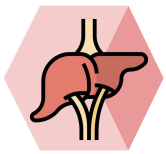
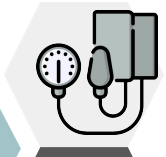
Medicine
TEAM 437

MED437
KING SAUD UNIVERSITY

Healthcare Associated Infections




Objectives :

1. Know different types of HAI and how to prevent them
2. Highlight the crucial importance of Hand Hygiene
3. Understand different types of Isolation Precautions and how to comply with them

Done by :

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Resources :

Doctor's slides + Team 436
Lecturer: Dr. Mazin Barry
Same as 436 slides: Yes

Hospital Acquired Infections (HAI)

- Between 5% and 10% of patients admitted to hospitals acquire one or more HAI (20% in KSA)
- Causes more serious illness
- Prolonged hospital stay
- Long-term disability
- High personal burden on patients and their families
- High additional financial burden
- Deaths

Estimated Rates of HAI Worldwide

- **In the developed world:**
  5–10% of patients acquire one or more infections
- **In developing countries:**
  HAI can exceed 25%
- **In intensive care units:**
  HAI affects about 30% of patients and the attributable mortality may reach 44%

Source of Infection

HAIs are caused by infectious agents from:

1] Endogenous sources

Such as the skin, nose, mouth, GI tract, or vagina that are normally inhabited by microorganisms (normal flora) own body own flora

2] Exogenous sources

External to the patient such as health care workers (HCW), visitors, patient care equipment, medical devices, or the healthcare environment

Types of HAI

Catheter-Associated Urinary Tract Infections (CAUTI)

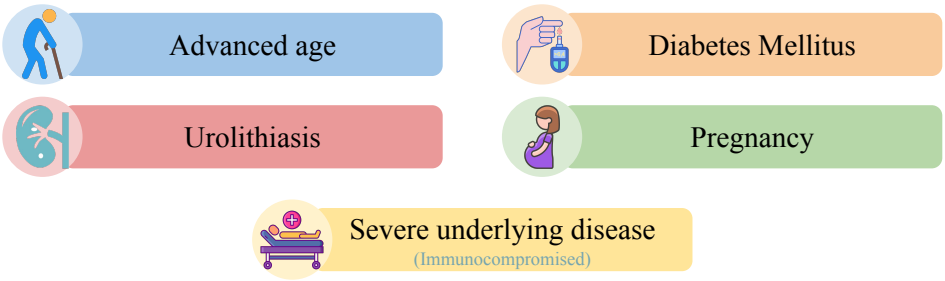
Surgical site infections (SSI)

Central line-Associated Bloodstream Infections (CLABSI)

Ventilator-Associated Pneumonia (VAP)

Catheter-Associated Urinary Tract Infections (CAUTI)

- Indwelling urinary catheter
- Urinary invasive procedures
- **Risk Factors:** more common in these people than other



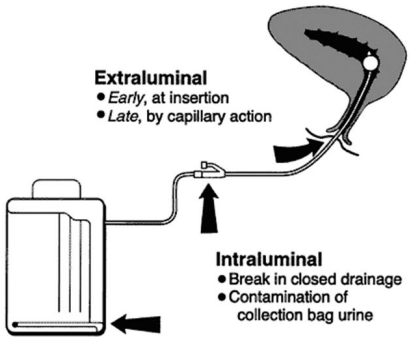
- Most common type of HAI: > 30%
  - Estimated > 500,000 of hospital UTIs annually
- Increased morbidity & mortality
  - Estimated 13,000 attributable deaths annually
  - Leading cause of secondary bloodstream infection with ~10% mortality
- Excess length of stay: 2-4 days

Indwelling Urinary Catheters

- 15-25% of hospitalized patients
- Often placed for inappropriate indications not every surgery needs catheterization
- Physicians frequently unaware:
  - > 50% did not monitor which patients catheterized
  - 75% did not monitor duration and/or discontinuation

Pathogenesis of CAUTI

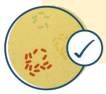
- **Source of microorganisms:**
  - Endogenous (meatal, rectal, or vaginal) most common
  - Exogenous, usually via contaminated hands of HCW during catheter insertion or manipulation of the collecting system
- Formation of biofilms by urinary pathogens is common on the surfaces of catheters and collecting systems
- Bacteria within biofilms are **resistant** to antimicrobials and host defenses
- Must remove catheter for cure if it stays no cure



