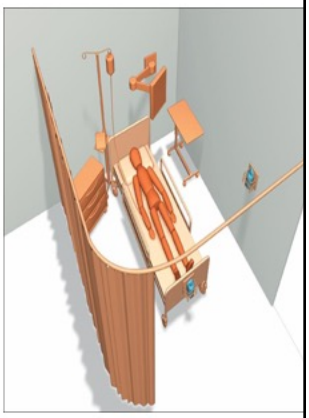


Environmental cleaning contributes to safer care

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

Type of bacterium	Duration of persistence (range)
Acinetobacter spp.	3 days to 5 months
Bordetella pertussis	3 – 5 days
Campylobacter jejuni	up to 6 days
Clostridium difficile (spores)	5 months
Chlamydia pneumoniae, C. trachomatis	≤ 30 hours
Chlamydia psittaci	15 days
Corynebacterium diphtheriae	7 days – 6 months
Corynebacterium pseudotuberculosis	1–8 days
Escherichia coli	1.5 hours – 16 months
Enterococcus spp. including VRE and VSE	5 days – 4 months
Haemophilus influenzae	12 days
Helicobacter pylori	≤ 90 minutes
Klebsiella spp.	2 hours to > 30 months
Listeria spp.	1 day – months
Mycobacterium bovis	> 2 months
Mycobacterium tuberculosis	1 day – 4 months
Neisseria gonorrhoeae	1 – 3 days
Proteus vulgaris	1 – 2 days
Pseudomonas aeruginosa	6 hours – 16 months; on dry floor: 5 weeks
Salmonella typhi	6 hours – 4 weeks
Salmonella typhimurium	10 days – 4.2 years
Salmonella spp.	1 day
Serratia marcescens	3 days – 2 months; on dry floor: 5 weeks
Shigella spp.	2 days – 5 months
Staphylococcus aureus, including MRSA	7 days – 7 months
Streptococcus pneumoniae	1 – 20 days
Streptococcus pyogenes	3 days – 6.5 months
Vibrio cholerae	1 – 7 days



Kramer BMC ID 2006

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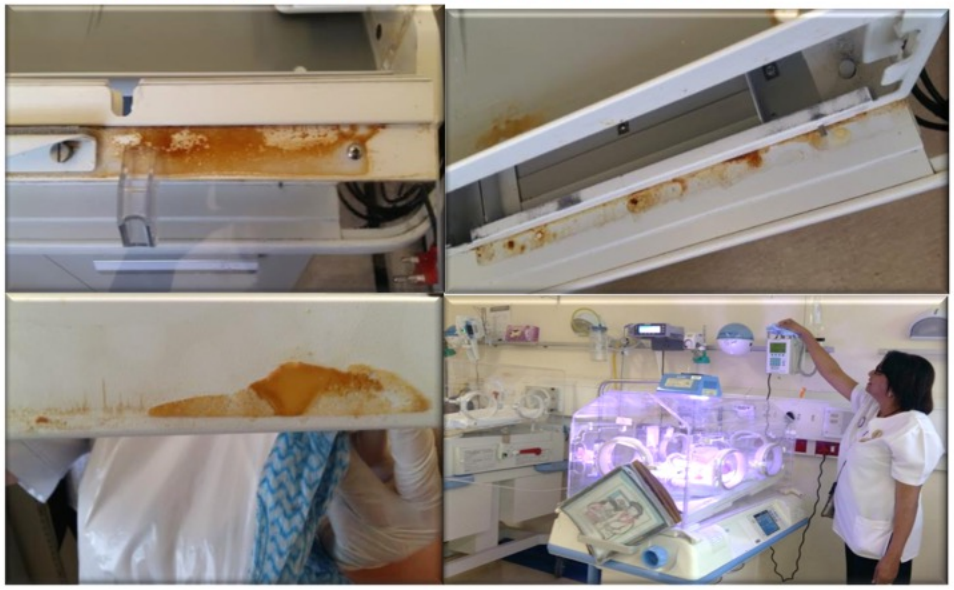
Cleaning of incubators and basinettes



