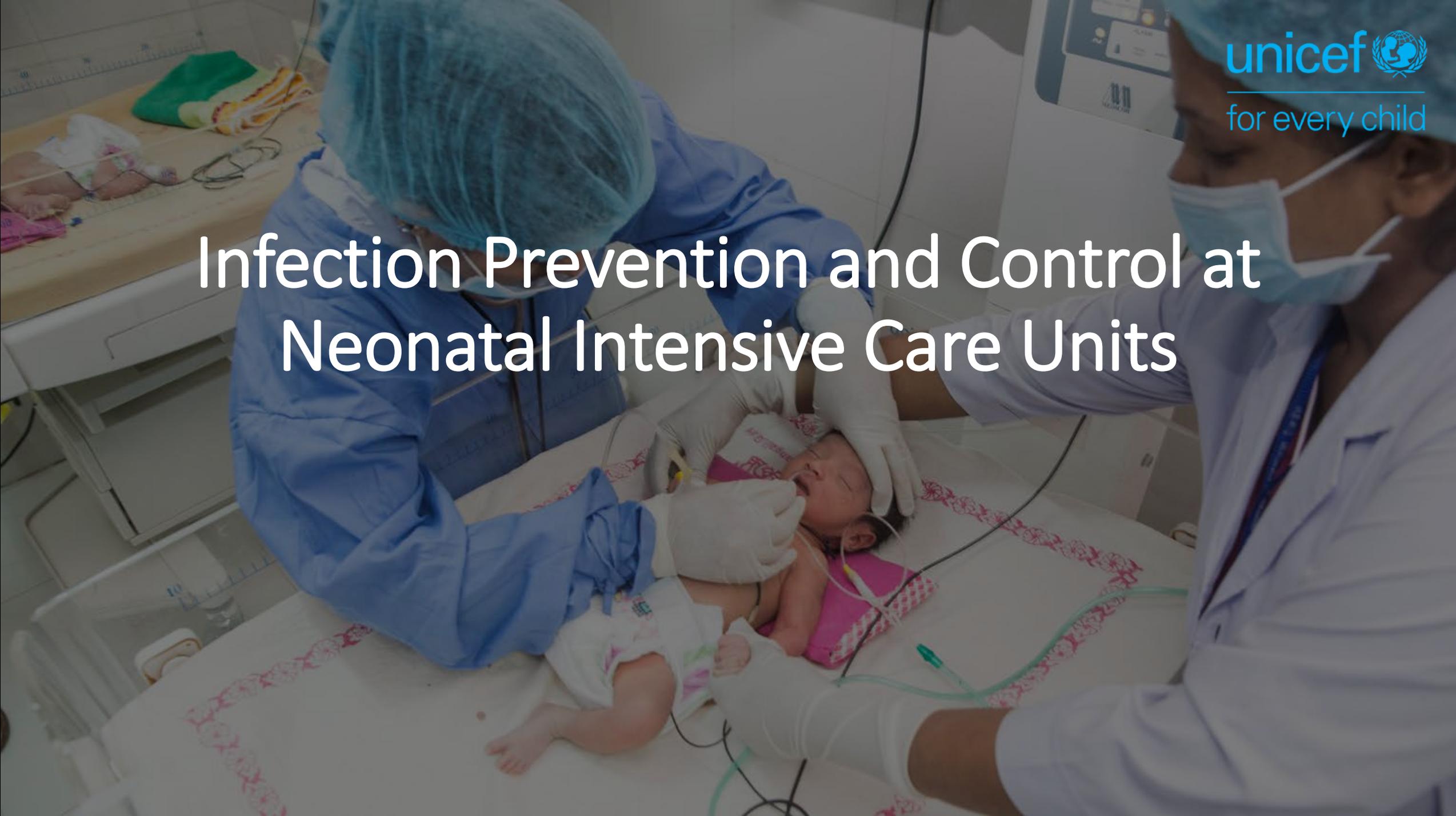


Infection Prevention and Control at Neonatal Intensive Care Units



Adapting this presentation

- Adapt based on the country context
- Personalize with local photos.
- Consider adding country or regional-level data as comparison slides.
- Add suitable local examples of Infection Prevention and Control program experiences
- Add local data and initiatives on antimicrobial resistance

Suggested citation: Gaurav Sharma, Nabila Zaka and Tedbabe Hailegebriel; Infection Prevention Control at Neonatal Intensive Care Units; UNICEF, New York (2018).

List of references provided at the end for further reading

Course Outline

- Background: Definition, Aetiology, burden, common pathogens- bacterial and viral
- Types of Health Care Associated Infections
- Infection Prevention and Control: Overview, Guidelines, WASH and IPC
 - Antimicrobial Resistance
 - Effective interventions for reducing infections at the time of birth
 - General Infection Prevention and Control for all newborns
 - Prevention of infections in neonates requiring special care
 - Spacing requirements
 - Water supply and use
 - Handling infant feeds
- Hand Hygiene
- Family Centred Care
- Isolation and Cohorting
- Improving IPC targets through QI projects
- Summary



Discussion

Have you heard of the term Healthcare Associated Infections?

Is it important at your workplace?

Why is it important in neonates?





Definition of Healthcare Associated infection (HAI)

- Infection that occurs in a patient as a result of care received at a health facility and was not present at the time of arrival at the facility.
- HAI starts on or after the 3rd day of admission to the health facility (Day of admission is Day 1) or on the day of or the day after discharge from the facility.
- Replaces the formerly used “nosocomial” or “hospital” infection because evidence has shown that these infections can affect patients in any setting where they receive health care.

Definition of Healthcare Associated Infections in newborns

- Infection of the newborn that occurs after birth in a health care facility.
- Timeframes between 72 hours and 7 days are often used.
- Infections occurring on the day of birth/admission or the day after are not health care-associated infections.





Aetiology of infections amongst newborns

Source	Microorganisms
Across the placenta	Treponema pallidum, cytomegalovirus, rubella, varicella (chicken pox), Toxoplasmosis gondii, HIV
Mother's birth canal	Group B streptococci, E. coli, Coagulase-negative staphylococcus, Listeria monocytogenes, HBV, HIV, HSV
Environment within health care facility	Gram-negative organisms (e.g., Klebsiella pneumoniae) often multidrug resistant (MDR), opportunistic infections (e.g., coagulase-negative Staphylococcus spp.), Gram positive organisms (e.g., MRSA), respiratory viruses, and gastrointestinal infections (e.g., Staphylococcus spp.)

Risk factors for neonatal infections

Newborn risk factors that increase the risk of infection

- Lower birth weight (ELBW>VLBW)
- Younger gestational age
- Immunology of the neonate: Immunocompromised, immature, ineffective and inadequate levels of antibodies
- Co-morbidities (e.g.: congenital conditions)

Care-related risk factors that increase the risk of infection

- Intensive care stay
- Presence of invasive medical devices
- Parenteral nutrition
- Antimicrobial therapy which may lead to multiple drug resistance organism (MDRO) infections
- Overcrowding and Understaffing
- Ward layout (sinks, bed spacing)
- Use of foetal scalp electrodes/ probes and canula
- Contact with colonized/ infected family, visitors, or healthcare workers
- Proximity of colonized neonates.
- Increased length of stay



Rates of healthcare-acquired infections (HAI) in newborns are 20 times higher in resource-limited settings compared to developed country context, with **inadequate environmental hygiene** and **low adherence to infection prevention and control** cited as potential explanations (Allengranzi et al, 2011)

Contributing Factors for Healthcare Associated Infections

- High patient-to-nurse ratio
- Bed space less than 1 meter (3 feet) apart
- Low compliance with hand hygiene practices
- Limited resources for isolation or cohorting (grouping babies with the same condition together)
- Lack of trained IPC practitioners and limited opportunities for staff training
- Increasing use of complex medical and surgical procedures
- Increasing use of invasive medical devices (e.g., mechanical ventilators, central intravenous lines)
- Inadvertent contamination of prepared supplies/pharmaceuticals (e.g., IV fluid, infant formula, general medications)
- Suboptimal cleaning, disinfection, and sterilization practices
- Antibiotic resistance due to overuse of broad-spectrum antibiotics

Discussion

What is the burden of Healthcare Associated Infections in NICUs?

What are the most frequent types of infections in Neonatal Intensive Care Units?

Burden of Healthcare Associated Infections

- Variations in definitions and reporting mean that exact global burden of HAIs is difficult to quantify
- Higher incidence in NICUs than other ICUs because of unique vulnerabilities of neonates and environmental risk factors specific to NICUs

United States of America:

- 1.7 million annually, causing approximately 99,000 deaths and severe morbidity (Klevens 2007; Stone 2009; Hooven 2014).
- 33,000 infants are diagnosed with HAI each year in NICUs (Klevens 2007).
- Types of HAIs in NICUs (Polin 2012; Hooven 2014)
 - Central line-associated bloodstream infections (CLABSI)
 - Pneumonia
 - Infections of the skin and soft tissues, urinary tract and the central nervous system



Source: Getty images

Burden of HAI – Southeast Asia

- Overall prevalence 9% (7.2 – 10.8%)
- Incidence density: 20 per 1000 ICU days
- Associated mortality
- Excess Length of stay: 5-21 days

Types of Infection

- Central Line Associated Blood Stream Infections – 4.7/1000 catheter days (95%CI: 2.9-6.5)
- Ventilator Associated Pneumonia – 14.7/1000 ventilator days (95% CI: 11.7 – 17.7)
- Catheter Associated Urinary Tract Infection – 8.9/1000 catheter days (95% CI: 6.2-11.7)
- Surgical Site Infection – 7.8% (95% CI: 6.3 – 9.3%)



Source: UNICEF, UN0188843



Neonatal Sepsis in Low and Middle Income Countries (LMIC)

- Hospital-born babies in LMICs are at ↑ risk of infections given poor infection-control practices.
- Neonatal sepsis could be early or late onset.
- *Major pathogens: Klebsiella pneumoniae, Escherichia coli, Pseudomonas spp, Acinetobacter spp and Staphylococcus aureus*
 - About **70% resistant** to ampicillin and gentamicin and many might be untreatable
- Associated with high mortality, morbidity and treatment costs which pose as barriers to improving health seeking behaviour
- Low-cost, “bundled” interventions using systems quality improvement approaches for improved infection control are needed.

Common pathogens causing neonatal infections

Bacterial infections	Viral Infections
Group B streptococcus	Hepatitis B
Staphylococcus aureus	Hepatitis C
Chlamydia	Herpes simplex virus
Gonorrhoea	Human immunodeficiency virus
Listeriosis	Human papilloma virus
Tetanus	Influenza virus
Syphilis	Rubella
	Varicella

Group B Streptococcus

- Gram + bacterium, causes invasive disease primarily in infants and pregnant or postpartum women.
- Major cause of newborn meningitis and septicaemia (Gray *et al.* 2011)
- Early-onset GBS disease (within first 6 days)- maternally acquired.
 - Women with diabetes are more likely to be colonized with GBS (AAP 2012).
- Late-onset GBS disease (7 days to 89 days) is considered to be an HAI.
- Symptoms and signs: Respiratory distress, apnoea, or other signs of sepsis, mostly characterized by pneumonia and sepsis.

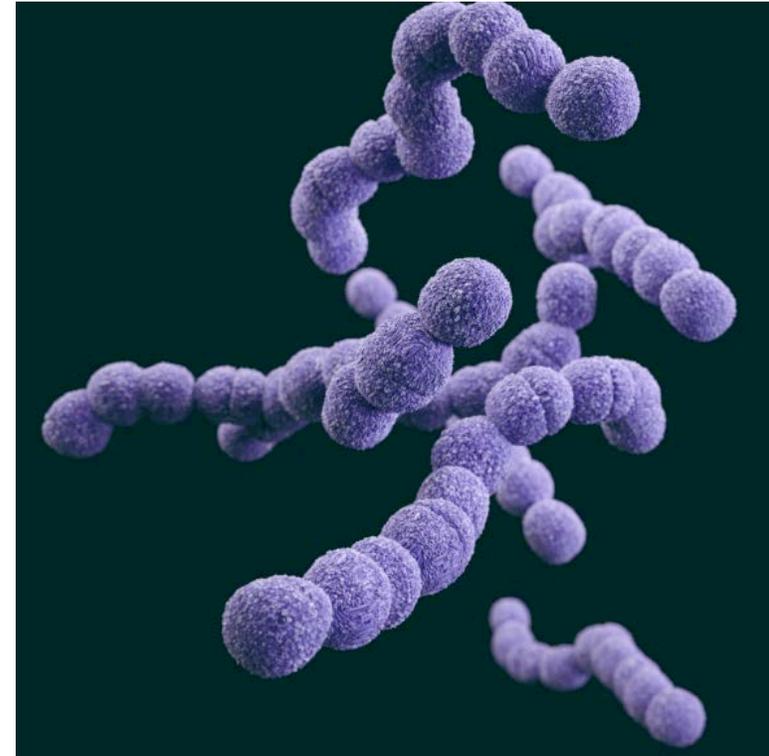


Image credit: James Archer / CDC.

Screening for Group B Streptococcus- 1

Risk factor based: If the woman has one of the following intrapartum risk factors, intravenous antibiotic prophylaxis is indicated:

- Childbirth at less than 37 weeks' gestation
- Amniotic membrane rupture for 18 or more hours
- Intrapartum temperature of at or above 38°C (100.4°F)

Culture-based screening: Based on a positive vaginal-rectal swab, obtained at 35–37 weeks of gestation and cultured for GBS

Best practice: Screen all pregnant women for GBS when in labour and provide intrapartum antibiotic prophylaxis at the onset of active labour for those who have a positive GBS culture.

Screening for Group B Streptococcus - 2

In facilities where cultured-based screening is not possible,

prophylaxis is indicated in the following conditions:

- Previous infant with invasive GBS disease
- GBS bacteriuria during any trimester of the current pregnancy
- Positive GBS vaginal-rectal screening culture in late gestation during current pregnancy
- Intrapartum tests positive for GBS
- Unknown GBS status at the onset of labour and any of one of the following:
 - Childbirth at less than 37 weeks' gestation
 - Amniotic membrane rupture for 18 or more hours
 - Intrapartum temperature of at or above 38°C (100.4°F)

Prophylaxis not indicated in the following conditions:

- Colonization with GBS during the previous pregnancy
- GBS bacteriuria during previous pregnancy
- Negative genital and rectal GBS screening culture in late gestation during current pregnancy, regardless of intrapartum risk factors
- Elective C-section (with intact membrane) regardless of GBS colonization status or gestational age.

Chlamydial Infection

- Chlamydia trachomatis is transmitted to newborns from infected mothers during birth
- Approximately 50% of infants delivered vaginally from infected mothers will acquire an infection.
 - 25–50% will develop purulent conjunctivitis unless treated prophylactically at birth with antibiotic eye drops (tetracycline or erythromycin)
 - 5–20% will develop pneumonia.

