

GUIDELINES: HOW TO MODIFY RISK FACTORS FOR HAIs

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DISCUSSION TOPICS

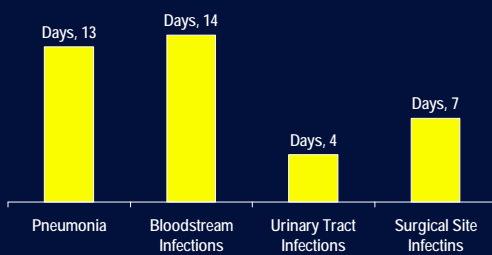
- Impact of healthcare-associated infections
- Risk factors, interventions and guidelines for preventing HAIs
 - Central line-associated bloodstream infections
 - Surgical site infections
 - Urinary tract infections
- Challenges in infection control

HEALTHCARE-ASSOCIATED INFECTIONS: IMPACT

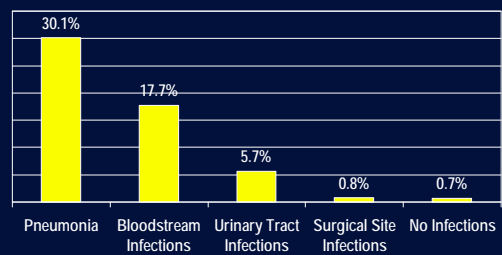
- 1.7 million infections per year
- 98,987 deaths due to HAI
 - Pneumonia 35,967
 - Bloodstream 30,665
 - Urinary tract 13,088
 - SSI 8,205
 - Other 11,062
- 6th leading cause of death (after heart disease, cancer, stroke, chronic lower respiratory diseases, and accidents)¹

¹ National Center for Health Statistics, 2004

INCREMENTAL HOSPITAL DAYS DUE TO COMMON HAIs



MORTALITY RATE OF COMMON HAIs

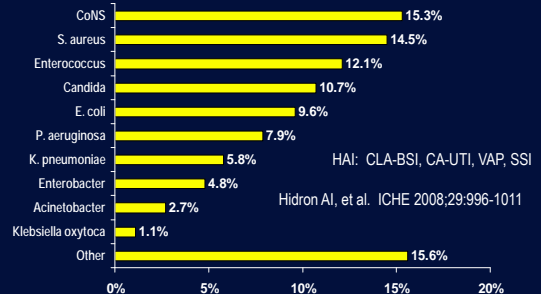


COST ESTIMATES FOR HEALTHCARE-ASSOCIATED INFECTIONS (HAIs)

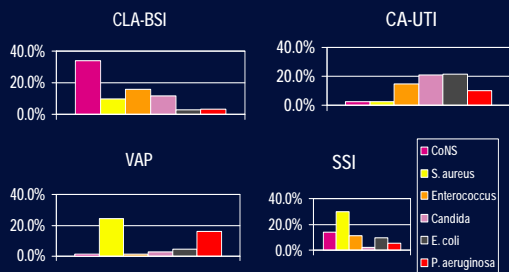
HAI	Cost per HAI ± SE	Range
Ventilator-associated pneumonia	25,072 ± 4,132	8,682-31,316
Healthcare-associated bloodstream infections	23,242 ± 5,184	6,908-37,260
Surgical site infections	10,443 ± 3,249	2,527-29,367
Catheter-associated urinary tract infections	758 ± 41	728-810

Anderson DJ, et al. ICHE 2007;28:767-773
Costs based on literature review 1985-2005; adjusted to US 1995 dollars

PATHOGENS ASSOCIATED WITH HAIs*: NHSN, 2006-2007



PATHOGENS CAUSING HAIs, NHSN, 2006-2007



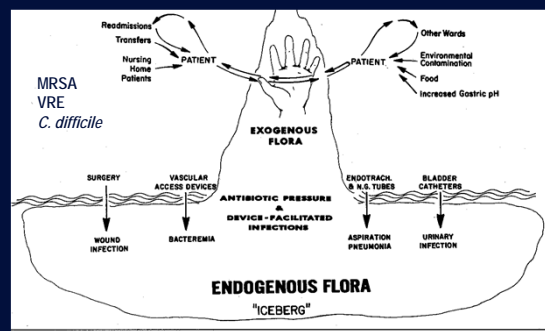
DISCUSSION TOPICS

- Impact of healthcare-associated infections
- Risk factors, interventions and guidelines for preventing HAIs
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RISK FACTORS FOR HEALTHCARE-ASSOCIATED INFECTIONS