Daily cleaning of frequently-touched equipment 31

Employed carers to help clean equipment

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Replaced mattress covers and bedside lockers

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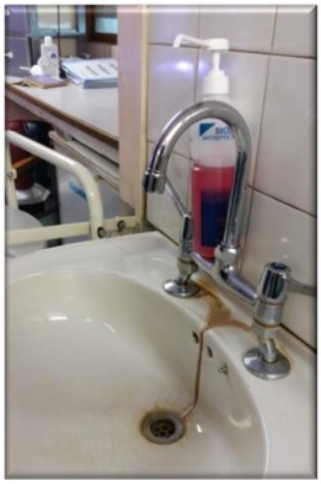
Removed hand washbasins from NICU



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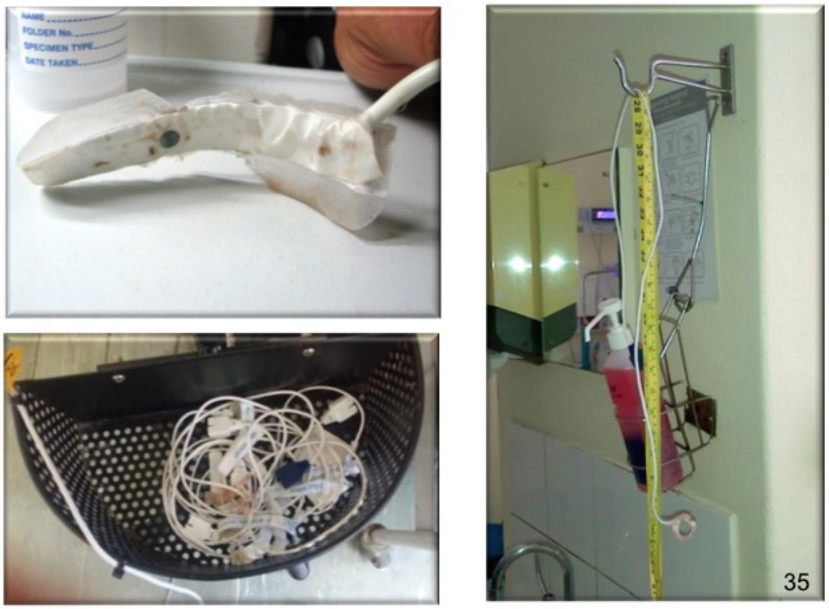
Reuse of equipment e.g. oxygen saturation probes



Core elements of a neonatal IPC programme

Improvements in management of EBM and EBM containers / utensils

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Infant feeds as a risk factor for HAI



Totaal BOTTEL/BEKER voedings in Neonatale Sale:
01 Jan - 31 Maart 2015: 24, 463.
ALLE donormelkvoedings is UITgesluit

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

Conde-Agudelo. Cochrane Database Syst Rev. 2014.

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Core elements of a neonatal IPC programme

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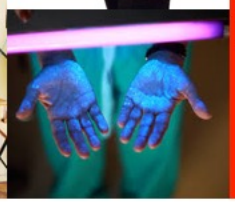
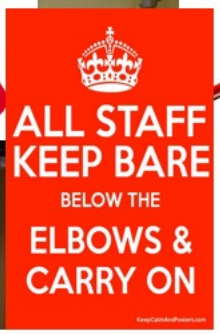
Hand hygiene: it's no joke!

"Sounds like an obsessive-compulsive disorder. Normal people don't spend that much time washing their hands."