Prevention:

- Treatment of infected pregnant women in the 3rd trimester with erythromycin.
- Use of antibiotic eye drops after birth

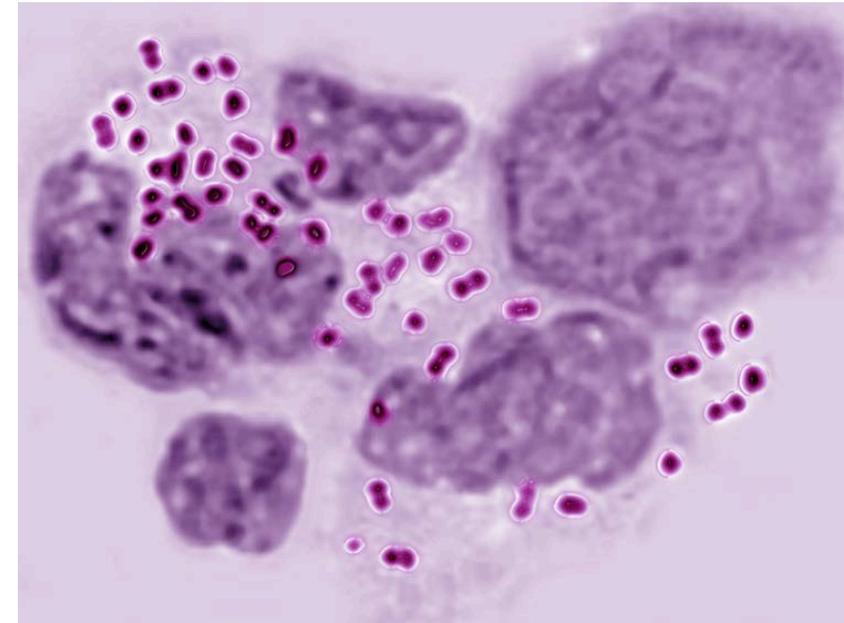
Treatment:

- Infants with chlamydial conjunctivitis or pneumonia can be treated with erythromycin base or erythromycin ethylsuccinate 50 mg/kg/day in four divided daily doses for 14 days. (AAP 2012)
- Oral sulfonamides may be used to treat chlamydial conjunctivitis if the infant does not tolerate erythromycin.
- Standard precautions for newborns with purulent conjunctivitis in a nursery or NICU.
- When caring for patients with chlamydial conjunctivitis or pneumonia and mothers with genital chlamydia, use standard precautions.
- Good hand hygiene practices.

Ref: AAP 2012 and Seigel et al.2007

Gonorrhoea Infection

- Usually occurs during birth from an infected mother and appears within 2–5 days after birth.
- Most severe manifestations: ophthalmia neonatorum and sepsis.
- Prevention: Screening, diagnosis, and treatment of infected pregnant women using appropriate antibiotics.
 - Antenatal testing is not available in most low-income countries, use of eye drops (tetracycline or erythromycin) is the only preventive measure usually available. (CDC 2015)
- Standard precautions should be used for newborns with purulent conjunctivitis in a nursery or NICU.
- When caring for patients with ophthalmia neonatorum and mothers with gonorrhoea infection, use Standard Precautions.
- Good hand hygiene practices are recommended. (Seigel et al. 2007)



BSIP/ UIG via Getty Images

Listeriosis

- Foodborne infection caused by *Listeria monocytogenes*
- Can lead to foetal loss, preterm labour, and illness or death in newborn infants.

Transmission:

- In utero
 - vertical transmission
 - through contact with infected persons.
 - Pregnant women x 10 more likely to get listeria infection compared to general population
- **Early onset syndrome:** Preterm birth, pneumonia, and septicaemia. An erythematous rash with small pale papules can also occur in early onset with severe newborn infection.
 - **Late onset syndrome:** Usually results in meningitis. (AAP 2012)

Management:

- Treatment with IV ampicillin and an aminoglycoside. Immunocompetent patients with mild infections can be treated with ampicillin alone. (AAP 2012).
- Use Standard Precautions while providing care and ensure good hand hygiene practices. (APIC 2014)

Neonatal Tetanus

- Still remains an important problem in settings where maternity services are limited and immunization against tetanus is inadequate.
- In 2015- approximately 34,019 newborns died (WHO 2018)
- Infection spreads through use of an unclean instruments or by harmful cord care practices for e.g.: applying ash, cow dung, dust or other harmful substances on the umbilical stump.

Prevention:

- Simple and effective solutions such as hygienic childbirth practices, clean cord care practices and maternal tetanus vaccine immunization.
- Non-immunized pregnant women should receive at least 2 doses prior to childbirth. If there is sufficient time before childbirth, 2 doses should be administered at least 4 weeks apart, and the second dose should be given at least 2 weeks before childbirth.

Syphilis

- Sexually transmissible infection caused by *Treponema pallidum* and also transmitted from mother to child during pregnancy.

Screening:

- Antenatal testing of pregnant women should be done to identify and treat women who are seropositive and to prevent congenital syphilis in newborns.
- If the results of serologic tests for syphilis are equivocal or not available, a cord blood or venous sample from the newborn should be tested.

Treatment:

- Infected women should be treated with penicillin according to the dosage appropriate for the stage of syphilis. (WHO 2017)
- When caring for patients with syphilis, use Standard Precautions. Always use good hand hygiene practices. (Siegel et al. 2007)

Hepatitis B

- Mother-to-child transmission is the major route of transmission (WHO 2015).

Prevention:

- HBV vaccination and one dose of hepatitis B immune globulin (HBIG), administered within 24 hour after birth, are 85–95% effective in preventing both HBV infection and the chronic carrier state. HBV vaccine administered alone, beginning within 24 hour after birth, is 70–95% effective in preventing perinatal HBV infection. (WHO 2015)
- Routine infant immunization is equally effective as a combination of HBIG and vaccine.

Management (APIC 2014):

- It is safe for a HBV infected mother to breastfeed her infant immediately after birth.
- Apply standard precautions while caring for infant with HBV
- Infants can stay in the nursery or NICU with other patients
- For all patients, there is no specific treatment for acute hepatitis B.
- Care is aimed at maintaining comfort and adequate nutritional balance, including replacement of fluids that are lost from vomiting and diarrhoea.
- Ensure that health care workers are vaccinated against HBV.

Hepatitis C

Mode of transmission:

- Infected mothers can transmit the virus to their children during birth.
- Does not spread through breast milk, food, or water, or by casual contact, such as hugging, kissing, and sharing food or drinks with an infected person (WHO 2014).
- Transmission from mother to child occurs in 4–8% of births in women with HCV infection and in 17–25% of births in women with HIV and HCV coinfection.

Prevention and treatment:

- No treatment or vaccine for prevention of HCV
- Interventions for prevention of HCV infection include:
 - Hand hygiene, including surgical hand preparation, handwashing, and use of gloves
 - Safe handling and disposal of sharps and waste
 - Safe cleaning of equipment
 - Testing of donated blood
 - Improved access to safe blood
 - Training of health personnel
- Breastfeeding is not contraindicated, but if nipples are cracked and bleeding, the mother may wish to abstain. (APIC 2014)

Herpes Simplex Virus

- Increased risk of abortion or preterm birth if pregnant woman has HSV infection
- Transmission from mother to neonate can cause severe disease and high morbidity and mortality even with treatment with antiviral medication.
- If the mother has primary HSV infection around the time of childbirth, the risk of transmission to the neonate ranges from 25–60% (AAP 2012).
- Use standard precautions when caring for asymptomatic neonates delivered vaginally or by C-section
- Mothers with HSV should perform hand hygiene before and after caring for their infants, and cover their lesions, such as with gowns or masks if herpes is around the lips or if stomatitis is present, until lesions have crusted and dried (APIC 2014).
- People with oral HSV should not kiss infants until lesions are dry and crusted. Mothers can continue to breastfeed their babies, provided there are no lesions in the breast area and all skin lesions are covered. (APIC 2014)

Human Immunodeficiency Virus -1

- HIV can be transmitted from a woman infected with the virus to her baby during pregnancy, childbirth, or breastfeeding.
- Approximately 90% of HIV infections among children are a result of mother-to-child transmission of HIV.
- Mortality in the first year of life is very high among untreated infants infected with HIV, therefore early infant diagnosis (EID), prompt return of results and rapid initiation of treatment are essential.
- Good success has been achieved with the following strategy:
 - Testing all pregnant women for HIV
 - Using an opt-out approach (an approach in which all pregnant women are offered HIV testing as part of routine antenatal care unless they refuse testing)
 - Initiating lifelong treatment to every pregnant woman with HIV using a three-drug combination antiretroviral (ARV) (Option B+), irrespective of the CD4 count
 - Providing prophylactic ARVs for children born to HIV-infected mothers
 - Testing and early treatment of children who test positive
- Lifelong treatment using a triple-drug combination of ARVs and elective C-sections can reduce mother to- child transmission of HIV to less than 1%.
- Follow the national guidelines on prevention of mother-to-child transmission for screening pregnant women and managing those testing positive for HIV. Patients with HIV are cared for using standard precautions.

Human Immunodeficiency Virus- 2

Option B+: All pregnant and breastfeeding women infected with HIV should initiate ART as lifelong treatment.

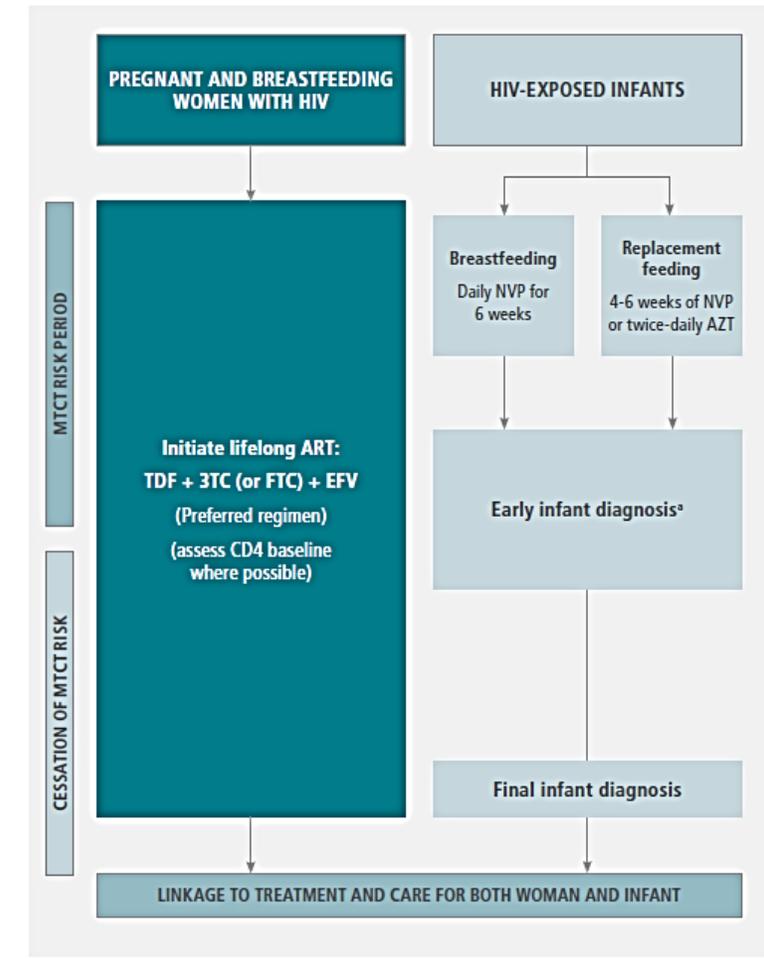
ARV and breastfeeding:

1. National agencies should decide between promoting mothers with HIV to either breastfeed and receive ARV interventions or to avoid all breastfeeding

2. Where the national guidelines support BF, mothers whose infants are HIV uninfected or of unknown HIV status should:

- Exclusively breastfeed their infants for the first six months of life
- Introduce appropriate complementary foods thereafter, and continue breastfeeding for the first 12 months of life
- Breastfeeding should then only stop once a nutritionally adequate and safe diet without breast-milk can be provided

Lifelong ART for all pregnant and breastfeeding women with HIV (Option B+)



Human Papilloma Virus

- Sexually transmitted virus that can cause genital warts and is associated with cancers in both sexes.
- HPV is thought to cause:
 - 100% of cervical cancer cases
 - 90% of anal cancer cases
 - 40% of cases of cancers of the external genitalia (vulva, vagina and penis)
 - at least 12% of oropharyngeal cancer cases
 - at least 3% of oral cancer cases.
- C – section is generally not recommended unless in women whose genital warts are so extensive that soft tissue stretching of the vulva and perineum may not be sufficient to allow vaginal delivery.
- Primary prevention: Education, counselling and vaccination
- Vaccination: All girls ages 9–13 should be vaccinated with two doses of HPV vaccine, preferably before they become sexually active (WHO 2014).
- Infants born to mothers infected with genital HPV are cared for with standard precautions.

Influenza virus

- Uncommon infection, however, some outbreaks in NICUs are known to occur
- Care for patient with influenza using droplet and standard precautions.
- Consider separation of a mother who is ill with suspected or confirmed influenza from her newborn during her hospital stay.
- Mothers with influenza should wear a surgical mask while breastfeeding and when within 3 feet of the infant. (APIC 2014)
- In case of outbreaks in NICU:
 - Screen patients using a rapid diagnostic test to enable cohorting of pre-symptomatic or asymptomatic infants.
 - Affected infants should be cohorted and droplet precautions taken to minimize spread.
 - Infants admitted from home and other units should be isolated until screening test results are available.
 - Immunize all staff and parents
 - Staff or parents who are unwell should not enter the unit, or should be sent home.
 - Anti-viral prophylaxis should be provided for staff and parents if unvaccinated, or if infection has occurred with a strain not covered by the vaccine.

Rubella virus

Symptoms:

- Mild disease with fever, rash, and lymphadenopathy that disappears in 3 days. However, babies of non immunized mothers can develop congenital rubella syndrome if exposed to the virus during pregnancy
- Women receiving vaccine should be counselled to avoid pregnancy for 3 months because of the risk of congenital abnormality.
- Rubella infection during early pregnancy can result in miscarriage and stillbirth.
- Congenital rubella syndrome: cataracts, congenital heart disease, hearing impairment, and developmental delays.
- The risk is highest during the first 12 weeks of gestation and decreases after the twelfth week; defects are rare after the twentieth week of gestation.

Primary prevention:

- Vaccination of all children and non-pregnant women is the most effective method of preventing congenital rubella in infants.

Management:

- Initiate Standard and Droplet Precautions for 7 days after onset of the rash.
- Use Contact Precautions for newborns with proven or suspected congenital rubella. Duration of precautions is until they are at least 1 year of age, because they may shed virus from the throat and urine until they are older than 1 year unless two cultures of clinical specimens obtained 1 month apart after 3 months of age are negative.
- Place exposed, susceptible patients on Droplet Precautions.
- Susceptible health care workers should not enter the room if immune caregivers are available. Pregnant women who are not immune (have not been vaccinated or had rubella) should not care for these patients. (AAP 2012; APIC 2014; CDC 2012)

Tuberculosis- 1

Important public health problem globally esp. in LMICs

Causes high neonatal mortality and morbidity - warrants early diagnosis and treatment of neonates suffering from TB.

Mother to child transmission of TB

- *In utero*
 - Hematogenous dissemination via the umbilical vein
 - Aspiration/ingestion of infected amniotic fluid
- *Intrapartum*
 - Aspiration/ingestion of infected amniotic fluid or genital secretions
- *Postpartum*
 - Inhalation/ingestion of respiratory droplets from the mother
 - Ingestion of infected breast milk

Screening pregnant women for active TB in low-income countries:

- Detailed history of maternal infection during antenatal period
- Screening of house hold contacts
- Morphological and histological examination of the placenta

Investigations in neonates:

- Microscopy and culture from gastric aspirates, sputum, tracheal aspirates, skin lesions, ear lesions and CSF.
- Bronchoalveolar lavage
- Newer methods such as LED fluorescence microscopy and liquid based mycobacteria growth indicator tube (MGIT) also exist.