Catheter-Associated Urinary Tract Infections (CAUTI)

- Symptomatic (is a must) UTI must meet at least 1 of the following criteria:
  - Fever (38^0 C or above), urgency, frequency, dysuria, or suprapubic tenderness on exam

  - Positive urine culture, that is more than 10^5 CFU per ml, with no more than 2 species of microorganisms 90% is 1. If it is more than 2 repeat it



- A positive culture of a urinary catheter tip is not an acceptable laboratory test to diagnose UTI ! very commonly done and very wrong

Prevention: CAUTI Bundle **IMPORTANT!**

- Insert catheters only for appropriate indications
- Leave catheters in place only as long as needed the longer the duration the more is the risk
- Ensure that only properly trained persons insert and maintain catheters
- Insert catheters using aseptic technique and sterile equipment (acute care setting)
- Following aseptic insertion, maintain a closed drainage system
- Maintain unobstructed urine flow
- Daily revision of need of catheterization
- Hand hygiene before handling the collecting system and it is part of the aseptic procedure
- Minimize use in all patients, particularly those at higher risk of CAUTI and mortality
  - Women, elderly, impaired immunity
- Avoid its use for management of urinary incontinence it is a common mistake
- Use catheters in operative patients only as necessary not every operation needs
- Remove catheters ASAP postoperatively, preferably within 24 hours, unless there are appropriate indications for continued use even if mistakenly done remove within 24 hours
- All HAI should be monitored regularly!

Surgical Site Infection (SSI)

- Inadequate antibiotic prophylaxis THE KEY
- Incorrect surgical skin preparation
- Inappropriate wound care
- **Risk Factors:**
  - Surgery duration the longer the more likely
  - Type of surgery: clean, clean-contaminated, contaminated, dirty
  - Type of wound
  - Improper surgical aseptic preparation
  - Poor glucose control during OR to unable to maintain it
  - Malnutrition
  - Immunodeficiency
  - Hypothermia in OR (by anesthetic) and after if not 3 times more likely to develop SSI in contrast those who are normal
  - Lack of training and supervision

Surgical Wound Classification	
Clean	• Uninfected, no inflammation • Resp, GI, GU tracts not entered not touched • Closed primarily • ***Examples:*** *Ex lap, mastectomy, neck dissection, thyroid, vascular, hernia, splenectomy*
Clean-contaminated	• Resp, GI, GU tracts entered, controlled still minimal • No unusual contamination • ***Examples:*** *Chole, SBR, Whipple, liver txp, gastric surgery, bronch, colon surgery, bypass*
Contaminated	• Open, fresh, accidental wounds • Major break in sterile technique • Gross Spillage from GI tract like fecal matter • Acute non purulent inflammation • ***Examples:*** *Inflamed appendix, bile spillage in chole, diverticulitis, Rectal surgery, penetrating wounds, cholecystectomy*
Dirty	• Old traumatic wounds, devitalized tissue • Existing infection or perforation purulent • Organisms present BEFORE procedure • ***Examples:*** *Abscess I&D, perforated bowel, peritonitis, wound debridement, positive cultures pre-op* • They should be on antibiotics before surgery

Surgical Site Infection (SSI)

- **Burden**
  - **17% of all HAI; second to UTI**
  - 2%-5% of patients undergoing inpatient surgery
- **Mortality**
  - 3 % mortality
  - 2-11 times higher risk of death
  - 75% of deaths among patients with SSI are directly attributable to SSI
- **Morbidity**
  - long-term disabilities

Superficial SSI

- The better type to have
- Infection occurs within 30 days after the operative procedure and involves only skin and subcutaneous tissue of the incision deep space not affected
- Purulent drainage from the superficial incision like the surgical site
- Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision
- Often Clinical diagnosis: pain or tenderness, localized swelling, redness, or heat, lack of systemic symptoms (e.g. fever) cause localised not systemic CBC is normal ESR is normal
- A negative culture does not rule it out

Deep SSI

- Infection occurs within 30 days after the operative procedure if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operative procedure
- Involves deep soft tissues (eg, fascial and muscle layers) of the incision deep organ spaces
- Clinically may have abscess, fever, purulent discharge, tenderness, abscess formation , and systemic
- CBC elevated → WBC elevated
- ESR elevated