HAZARDS IN THE ICU



More HCPs and more invasive devices = higher HAI rates

KEY INFECTION CONTROL INTERVENTIONS

- Compliance with CDC recommendations, Category IA and IB
- Surveillance
- Isolation (based on transmission mechanism)
 - Standard: Gloves for contact with all body fluids except sweat
 - Contact: via direct or indirect contact = gloves, gowns (MRSA, VRE)
 - Droplet: via large droplets (<3 feet) = mask, private room (pertussis)
 - Airborne: via small droplets (>3 feet) = N95 respirator (TB, measles)
- Hand hygiene (before and after patient care)
- Proper disinfection and sterilization (devices, environment)
- Occupational health
 - Pre- and post-exposure prophylaxis

SOURCE OF INFECTION PREVENTION STRATEGIES Evidence-Based

- Centers for Disease Control and Prevention
- The Joint Commission
- Centers for Medicare and Medicaid Services (CMS)
- Institute for Healthcare Improvement (IHI)
- Professional Organizations: APIC, SHEA, AAMI, AORN, SGNA, AIA, SGNA, ASGE

INFECTION PREVENTION STRATEGIES

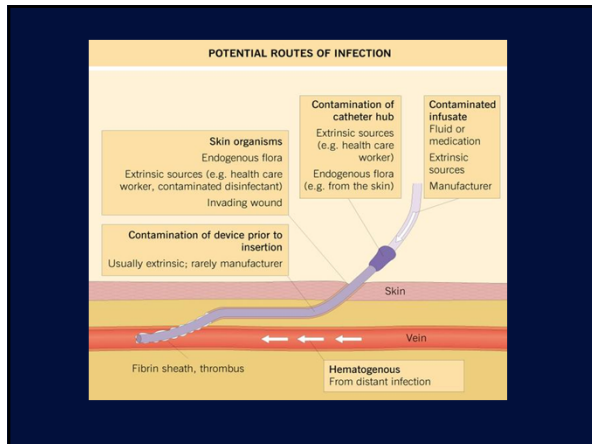
- Centers for Disease Control and Prevention
 - Prevention of Catheter-Associated UTI, 2009
 - Guideline for D/S in Healthcare Facilities, 2008
 - Guideline for Isolation Precautions, 2007
 - Management of MDR Organisms, 2006
 - Preventing HA Pneumonia, 2003
 - Environmental Infection Control in HCF, 2003
 - Hand Hygiene in Healthcare Settings, 2002
 - Prevention of Intravascular Device-Related Infections, 2002, 2010
 - Prevention of Surgical Site Infections, 1999
 - Management of Occupational Exposure to HBV, HCV, HIV, 2002
 - Infection Control in Healthcare Personnel, 1998

INFECTION PREVENTION STRATEGIES

- SHEA
 - Management of HCWs Infected with HBV, HCV, HIV, March 2010
 - Disinfection and Sterilization of Prion-Contaminated Medical Instruments, February 2010
 - Compendium of Strategies to Prevent HAIs, October 2008
 - ◆ Surgical Site Infection
 - ◆ CLA-Bloodstream Infection
 - ◆ Catheter-Associated UTI
 - ◆ Ventilator-Associated Pneumonia
 - ◆ *Clostridium difficile*
 - ◆ Methicillin-resistant *S. aureus*

IMPACT OF BLOODSTREAM INFECTIONS

- Approximately 250,000 nosocomial BSIs per year
- Major risk = use of an intravascular device
- Rate of BSIs varies by:
 - Hospital size, unit, and service
 - Population served (elderly/infants, acute/chronic)
 - Type of device
 - Time-trends
 - Endemic/Epidemic



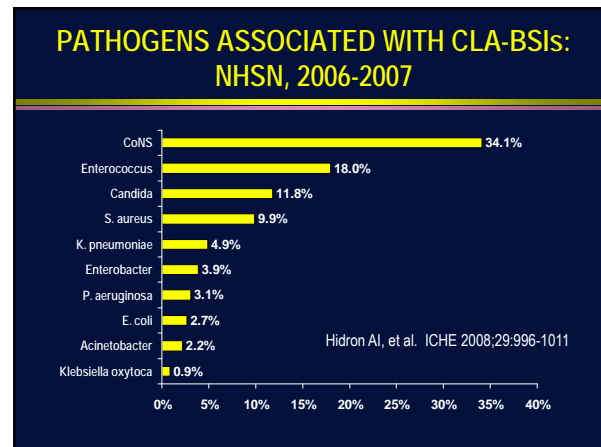
Sources of CR-BSI

- Early (first 7-14 d) – Insertion related
- Late (>14 d) – Maintenance related (breach in aseptic technique when manipulating hubs, connectors, or stopcocks or contamination of infusate itself or line breaks)
- Hematogenous – relates to infections at other sites and occurs only in severely ill patients (ICU, hematology-oncology, etc).