Prevention of TB in the newborn:

Protection from exposure, early detection, treatment of TB in pregnant women and mothers, TB screening of health workers, and attention to proper environmental air controls in health care facilities. (APIC 2014)

Tuberculosis-2

- Care for patients with suspected or confirmed pulmonary TB using Airborne and Standard Precautions.
- For infants with extra-pulmonary TB, use Airborne Precautions until active pulmonary tuberculosis in visiting family members is ruled out. (APIC 2014)
- Mothers with multidrug-resistant and extensively drug-resistant TB should be separated from their infants until appropriate anti-TB therapy has been started, the mother wears a mask, and the mother understands and is willing to adhere to infection control measures. (APIC 2014)
- Treatment regimen for pregnant woman with confirmed TB disease: Isoniazid, Rifampin and ethambutol daily for 2 months, followed by Isoniazid and Rifampin daily, or twice weekly for 7 months (for a total of 9 months of treatment).
- Breastfeeding should not be discouraged for women being treated with the first-line anti-tuberculosis drugs because the concentrations of these drugs in breast milk are too small to produce toxicity in the nursing newborn.
- Breastfeeding women taking Isoniazid should also take pyridoxine (vitamin B6) supplementation. (CDC guidelines)

Varicella (Chicken Pox)

- Chicken pox is caused by varicella-zoster virus (VZV)- a herpes virus.
- Herpes zoster (shingles) is caused by reactivation of VZV in adults and can be very painful.
- Unborn babies lacking passively acquired maternal antibodies can develop a life-threatening infection if exposed to the virus within the last 2 weeks of pregnancy or at the time of childbirth.
- The greatest risk is if the baby is born within 2 days before or 5 days after the onset of maternal chicken pox.
- A post-exposure vaccine should be provided as soon as possible, but within 120 hours of exposure.
- For susceptible exposed persons for whom the vaccine is contraindicated (newborns whose mothers' varicella onset < 5 days before delivery or within 48 hours after delivery, pregnant women, and immunocompromised persons), provide varicella-zoster immunoglobulin (VIZG), when available, within 96 hours; if unavailable, use intravenous immunoglobulin (IVIG). (APIC 2014; Seigel et al. 2007)

Varicella (Chicken Pox)- 2

- Pregnant women with active varicella at the time of admission and babies born to women with varicella at the time of childbirth should be placed on Airborne and Contact Precautions.
- While hospitalized, the newborn should remain on these precautions until 21 days of age (or 28 days of age if VZIG is given). (APIC 2014; Seigel et al. 2007)
- Susceptible health workers or pregnant health workers should not care for these patients if other staff available.
- Where possible, only health workers known to have had varicella or those previously vaccinated should provide care to the newborns and mothers. (Seigel et al. 2007)

Preventive strategies in the NICU

- Cohort in selective outbreak situations
- Regular surveillance of infections
- Vaccination of health care workers
- Appropriate visitation policies
- Overcrowding should be avoided
- Human resources: Avoid understaffing in NICUs
 - 47% in 2008 and 31% in 2009 (67 NICUs from the Vermont Oxford Network, USA) Ref: Rogowski JA *et al* : Nurse Staffing and NICU Infection Rates. JAMA Pediatr. 2013;167(5):444–450. doi:10.1001/jamapediatrics.2013.18
 - 54% of nursing shifts failed to meet standards in UK (BAPM standards): Ref: Pillay *et al*. 2011- <http://dx.doi.org/10.1136/adc.2011.300224>



Source: UNICEF/UN0158022/Voronin

British Association of Perinatal Medicine (BAPM) Service Standards for hospitals providing neonatal care 3rd edition (2010)

- **Recommendations for Nurse to patient ratio:**
 - Intensive care unit 1:1 – 1:2 patients
 - High Dependency unit: 1:2-3 patients
 - Special Care Baby Units 1:3-4 patients

Common types of hospital infections in the NICU

1. Blood stream infections (BSI)

- Central Venous Catheter (CVC)/ PICC
- Umbilical catheter-associated blood stream infections

Prevalence:

- 5-30% of infections depending on the diagnostic criteria
- Ref: Balain et. Al; *Cochrane Database of Systematic Reviews* 2015 [DOI: [10.1002/14651858.CD011078.pub2](https://doi.org/10.1002/14651858.CD011078.pub2)]

2. Ventilator-associated pneumonia - 6.8% to 32.2%. (CDC 2014)

- Large impact on neonatal morbidity, hospital costs and length of stay
- Premature birth, repeated and prolonged intubation and genetic diseases increase VAP frequency

3. Device associated infections

Most frequent infective agents were:

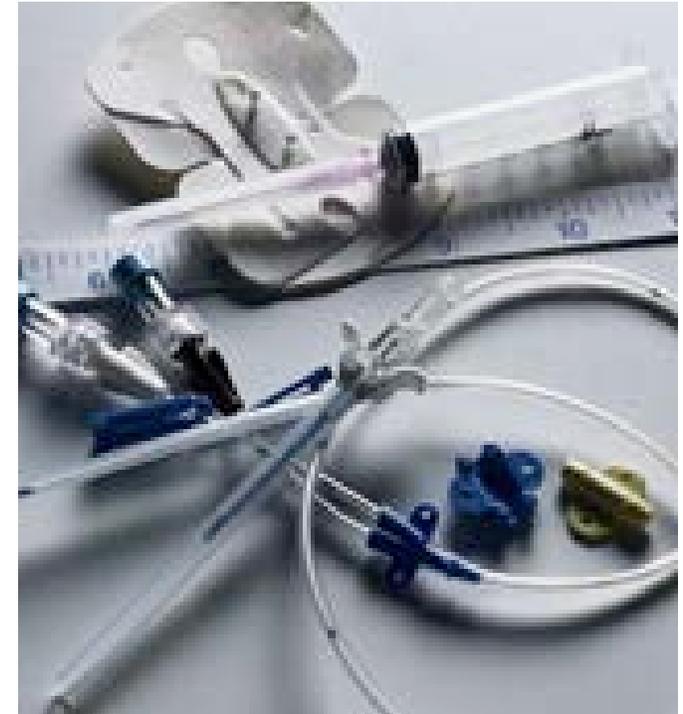
- Gram-negative pathogens for VAP
- Coagulase-negative staphylococci for CVC/UC BSIs



Evidence supports proactive strategies to prevent health care-associated infections in the NICU

Device associated infections

- Device associated infections may not be completely preventable in NICUs
- Clinicians should aim to decrease these infectious complications by taking the necessary precautions
- Every NICU should evaluate its own device associated infection trends regularly and then compare with the national and international data
- Determine problems and resolve them
- Active surveillance programs are essential for determination of pathogens and antibiotic resistance patterns

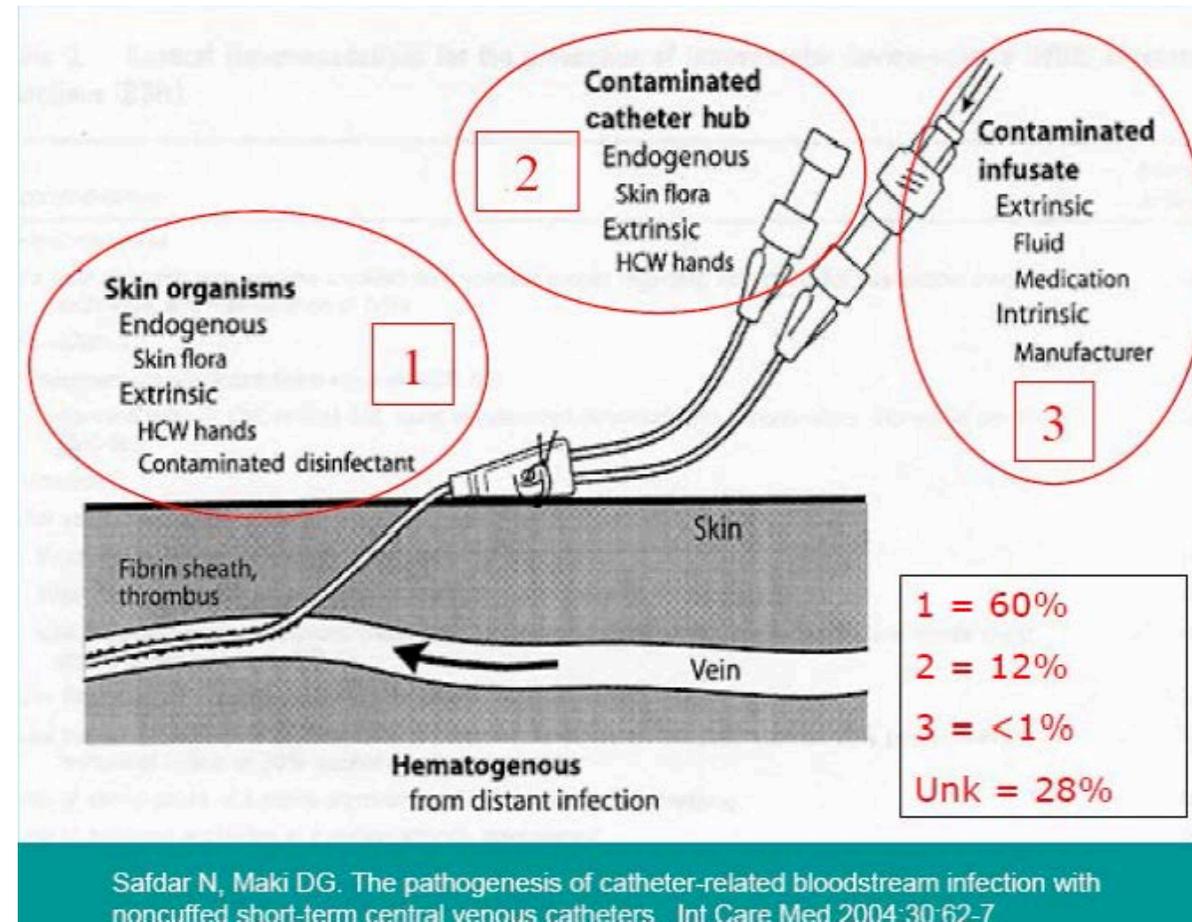


Central Line Associated Bloodstream Infection (CLABSI)

Commonest HAI in NICU

Pathophysiology:

- Migration of skin organisms at the insertion site into the cutaneous catheter tract with colonization of the catheter tip is the most common route of infection. (More common early <7 days)
- Contamination of the catheter hub also contributes to intraluminal colonization of long-term catheters. (More common ~ 10 days)
- Rarely, contamination of the infused fluid leads to infection
- Result of poor technique at insertion and ongoing care



Prevention Strategies for CLABSI: Core Hand Hygiene

- Hand hygiene should be a cornerstone of CLABSI prevention efforts (for both insertion and maintenance)
- Ensuring easy access to soap and water and alcohol-based hand gels in NICUs
- Education for Health care providers and patients
- Observation of practices - particularly around high-risk procedures (before and after contact with CL)
- Feedback – “Just in time” feedback if failure to perform hand hygiene observed

Fig: Hand hygiene is the Achilles' heel for CLABSI prevention



Berenholtz SM, et al. *Crit Care Med.* 2004;32:2014-2020.

Background: Prevention Strategies for CLABSI

- Michigan Keystone Project
- Decrease in CLABSI in 103 ICUs in Michigan (66% reduction)

Basic interventions:

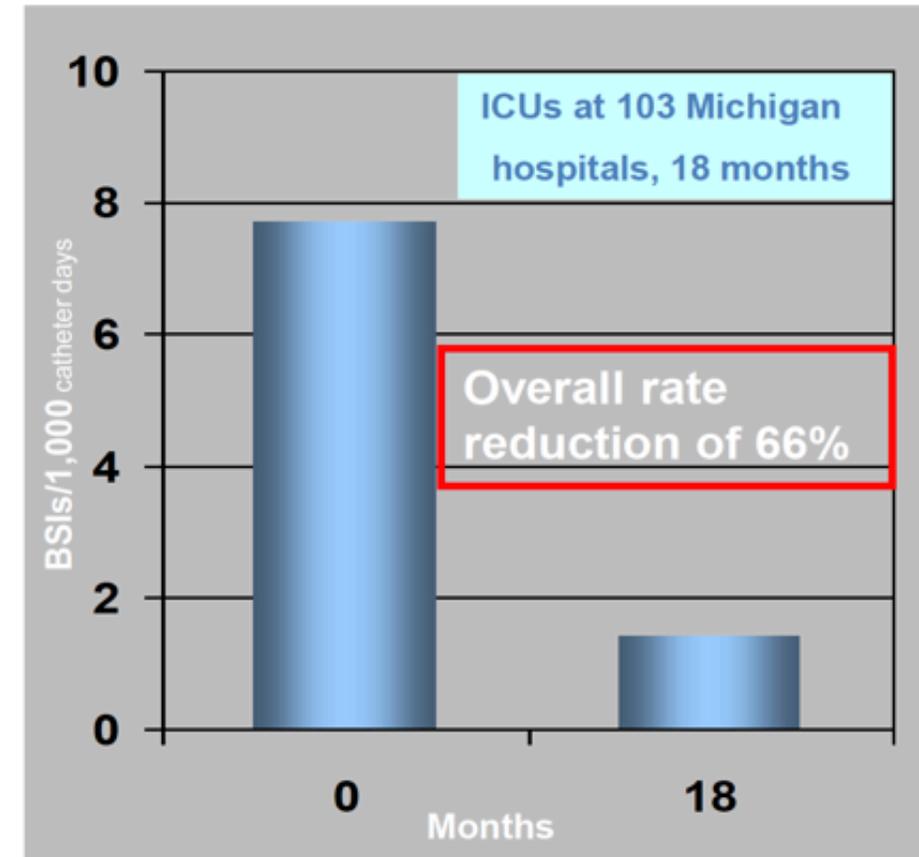
- Hand hygiene
- Full barrier precautions during CL insertion
- Skin cleansing with chlorhexidine
- Avoiding femoral site
- Removing unnecessary catheters
- Use of insertion checklist
- Promotion of safety culture

ORIGINAL ARTICLE

An Intervention to Decrease Catheter-Related Bloodstream Infections in the ICU

Peter Pronovost, M.D., Ph.D., Dale Needham, M.D., Ph.D., Sean Berenholtz, M.D., David Sinopoli, M.P.H., M.B.A., Haitao Chu, M.D., Ph.D., Sara Cosgrove, M.D., Bryan Sexton, Ph.D., Robert Hyzy, M.D., Robert Welsh, M.D., Gary Roth, M.D., Joseph Bander, M.D., John Kepros, M.D., [et al.](#)

Michigan Keystone Initiative



Pronovost P. *New Engl J Med* 2006;355:2725-32.