SSI Pathogenesis

Pathogen sources:

1] Endogenous sources

- Patient flora
  - skin
  - mucous membranes
  - GI tract
- Seeding from a distant focus of infection
  example: bacteremia

2] Exogenous sources

- Surgical Personnel (surgeon and team)
  - Soiled attire dont use the same scrubs from one OR to another (contamination)
  - Breaks in aseptic technique
  - **Inadequate hand hygiene** v.imp
- O.R. physical environment and ventilation
- Tools, equipment, materials brought to the operative field sources of SSI

Organisms Causing SSI

Staphylococcus aureus	***30.0%***
Coagulase-negative staphylococci *(⅓ of SSI)*	*13.7%*
Enterococcus spp.	*11.2%*
Escherichia coli	*9.6%*
Pseudomonas aeruginosa	*5.6%*
Enterobacter spp	*4.2%*
Klebsiella pneumoniae	*3.0%*
Candida spp.	*2.0%*
Klebsiella oxytoca	*0.7%*
Acinetobacter baumannii	*0.6%*

SSI Epidemiology

- Important Modifiable Risk Factors:
  - Antimicrobial prophylaxis
    - Inappropriate choice (procedure specific)
    - Improper timing (pre-incision dose) different than before being in OR
    - Inadequate dose based on body mass index, procedures >3h
      should be redosed in the procedure
- Skin or site preparation ineffective
- Colorectal procedures
  - Inadequate bowel prep/antibiotics
- Inadequate wound dressing protocol
- Improper glucose control
- Colonization with preexisting microorganisms

SSI Prevention Strategies

- **Preoperative Measures:**
  Administer antimicrobial prophylaxis in accordance with evidence based standards and guidelines
  - Administer <u>within 30-45 minutes to incision</u> B lactam abx most important and cephalosporins
    - 1-2hr for vancomycin and fluoroquinolones
  - Select appropriate agents on basis of
    - Surgical procedure each type of surgery has a type of antibiotics
    - Most common SSI pathogens for the procedure
    - Published recommendations
- Nasal screen and decolonize only ***Staphylococcus aureus*** carriers undergoing (anterior nares)


Elective cardiac surgery


Orthopaedic surgery


Neurosurgery procedures with implants

USING Pre-operative <u>mupirocin ointment</u> therapy IT IS A MUST!

- Don't recommend Shaving or clipping The night before!

Prevention: SSI Bundle

- Shower night before surgery by nurse is better (use F.chloro soap)
- Antimicrobial prophylaxis should be administered only when indicated
  - Certain surgeries only
  - Single preoperative dose 30-45 min before incision
  - Topical antibiotics should not be applied to the surgical site
  - In clean and clean-contaminated surgery: No additional prophylactic antimicrobial doses should be given even in the presence of a drain no in Post-Op only Pre-Op.
- Skin preparation in the O.R. by alcohol-based agent
- Good glycemic control during surgery
- Normothermia should be maintained throughout surgery
- Administration of FIO_2 during surgery and after extubation





CLABSI

- **Definition:**
  - Laboratory-confirmed bloodstream infection by a positive blood culture
  - Not related to an infection at another site
  - Develops at least after 48 hours of a central line placement
- **Most common site:** femoral central lines

CLABSI Organisms

GPC
gram + cocci

- *CoNS 35%* (coagulase negative staphylococcus)
- *Enterococci spp 15%*
- *Staphylococcus aureus 10%*

GNB
gram - bacilli

- *Klebsiella pneumoniae 6%*
- *E.coli 3%*
- *Enterobacter spp. 3%*
- *Pseudomonas aeruginosa 3%*
- *Acinetobacter baumanii 2%*

Candida spp. 12%

Other 10%

CLABSI Treatment

- Removal of central line
- Antimicrobial therapy depends on organism in the culture
  - Type and duration depends on culture results, type of organism, complicated disease
    - ***e.g. of antibiotics used:*** *Vancomycin, cloxacillin, cefazolin, piperacillin/ tazobactam, cefepime, ceftazidime, carbapenems, Aminoglycosides, colistin, daptomycin, echinocandins*
      - *Vancomycin MRSA 7 days*
      - *Cloxacillin S.aureus 21 days*

