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Paediatric Infection Prevention and Control

Dr Alison Kent

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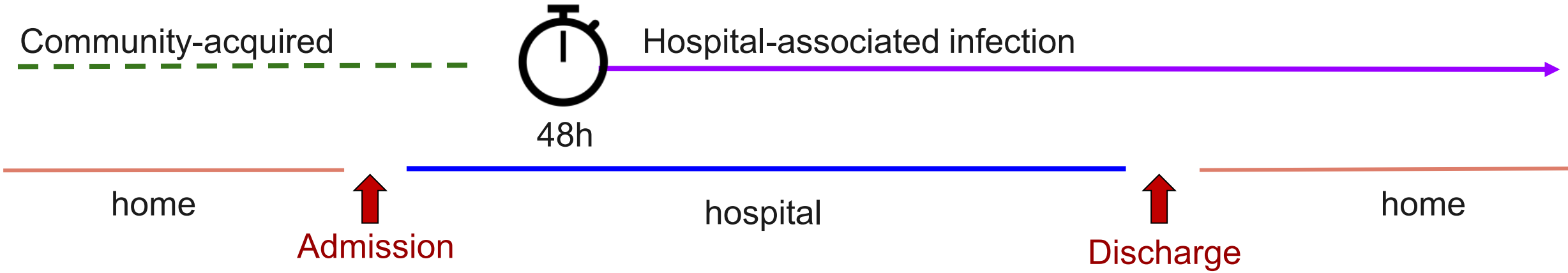
"The patient in the next bed is highly infectious. Thank God for these curtains."

What is a healthcare associated infection (HCAI)?

Infection which has become apparent ≥48 hours into hospital admission, or within 30 days following discharge from inpatient care

i.e. was not present or incubating at the time of admission

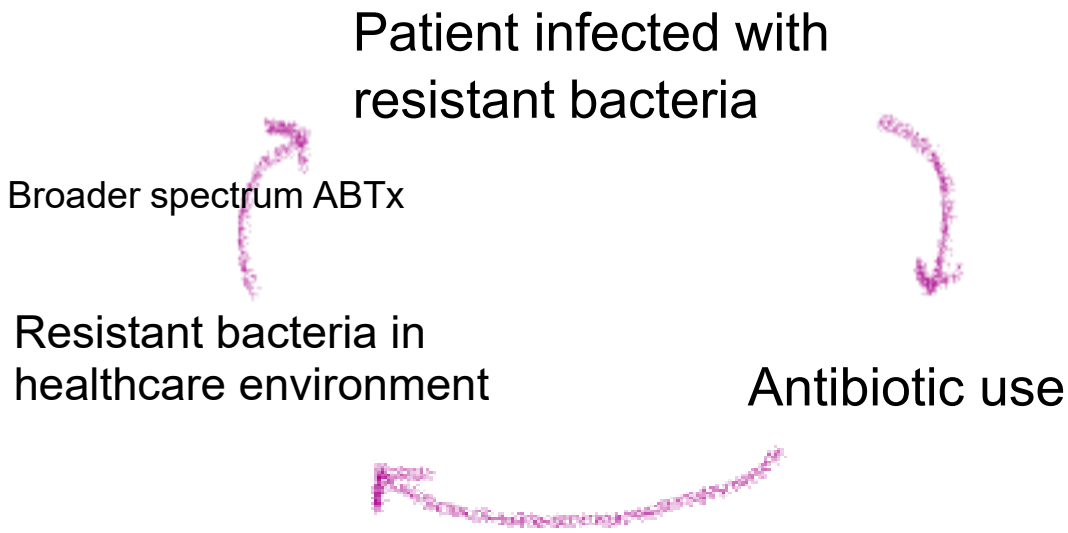


Why are we talking about it?

Common and severe

>1000 deaths neonatal sepsis / year directly attributable to HCAI

75% of AMR burden in Europe due to healthcare-associated infections



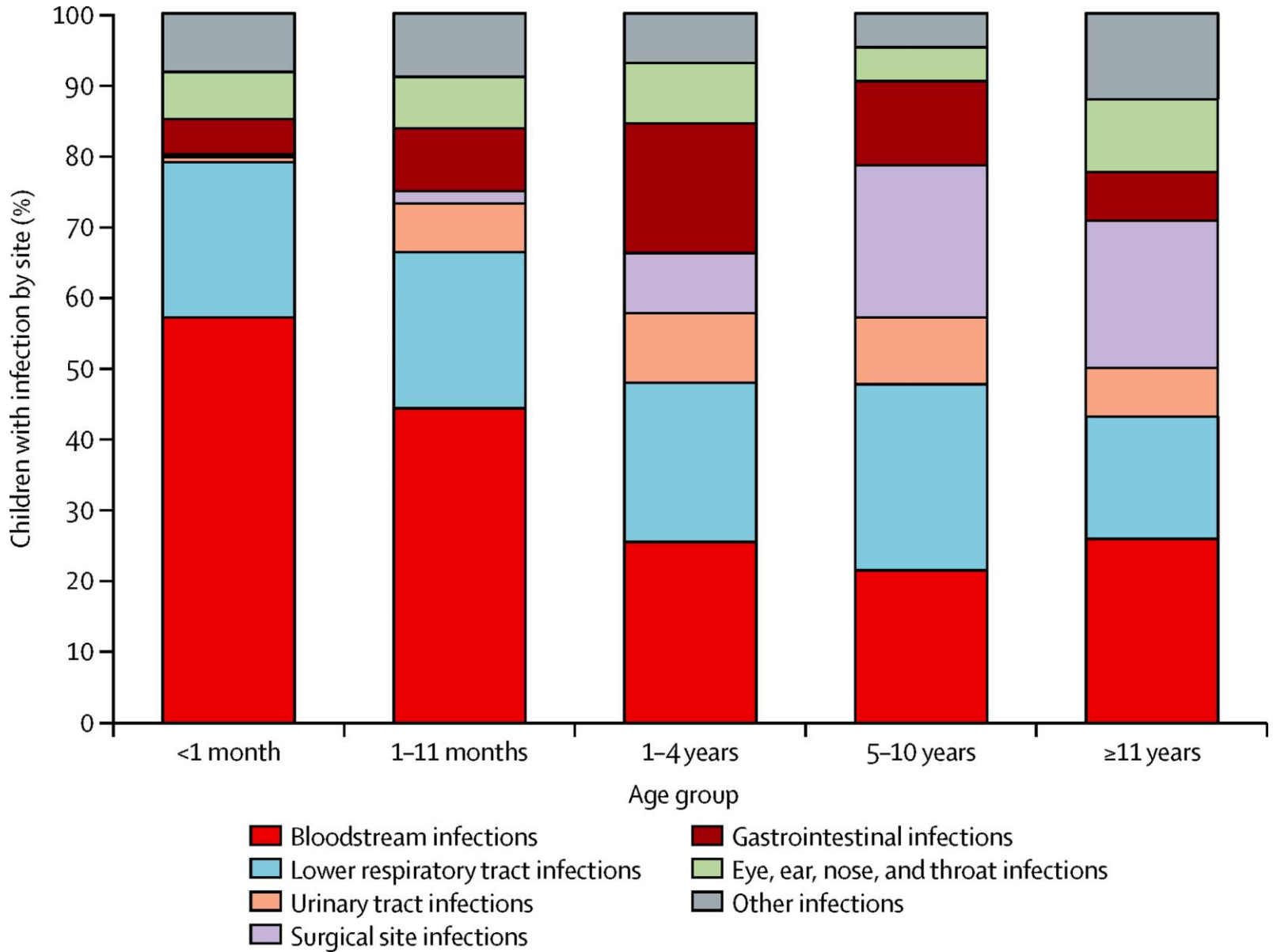
ARTICLES · Volume 17, Issue 4, P381-389, April 2017 Download Full Issue