Background: Prevention Strategies for CLABSI

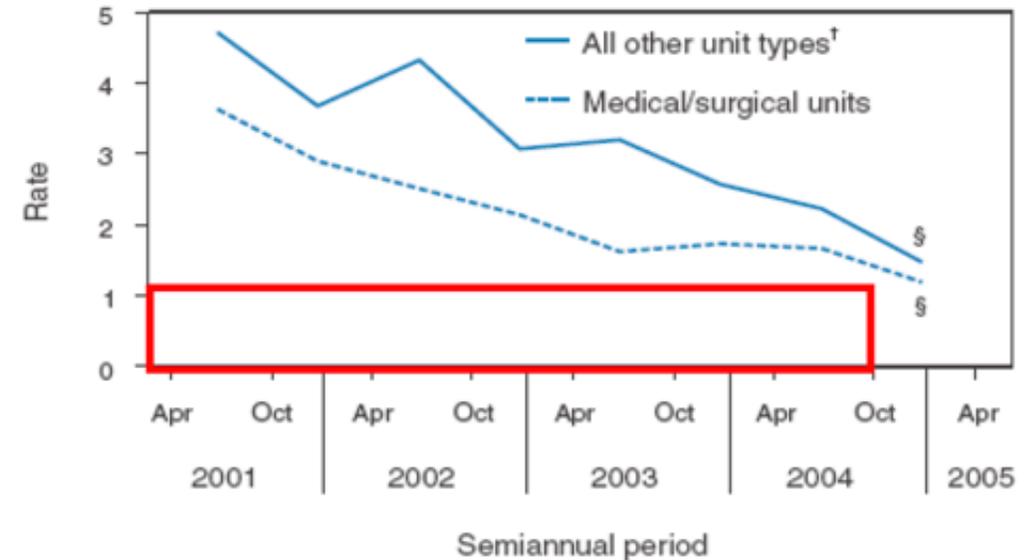
Pittsburgh Regional Health Initiative – Decrease in CLABSIs in 66 ICUs (68% decrease)

Interventions

- Promotion of best practices
 1. Maximal barrier precautions
 2. Use of chlorhexidine for skin cleansing prior to insertion
 3. Avoidance of femoral site for CL
 4. Use of recommended insertion-site dressing practices
 5. Removal of CL when no longer needed
- Educational module about BSI prevention
- Engagement of leadership and clinicians
- Standard tools for recording adherence to best practices
- Standardizing catheter insertion kits
- Measurement of CLABSI and reporting of rates back to facilities

Pittsburgh Regional Healthcare Initiative

FIGURE. Central line–associated bloodstream infection rate* in 66 intensive care units (ICUs), by ICU type and semiannual period — southwestern Pennsylvania, April 2001–March 2005



* Pooled mean rate per 1,000 central line days.

† Includes cardiothoracic, coronary, surgical, neurosurgical, trauma, medical, burn, and pediatric ICUs.

§ $p < 0.001$.

Antiseptic Non Touch Technique (ANTT)

ANTT aims to prevent the contamination of wounds and other susceptible sites, by ensuring that **only uncontaminated equipment or sterile fluids come into contact with susceptible or sterile body sites during clinical procedures.**

ANTT:

- Always wash hands effectively
- Never contaminate Key parts
- Touch non- key parts with confidence
- Take appropriate infective precautions

*Protect patients every time with...
6 Actions for Safe Aseptic Technique*

The ANTT-Approach



1

Risk Assessment

Select Standard or Surgical-ANTT according to the technical difficulty of achieving asepsis



2

Manage the Environment

Avoid or remove contamination risks



3

Decontaminate & Protect

Hand cleaning, personal protective equipment (PPE), disinfecting equipment, surfaces and Key-Parts



4

Use Aseptic Fields

General, Critical and Micro Critical Aseptic Fields protect Key-Parts & Key-Sites



5

Use Non-Touch Technique

Key-Parts must only come into contact with other Key-Parts & Key-Sites



6

Prevent Cross Infection

Safe equipment disposal, decontamination & hand cleaning

Aseptic Non-Touch Technique (ANTT)

Key parts: Key parts are the most critical parts of the procedural equipment, that if contaminated are likely to cause infection. For example: syringe tip, needle, catheter tip, patient skin, gauze swab, cannula tip



Key sites: Key sites are medical device access sites or open wounds



Discussion

What does infection prevention and control mean?

What can you do to prevent infections in your NICU?



Prevention



Cure



Preventability of Infections

Study on the Efficacy of Nosocomial Infection Control (SENIC) - J Hosp Infection 2003;54:258

- 6% of all HAIs preventable with minimal infection control efforts
- 32% preventable with “well organized and highly effective infection control programs”

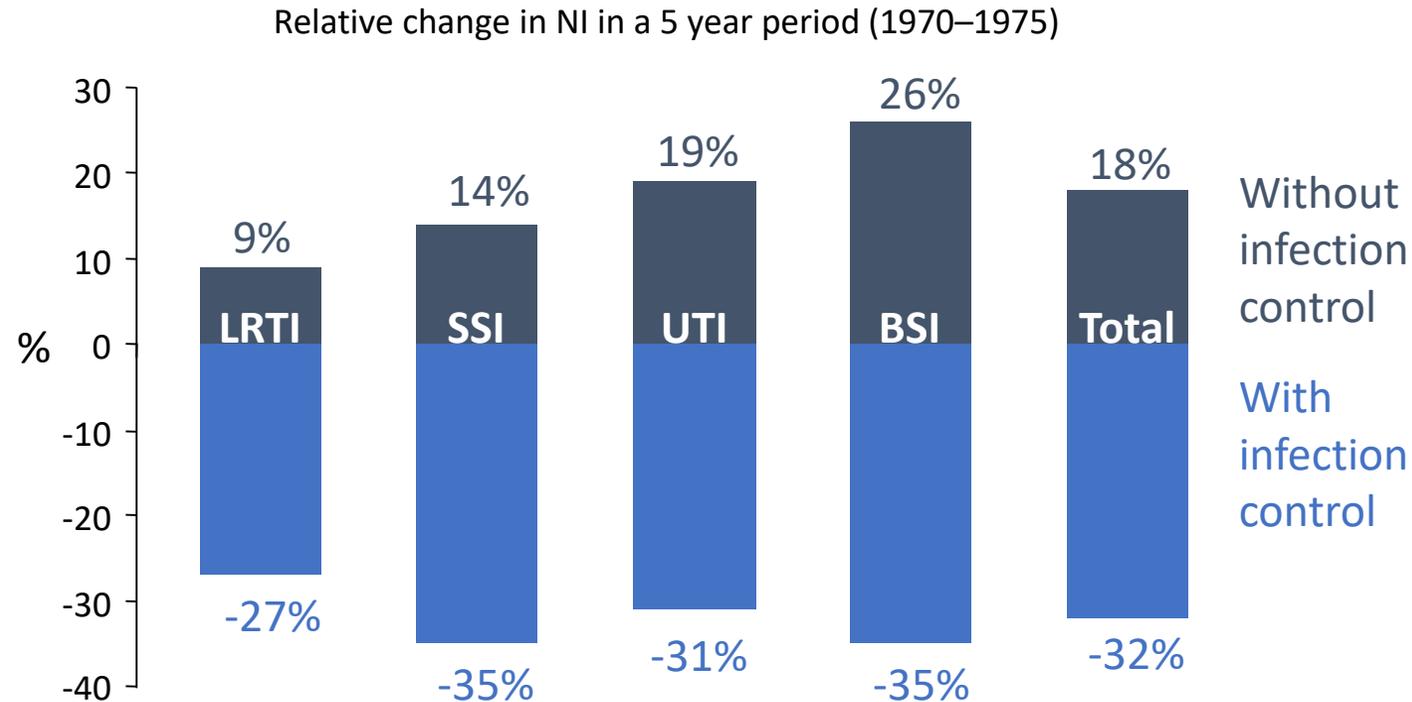
CLABSI Initiative Committee – QI in NICU 2005 – 2007 (Bizarro et al/ Infect Control Hosp Epidemiol 2010)

- CLABSI rate reduced from 8.4 to 1.28/1000 central line days
- Late onset Sepsis reduced from 5.84 to 1.42 cases/1000 patient days
- 20-70% of infections are preventable



Study on the Efficacy of Nosocomial Infection Control

- >30% of HCAI are preventable



Haley RW et al. *Am J Epidemiol* 1985

Guidelines for HAI in NICUs are available

April 2012 in *Pediatrics*

Strategies for Prevention of Health Care–Associated Infections in the NICU

Richard A. Polin Susan Denson Michael T. Brady

THE COMMITTEE ON FETUS AND NEWBORN and COMMITTEE ON INFECTIOUS DISEASES

[Full Text](#) [PDF](#)

DOI: 10.1542/peds.2012-0145

epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England

[H.P. Loveday](#)  [J.A. Wilson](#), [R.J. Pratt](#), [M. Golsorkhi](#), [A. Tingle](#), [A. Bak](#), [J. Browne](#), [J. Prieto](#), [M. Wilcox](#)

 PlumX Metrics

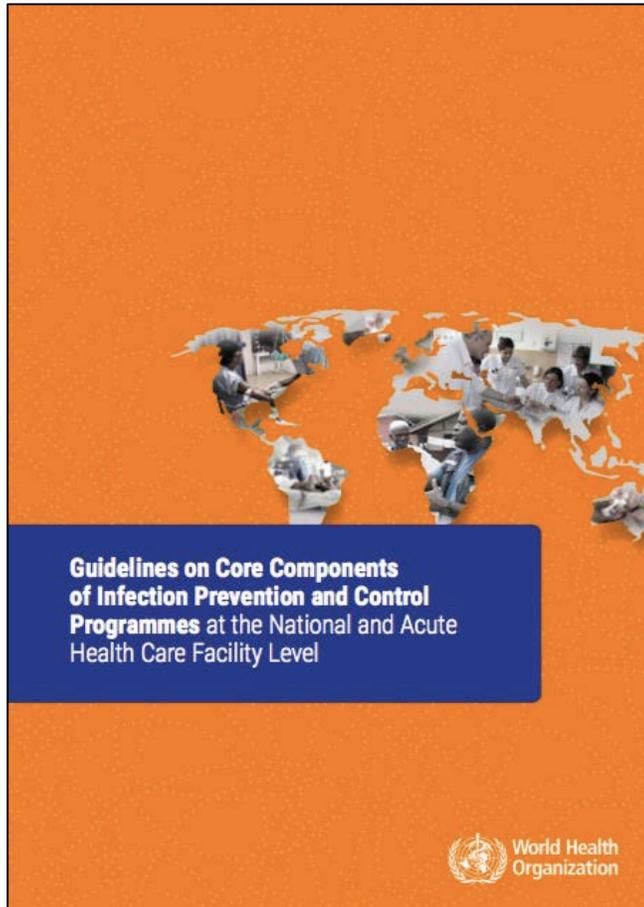
DOI: [https://doi.org/10.1016/S0195-6701\(13\)60012-2](https://doi.org/10.1016/S0195-6701(13)60012-2)

Preventative strategies



- Hand hygiene
- Environmental hygiene
- Use of personal protective equipment
- Safe use and disposal of sharps
- Prevention of a central line-associated bloodstream infection (CLABSI)
- Prevention of Ventilator Associated Pneumonia (VAP)
- Judicious Antibiotic use and prevention of misuse
- Use of breast milk and early enteral feeding
- Reduce duration of Total Parenteral Nutrition
- Avoid use of topical emollients

Infection Prevention & Control: Overview



Infection Prevention and Control are the measures that a healthcare facility undertakes to prevent harm caused by infection to patients and healthcare workers.

These measures include hygiene and environmental cleanliness as well as needle safety, personal protective equipment and healthcare waste management.

Infection Prevention & Control: Impact on Population

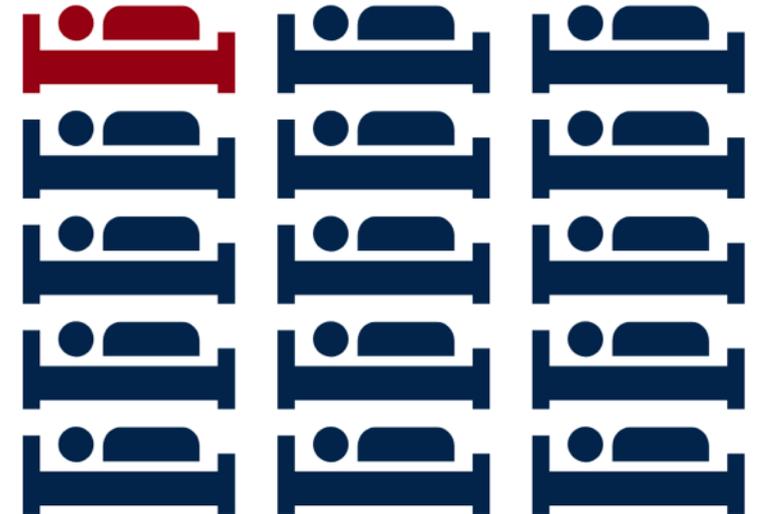
- Effective infection prevention and control reduces hospital-acquired infections by at least 30% (WHO).
- Handwashing, long considered to be the most cost-effective IPC measure, is only practiced by 39% of healthcare workers on average
- Newborn survival rates potentially increase 44% when handwashing and clean birthing kits are in place (Blencowe *et al.* 2010).



Hospital-Acquired Infections: Impact on Populations

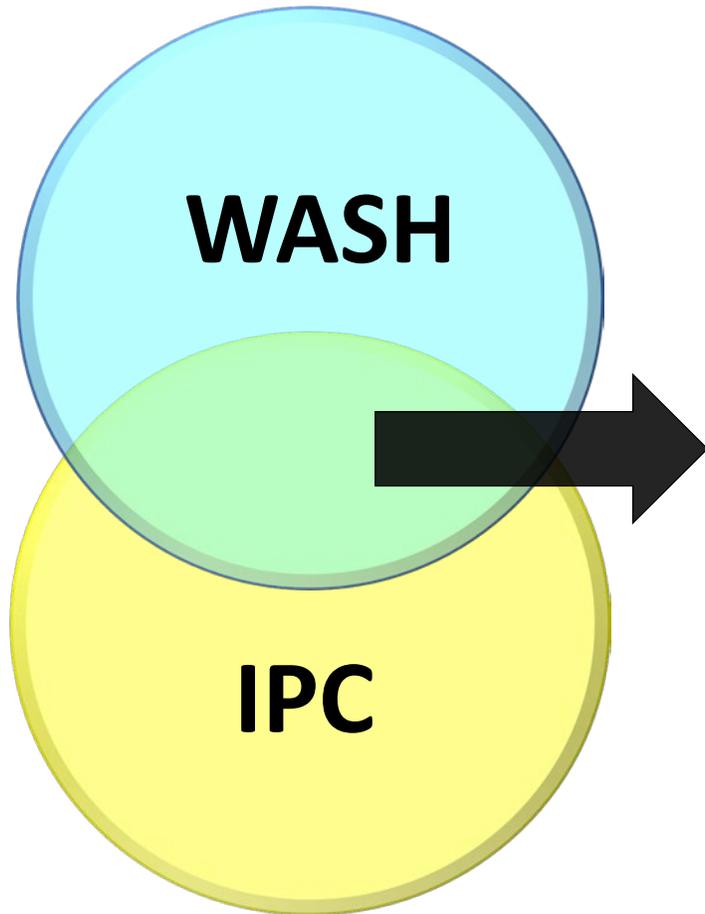


In LMIC, one in six patients (16%) contracts an HAI during their stay at a HCF



In HIC, one in 15 patients (7%) contracts an HAI during their stay at a HCF

Infection Prevention & Control + WASH in Health care facilities



Key Behaviors include:

1. Hand Hygiene
2. Environmental Cleanliness
3. Medical Equipment Processing
4. Healthcare Waste Management

Discussion

What is antimicrobial resistance ?

What are common infections that are antibiotic resistant?

How can we reduce antimicrobial resistance?



Antimicrobial Resistance: Overview

Antimicrobial resistance (AMR) is the ability of a microorganism (like bacteria, viruses, and some parasites) to stop an **antimicrobial** from working against it. As a result, standard treatments such as antibiotics become ineffective, infections persist and may spread to others.



Antimicrobial Resistance: Impact on Populations

- Studies have estimated that the percentage of people washing their hands with soap after contact with excreta may be below 20% .
- Because many antibiotics belong to the same class of medicines, resistance to one specific antibiotic agent can lead to resistance to a whole related class.
- The lack of robust surveillance make it impossible to determine the exact global burden, however experts agree that the rate of AMR is increasing at an alarming rate.