Sherertz et al, J Clin Micro 1997;35:641

Prevention of CLA-BSI Depends of Eliminating Routes of Infection

- Skin-catheter interface
 - Aseptic insertion key (insertion bundle)
 - Focus on site of catheter insertion through the skin
- Infection via contaminated hub
 - Aseptic maintenance of hub (maintenance bundle)
 - Focus on disinfection of hub; maintaining a closed system
- Contaminated infusate
 - Intrinsic contamination: Focus on good manufacturing practice
 - Extrinsic contamination: Focus on sterile fluid compounding
- Hematogenous seeding
 - Focus on preventing bacteremia (e.g., prophylactic antibiotics for neutropenic patients)



STRATEGIES TO PREVENT CLA-BSI IN ACUTE CARE HOSPITALS

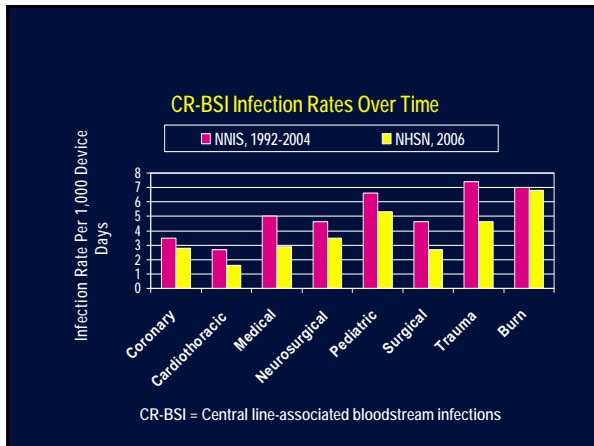
- Best practices (at insertion)
 - Use a **catheter checklist** (B-II)
 - Perform **hand hygiene** before catheter insertion (B-II)
 - Avoid the femoral for access (A-I)
 - In adults, **preferentially use the subclavian vein**
 - Use an **all-inclusive catheter kit or cart** (B-II)
 - Use **maximal sterile barrier precautions** (mask, cap, sterile gown, sterile gloves; cover patient with a large sterile drape)(A-I)
 - Use CHG antiseptic (**CHG-alcohol**) for **skin preparation** (A-I)

Marschall J, et al. ICHE 2008;29 (suppl 1):S22-S30

STRATEGIES TO PREVENT CLA-BSI IN ACUTE CARE HOSPITALS

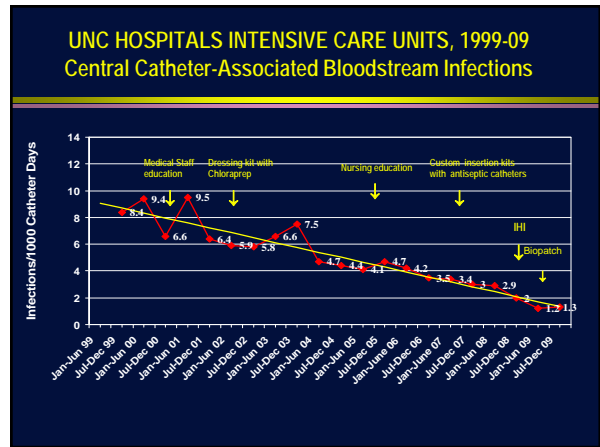
- Best practices (after insertion)
 - **Disinfect** (CHG-alcohol, 70% alcohol) **catheter hubs**, needleless connectors, and injection ports before accessing the catheter (B-II)
 - **Remove non-essential catheters** (A-II)
 - For non-tunneled CVCs change dressing every 5-7 days; more frequently if soiled (A-I)
 - Replace administration sets not used for blood/blood products at intervals not longer than 96 hours (A-II)
 - Use antimicrobial ointment for hemodialysis catheter insertion sites (A-I)