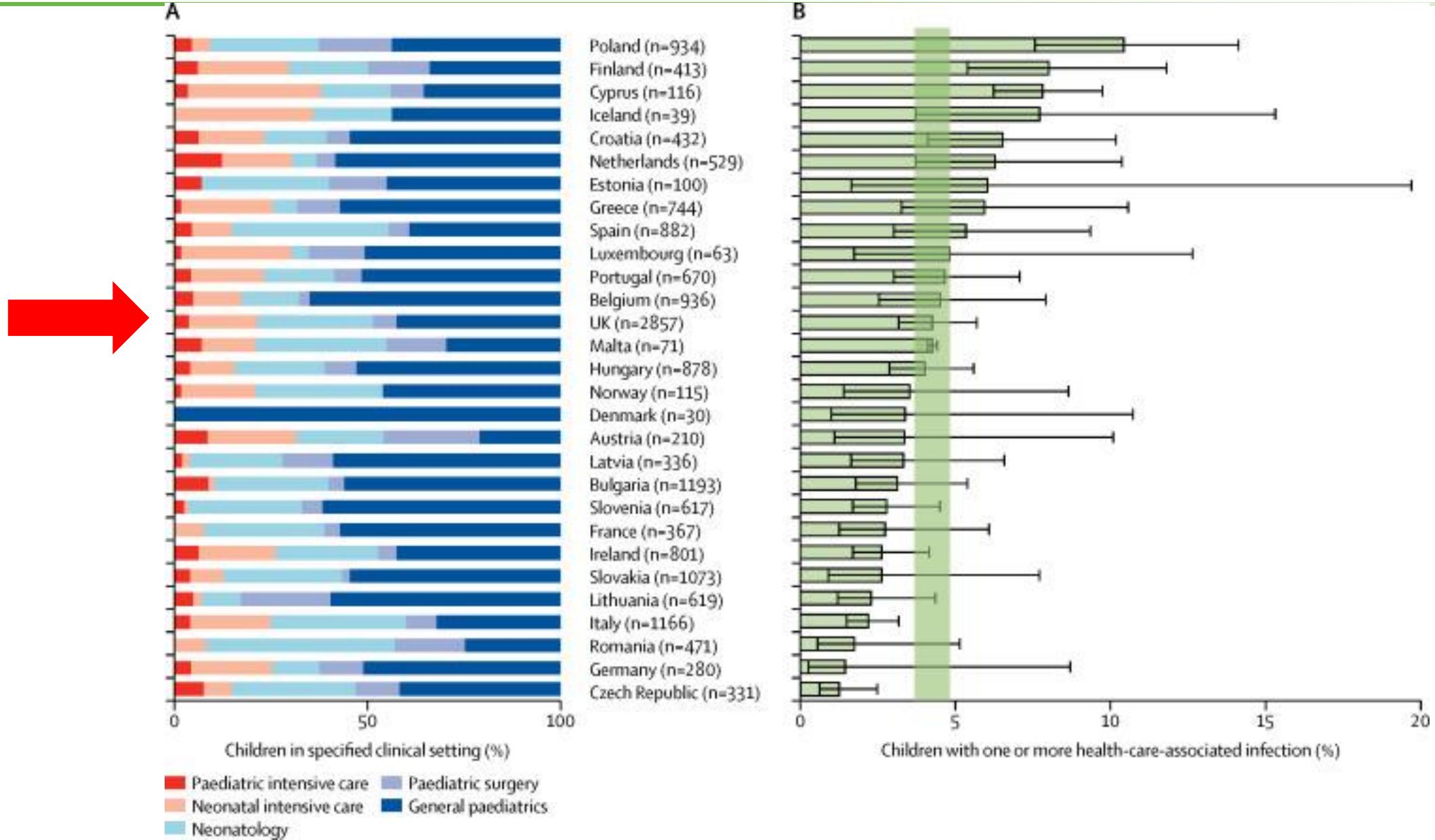
Health-care-associated infections in neonates, children, and adolescents: an analysis of paediatric data from the European Centre for Disease Prevention and Control point-prevalence survey

Dr Walter Zingg, MD [a,b] · Susan Hopkins, MD [c,d] · Angèle Gayet-Ageron, MD [b] · Prof Alison Holmes, MD [a,d] · Mike Sharland, MD [e] · Carl Suetens, MD [f] · et al. Show more

- 2011-2012, ECDC
- 1149 hospitals, 29 countries
- 17 273 children

- 770 HCAI = 4.2%
- PICU 15.5%
- NICU 10.7%


Children with infection by site (%)
100
90
80
70
60
50
40
30
20
10
0
<1 month
1–11 months
1–4 years
5–10 years
≥11 years
Age group
Bloodstream infections
Lower respiratory tract infections
Urinary tract infections
Surgical site infections
Gastrointestinal infections
Eye, ear, nose, and throat infections
Other infections