Antimicrobial resistance

Results from overuse, misuse, inadequate use of antimicrobials

Overuse:

1. Overprescribing
2. Continuous use in livestock feed

Costs money, lives and undermines effectiveness of health systems

Threat to global stability and national security

<https://amr-review.org/file/327>

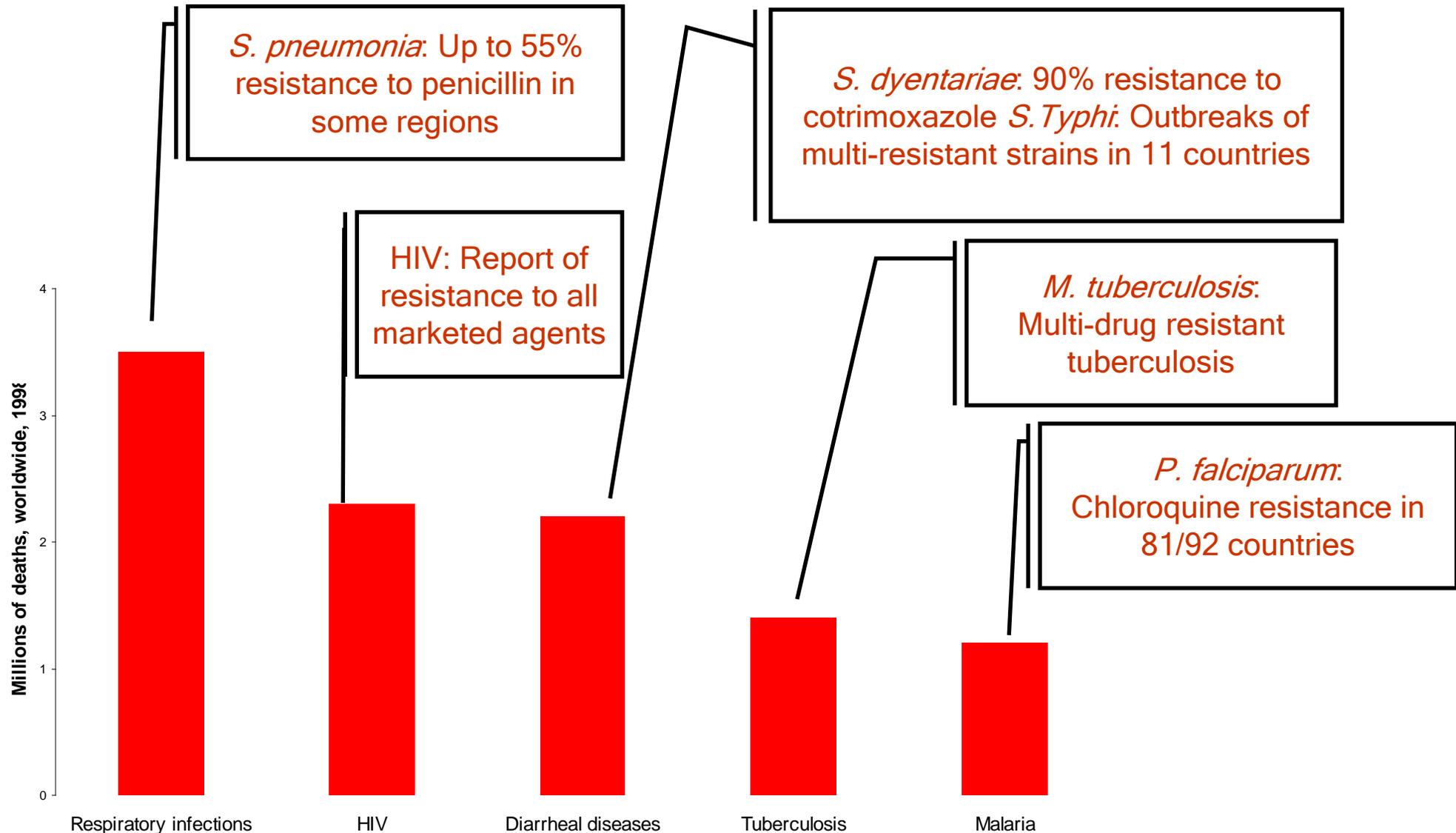


Humans = 30% antibiotic use



Animals = 70%

Leading global infectious diseases that are antibiotic resistant



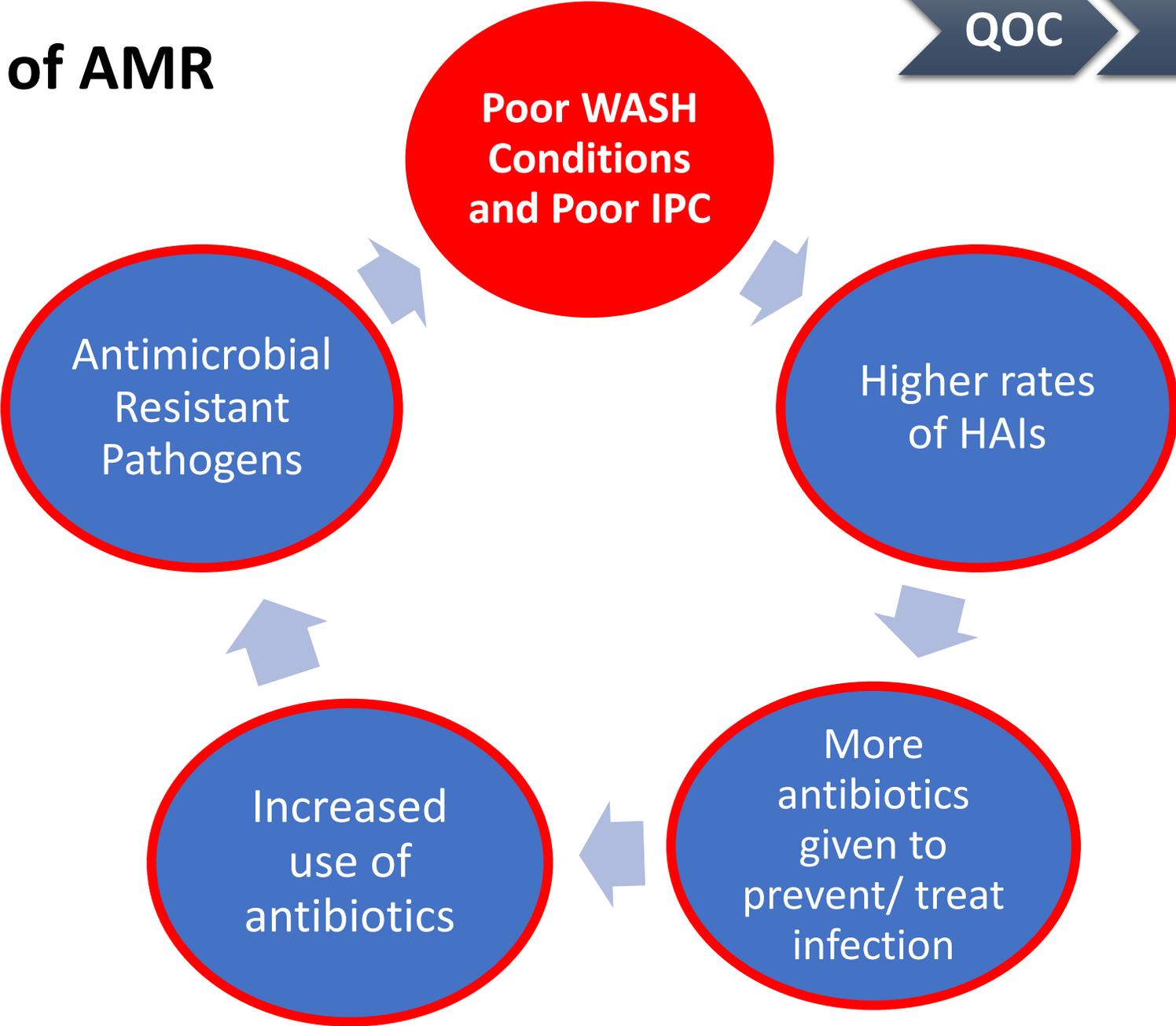
Antibiotic resistant infections

Diseases	Agent	Resistances
Pneumonia	<i>S pneumoniae</i>	Penicillin
Dysentery	<i>S dysenteriae</i>	Multiple resistances
Typhoid	<i>S typhi</i>	Multiple resistances
Gonorrhoea	<i>N gonorrhoeae</i>	Penicillin and tetracycline
Tuberculosis	<i>M tuberculosis</i>	Rifampicine and INH
Health care associated infections	<i>S aureus</i>	Methicillin, vancomycin
	<i>E species</i>	Vancomycin
	<i>Klebsiella,</i> <i>Pseudomonas</i>	Multiple resistances

Antimicrobial Resistance + WASH in Health facilities

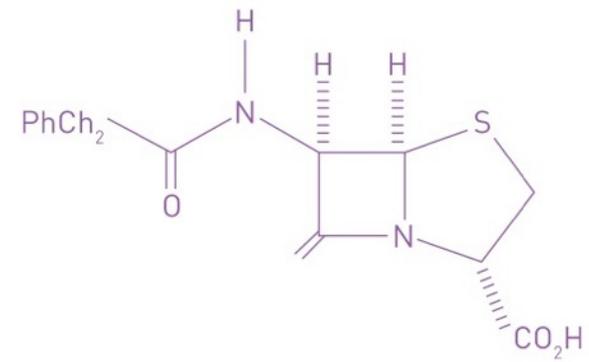
- Poor WASH conditions in healthcare facilities and inadequate IPC practices allow for more bacteria to survive in the healthcare facility
- These bacteria can cause HAIs in patients who have come in for a variety of health visits, including labor and delivery.
- To prevent infection, hospitals often prescribe prophylactic antibiotics to those undergoing surgery or delivery
- The increased use of antibiotics is leading to AMR.
- With improved infrastructure, stronger management systems and trained staff, it is possible to prevent these illnesses

Relationship of AMR and IPC



ANTIMICROBIAL RESISTANCE

Global Report
on surveillance
2014



What you need to know

WHO's first global report on antimicrobial resistance, with a focus on antibiotic resistance, reveals that it is no longer a prediction for the future. Antibiotic resistance - when bacteria change and antibiotics fail - is happening **right now**, across the world

What does this mean?

Without urgent action we are heading for a post-antibiotic era, in which common infections and minor injuries can once again kill

How can infections be prevented in the first place to reduce the need for antibiotics?



Better
hygiene



Access to
clean water
and sanitation



Infection control
in healthcare
facilities

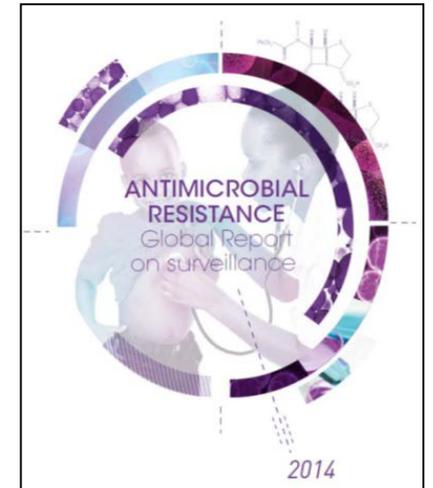


Vaccination

Antibiotic resistance: a problem globally...

2014: WHO Global Report on Surveillance

- Very high rates of resistance observed for common bacteria that cause healthcare associated and community-acquired infections in all WHO regions
- Significant gaps in surveillance
- Urgent need to strengthen collaboration on global surveillance to address antimicrobial resistance (AMR).



May 2015

- World health assembly endorses global action plan to tackle AMR.



September 2016

- 193 countries sign UN Declaration to take action on AMR, reaffirming their commitment to develop national action plans on AMR, based on the global action plan.



WHO Global Strategy for Containment of Antimicrobial Resistance

Intervention framework to slow emergence and reduce the spread of antimicrobial resistant microorganisms

Policy package:

- Commit to a comprehensive, financed national plan with accountability and civil society engagement
- Strengthen surveillance and laboratory capacity
- Ensure uninterrupted access to essential medicines of assured quality
- Regulate and promote rational use of medicines, including in animal husbandry, and ensure proper patient care
- Enhance infection prevention and control
- Foster innovations and research and development for new tools

Antimicrobial Resistance: Improvement through Infection Prevention and Control

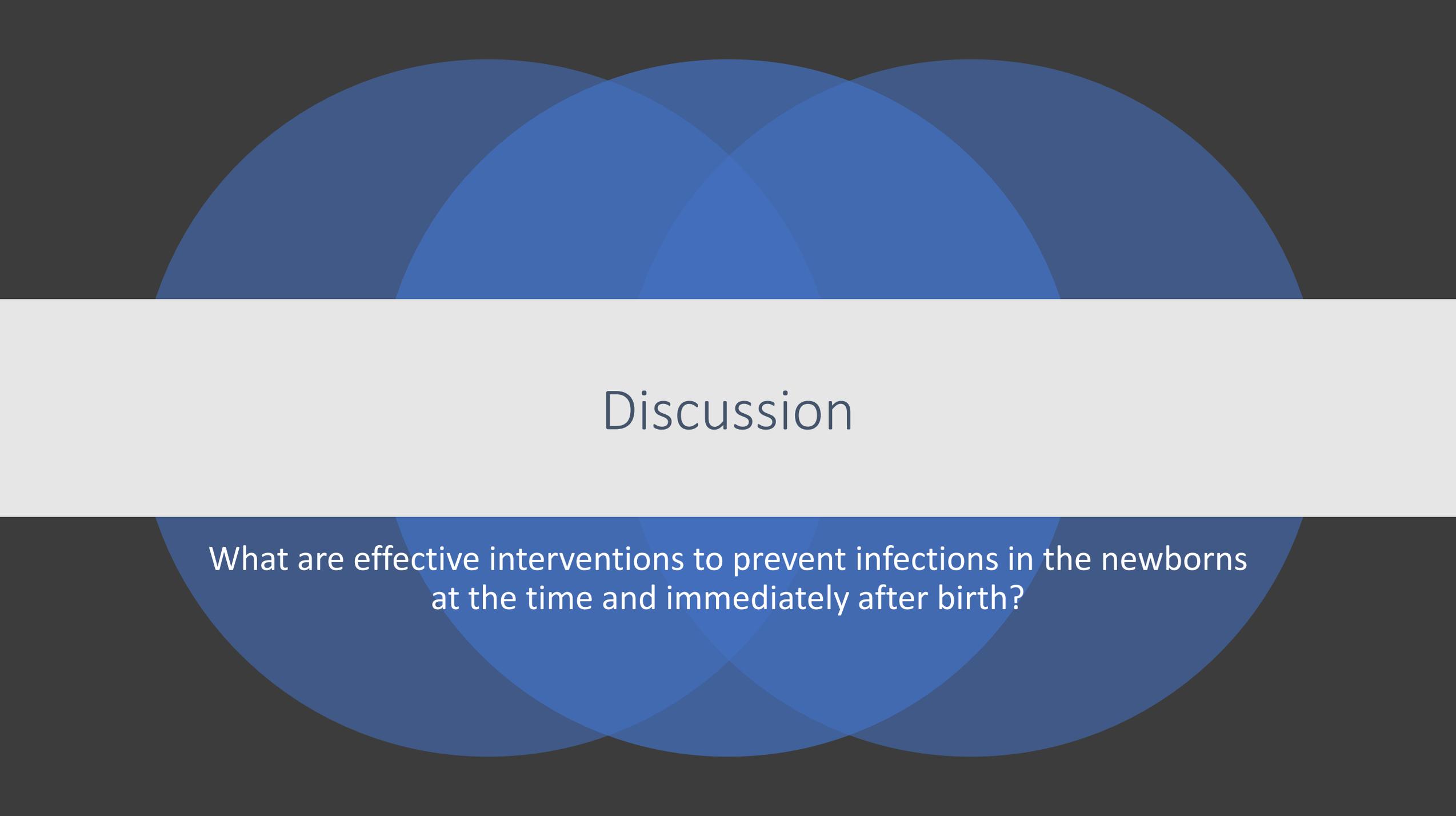
- Hygienic conditions and behaviors are necessary to prevent and control the spread of HAIs and the subsequent use of antibiotics.
- Potential WASH-related AMR interventions include:
 - Routine monitoring of WASH-related behaviors, such as hand hygiene and waste management
 - Hand and environmental hygiene compliance to be included on the list of criteria for facility accreditation or certification
 - Initiating competition between healthcare facilities for the cleanest hospital via a national “clean hospital” recognition program

Antimicrobial Stewardship

Set of activities that promotes appropriate selection, appropriate dosing, appropriate route and duration of antimicrobial therapy.