CLABSI Prevention Bundle

- **Prevention Guidelines During Insertion:**
  type 1: A nurse has to be there and uses a checklist to observe
  - Hand hygiene before wearing gloves
  - Strict aseptic technique by maximal sterile barrier precautions including a full-body drape (not only the area around it)
  - Use of 2% chlorhexidine skin preparations for disinfecting/ cleaning skin before insertion (not alcohol)
  - Ultrasound guidance by an experienced personnel and reduce the number of attempts (Highly recommended)
  - Avoid the femoral vein frequent site of infection, prefer the subclavian vein then Jugular
  - Promptly remove any central line that is no longer required
  - Replace central lines placed during an emergency (asepsis not assured) as soon as possible or at least within 48 hours if done quickly without aseptic technique to save him when stable remove and put another properly
  - Use a checklist

- **Prevention Guidelines During Maintenance:** type 2
  - Disinfect catheter hubs by alcohol, injection ports, and connections before accessing line
  - Replace administration sets other than sets used for lipids or blood products every 96 hours
  - Assess the need for the central line daily

VAP

- VAP is one of the most common infections acquired by adults and children commonly in intensive care units
- Affects critically ill patients
- VAP is a cause of significant morbidity and mortality, increased utilization of healthcare resources
- The mortality attributable to VAP exceed 15%

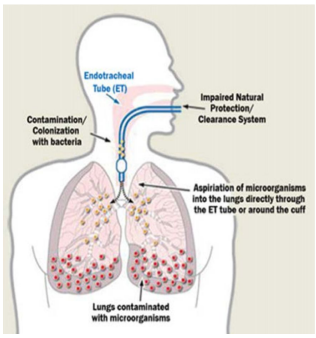
Pathogenesis and Risk Factors for VAP

- **The 3 common mechanisms:**


Aspiration of secretions


Colonization of the aerodigestive tract


Use of contaminated equipment ex: NGT or mechanical ventilator



Prevention: VAP Bundle

- **Prevent Aspiration of Secretions**
  - Maintain elevation of head of bed (HOB) 30-45 degrees not flat
  - Avoid gastric overdistention
  - Avoid unplanned extubation and re-intubation
  - Use cuffed endotracheal tube with in-line or subglottic suctioning
  - Encourage early mobilization of patients with physical/occupational therapy
- **Reduce Duration of Ventilation**
  - Conduct "sedation vacations" for example pts in ICU are sedated, we stop anesthesia so they cough up secretions.
  - Assess readiness to wean from vent daily
  - Conduct spontaneous breathing trials
- **Reduce Colonization of Airway and Digestive Tract**
  - Use cuffed Endotracheal Tube with inline or subglottic suctioning
    - Minimizes secretions above cuff; prevents contamination of lower airway
  - Avoid acid suppressive therapy for patients not at high risk for stress ulcer or stress gastritis
    - Increases colonization of the digestive tract

      Don't use PPI or Acid blocker cause acid protective factor
- **Prevent exposure to contaminated equipment**

Most Frequent Sites of Infection and Their Risk Factors

URINARY TRACT INFECTIONS 34%
Urinary catheter
Urinary invasive procedures
Advanced age
Severe underlying disease
Urolithiasis
Pregnancy
Diabetes

13% **LOWER RESPIRATORY TRACT INFECTIONS**
Mechanical ventilation
Aspiration
Nasogastric tube
Central nervous system depressants
Antibiotics and antacids
Prolonged healthcare facilities
Malnutrition
Advanced age
Surgery
Immunodeficiency

LACK OF HAND HYGIENE

SURGICAL SITE INFECTIONS
Inadequate antibiotic prophylaxis
Incorrect surgical skin preparation
Inappropriate wound care
Surgical intervention duration
Type of wound
Poor surgical asepsis
Diabetes
Nutrition state
Immunodeficiency
Lack of training and supervision
17%

BLOOD INFECTIONS
Vascular catheter
Neonatal age
Critical care
Severe underlying disease
Neutropenia
Immunodeficiency
New invasive techniques
Lack of training and supervision
14%

Prevention of HAI

- Validated and standardized prevention strategies have been shown to reduce HAI
- At least 50% HAI could be prevented
- Most solutions are simple and not resource-demanding and can be implemented with ease by all HCW
    - Hand hygiene to prevent them and it is the most important
    - Bundles
    - Compliance with isolation precautions
    - Annual influenza vaccination v imp.
    - Annual TB screening: TST, IGRA
    - UpToDate with vaccinations: HBV Ab titre above 10, MMRV, Td