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Hand hygiene awareness and handrub availability

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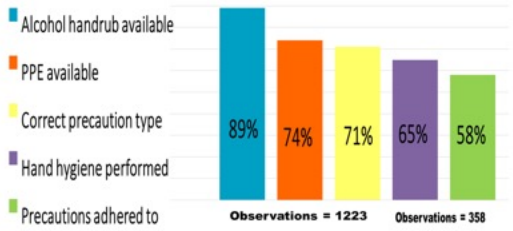
Personal protective equipment

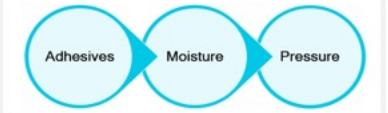


Dramowski ARIC 2015 43

Core elements of a neonatal IPC programme

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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Maintenance of skin integrity

- Medical adhesive-related skin damage (MARSI)
- Moisture-associated skin damage (MASD)
- Medical device-related pressure injuries (MD-PrIs)

Adhesives
Moisture
Pressure

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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

Milstone Lancet 2013

Daily chlorhexidine bathing to reduce bacteraemia in critically ill children: a multicentre, cluster-randomised, crossover trial

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

Evaluation of efficacy of skin cleansing with chlorhexidine in prevention of neonatal nosocomial sepsis - a randomized controlled trial

Gupta J Mat-Fet Neo Med 2015

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Core elements of a neonatal IPC programme

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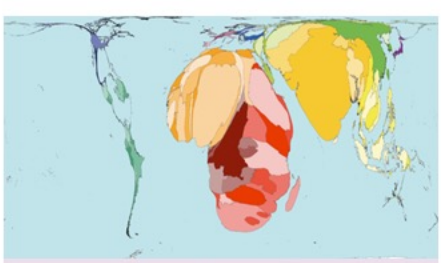
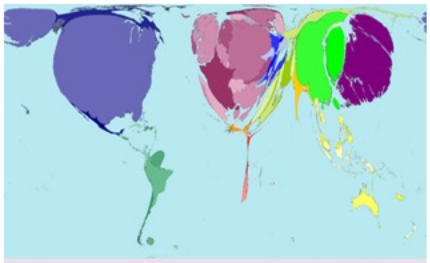
Risk factors for HAI in Africa: weak health systems



Infectious disease burden



Human resources for health

- 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

www.worldmapper.org 49

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

INTERVENTIONS (KNOW)

MINDSHIFT (DOING)

Challenges	Opportunities
Lack of neonatal HA-BSI/HAI data	Growing pool of IPC-trained HCW
Lack of IPC training & practitioners	Increasing laboratory capacity
Understaffing / Overcrowding	Political will
Lack of isolation facilities	Quality improvement initiatives
Aging infrastructure/equipment	Motivated neonatal staff
Lack of HCW accountability	Antimicrobial stewardship/IPC alliance

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Acknowledgements

Sr Marina Aucamp (UIPC)

Sr Arina Jenkins (NICU)

Prof Adrie Bekker (Neonatology)

Prof Andrew Whitelaw (Microbiology)

Mothers, babies & staff of Tygerberg Hospital

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www.webbertraining.com/schedulep1.php

November 26, 2018	*(FREE Teleclass – Broadcast live from the Healthcare Infection Society conference)* **DECOLONISATION TO REDUCE MULTI-DRUG RESISTANT PATHOGENS IN HEALTHCARE: WHO, WHAT, WHERE, WHEN, AND WHY?** Speaker: **Professor Susan Huang**, Professor and Hospital Epidemiologist, University of California Irvine School of Medicine **Live broadcast sponsored by Clinell (www.clinell.com)**
November 27, 2018	*(FREE Teleclass – Broadcast live from the Healthcare Infection Society conference)* **SPORICIDES AND HOW TO TEST THEM** Speaker: **Professor Jean-Yves Maillard**, Professor of Pharmaceutical Microbiology, Cardiff University **Live broadcast sponsored by Clinell (www.clinell.com)**
December 6, 2018	**INFECTIOUS DISEASE HIGHLIGHTS AND LOWLIGHTS IN 2018, AND WHAT TO EXPECT IN 2019** Speaker: **Dr. Larry Madoff**, ProMED Editor, Director, Division of Epidemiology and Immunization, Massachusetts Dept. of Public Health
December 12, 2018	*(South Pacific Teleclass)* **CONTROL OF CARBAPENEMASE-PRODUCING ENTEROBACTERIACEA IN AN ENDEMIC SETTING: DO CLASSICAL IPC METHODS WORK FOR NEW AGE**

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