Potential strategies for NICU setting:

- Auditing antimicrobial use of practitioners and providing feedback
- Formulary restriction and preauthorization requirements for selected antimicrobial agents
- Education of prescribers and nurses concerning the role of antimicrobial use and the development of resistance
- Development of clinical guidelines/pathways for selected conditions



Discussion

What are effective interventions to prevent infections in the newborns at the time and immediately after birth?

Preventing infection in the newborn at the time of birth

- Keep the baby in a clean area and follow standard precautions for newborn resuscitation.
- Ensure that resuscitation team wears appropriate PPE; non-sterile, fluid-proof, long-sleeved gowns, face-shields or goggles and masks, boots or shoe covers, and non-sterile gloves.
- Wear non-sterile gloves for contact with the newborn until after the first bath.
- Wipe both of the newborn's eyes with a sterile gauze square and discard the wet cloth. Use a separate square for each eye and wipe from the inner corner to the outer corner.

Preventing infection in the newborn at the time of birth -2

- Keep the newborn warm.
- After delivery, **do not perform** routine suction or aspiration.

In the presence of meconium-stained amniotic fluid:

- Do not perform tracheal suctioning and avoid suctioning of the mouth and nose before initiating PPV for infants who do not start breathing on their own.
- For newborns who do not start breathing on their own by 1 minute after birth, start PPV with room air with a self-inflating bag and mask.

Infection prevention and control within the first hour of life

- Initiate early breastfeeding within 1 hour of birth.
- Encourage exclusive breastfeeding.
- Apply antiseptic eye drops or ointment (e.g., tetracycline ointment) to both eyes once, according to national guidelines.
- Administer vitamin K and recommended immunizations (birth dose of oral polio vaccine and HBV vaccine), using safe injection practices and sharps safety.
- Apply relevant IPC precautions (Transmission-Based Precautions and prophylaxis) to those who are exposed or infected during or before birth (e.g., congenital syphilis, rubella, HIV, HBV, and other infectious diseases).



Discussion

What are general Infection prevention and control guidelines for all newborns?

General IPC guidelines for all newborns

- Comply with standard precautions at all times and use transmission-based precautions
- Keep the mother separated from the baby for IPC purposes only when the mother has **multi-drug resistant TB**.
- Consult to IPC staff regarding precautions for other infections in the mother.
- Follow patient spacing guidelines in the newborn nursery.
- Encourage exclusive breastfeeding (including appropriate policies, staff capacity, support)
- Manage expressing and storage of breast milk carefully to prevent infection

General IPC guidelines for all newborns- 2

- Manage the preparation of formula feeds
- Screen visitors and exclude for signs of infection- fever, respiratory infection, diarrhoea, and draining skin infection
- Perform recommended cord care:
 - For newborns born in low NMR settings (in health facilities and home), use clean, dry cord care.
 - In settings with high NMR (>30 per 1000): Apply 7.1% chlorhexidine digluconate (i.e., 4% chlorhexidine) aqueous solution or gel for 7 days on umbilical cord stumps of infants born at home



Discussion

How to prevent infections in newborns requiring specialized care?

Preventing infection in newborns requiring specialized care- 1

- As the level of care increases so does the risk of infection.
- Requires stricter and more vigilant application of IPC practices than caring for all newborns
- Hand hygiene before and after contact with each infant is essential
- Not sharing equipment and supplies between infants
- Preventing the acquisition of infection from contaminated feedings, water, or air
- Protecting the infant from infected health care workers and visitors
- Using invasive medical devices judiciously
- Strictly adhering to aseptic techniques

Preventing infection in newborns requiring specialized care- 2

- Newborns receiving care in the nursery, SCN, or NICU are exposed to other infants and more pathogens compared to infants that room in with their mothers
- Health care workers need to have expertise in incorporating these IPC practices into all aspects of workflow at all times.
- Sick and premature newborns are especially vulnerable to organisms acquired from hands-on contact, invasive medical device access, and procedures that occur in the NICU.
- Even small breaches in IPC puts the immuno-compromised newborn at risk
- Use of multi-dose vials should be discouraged, if possible

Preventing infections amongst neonates requiring specialized care -3

- Good hand hygiene highly effective in reducing all types of HAIs in NICU patients
- Health care workers should perform a wash of their hands and arms to above the elbows, with care to cleaning all parts of the hands and beneath the nails before their shift begins and before handling a newborn
- Sufficient time should be taken to thoroughly wash and rinse all parts of the hands.
Careful hand hygiene between patients is most likely of more benefit than the length of hand scrub upon entry to the nursery.
- Health care workers should perform meticulous hand hygiene before and after each patient contact and after contact with potentially contaminated patient care equipment.
- Special attire for entrance to the NICU is not required.

Preventing infections amongst neonates requiring specialized care -4

- Staff and parents should wear long-sleeved gowns if they are handling the infant outside of the bassinet/crib/warmer/incubator.
- Staff gowns should be discarded after care of one infant and a new gown should be worn for handling the next infant.
- Parent gowns should be discarded at the end of the visit.
- Gowns should be worn when entering the infant's area (even if not handling the infant) in the following situations:
 - Soiling with blood or body fluids is expected (Standard Precautions apply.)
 - The infant is on Contact or Droplet Precautions.
 - The parents are concerned about their own soiled clothing.

Preventing infections amongst neonates requiring specialized care -5

- Shoe covers or special shoes are not required. There is no known benefit, it takes resources, and hands may become contaminated when putting on and removing them.
- Sterilized or autoclaved linens for the NICU are not required
- Use recommended temperatures and detergents to launder NICU linens
- Wrap or cover NICU linens during transport from the laundry and store them in closed cabinets to prevent contamination

Preventing infections amongst neonates requiring specialized care -6

- When to suspect an outbreak?
 - If two or more newborns have the same condition (e.g., skin infection or sepsis with the same organism) or one incidence of a new or unusual organism occurs at the same time in a nursery or NICU.
- What to do in outbreak situations:
 - Initiate investigations and measures to halt any further spread
 - Dedicate health care workers to each patient cohort with no movement among patient cohorts.
 - Control measures should be monitored along with any new infections to make sure that they have been effective and the problem is resolving.
- In non-outbreak situations, dedicate health care workers to each patient cohort, but with some flexibility according to the risks and benefits.



Discussion

What are spacing requirements for newborns in intensive care units?

Spacing for Facilities with Newborns- 1

Type of design	Newborn nursery	Special care unit NICU	
Multi-patient rooms	<ul style="list-style-type: none"> • 2.2 square meters (24 net square feet) per infant • 1 meter (3 feet) between bassinets 	<ul style="list-style-type: none"> • 11.2 square meters (120 net square feet) per infant • 2.4 meters (8 feet) between incubator /warmer/bassinet/ crib • Aisles > 1.2 meters (4 feet) wide 	
Single patient rooms	2.2 square meters (24 net square feet), at least 1 meter (3 feet) in all directions between cribs	<ul style="list-style-type: none"> • > 14 square meters (150 net square feet) 	<ul style="list-style-type: none"> • > 14 square meters (150 net square feet) • 2.4 meter (8 feet) wide aisles • Space should be added for sinks, desks, cabinets, computers, and corridors

Spacing for Facilities with Newborns- 2

Type of design	Newborn nursery	Special care unit	NICU
Handwashing sinks	1 sink for every 6–8 patients <ul style="list-style-type: none">• A sink in the resuscitation area• 1 sink per 3–4 patients in admission, observation, and continuing care areas	1 sink for every 3–4 patients	
Air supply		<ul style="list-style-type: none">• Positive pressure to adjacent areas• 90% efficiency filtration• 6 air exchanges/hour	
Airborne infection isolation room (AIIR)	Access to at least one AIIR, which may be located on another ward		

Water supply and use in NICUs

- Water supply at NICU needs to be treated adequately
- Water storage tanks can often become sources of contamination
- Drain the water reservoir of evaporative humidifiers in incubators, clean, and refill with sterile water every 24 hours.
- Replace nebulizers, attached tubing, and water traps regularly
- Use new, sterilized, or high-level disinfected equipment.
- Use only sterile water in nebulizers and humidifiers.
- Drain and discard condensate in ventilator tubing periodically.

Infection prevention for bassinets, cribs, warmers, and incubators

- Clean regularly to remove visible soil (blood, milk, body fluids) and reduce microbial burden
- Change periodically
- Use disinfectants such as quaternary ammonium and chlorine compounds
 - Avoid the use of phenolic compounds (e.g. Dettol, Triclosan). Phenol known to cause neonatal hyperbilirubinemia and hexachlorophene has been associated with neurotoxicity.
- Use caution when using evaporative humidifiers in incubators:
 - Do not use if central humidification provides enough humidity.
 - Drain, clean, and refill with sterile water every 24 hours when in use.
- Avoid placing toys that cannot be adequately cleaned, such as stuffed toys, in incubators.

Remember Breastfeeding reduces risk for infections

- Breast milk has been associated with a lower risk of sepsis and necrotizing enterocolitis in preterm infants
- Immunologic properties of breast milk secretory IgA
- Specific macrophages and lymphocytes
- Secretory molecules with antibacterial properties
- All may all contribute to this **protective effect of breastfeeding**



Handling infant feeds -Breast milk handling and storage-1

- Infections have been associated with contaminated breast milk pumps and refrigerated storage practices.
- For mothers expressing, ensure hand hygiene and expression of milk into sterile containers.
 - Clean the containers with hot, soapy water after each use, before they are sterilized.
- For mothers using a breast pump dedicated to one mother:
 - Wash all pump components that are in contact with milk with hot, soapy water after each use, dry thoroughly, and store in a clean place.
 - Sterilize or high-level disinfect pump components daily.
- For a breast pump shared between mothers:
 - Wash all pump components that are in contact with milk with hot, soapy water after each use, then sterilize or high-level disinfect before use by a different mother.

Handling infant feeds -Breast milk handling and storage- 2

- Store milk in sterile, labelled containers covered securely
 - Label with infant's name, medical record number, date of birth and date of pumping
 - When stored in a refrigerator or freezer with milk for other infants, place all the feeds for each infant into a larger, labelled, cleanable bin or zip-lock bag, one for each infant.
- Clean and disinfect the container after the infant is discharged.
- Use oldest milk first
- Confirm the right milk for the right infant with two separate patient identifiers (e.g., name and medical record number or name and date of birth).
- If breast milk is given to the wrong infant, treat as a blood/body fluid exposure. Follow the facility's written policy to identify and follow up (create a policy if none exists).

Fresh Breast milk storage

Location	Temperature	Length of time	Details
Room temperature (fresh)	16–29°C [61–84°F]	Storage time: 3–4 hours (less in hotter environments) Hang time for feeds: < 4 hours. Replace entire feeding set every 4 hours.	<ul style="list-style-type: none">• Potential for contamination if stored at bedside awaiting use• Use containers covered with a lid or tied at the top• Label with infant’s name, medical record number and date of birth
Refrigerator	4°C [39°F] or below	72 hours	<ul style="list-style-type: none">• Use containers covered with a lid or tied at the top• Label with infant’s name, medical record number, and date of birth• Place all the feeds for each infant into a larger, labelled, cleanable container, one for each infant

Frozen Breast milk storage

Location	Temperature	Length of time	Details
Freezer	below -17°C [0°F]	6 months (optimal) up to 12 months (acceptable)	<ul style="list-style-type: none">• Use containers covered with a lid• Label with infant's name, medical record number, and date of birth• Place all the feeds for each infant into a larger, labelled, cleanable container, one for each infant
Thawing frozen milk	In the refrigerator or quickly under running water	Until thawed	<ul style="list-style-type: none">• Avoid contamination from water• Do no use hot water• Do not thaw in microwave

Thawed breast milk storage

Location	Temperature	Length of Time	Details
Thawed milk in refrigerator	4°C [39°F] or below	No longer than 24 hours	<ul style="list-style-type: none">• Do not refreeze• Do not refrigerate once milk has been warmed (use within 4 hours or discard)
Thawed milk at room temperature	6–29°C [61–84°F]	Maximum of 4 hours (less in hotter environments)	<ul style="list-style-type: none">• Do not refreeze• Discard unused milk once warmed

Formula preparation and care

- Powdered infant formula is not sterile and can be contaminated by the manufacturer, after the formula container is opened, during the preparation, or during storage.
- When formula feeds are used, take meticulous care with hand hygiene, disinfection and sterilization of the area and equipment used, storage, and length of time at room temperature.
- It is safer to make only the amount of formula needed just before for each feed.
- Do not prepare feeds in areas where patient care is taking place.

Discussion



- What is the most effective intervention for reducing health care associated infections?
- Why should you wash your hands?
- How should you wash your hands?

Hand transmission

- Hands are the most common vehicle to transmit health care-associated pathogens
- Transmission of health care-associated pathogens from one patient to another via health-care workers' hands requires **5 sequential steps**



Five stages of hand transmission

One	Two	Three	Four	Five
Germs present on patient skin and immediate environment surfaces	Germ transfer onto health-care worker's hands	Germs survive on hands for several minutes	Suboptimal or omitted hand cleansing results in hands remaining contaminated	Contaminated hands transmit germs via direct contact with patient or patient's immediate environment

Why should you clean your hands?