A
B
Poland (n=934)
Finland (n=413)
Cyprus (n=116)
Iceland (n=39)
Croatia (n=432)
Netherlands (n=529)
Estonia (n=100)
Greece (n=744)
Spain (n=882)
Luxembourg (n=63)
Portugal (n=670)
Belgium (n=936)
UK (n=2857)
Malta (n=71)
Hungary (n=878)
Norway (n=115)
Denmark (n=30)
Austria (n=210)
Latvia (n=336)
Bulgaria (n=1193)
Slovenia (n=617)
France (n=367)
Ireland (n=801)
Slovakia (n=1073)
Lithuania (n=619)
Italy (n=1166)
Romania (n=471)
Germany (n=280)
Czech Republic (n=331)
0
50
100
Children in specified clinical setting (%)
Paediatric intensive care
Neonatal intensive care
Neonatology
Paediatric surgery
General paediatrics
0
5
10
15
20
Children with one or more health-care-associated infection (%)

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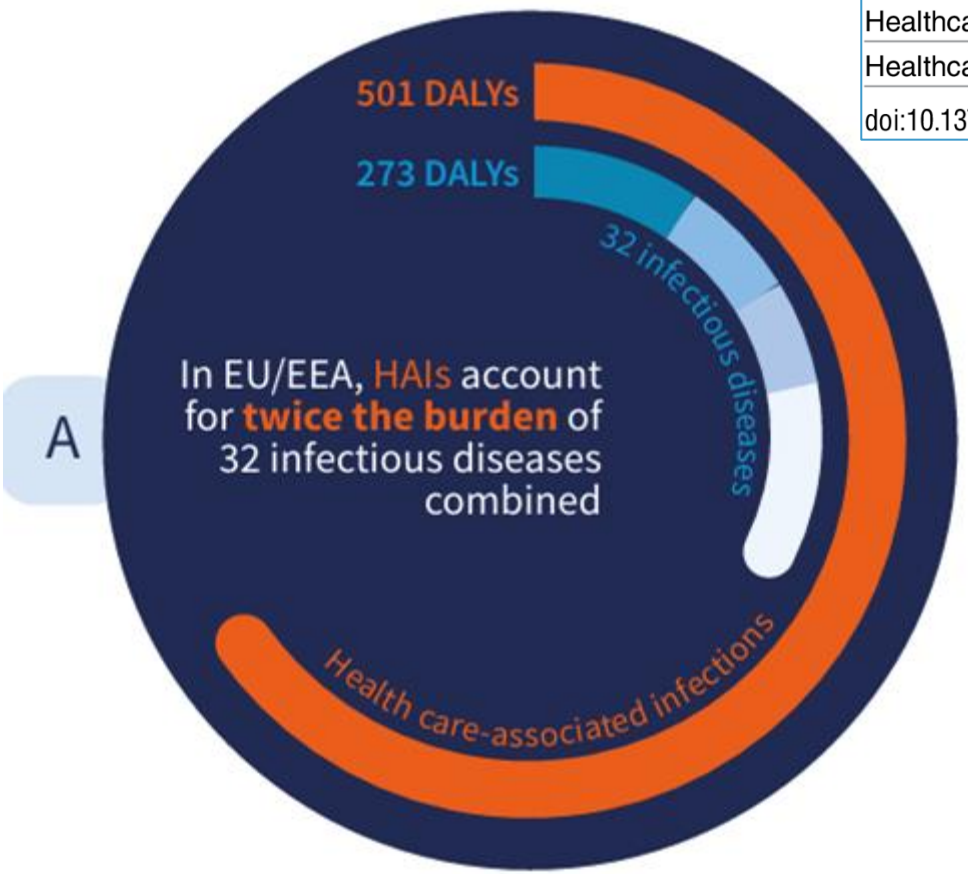
Healthcare-associated infections
Healthcare-associated *Clostridium difficile* infection (HA CDI)
Healthcare-associated pneumonia (HAP)
Healthcare-associated neonatal sepsis
Healthcare-associated primary bloodstream infection (HA primary BSI)
Healthcare-associated surgical site infection (HA SSI)
Healthcare-associated urinary tract infection (HA UTI)
doi:10.1371/journal.pone.0170662.t001