Hand Transmission

- Hands are the most common vehicle to transmit healthcare associated pathogens
- Transmission of microbiological organisms from one patient to another via HCW hands

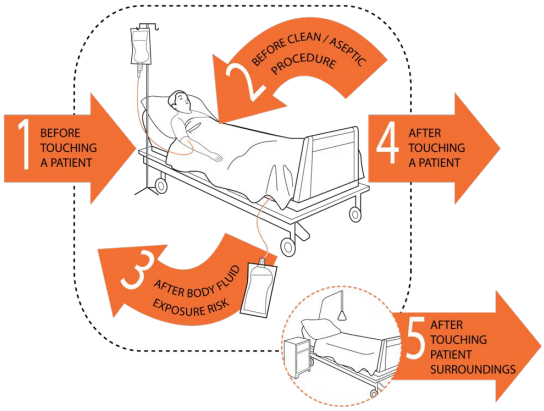
Why Should You Clean Your Hands?

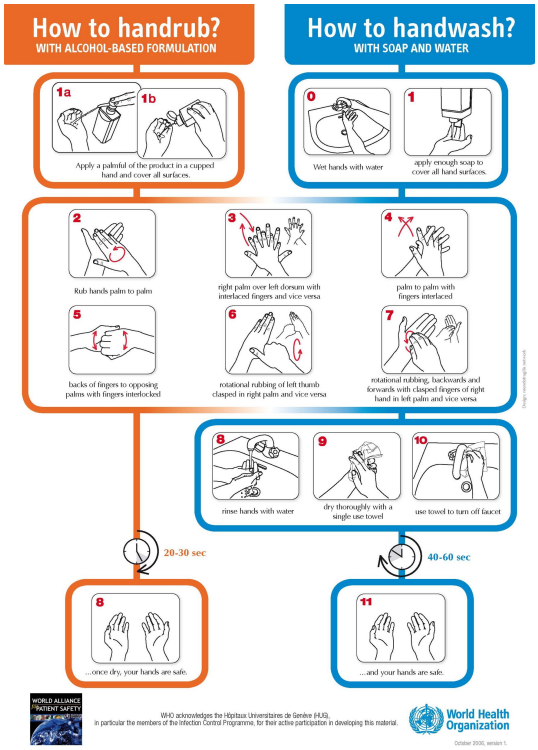
- Any HCW involved in health care needs to be concerned about hand hygiene
- Other HC workers (e.g. your colleagues and seniors) hand hygiene concerns you as well
- You must perform hand hygiene to :
  - protect the patient against harmful microbes in your hands or present on your skin
  - protect yourself and the healthcare environment from harmful microbes

Bacteria Isolated Everywhere (e.g. VRE)

It's around the whole hospital

Five Moments of Hand Hygiene





How to Clean Your Hands

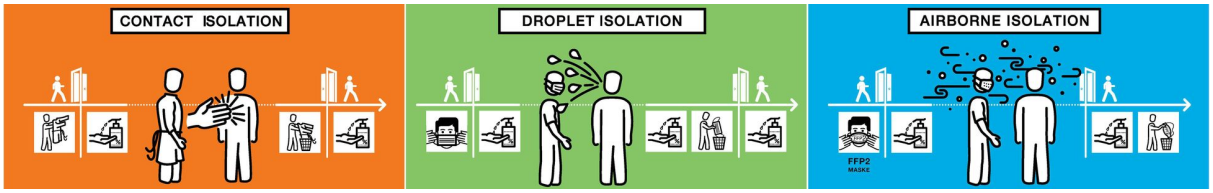
- Handrubbing with alcohol-based handrub is the preferred routine method of hand hygiene if hands are not visibly soiled hand gel/ alcohol based is usually enough except when 1-hand are visibly soiled 2- C.difficile patients
- Handwashing with soap and water – essential when hands are visibly dirty or visibly soiled (following exposure to body fluids) wash after gloves since the white paste comes on your hands
- Don't grow long nails don't wear artificial nails

Hand Hygiene and Glove Use

- The use of gloves does not replace the need to clean the hands
- Remove gloves to perform Hand hygiene, when an indication occurs while wearing gloves
- Wear gloves only when indicated, otherwise they become a major risk for germ transmission
- Don't wear it if is not indicated
- Wash before and after

Types of Isolation Precautions

- Standard precautions all patients (gloves, hygiene, surgical,central line)
- Transmission-based precautions: very imp.