Marschall J, et al. ICHE 2008;29 (suppl 1):S22-S30



- ### 100,000 LIVES CAMPAIGN: CLA-BSI BUNDLE
- Hand hygiene
 - Maximal barrier precautions
 - Chlorhexidine skin antisepsis
 - Optimal catheter site selection, with subclavian vein as the preferred site for non-tunneled catheters
 - Daily review of line necessity, with prompt removal of unnecessary lines

- ### INFECTION CONTROL INTERVENTIONS
- 2000: Addition of 2% chlorhexidine/70% isopropyl alcohol (ChoraPrep®) to the central line dressing kit.
 - 2001: Mandatory training for nurses on IV line site care and maintenance.
 - 2003: Full body drape added to central line kit. MD could choose kit containing a catheter impregnated with antiseptic or antibiotic.
 - 2005: 2nd generation impregnated catheter included in all central line kits (except for Neonatal ICU).
 - 2006: Pilot in MICU of IHI bundle to prevent CLA-BSI.
 - 2007: Implementation of the IHI bundle in all ICUs.
 - 2008: Implementation of Infection Control Liaison Program
 - 2009: Implementation of Biopatch.



- ### IMPACT OF UNC HEALTH CARE REDUCTION IN CLA-BSI, 1999-2008
- Infections prevented
 - 887
 - Deaths prevented (based on attributable mortality)
 - 222 to 266 death preventing (attributable mortality 25% to 30%)
 - Savings (2005 dollars)
 - \$20,615,654

CENTRAL LINE-ASSOCIATED BSI RATE: NHSN, 2006-2007

Unit	Infection Rate (pooled mean)	Infection Rate (10% - 90%)	Central Line Utilization Ratio
Burn ICU	5.6	0.0 - 13.5	0.59
Coronary ICU	2.1	0.0 - 5.3	0.40
Surgical CT ICU	1.4	0.0 - 3.4	0.72
Medical ICU	2.4	0.0 - 5.3	0.58
Med/Surg ICU, teaching	2.0	0.0 - 4.2	0.59
Med/Surg ICU, others	1.5	0.0 - 3.6	0.46
Ped Med/Surg ICU	2.9	0.0 - 6.0	0.46
Ped Med ICU	1.0	NA	0.38
Surgical ICU	2.3	0.0 - 5.1	0.61
Trauma ICU	4.0	0.3 - 7.7	0.65
Adult SDU (surg)	2.4	0.0 - 3.5	0.26
Med Inpatient floor	1.8	0.0 - 3.4	0.24

Innovations to Reduce Risk

CHG PATCH



PROTECTIVE DISK WITH CHG

- Bacteria can recolonize the skin and CHG suppresses regrowth
- CHG patch provides contact around the insertion site and 7 day continuous release of CHG provides ongoing antimicrobial protection
- Randomized, controlled trials show CHG patch reduces risk of infection (JAMA 2009;301:1231 and Ann Hematol 2009;88:267)

CENTRAL LINE INFECTION RATES (/1000 days)

Before (Feb-Oct 08) and After (Feb-Oct 09) Introduction of CHG Patch

ICU	BSI	CL day	Rate	BSI	CL day	Rate
MICU	7	3971	1.8	4	3984	1.0
CICU	6	1604	3.7	2	2190	0.9
SICU	9	2749	3.3	6	3222	1.9
NSICU	5	1434	3.5	0	1298	0.0
TICU	1	1758	0.6	2	1924	0.8
PICU	14	2878	4.9	4	2495	1.6
Overall	42	14394	2.9	18	15113	1.2

CENTRAL LINE INFECTION RATES (/1000 days)

Before (Feb-Oct 08) and After (Feb-Oct 09) Introduction of Biopatch

- Reduced BSIs from 42 (2.9/1000 device days) to 18 (1.2/1000 device days) ($p=0.001$)
- Preventing 24 infections avoided \$720,000 in costs and 5 deaths (costs ~\$65,000)
- Implementing CHG patch hospitalwide should save ~\$3.93 million [should have 97 BSI rather than 218 BSI, preventing 121](costs ~\$250,000)