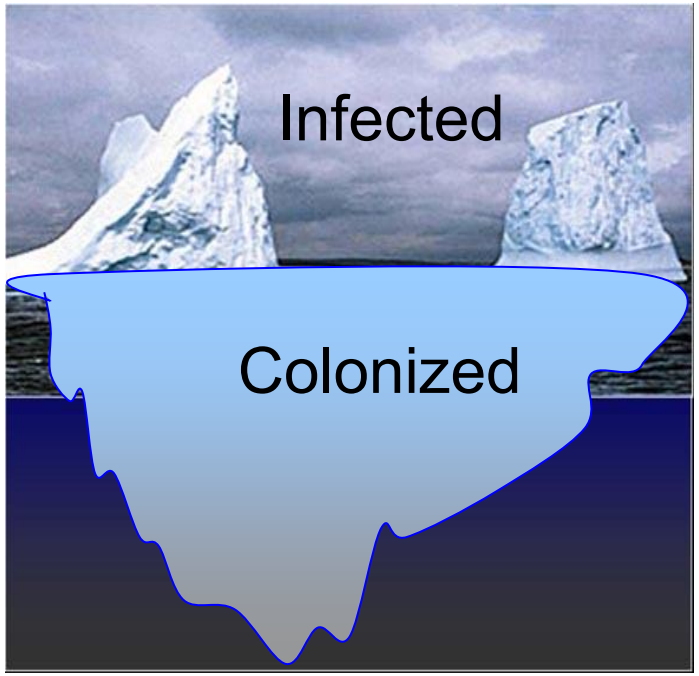
2x

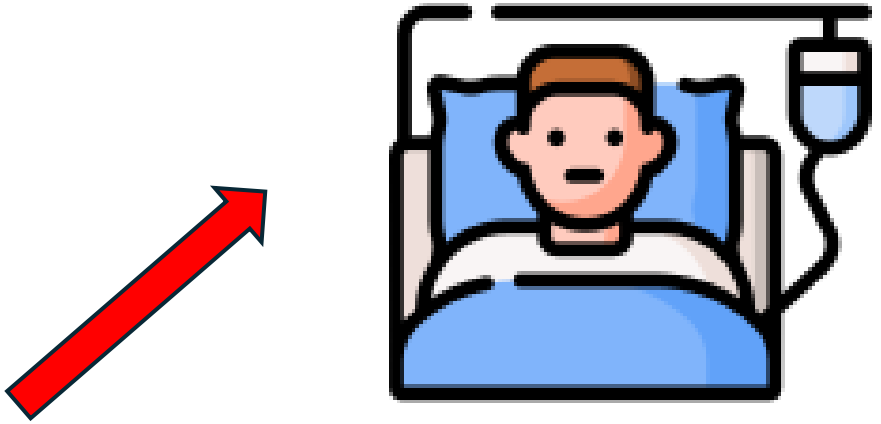
Diseases
Campylobacteriosis
Chlamydia
Congenital Toxoplasmosis
Cryptosporidiosis
Diphtheria
Giardiasis
Gonococcal infections
Hepatitis A
Hepatitis B
Hepatitis C
HIV/AIDS
Infection with STEC/VTEC
Influenza
Invasive *Haemophilus influenza* disease
Invasive meningococcal disease
Invasive pneumococcal infections
Legionnaires'disease
Listeriosis
Measles
Mumps
Pertussis
Poliomyelitis
Q fever
Rabies
Rubella
Salmonellosis
Shigellosis
Syphilis
Tetanus
Tick-borne encephalitis
Tuberculosis
Variant Creutzfeldt-Jakob disease

Cassini A, Plachouras D, Eckmanns T, et al. Burden of Six Healthcare-Associated Infections on European Population Health: Estimating Incidence-Based Disability-Adjusted Life Years through a Population Prevalence-Based Modelling Study. PLOS Medicine. 2016;13(10):e1002150. doi:10.1371/journal.pmed.1002150

Colzani E, Cassini A, Lewandowski D, et al. A Software Tool for Estimation of Burden of Infectious Diseases in Europe Using Incidence-Based Disability Adjusted Life Years. *PLOS ONE*. 2017;12(1):e0170662. doi:10.1371/journal.pone.0170662

The Iceberg Effect





1 day – 2 weeks

Colonisation

Infection

CLABSI

HAP/VAP

Why Contact Precautions* for MDRO are Important

STUDY:

- Observational study of clinical care of MDRO+ patients
- Cultures of gloves, gowns, and hands after care

MDRO contamination present after:

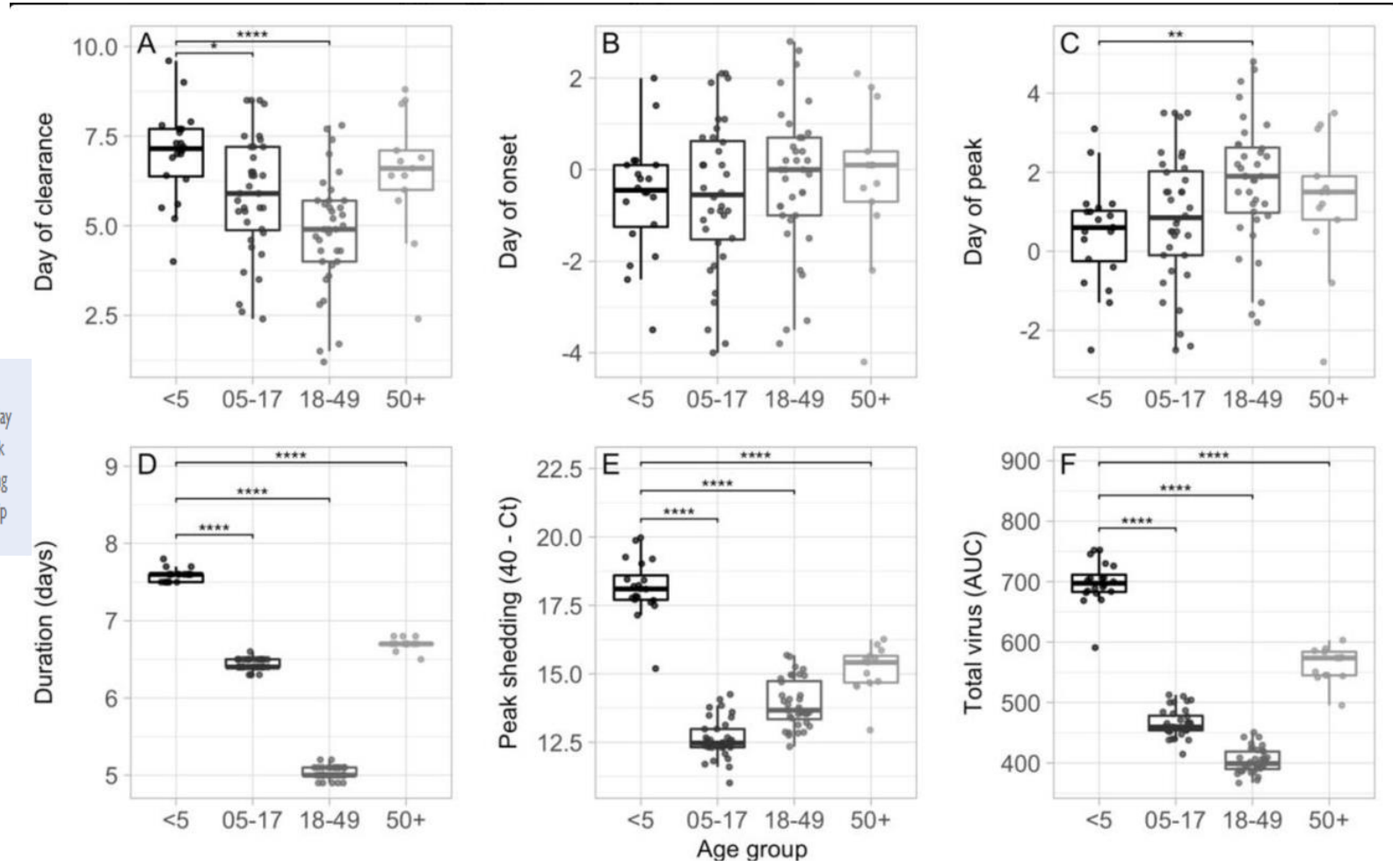
- 77 of 199 (38.7%) on gowns OR gloves
- 9 of 199 (4.5%) on hands **<u>after glove removal*</u>**

**after glove removal but before HH*

Morgan, ICHE, 2010.

Paediatric-specific challenges

- Shed more, for longer…



Children aged <5 years shed more virus than other age groups.