Contact Precautions

Gloves and Gown

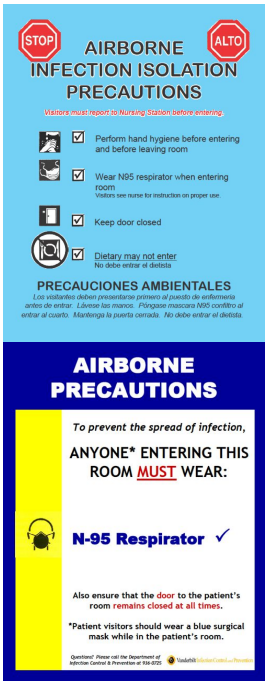
- Infections spread by direct or indirect contact with patients or patient-care environment –C. difficile, MRSA, VRE, ESBL, CRE and MDR GNR drug resistant organisms
- Limit patient movement no going out/ no roaming around
- Private/SINGLE room or cohort with patients with same infection
- Wear disposable gown and gloves when entering the patient room in the yellow bin
- Remove and discard used gown and gloves inside the patient room
- Wash hands immediately after leaving the patient room
- Use dedicated equipment if possible (e.g., stethoscope) don't use your own stuff and if used disinfect
- Don't take your ipad or notes or anything inside cause it would get contaminated

Droplet Precautions

- Reduce the risk of transmission by large particle droplets (larger than 5 μ in size). Spit/cough/sneeze
- Requires close contact between the source person and the recipient
- Droplets usually travel 3 feet or less
- E.g., influenza, MERS-CoV, other respiratory viruses, rubella, parvovirus B19, mumps, *H. influenzae*, and *N. meningitidis* *respiratory viruses*
- A private/single room or Cohort with patient with active infection with same microorganism
- Use a surgical mask when entering the room especially within 3 feet of patient
- Limit movement and transport of the patient. Use a mask on the patient if they need to be moved and follow respiratory hygiene/cough etiquette when patients leaves for ct or anything he should wear a mask

Airborne Precautions

- Tuberculosis, measles, varicella chickenpox, MERS-CoV (severe) the one in china (2019-nCoV)
- Place the patient in an airborne infection isolation room (AIIR) special type
- Negative Pressure should be monitored with visible indicator every 6 hours
- Use of respiratory protection (e.g., fit tested N95 respirator) or powered air-purifying respirator (PAPR) 2nd choice when FN95 doesn't work when entering the room
- Limit movement and transport of the patient. Use a mask on the patient if they need to be moved
- Keep patient room door closed, do not open anteroom door till other door closed for the pressure



Quiz

Q1: 36 Y/O man with indwelling urinary catheter for past 3 months after a motor vehicle accident, his nurse noticed the urine output to be a little turbid. He has no fever, no dysuria, no lower abdominal pain. His CBC and renal functions are normal, Urine culture grew more than 100,000 colonies of *E.Coli*, susceptible to all beta-lactams, fluoroquinolones and TMP-SMX.

You recommend:

A. Start ceftriaxone 1 gm IV od
B. Start ciprofloxacin 500 mg pp Q12h
C. Remove catheter
D. Remove catheter and start TMP-SMX 960 mg po q12h

Q2: 30 Y/O man underwent knee ligament tear repair 2 weeks ago; he now presents to clinic with 5 days of opening gap of surgical scar with pussy discharge. He has no fever, WBC 15, platelets 450, ESR 80, creatinine 70, culture from pus grew MRSA resistant to tetracycline TMP-SMX and clindamycin

You recommend:

A. Clindamycin 300 mg po q 8h
B. TMP-SMX 960 mg po q 12h
C. Ciprofloxacin 500mg po q 12h
D. Linezolid 600 mg po q 12h

Q3: 22 years old lady in ICU for past 6 months has tracheostomy for ventilation, she is on 2 L O2, with minimal sputum, has no fever, CXR normal, the RT send a sputum culture which grows Pseudomonas aeruginosa susceptible to ceftazidime, meropenem, ciprofloxacin

You recommend:

A. Ceftazidime
B. Meropenem
C. Moxifloxacin
D. Change tracheostomy tube

Answers:
1: C
2: D
3: D

Summary

HAIs are caused by infectious agents from:

1] Endogenous sources

Such as the skin, nose, mouth, GI tract, or vagina that are normally inhabited by microorganisms (normal flora) own body own flora

2] Exogenous sources

External to the patient such as health care workers (HCW), visitors, patient care equipment, medical devices, or the healthcare environment

Types : **A) catheter associated urinary infection**

Due 1) invasive urinary tract infection
2)urinary catheter

Organism: E.coli , klebsiella pneumonia

Risk factors: age, DM , pregnancy, severe underlying disease

It should be only as necessary

B) surgical site infection

Causes: inadequate prophylaxis ,, inappropriate antibiotic or time or dose ,, improper glucose control

Organism: staph.aureus ,, coagulase -ve staphylococcus

Risk factors : surgical duration ,, immunodeficiency

Type of wound

1) **clean**: thyroid ,,vascular ,,neck dissection ,, hernia ,, splenectomy
2) **Clean-contaminated**: bronchoscopy ,, gastric surgery ,, liver transplant,, small bowel obstruction ,, colonoscopy,, whipped procedure
3) **Contaminated** : inflamed appendicitis ,, diverticulitis ,, rectal surgery
4) **Dirty**: abscess ,, perforated bowel ,, peritonitis

Prevention: prophylaxis 30 min prior surgery & 2h for vancomycin and fluoroquinolones

Decolonies S.aureus in cardiac, neuro, orthopedic surgeries

C) central line associated bloodstream infection

At least after 48 h

Most common site femoral central line

Organism: coagulase -ve staph

Prevention: chlorhexidine on skin - ultrasound guidance
- avoid femoral - new set every 96 h

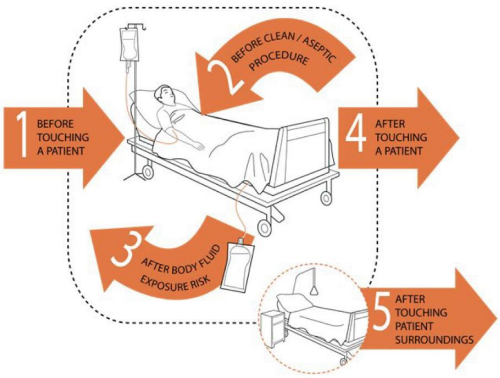
Treatment : remove of central line & antibiotic

D) ventilator associated pneumonia

Most common in ICU

Prevention through : prevent aspiration
Prevent colonization
Reduce ventilation duration

Five moment of hand hygiene :



Questions

1) A 60-year-old female patient is admitted to the hospital in septic shock secondary to a urinary tract infection. The patient is started on antibiotics awaiting culture results. She improves with complete resolution of her symptoms. The patient continues to have a urinary catheter in place. On the 10th hospital day, the patient is discharged to a rehabilitation facility. As a part of the routine admission orders, urinalysis and culture are ordered. The patient denies fever, abdominal pain, nausea, or vomiting. The urinalysis shows 5 to 10 white blood cells and a negative dipstick for nitrite and leukocyte esterase, but the culture grows more than 105 colonies of Candida albicans. Which of the following is the best course of action?

A. Start antifungal therapy with fluconazole.
B. Continue broad-spectrum antibiotics.
C. Remove the urinary catheter.
D. Encourage water intake and continue to observe.
E. Remove the urinary catheter and start liposomal amphotericin B.

2) You are called to see a 69-year-old male with acute SOB. Vital signs are: Temperature = 100.1, BP = 166/88, pulse = 130, RR = 33. You rush to see the patient and on your arrival, oxygen saturation is 79% on a 100% oxygen non rebreather face mask. The nurse informs you that his oxygen saturation was 68% on room air. He currently has heavily labored breathing and appears cyanotic. The nurse informs you that the patient was admitted 2 days ago for a severe COPD exacerbation. You decide to emergently intubate the patient. Which of the following will reduce the risk of developing pneumonia in this patient?

A. Place the patient in a supine position
B. Avoid daily attempts to wean the patient from the ventilator
C. Administer oral chlorhexidine solution twice daily
D. Administer daily omeprazole
E. Avoid any instrumentation of the airway, including endotracheal suctioning

Answer key: 1 (C) | 2 (C)