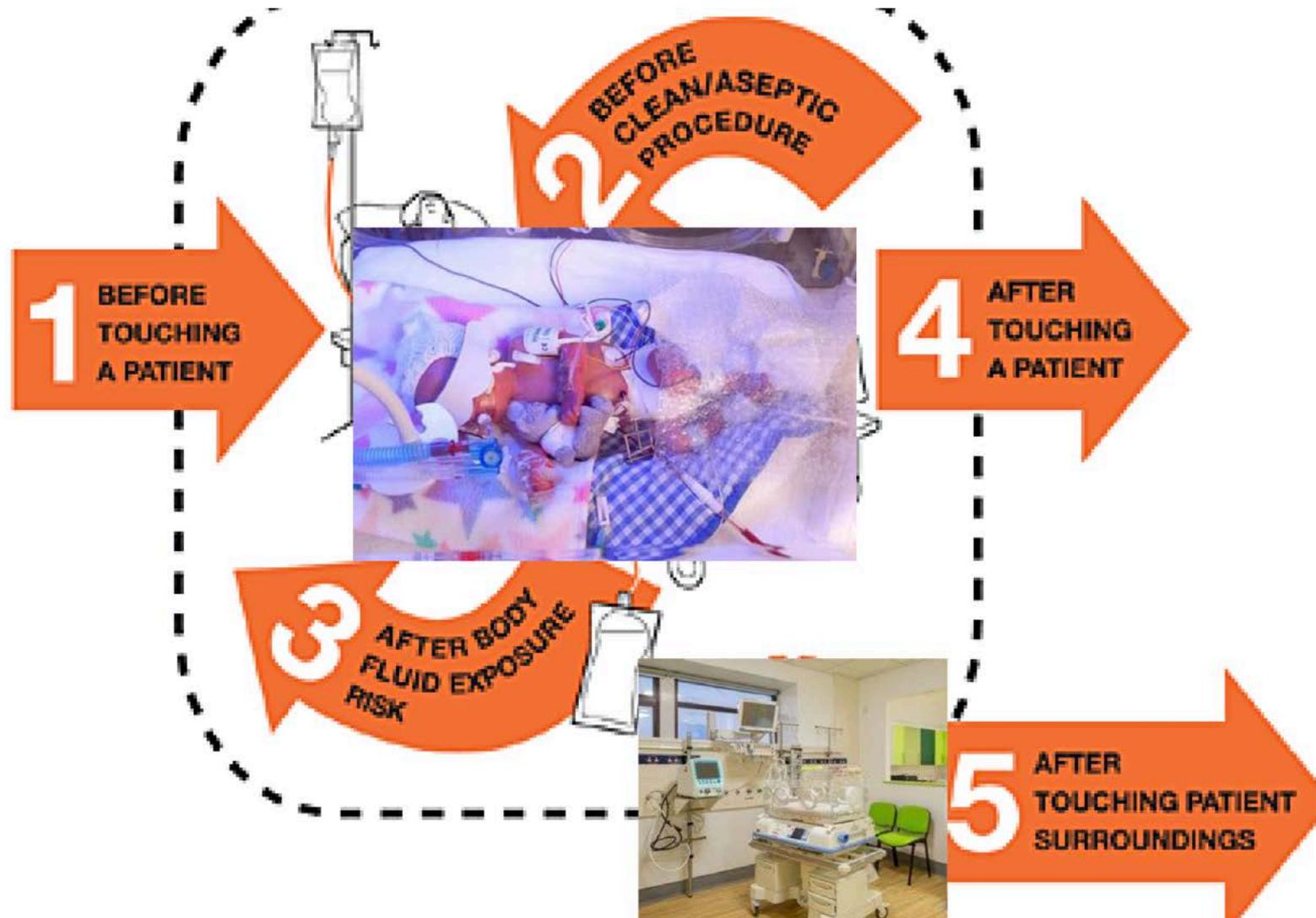
- Any health-care worker, caregiver or person involved in patient care needs to be concerned about hand hygiene
- Therefore hand hygiene concerns **you!**

You must perform hand hygiene to:

1. **Protect the patient** against harmful germs carried on **your** hands or present on his/her own skin
2. **Protect yourself** and the health-care environment from harmful germs

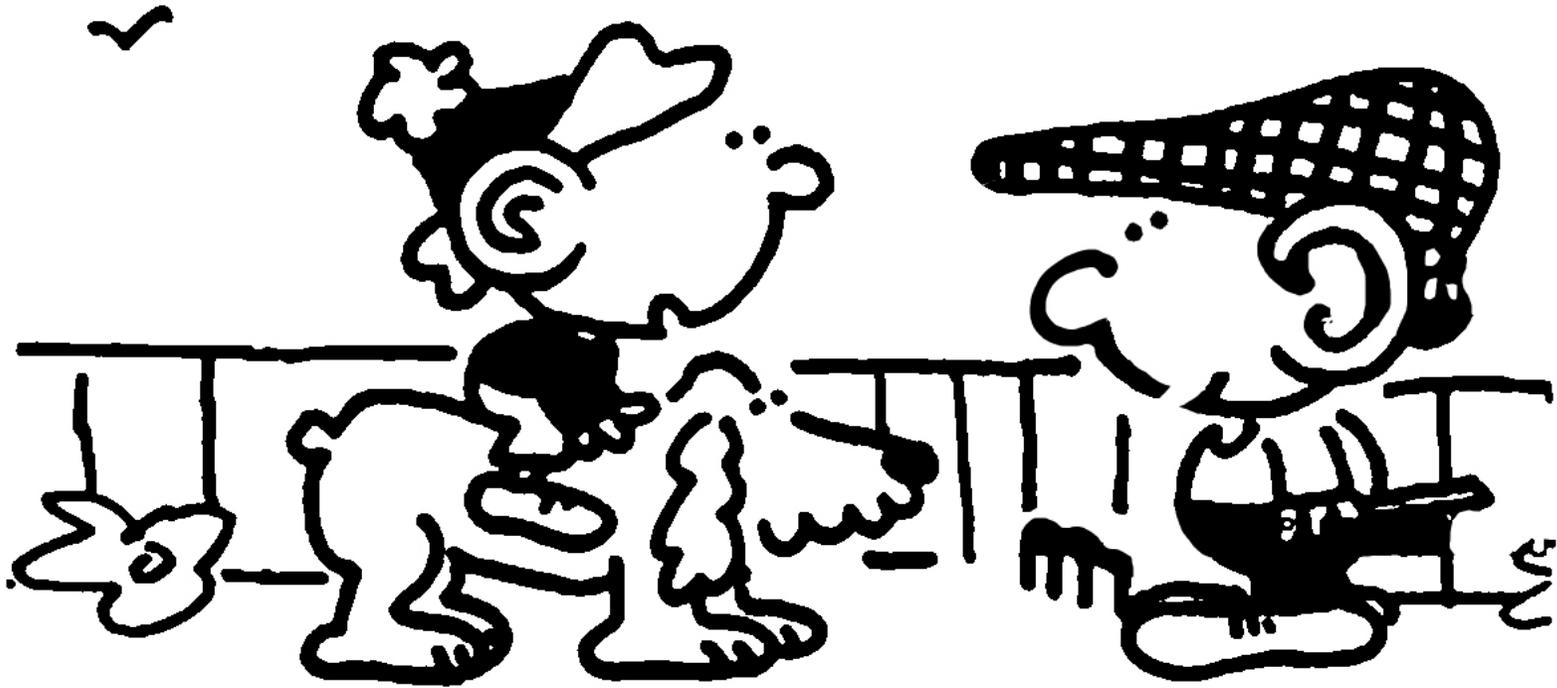


My “five moments for hand hygiene” approach



I'VE CHANGED MY
MIND ABOUT
BECOMING A
DOCTOR.

YOU HAVE TO WASH
YOUR HANDS TOO
OFTEN!



Time constraint = major obstacle for hand hygiene

- Adequate handwashing with water and soap requires **40–60 seconds**
- Average time usually adopted by health-care workers: <10 seconds
- Alcohol-based hand rubbing: **20–30 seconds**



How to clean your hands

- Hand rubbing with alcohol-based hand-rub is the preferred routine method of hand hygiene if hands are not visibly soiled.
- Hand washing with soap and water- essential when hands are visibly dirty or visibly soiled (following visible exposure to body fluids).
- *If exposure to spore forming organisms, for e.g.: clostridium difficile is strongly suspected or proven, including during outbreaks—clean hands thoroughly using soap and water*



How to hand rub

To effectively reduce the growth of germs on hands, **hand rubbing** must be performed by following all of the illustrated steps.

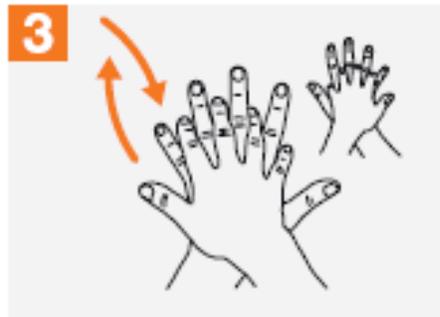
This takes only 20–30 seconds!



Apply a palmful of the product in a cupped hand, covering all surfaces;



Rub hands palm to palm;



Right palm over left dorsum with interlaced fingers and vice versa;



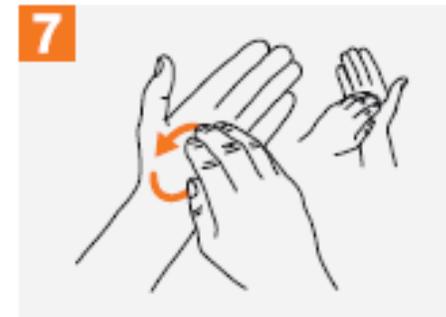
Palm to palm with fingers interlaced;



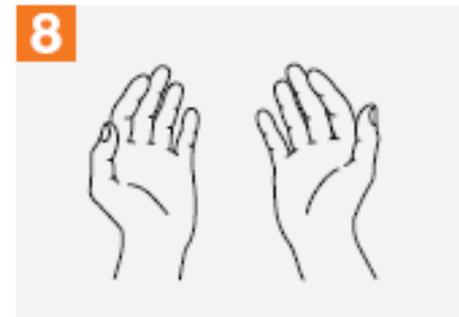
Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Once dry, your hands are safe.

How to hand wash

To effectively reduce the growth of germs on hands, wash your hands thoroughly following all of the illustrated steps.

Must last at least 40–60 secs



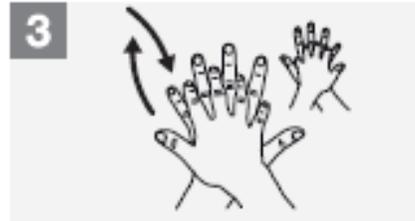
Wet hands with water;



Apply enough soap to cover all hand surfaces;



Rub hands palm to palm;



Right palm over left dorsum with interlaced fingers and vice versa;



Palm to palm with fingers interlaced;



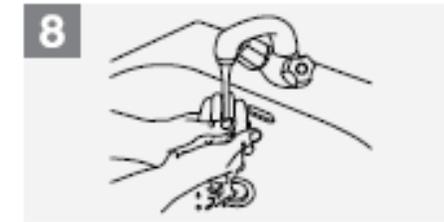
Backs of fingers to opposing palms with fingers interlocked;



Rotational rubbing of left thumb clasped in right palm and vice versa;



Rotational rubbing, backwards and forwards with clasped fingers of right hand in left palm and vice versa;



Rinse hands with water;



Dry hands thoroughly with a single use towel;



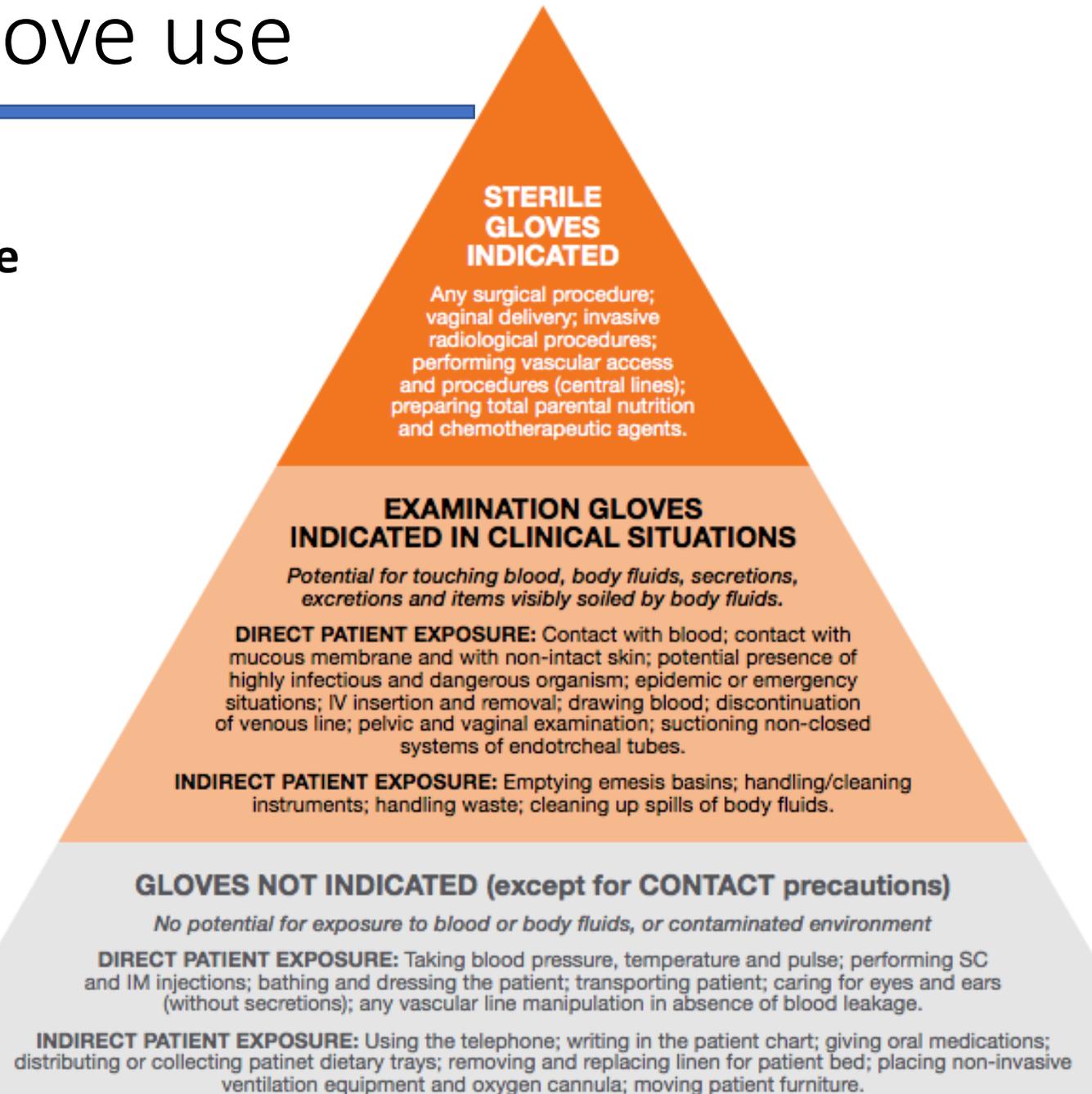
Use towel to turn off faucet;



Your hands are now safe.

Hand hygiene and glove use

- **The use of gloves does not replace the need to clean your hands!**
- You should remove gloves to perform hand hygiene, when an indication occurs while wearing gloves
- You should wear gloves only when indicated otherwise they become a major risk for germ transmission



Hand Hygiene



**BARE
BELOW
THE
ELBOWS
PLEASE**



- Use of gloves does not replace hand washing
- Other aspects of hand hygiene
 - Avoid jewellery, wrist watches
 - No artificial finger nails, nail polish
 - Keep natural nails short
 - Cover cuts/abrasions with waterproof dressing
- Hand Hygiene promotion programs
- Address behaviour and attitude of health workers
- Monitor hand hygiene and provide performance feedback
- Encourage hand hygiene practice among families/visitors



Compliance with hand hygiene

- Differs across facilities and countries
- Globally estimated to be <40% (Pittet & Boyce. *Lancet Infectious Diseases* 2001)
- Main reasons for non-compliance reported by health-care workers.
 - Too busy/ insufficient time
 - Skin irritation
 - Glove use
 - Don't think about it
 - Sinks are inconveniently located/lack of sinks
 - Lack of soap and paper towels
 - Understaffing/overcrowding
 - Patient needs take priority
 - Low risk of acquiring infection from patients
 - Lack of guidelines/ protocols

What is the WHO Multimodal Hand Hygiene Improvement Strategy?