Associations between age group and viral shedding summary metrics: (A) day of shedding clearance relative to ILI onset; (B) day of shedding onset relative to ILI onset; (C) day of peak shedding relative to ILI onset; (D) duration of shedding in days; (E) Peak value of shedding attained (transformed as 40 – Ct); and (F) total virus shed, as measured by the area under the fitted shedding curve. ILI represents influenza-like-illness and AUC represents the area under the curve.*p <0.05, **p <0.01, ***p <0.001, ****p <0.0001.

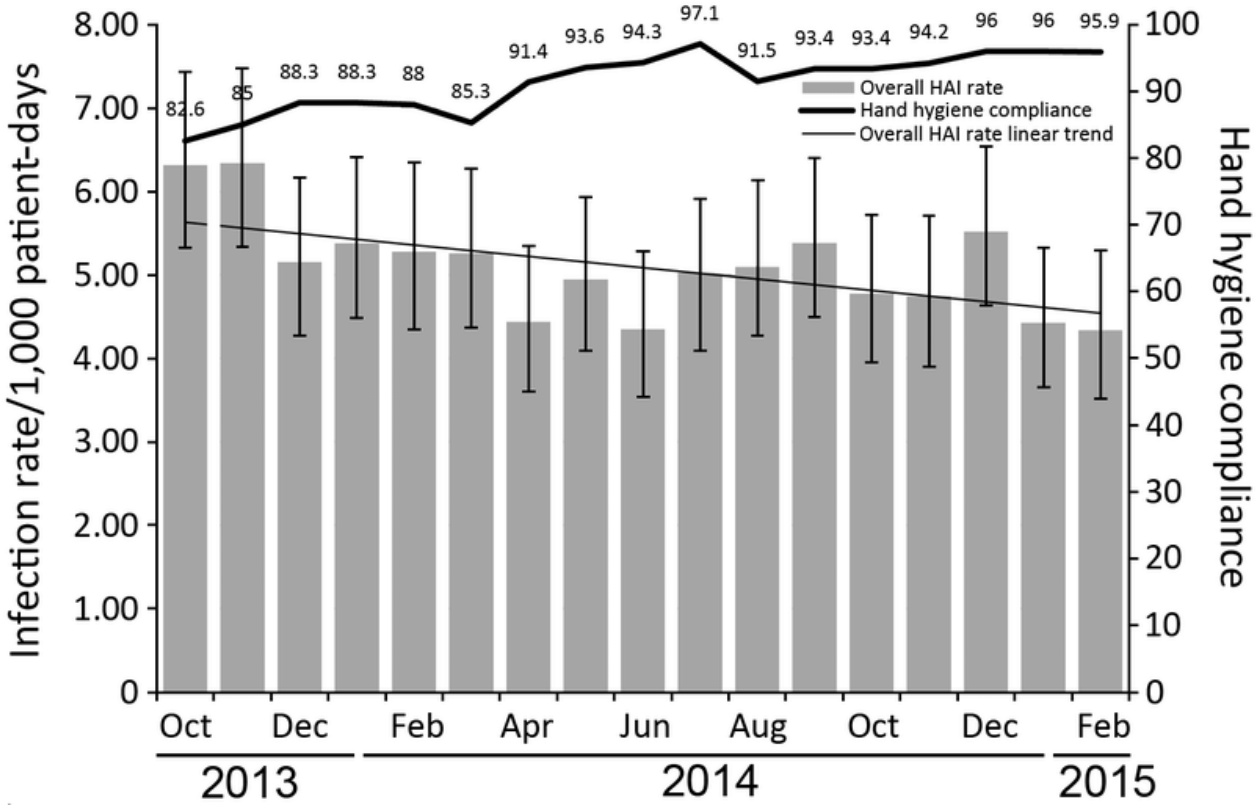
doi: 10.1093/pnasnexus/pgae338

Paediatric-specific challenges

- Shed more, for longer…
- No personal space…(poor cough etiquette, close contact play, mouthing)
- Family involvement: more people = more vectors
- Not a fan of PPE
- Vaccination gaps / catch up schedules

Core Infection Prevention Measures

- Hand hygiene
- Bare below the elbows
- Standard and transmission-based precautions
- Environmental & equipment hygiene



Emerging Infectious Diseases 22(9):1628-1630

Overview of the use of standard and transmission-based precautions

Type of precautions	Examples of infectious agents	Patient placement	Gloves	Gowns	Masks	Protective eyewear	Shared equipment	Environmental cleaning	Visitors*
Standard precautions	Hepatitis B, Hepatitis C, Cytomegalovirus (CMV)	No restrictions on patient placement.	**PPE use**: • Gloves and gowns to be worn when there is potential exposure to blood or body substances • Mask and protective eyewear to be worn when there is potential for blood or body substances exposure to mucosa (for e.g., attending to a patient who is coughing and sneezing).				Single-use, single - patient use or reprocess	Clean with neutral detergent. If surfaces are contaminated with blood or body fluids, cleaning should be followed with disinfection.	Hand hygiene, respiratory hygiene, cough etiquette.
Contact	Multidrug-resistant organisms, *C.difficile*, norovirus	Single room, or cohort with same strain of infectious agent.	Yes	Yes	As per standard precautions	As per standard precautions		Neutral detergent and disinfectant are required.	As per standard precautions
Droplet^	Norovirus, pertussis#, meningococcus	Single room with door open, or cohort with same strain of infectious agent.	As per standard precautions	As per standard precautions	Yes- use surgical mask			Neutral detergent. Use disinfectant if infectious agent is a multidrug-resistant organism or in the event of an outbreak. .	Restrict visitor numbers and use same precautions as staff.
Airborne	Pulmonary TB, rubella#, measles# and chicken pox#	Single room with door closed. Use negative pressure room if available.			Yes- use particulate respirator (P2 or N95 mask)				

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But there's not enough side rooms..