SSIs: IMPACT

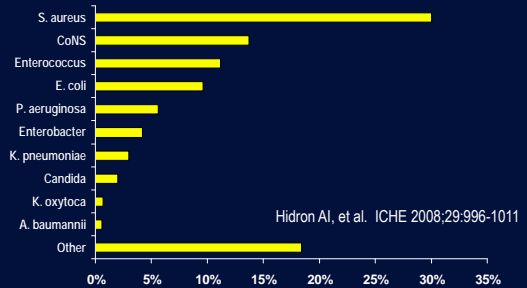
- 27,000,000 surgical procedures per year
- 2-5% of surgical patients develop an SSI
 - 290,000 infections per year
 - ~70% superficial, ~30% organ/space infections
- SSIs account for ~22% of nosocomial infections
 - 2nd most common nosocomial infection
- Each SSI results in 7-10 additional hospital days at a large cost
- Patients with SSI have a 2-11-fold higher risk of death
www.cdc.gov/ncidod/dhqp/FAQ_SSI.html (3/15/09)

SSI: Primary Risk Factors

- Endogenous microorganisms
 - Skin-dwelling microorganisms
 - ◆ Most common source
 - ◆ *S. aureus* most common isolate
 - ◆ Fecal flora (gnr) when incisions are near the perineum or groin
- Exogenous microorganisms
 - Surgical personnel (members of surgical team)
 - OR environment (including air)
 - All tools, instruments, and materials

Mangram AJ, et al. Infect Control Hosp Epidemiol. 1999;20(4):250-278.

PATHOGENS ASSOCIATED WITH SSIs: NHSN, 2006-2007



SSI: Intrinsic/Patient Risk Factors

- Age-extremes
- Nutritional status-poor
- Diabetes-controversial; increased glucose levels in post-op period ↑ risk
- Smoking-nicotine delays wound healing ↑ risk
- Obesity >20% ideal body weight
- Remote infections ↑ risk
- Endogenous mucosal microorganisms
- Preoperative nares *S. aureus*-CT patients
- Immunosuppressive drugs may ↑ risk
- Preoperative stay-surrogate for severity of illness

CDC SURGICAL SITE INFECTION PREVENTION GUIDELINES - 1999

Category IA and IB

- | | |
|--|---|
| <ul style="list-style-type: none"> No prior infections Do not shave in advance Control glucose in diabetes pts Stop tobacco use Shower with antiseptic soap Prep skin with approp. agent Surgical team nails short Surgical team scrub hands Exclude I/C surgical team Give prophylactic antibiotics | <ul style="list-style-type: none"> 15 air changes/hr in OR Keep OR doors closed Use sterile instruments Wear a mask Cover hair Wear sterile gloves Gentle tissue handling DPC for heavily contaminated wounds Closed suction drains (when used) Sterile dressing x 24-48 hr |
|--|---|
- Pos pressure ventilation in OR
SSI surveillance with feedback to surgeons

INSTITUTE FOR HEALTHCARE IMPROVEMENT

- Appropriate use of antibiotics
 - Antibiotics within 1 hour before surgical incision (vancomycin within 2 hours)
 - Prophylactic antibiotic consistent with national guidelines
 - Discontinuation of prophylactic antibiotics within 24 hours after surgery
- Appropriate hair removal
 - Clip versus shave

Innovations to Reduce Risk

CHLORHEXIDINE-ALCOHOL



CHG-ALCOHOL VERSUS PI FOR SURGICAL-SITE ANTISEPSIS

NEJM 2010;362:18-26

- Background-patient's skin is a major source of pathogens that cause SSI and optimization of preoperative skin antiseptics may decrease SSIs
- Methods-Randomly assigned patients undergoing clean contaminated surgery to CHG-alcohol or PI scrub and paint
- Results-SSIs lower in CHG-alcohol group to PI group (9.5% vs 16.1%). CHG better for superficial incisional and deep incisional but not organ-space infections
- Conclusion-CHG-alcohol superior for preventing SSIs

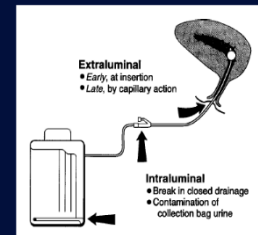
CATHETER-ASSOCIATED URINARY TRACT INFECTIONS (CA-UTI)

- Prevalence, Incidence
 - Most common site of HAI: Accounts for more than 30% of all reported HAIs by acute care hospitals
 - Estimated >560,000 healthcare-associated UTIs annually
 - 15-25% patients in hospitals have a urethral catheters
 - Most hospitalized patients are catheterized for only 2-4 days but many longer
 - Incidence of bacteriurias associated with indwelling catheter is 3-8% per day