Based on the evidence and recommendations from the WHO Guidelines on Hand Hygiene in Health Care (2009), a number of components make up an effective multimodal strategy for hand hygiene



ONE System change

Access to a safe, continuous water supply as well as to soap and towels; readily accessible alcohol-based hand rub at the point of care



TWO Training / Education

Providing regular training to all health-care workers



THREE Evaluation and feedback

Monitoring hand hygiene practices, infrastructure, perceptions and knowledge, while providing results feedback to health-care workers



FOUR Reminders in the workplace

Prompting and reminding health-care workers



FIVE Institutional safety climate

Creating an environment and the perceptions that facilitate awareness-raising about patient safety issues

SAVE LIVES
Clean **Your** Hands

Guide to Implementation

A Guide to the Implementation of the WHO Multimodal Hand Hygiene Improvement Strategy



World Health
Organization

Patient Safety
A World Alliance for Safer Health Care



Health Education/Motivational Programs

- Monitor healthcare workers adherence with recommended hand hygiene practices and give feedback
- Implement behavioral approaches to identify barriers and facilitators to improve handwashing rates.
- Implement a multidisciplinary program to improve adherence to recommended practices
- Provide training to new or transferred in staff on hand hygiene and IPC protocols
- Encourage patients and their families to remind health care workers to practice hand hygiene



Administrative Measures to Improve Hand Hygiene

- Make improved hand hygiene an institutional priority
- Place reminders on the importance of hand hygiene at health facilities
- Place alcohol-based hand rubs at entrance to patient room, or at bedside
- Provide health care workers with pocket-sized containers
- Include as a part of quality improvement efforts

Example: Scaling up an Evidence-Based Package for WASH in health care facilities in Zambia (UNICEF 2015)

An infection prevention and control project in 4 urban health facilities

- Re-activation of the infection prevention committees
- on-site chlorine production and utilisation
- Improved waste management
- Promotion of hand washing with soap
- decontamination practices of surfaces and “hand-touch sites”
- Behaviour change triggers were used to motivate staff

Study design: Base line and end line microbiological assessments

Findings:

At baseline only 1% handwashing observed, improved after pilot

Hand touch sites that passed defined hygiene criteria improved from 27% (baseline) to 49% (endline)

Improved water quality

50% of samples from hand-touch sites showed bacteria resistant to commonly used antibiotics

Impact:

Now scaled up to 55 health facilities.



Chlorine production room in Makeni Health Center in Chilanga District

Discussion

What is meant by family centered care?

What are the benefits of family centered care?



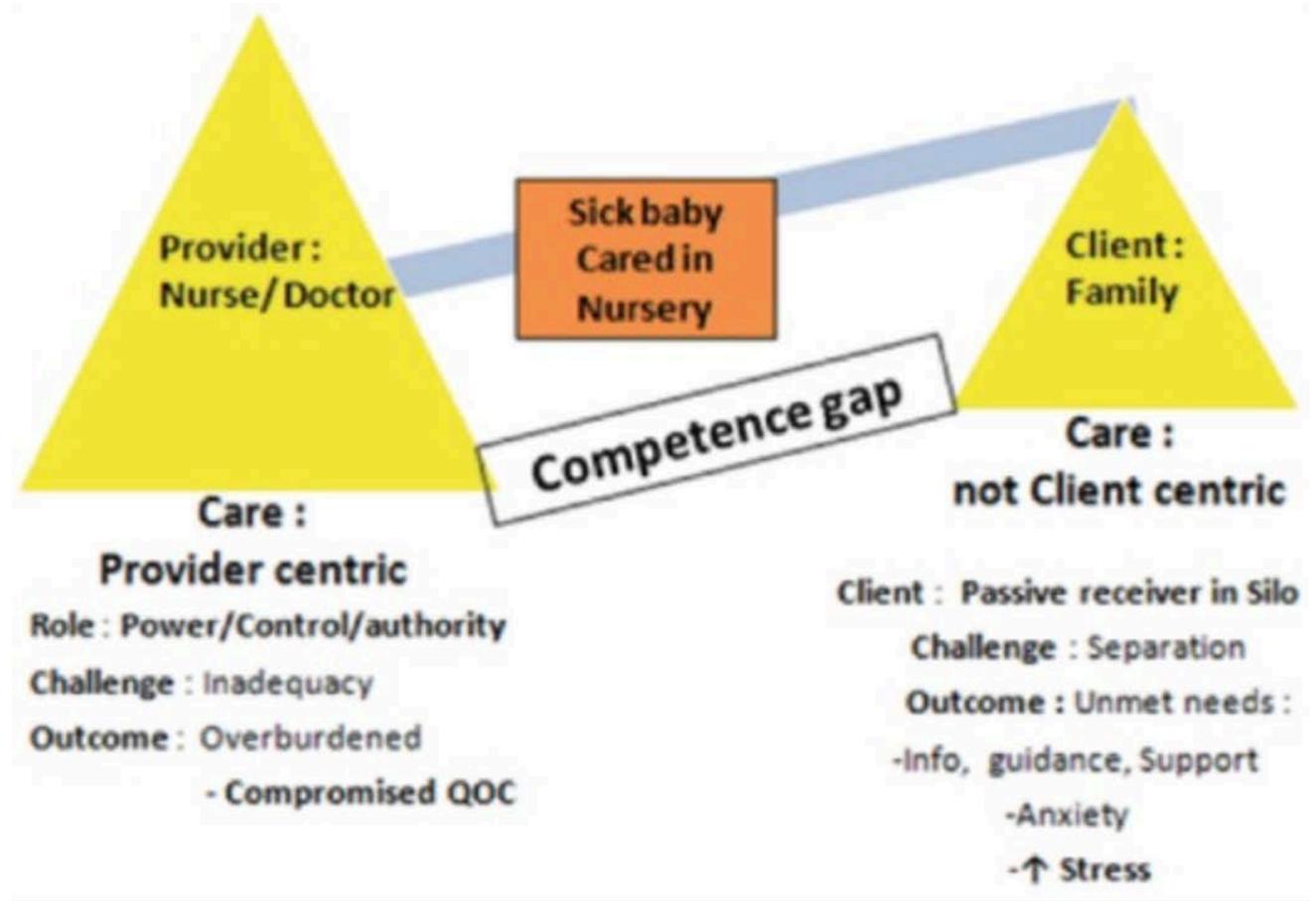
Conventional model of care for neonates in the ICU

Professionals provide care- not family

Mother and baby are kept separately

Health workers may be overburdened

Often we arrange activities for family convenience



Levin Study (Birth 1994) – Humane Care

Compared 84 care by parent with 72 care by nurses babies in the NICU

Weight gain	Maternal Care	Nursing care
20 days	332 \pm 20	235 \pm 30
30 days	769	490

Results

- 30% reduction in Neonatal Infections
- 20% reduction in Length of stay
- 50% reduction in nurse utilization
- improved parent/staff satisfaction

Ref: Levin A. The Mother-Infant Unit at Tallinn Children's Hospital, Estonia: A Truly Baby-Friendly Unit. Birth. 1994 Mar 1;21(1):39-44.

Family centered care- 1

- Emerging as an important feature of NICU care
- Parents are part of the care team
- Parental education is a requirement
- Parents are integrated into most aspects of care
 - *Except for IV, medication and tests*
- The care team must support parents
- Parents gain confidence, knowledge and control



Family centered care - 2

- Creates unique Infection Prevention and control challenges
- Educate family members on IPC measures (e.g., hand hygiene, safe care of infant feeds, handling of invasive medical devices, cord care, wound care).
- Have a strict hand hygiene policy for family members entering the infant's bed space.
- Enforce strict hand hygiene for family members before they enter common kitchens, breast milk expressing areas, and other areas family members of the admitted infants co-inhabit.
- Do not allow family members to visit or assist with other infants.
- Do not allow ill visitors to enter the NICU with the exception of the mother, who may be allowed to care for the infant (with barriers in place) after consultation with IPC staff.



Family centered care: Example from India- 1

Study design:

- Randomized control trial (RCT) comparing care provided by accompanying parent-attendant in addition to standard care provided by nurses and doctors.
- A simplified audio-visual training tool was developed for parents-attendants
- Extensive pre-testing and piloting prior to implementation

Objective:

Make parents aware, educate, train, and build capacity - personal hygiene, hand washing, identification of danger signs, reporting of adverse events and feeding and KMC for low birth weight sick newborns.

Impact:

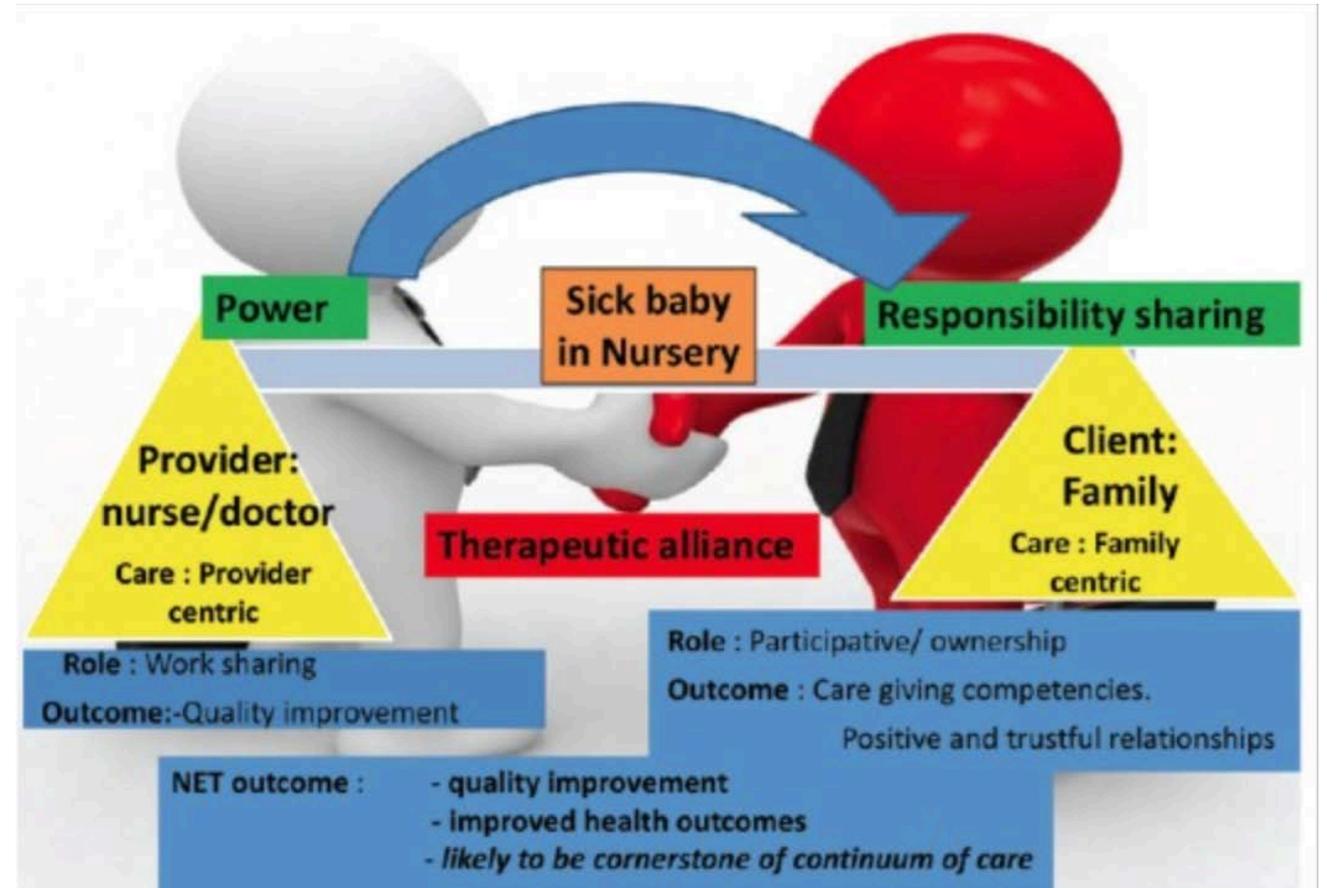
No increase in infection rate

Improved exclusive breast feeding rates (prior to discharge).

Feasible, well accepted, and safe.

Family centered care: Example from India- 2

- Changes in power dynamics between health workers and patients
- Therapeutic alliance between parents- attendants and health workers
- Work sharing
- Improved health outcomes
- Quality improvement



Discussion

What do you mean by isolation and cohorting for infection prevention and control in Neonatal Intensive Care Units?

Isolation and cohorting of neonates- 1

Aim:

Preventing the horizontal spread of infection from one patient to another. (Gastmeier P. 2004)

When:

- Outbreaks
- If infections spread via direct or indirect contact
- If neonates are known or suspected to be colonized or infected with a different pathogen based on clinical diagnosis, microbiologic confirmation or epidemiology
- If neonates are particularly at risk of acquiring a HAI (protective isolation).
- Segregation of Inborn and outborn neonates admitted with infections

Isolation

- Centers for Disease Control and Prevention (CDC) guidelines recommend single room isolation for infections transmitted by direct contact or indirectly via equipment or other surfaces (Garner 1986).
- Single room isolation coupled with adherence to hand hygiene has been shown to decrease transmission of MRSA infections in the intensive care unit (Cheng 2010).
- However, NICUs are often faced with lack of isolation rooms and/or limited numbers of health workers devoted to the care of infants in these isolation rooms.
- Considerations include severity of illness in the infant, available resources and the transmissibility of the infection.



Cohorting of neonates

- Physical segregation of infants in separate areas where newborns with similar exposures, colonization, or infections are cared for by designated staff assigned exclusively to these infants.
- Cohorts are created based on clinical and microbiological diagnoses, epidemiology, and mode of transmission of the infectious agent (Siegal 2007).
- May be useful in reducing horizontal transmission of infection or colonization by pathogens that are transmissible by contact (Koch 2003; Rosenberger 2011; Rosenberger 2012).
- In a study of MRSA surveillance and cohorting of colonized neonates, cohorting decreased MRSA colonization in non-colonized neonates and decreased MRSA-associated bloodstream infections (Kaushik 2015).
- More feasible than single room isolation during outbreaks in the NICU setting but success depends on strict adherence of the healthcare staff to the cohort system (AAP 2012).
- Assigning or cohorting healthcare workers may be difficult because of staffing shortages (Siegal 2007).



Isolation and cohorting

- Isolation and cohorting may introduce potential risks to patients, which may related decreased frequency of care, decreased patient observation and parental anxiety (Landelle 2013).
- Availability of adequate numbers of health workers is often challenge
- Risks due to infection control measures need to be balanced against the benefits of decreasing horizontal transmission in the neonatal unit for optimal neonatal outcomes.



How to set realistic targets for improvement of IPC practices in QI projects

- Set targets for improvement of infection prevention and control practices e.g.
 - Improve compliance by x% in Year 1
 - Improve compliance by y% during Years 1–5
 - Increase compliance by z% by 2020
 - Reduce infection rates by x% over a z-year period
- Targets will be influenced by baseline data
- Targets should be realistic
 - If baseline compliance is 20%, it is unrealistic to set a target of 60% after 1 year of an intervention
- Targets are dependent upon the necessary infrastructures being in place

Summary- 1

- MNH is unique and complex, requiring the simultaneous care of two interdependent patients. Outcomes may depend upon mother's health, risk factors for infection, care of the mother and the newborn from preconception to after the birth.
- The nature and complexity of the childbirth provides many opportunities for infection to be introduced to the mother, newborn, and health care workers.
- Infants in specialized care settings such as the Special Care Nurseries and NICUs are particularly vulnerable to infection.
- The importance of effective IPC practices in preventing infection during childbirth and in NICUs is well-established.

Summary- 2

- Health workers should correctly and consistently practice all basic IPC practices when caring for mothers and newborns
- Handwashing at key moments is the most important intervention to reduce HAIs
- Outbreaks of HAIs are common and need to be investigated and measures to halt any further spread implemented promptly
- Device associated infections can be minimized with good infection control practices
- Catheter associated infections can be reduced proper technique and barrier protection
- Surveillance of Healthcare Associated Infections (Microbiological or outcome-based) is likely to be useful in all settings.
- It is possible to improve IPC and handwashing compliance through small-scale QI projects



Thank you

Questions, comments or suggestions?

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