Organism / infection (suspected or confirmed) - the following require isolation and discussion with the Infection Control Team. They are listed in order of priority (high to low). Click here to access further information.	**Priority score for isolation (1 to 9, where 9 is highest)**
Epiglottitis or Supraglottitis (Pending laboratory results, as these can be caused by Haemophilus influenzae type b or Streptococcus pyogenes (Group A Strep))	9
Haemophilus influenzae type b causing any infection - **Notifiable disease**	9
Diarrhoea and/or vomiting of potentially infectious cause (pending laboratory results)	8
Clostridium difficile	8
E. coli O157 – **Notifiable disease**	8
Shigella	8
Streptococcus pyogenes (Group A Strep) causing any infection. Invasive Group A Strep is a **Notifiable disease**	8
Influenza	7
Neisseria meningitidis, causing meningitis or septicaemia (until 24hrs of appropriate antibiotics) - **Notifiable disease**	7
Mumps - **Notifiable disease**	7
Whooping Cough (Bordetella pertussis) - **Notifiable disease**	6
Respiratory syncytial virus (RSV)	6
Mycobacterium tuberculosis (TB) extra-pulmonary - **Notifiable disease**	6
Shingles	5
Vancomycin Resistant Enterococcus (VRE)	5
Salmonella	5
Acute viral encephalitis, of all causes including herpes simplex virus (HSV)	4
Extended Spectrum Beta Lactamase (ESBL) producing organisms, symptomatic of infection	4
Common cold (not including RSV or influenza)	2
Lice	2
Rotavirus	2
Scabies	2
Campylobacter	1
Cryptosporidium	1

MRSA - different isolation priority scores apply depending on patient factors and patient location. 'Skin shedders' include patients with eczema and psoriasis	**Priority score for isolation (1 to 9, where 9 is highest)**
For patients currently in UHC or UHA	
MRSA in sputum, multiple sites, or skin shedders	8
MRSA in nose only	5
MRSA Clinical Risk Assessment positive (yes to any question)	5
For patients currently in a community hospital or GP unit	
MRSA in sputum, multiple sites, or skin shedders	6
MRSA in nose only (applies to GP units only)	3

Contact and droplet precautions - rediroom

Paediatric respiratory infection challenges

- Seasonality and outbreak management
- Cohorting vs single room isolation
- Aerosol generating proceedures
- Carriage vs infectivity

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Managing children requiring admission to hospital with viral respiratory tract infections: summary flow chart (November 2025)

RCPCH Royal College of Paediatrics and Child Health
Leading the way in Children's Health

During periods of high respiratory virus prevalence, cubicles should be prioritised for children at the highest risk of severe disease*

All staff involved in the care of symptomatic children must wear personal protective equipment (PPE) in accordance with appropriate transmission-based precautions.

Child requiring admission to hospital with presumed viral respiratory tract infection

Perform respiratory viral testing (RSV, influenza A/B, SARS-CoV-2).
Use rapid molecular testing where locally agreed. If limited testing capacity, prioritise rapid testing for children in whom AGPs are likely to be performed. NOTE: transfer from ED should not be delayed while awaiting viral results

Can initially be admitted to an undifferentiated respiratory bay whilst awaiting respiratory virus results unless AGP being performed (see Appendix 2).

Management of RSV or influenza positive children
Transfer to virus specific cohort bay or cubicle irrespective of whether an AGP is being performed.
De-escalate when appropriate**

Management of RSV or influenza negative children
(these children may be positive for other respiratory viruses including SARS-CoV-2)
Can manage in a non-RSV, non-influenza A/B respiratory cohort area.
De-escalate when appropriate**

Device related and procedural infection prevention

- CLABSI bundles and audits
- VAP prevention
- Catheter associated UTI
- ANTT
- Consideration for neonates – skin integrity, umbilical lines

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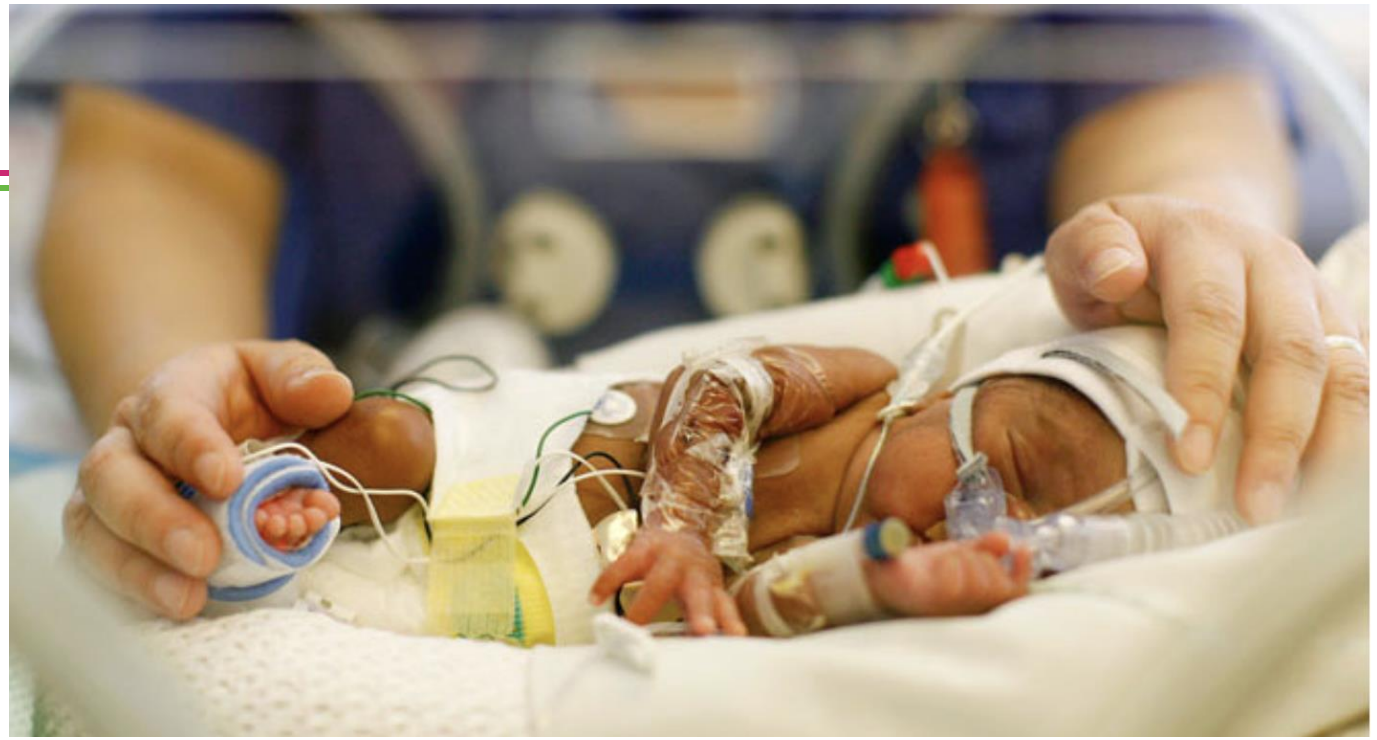
Neonates



Why?