Adapted from CDC: http://www.cdc.gov/HAI/pdfs/toolkits/CAUTItoolkit_3_10.pdf

PATHOGENESIS OF CA-UTI

- Source of microorganisms
 - Endogenous: migration of meatal, rectal, vaginal colonization
 - Exogenous: via contaminated hands of HCP during catheter insertion or manipulation of the collecting system



Maki DG, Tambyah PA. Emerg Infect Dis 2001;7:1-6

CA-UTIs

- Introduction of bacteria into the bladder at the time of catheter insertion
- Extraluminal migration of bacteria or perianal bacteria into the bladder along the outer surface of the catheter
- Intraluminal retrograde migration of bacteria into the bladder from the drainage bag along the inner surface of the catheter following a catheter care violation

CAUTI Prevention-IHI

- Avoid unnecessary catheters
- Insert urinary catheters using aseptic technique
- Maintain urinary catheters based on recommended guidelines
- Review urinary catheters necessity daily and remove promptly

CAUTI Prevention-IHI

- Avoid unnecessary urinary catheters
 - Explicit criteria for appropriate insertion should be in place and verification that criteria are met prior to insertion
 - Indications
 - ◆ Preoperative use for selected surgical patients
 - ◆ Urine output monitoring in critically ill patients
 - ◆ Management of acute urinary retention and urinary obstruction
 - ◆ Assistance in pressure ulcer healing for incontinent patients
 - ◆ As an exception, at patient request to improve comfort or for comfort during end-of-life care
 - Strategies: require verification that criteria are met; build criteria for catheter insertion into order entry systems and require documentation of need at time of order; review cases of insertion that do not meet criteria

CAUTI Prevention-IHI

- Insert urinary catheters using aseptic technique
 - Use appropriate hand hygiene
 - Insert catheter using aseptic technique and sterile equipment (gloves, drape, sponges, antiseptic solution for cleaning urethral meatus, sterile lubricant gel)
 - Use as small a catheter as possible consistent with proper drainage
 - Strategies: checklist for indications for catheter use and insertion; kits; education and training of staff; competency assessment

CAUTI Prevention-IHI

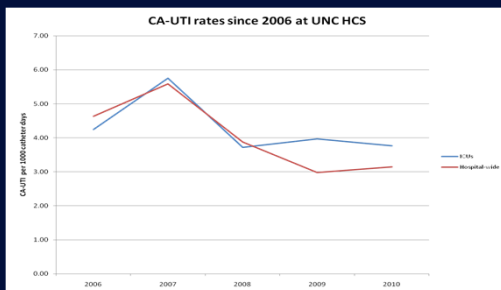
- Maintain catheters based on recommended guidelines
 - Maintain sterile, continuously closed drainage system
 - Keep catheter properly secured to prevent movement and urethral traction
 - Keep collection bag below the level of the bladder
 - Maintain unobstructed urine flow
 - Empty collection bag regularly
- Strategies: verify and document five items at least once per shift; avoid irrigating catheters, disconnecting the catheter from the drainage bag, and replacing catheters routinely

CAUTI Prevention-IHI

- Review urinary catheter necessity daily and remove promptly (duration of catheterization is the most important risk factor for development of infection)
 - Daily review of catheter necessity is recommended
- Strategies: automatic stop orders; daily reminders by nurses to physicians; alerts in computerized ordering systems; daily assessment at the start of every shift with the requirement to contact physician if criteria are not met

DISCUSSION TOPICS

- Impact of healthcare-associated infections
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CHALLENGES IN THE PREVENTION AND MANAGEMENT OF HEALTHCARE-ASSOCIATED INFECTIONS

- Changing population of hospital patients
 - Increased severity of illness
 - Increased numbers of immunocompromised patients
 - Increased numbers of older patients
 - Shorter duration of hospitalization
 - More and larger intensive care units
 - Larger step-down units
- Limited financial resources-Biopatch, CHG-Alcohol, etc
- Growing frequency of antimicrobial-resistant pathogens and emerging pathogens