Immature immune system

Poor skin integrity

Long duration of stay

Many high-dependency patients in open bays

Longer duration of CVC access (i.e. PN)

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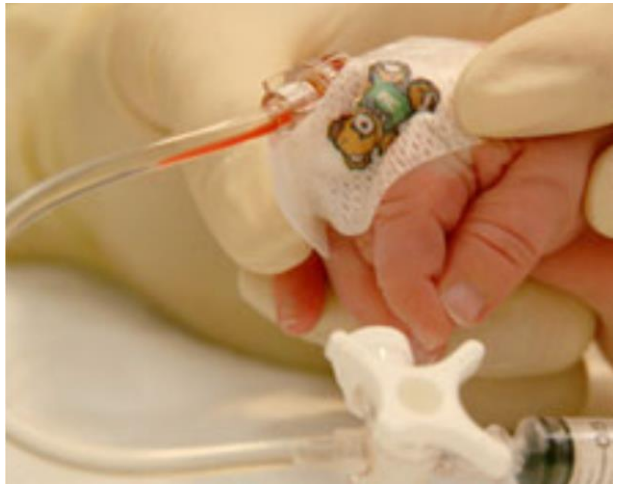
CLABSIs

13.8% mortality

65-70% are preventable

- Insertion bundles
- Cannula charts
- Use of vanc 1st line



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Central Line Insertion Checklist

Name_____

DOB __/__/__ MRN_____

Insertion: Date __/__/__ Time __:__

1. Decision making:

Consider review of central line insertion guideline

- ☐ Decision made by senior clinician
- ☐ Patient stable and no contraindications
- ☐ Consider site of central line
- ☐ ID labels checked
- ☐ Calculated length
- ☐ Family aware?

2. Drug prescribing:

- ☐ Contrast (NIOPAM 300)
  - 24G prime 0.1mls/ bolus 0.2mls
  - 28G prime 0.05mls/bolus 0.2mls

3. Preparation:

A. Equipment:

- ☐ Hat/mask/ sterile gown and gloves (operator)
- ☐ Central Line pack (instrument pack)
- ☐ Appropriate cleaning solution (see guideline)
- ☐ Chlorhexidine 2% Alcohol 70%
- ☐ Aqueous Chlorhexidine 0.5% + Insertion site (consider aqueous solution for extremely premature babies)
- ☐ Sterile drape (clear)
- ☐ Fixing - Umbilical line – sutures & zinc oxide tape; Longline – sterilstrips & Tegaderm
- ☐ Syringes/ needles/flush

B. Team:

- ☐ Experienced personnel available to perform or supervise
- ☐ Matching Michigan observer available- document if unavailable
- ☐ Procedure and individual roles discussed

C. Patient:

- ☐ Positioned appropriately
- ☐ Monitoring attached
- ☐ Procedural pain relief considered

NHS Bradford Teaching Hospitals NHS Foundation Trust

4. Pre procedure

- ☐ Screens used to secure area
- ☐ Hands decontaminated with Hibiscrub
- ☐ Incubator portholes cleaned with Clinell wipes

5. During procedure:

- ☐ Clean limb/ cord
- ☐ Area covered with transparent drape
- ☐ 24G cannula/ stylet for line introduction
- ☐ Guide wire removed (if applicable)
- ☐ Occlusive dressing for longlines
- ☐ Asepsis maintained throughout
- ☐ Observer present throughout

Number of attempts:

6. Post procedure:

- ☐ Attach needle free system to ports
- ☐ X-ray to check line position of line
- ☐ Contrast used
- ☐ Remove PPE/ waste disposal
- ☐ Decontaminate hands

7. Confirmation of placement

Line type:

UVC ☐ UAC ☐ 2Fr Nutriline ☐ 1Fr Premicath ☐

Insertion site:_____

Length:_____cm

Bleeds back freely from all lumens: Yes ☐ No ☐

Position on X ray:_____

Action (if any)_____

Final length:_____cm

Name & signature:_____

Procedure observed by:_____

Consultant x-ray review:

Date __/__/__ Time __:__

Name:_____ Signature_____

Please describe any deviation from checklist or difficulties/complications during the procedure:

Umbilical line inspected	30 min		60 min		90 min		2 hrs	

Karagiannidou S, Kourlaba G, Zaoutis T, Maniadakis N, Papaevangelou V. Attributable Mortality for Pediatric and Neonatal Central Line-Associated Bloodstream Infections in Greece. J Pediatr Intensive Care. 2021 Dec 16;13(2):174-183. doi: 10.1055/s-0041-1740448.

Umscheid CA, Mitchell MD, Doshi JA, et al. Estimating the proportion of healthcare-associated infections that are reasonably preventable and the related mortality and costs. *Infect Control Hosp Epidemiol*. 2011;32(2):101-114.

How / when do CLABSIs occur?

Opportunities to improve practice

CLABSI

- **During catheter insertion**
- At time of dressing change
- When catheter is being accessed

Slide by S. Coffin

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Infection Control & Hospital Epidemiology (2022), **43**, 553–569
doi:10.1017/ice.2022.87

SHEA

SHEA/IDSA/APIC Practice Recommendation

Strategies to prevent central line-associated bloodstream infections in acute-care hospitals: 2022 Update

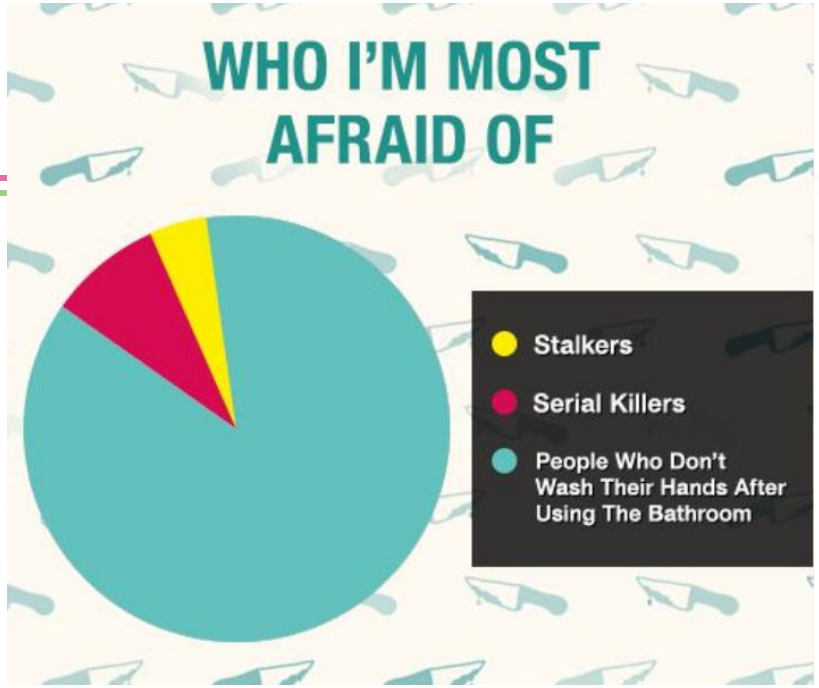
Niccolò Buetti MD, MSc, PhD[1,2,a], Jonas Marschall MD, MSc[3,4,a], Marci Drees MD, MS[5,6], Mohamad G. Fakih MD, MPH[7], Lynn Hadaway MEd, RN, NPD-BC, CRNI[8], Lisa L. Maragakis MD, MPH[9], Elizabeth Monsees PhD, MBA, RN, CIC[10,11], Shannon Novosad MD MPH[12], Naomi P. O'Grady MD[13], Mark E. Rupp MD[14], Joshua Wolf MBBS, PhD, FRACP[15,16], Deborah Yokoe MD, MPH[17] and Leonard A. Mermel DO, ScM[18,19]

Table 1. Summary of Recommendations to Prevent CLABSI

Essential Practices
Before insertion
1. Provide easy access to an evidence-based list of indications for CVC use to minimize unnecessary CVC placement (Quality of Evidence: LOW)
2. Require education and competency assessment of HCP involved in insertion, care, and maintenance of CVCs about CLABSI prevention (Quality of Evidence: MODERATE)[74–78]
3. Bathe ICU patients aged >2 months with a chlorhexidine preparation on a daily basis (Quality of Evidence: HIGH)[86–90]
At insertion
1. In ICU and non-ICU settings, a facility should have a process in place, such as a checklist, to ensure adherence to infection prevention practices at the time of CVC insertion (Quality of Evidence: MODERATE)[101]
2. Perform hand hygiene prior to catheter insertion or manipulation (Quality of Evidence: MODERATE)[102–107]
3. The subclavian site is preferred to reduce infectious complications when the catheter is placed in the ICU setting (Quality of Evidence: HIGH)[33,37,108–110]
4. Use an all-inclusive catheter cart or kit (Quality of Evidence: MODERATE)[118]
5. Use ultrasound guidance for catheter insertion (Quality of Evidence: HIGH)[119,120]
6. Use maximum sterile barrier precautions during CVC insertion (Quality of Evidence: MODERATE)[123–128]
7. Use an alcoholic chlorhexidine antiseptic for skin preparation (Quality of Evidence: HIGH)[42,129–134]
After insertion
1. Ensure appropriate nurse-to-patient ratio and limit use of float nurses in ICUs (Quality of Evidence: HIGH)[34,35]
2. Use chlorhexidine-containing dressings for CVCs in patients over 2 months of age (Quality of Evidence: HIGH)[45,135–142]
3. For non-tunneled CVCs in adults and children, change transparent dressings and perform site care with a chlorhexidine-based antiseptic at least every 7 days or immediately if the dressing is soiled, loose, or damp. Change gauze dressings every 2 days or earlier if the dressing is soiled, loose, or damp (Quality of Evidence: MODERATE)[145–148]
4. Disinfect catheter hubs, needleless connectors, and injection ports before accessing the catheter (Quality of Evidence: MODERATE)[150–154]
5. Remove nonessential catheters (Quality of Evidence: MODERATE)
6. Routine replacement of administration sets not used for blood, blood products, or lipid formulations can be performed at intervals up to 7 days (Quality of Evidence: HIGH)[164]
7. Perform surveillance for CLABSI in ICU and non-ICU settings (Quality of Evidence: HIGH)[13,165,166]
Additional Approaches
1. Use antiseptic- or antimicrobial-impregnated CVCs (Quality of Evidence: HIGH in adult patients[38,39,169–171] and Quality of Evidence: MODERATE in pediatric patients)[172,173]
2. Use antimicrobial lock therapy for long-term CVCs (Quality of Evidence: HIGH)[177–184]
3. Use recombinant tissue plasminogen activating factor (rt-PA) once weekly after hemodialysis in patients undergoing hemodialysis through a CVC (Quality of Evidence: HIGH)[192]
4. Utilize infusion or vascular access teams for reducing CLABSI rates (Quality of Evidence: LOW)[193,194]
5. Use antimicrobial ointments for hemodialysis catheter insertion sites (Quality of Evidence: HIGH)[197–201]
6. Use an antiseptic-containing hub/connector cap/port protector to cover connectors (Quality of Evidence: MODERATE)[202–208]
Approaches that Should Not Be Considered a Routine Part of CLABSI Prevention
1. Do not use antimicrobial prophylaxis for short-term or tunneled catheter insertion or while catheters are *in situ* (Quality of Evidence: HIGH)[209–213]
2. Do not routinely replace CVCs or arterial catheters (Quality of Evidence: HIGH)[214]
Unresolved Issues
1. Routine use of needleless connectors as a CLABSI prevention strategy before an assessment of risks, benefits, and education regarding proper use[215–219]
2. Surveillance of other types of catheters (eg, peripheral arterial or peripheral venous catheters)[11,21,22]
3. Standard, nonantimicrobial transparent dressings and CLABSI risk.
4. The impact of using chlorhexidine-based products on bacterial resistance to chlorhexidine
5. Sutureless securement
6. Impact of silver zeolite-impregnated umbilical catheters in preterm infants (applicable in countries where it is approved for use in children)[227]
7. Necessity of mechanical disinfection of a catheter hub, needleless connector, and injection port before accessing the catheter when antiseptic-containing caps are being used

Note. CLABSI, central line-associated bloodstream infection; CVC, central venous catheter; HCP, healthcare personnel; ICU, intensive care unit.

Key points



HCAI are a big and increasing problem

IPC precautions like the CQC are watching!

Think about which precautions and apply consistently with signage

Focus on lines