EMERGING INFECTIOUS DISEASES SINCE 1990

- 1993 (US) - Hantavirus pulmonary syndrome (Sin nombre virus)
- 1994 (US) – Human granulocyte ehrlichiosis
- 1994 (Australia) – Hendra virus
- 1995 (Worldwide) - Kaposi sarcoma (HHV-8)
- 1996 (England) – Variant Creutzfeldt-Jakob disease (vCJD) ✓ ✓
- 1998 (Malaysia) – Nipah virus
- 1999 (US) - West Nile encephalitis (West Nile virus) ✓
- 2001 (US) - Anthrax attack via letters ✓
- 2001 (Netherlands) – Human metapneumovirus ✓
- 2002 (US) – Vancomycin-resistant *S. aureus* ✓
- 2003 (China→worldwide) - SARS (coronavirus) ✓ ✓
- 2003 (US) – Monkeypox ✓
- 1997-present (Asia) – Avian influenza (H5N1)
- 2009 Novel H1N1 influenza ✓ ✓

EMERGING RESISTANT PATHOGENS: HEALTH CARE FACILITIES

- *Staphylococcus aureus*: Oxacillin (occ. vancomycin, linezolid)
- *Enterococcus*: Penicillin, aminoglycosides, vancomycin, linezolid, dalfopristin-quinupristin
- *Enterobacteriaceae*: ESBL producers, carbapenems
- *Pseudomonas aeruginosa*, *Acinetobacter* sp: Multiple
- *Mycobacterium tuberculosis*: MDR (INH, rifampin), XDR (multiple)



CHALLENGES IN THE PREVENTION AND MANAGEMENT OF HEALTHCARE-ASSOCIATED INFECTIONS

- Lack of compliance with hand hygiene and other infection preventive measures (e.g., endoscope)
- Difficulty in elimination of infection control practices that have proven ineffective
- Limited infection prevention resources
- Implementation of bundles demonstrated to reduce HAIs
- Public reporting of HAIs
- CMS non-reimbursement for HAIs
- Health insurance reimbursement tied to quality goals
- Development of new diagnostic and therapeutic technology that challenges the patient's defense mechanisms

ICP ACTIVITIES

- 1975 to 1990
 - Surveillance
 - Outbreak investigations
 - Exposure evaluations
 - Education
 - JCAHO
 - Policy development and review
 - Sterilizer monitoring
 - Dialysis water
- 1991 to 2003 (new)
 - Targeted surveillance
 - OSHA TB
 - OSHA Bloodborne
 - Molecular epidemiology
 - MRSA, VRE
 - BT preparedness
 - Construction rounds

ICP ACTIVITIES

- 2004 to 2008 (new)
 - IHI bundles
 - CMS core measures
 - NSQUIP (VAs, others)
 - NDNQI (ANA)
 - Other CQI initiatives
 - MRSA active surveillance
 - Unannounced TJC visits
 - Avian influenza preparedness
 - Endoscope sampling
- Future
 - Public health reporting
 - Mandated influenza vaccine
 - Mandated MRSA surveillance
 - Cost analyses
 - Comprehensive surveillance
 - Transparency

CHALLENGES IN THE PREVENTION AND MANAGEMENT OF HEALTHCARE-ASSOCIATED INFECTIONS

- Lack of compliance with hand hygiene and other infection preventive measures (e.g., endoscope)
- Difficulty in elimination of infection control practices that have proven ineffective
- Limited infection prevention resources
- Implementation of bundles demonstrated to reduce HAIs
- Public reporting of HAIs (redirects IP resources)
- CMS non-reimbursement for HAIs
- Health insurance reimbursement tied to quality goals
- Development of new diagnostic and therapeutic technology that challenges the patient's defense mechanisms

CONCLUSIONS

- Healthcare-associated infections are associated with significant patient morbidity and mortality
- Implement bundles and guidelines demonstrated to reduce SSIs, UTIs and CLA-BSI infections
- Improved compliance with infection prevention recommendations needed to prevent HAIs
- New issues: emerging pathogens/MDROs; public reporting; CMS non-reimbursement for HAIs; older/more immunocompromised patients; lack of compliance with infection prevention measures, etc

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Thank you

disinfectionandsterilization.org

HAIs CONTINUE TO INCREASE

- Number of older patients with chronic diseases
- Number of immunocompromised patients
- Development of new diagnostic and therapeutic technology that challenges the patient's defense mechanisms
- Inconsistent implementation of infection control practices
- Misuse of antibiotics
- Difficulty in elimination of infection control practices that have proven ineffective