INFECTION CONTROL IN ICU

Hospital acquired infections (HAIs) are common in intensive care unit (ICU) patient and are associated with increased morbidity and mortality. The main reason being severity of illness, interruption of normal defense mechanism (e.g. mechanical ventilation), malnutrition & inability to ambulate make it more susceptible to multi drug resistant organism (MDRO). The last several years, numerous developments have been made in infection preventive strategies. Including planning & execution of infection control practices, training, monitoring & data collection, interpretation of data as well as modification in practices.

The main focus in ICU settings is on monitoring hand hygiene, update on isolation precaution, new methods on environmental cleaning, prevention of device related in infections, MDRO, Clostridum difficile infection.

The three main clinical end points for controlling infection in ICU include cant. Control high infection rate, Maintain low infection rate, Prevention of antibiotics resistance.

SOURCE OF MICROORGANISM FOR HAI’s

Source of microorganism may be exogenous (such as bacteria, fungi, virus etc)

From other patient, health care worker or visitors. Other reservoir may be endogeous flora (flora from skin, mucous membrane, GI tract or respiratory tract) or inanimate object which has become contaminated (e.g. patient bed surface, equipment or other devices or objects used in ICU)

Intrinsic risk factors include immunocompromised state, severity of illness, extremes of age, inadequate nutrition, and immobilization make ICU patient more susceptible.

Extrinsic risk factors include invasive procedure, catheters, mechanical ventilation & other therapeutic interventions in ICU.

MODES OF TRANSMISSION- The most frequent mode of transmission is-
Contact transmission, this may be direct or indirect other modes include droplet transmission, airborne transmission, common vehicle such as ventilator etc.

CONTRIBUTING FACTORS
Factors common to ICU patients that contribute to the risk of nosocomial infections include-
1. Acuity of illness
2. Response to physiological stressors
3. Age and associated comorbidity
4. Indiscriminate use of antibiotics promoting the development of antibiotics- resistant organisms.
5. Drug therapies for stress ulcer
6. Sleep deprivation
7. Protein-energy malnutrition, and understaffing.

1) ACUITY OF ILLNESS
The severity of an illness increases, energy stores needed to sustain normal body processes such as immune function become depleted, reducing the ability of the patient to resist colonization by
exogenous organisms Critically ill patient are also more susceptible to overgrowth of resistant endogenous.

2) PHYSIOLOGICAL AND PSYCHOLOGICAL STRESSORS
Physiological stressors resulting from injury and illness psychological stressors such as noise. Pain, anxiety, and isolation are a few of the many stressors encountered daily by ICU patient.

3) AGE AND COMORBIDITY
Elderly patient are less resistant to infection than their younger counterparts. The mortality from bacterial nosocomial pneumonia is live times more likely in Patient more than 65 years old. One possible explanation is the progressive atrophy of the thymus that occurs with age; also, nature defenses in the elderly are compromised. The higher prevalence of chronic illnesses among the elderly also contributes to the risk for nosocomial infections.

4) INDISCIRMINATE USE OF ANTIBIOTICS AND THE DEVELOPEMENTOF RESISTANT ORGANISMS
Broad-spectrum Antibiotics are often prescribed for critically ill patient when signs and symptoms consistent with infection are present, white blood cell counts are elevated, or invasive procedures are required. Indiscriminate use of antibiotics leads to the elimination of a greater number of normal floras, thus enabling modified and more virulent organisms to produce infection. These modified organisms have new characteristics against which standard agents are no longer effective. The National Nosocomial Infection Surveillance System reported that the percentage of nosocomial infection caused by vancomycin – resistant enterococci increased from 0.4% to 13.6% between 1989 and 1993.

5) PROPHYLAXIS FOR STRESS ULCERS
Routine administration of antacid and histamine antagonists for prevention of stress ulcers in critically ill patient may increase the risk of infection. The increase in gastric Ph produced by these agents may attenuate the bactericidal effect of an acidic pH, thus promoting gastric colonization not only by gram-negative and gram – positive bacteria but also by yeasts.

6) SLEEP DEPRIVATION
Lack of the usual quantity and quality of sleep, including loss of normal progression through sleep cycles, adds to the stress critically ill patient experience and may alter immune function.

7) MALNUTRITION
Catabolism of protein, carbohydrate, and fat stores and changes in the use of defensive mechanism by reducing the production of immune cells. Protein malnutrition has been linked with a breakdown of the intestinal mucosal lining hat allows bacteria to move through the disrupted barrier into the and bloodstream to produce infection. (Another mechanism is) bacterial movement from the bowels, bacterial translocation, the process of bacterial movement through an intact mucosal barrier.

UNDERSTAFFING

VENTILATOR ASSOCIATED PNEUMONIA
VAP is most common infection acquired in ICU. VAP as defined by CDC is a pneumonia which occurs in a patient who was intubated & mechanically ventilated at the time of onset of pneumonia or within 48 hours before onset of pneumonia. The criteria include
New or progressive infiltrates, Consolidation, cavitation pr pleural effusion on chest X ray
And
At Least one of the following -
- New onset of purulent sputum or change of character of sputum.
- Fever
- Increased or Decreased WBC counts
- Organism cultured from blood Isolation of an etiological agent from biopsy or bronchial brushing specimen.

The prevention strategy of VAP includes pharmacological & non-pharmacological intervention.

Develop VAP prevention protocol
- Awareness & Training
- Shorten the duration of intubation and invasive ventilation.
- Consider use of noninvasive ventilation.
- Avoid continues use of paralytics as far as possible.
- Ensure appropriate dosages of sedation or narcotics.
- Consider use of sedation scale to avoid over-sedation.
- Daily Interruption of sedation to assess readiness for extubation. Wean patient off invasive ventilation as soon as possible.
- Prevent unplanned extubation e.g. patient self extubation.
- Practice of standard precaution should be observed
- Perform tracheal suction properly with aseptic precaution & avoid routine saline instillation during suctioning.
- Ensure appropriate disinfection, sterilization, and maintenance of respiratory equipment
- Prevent condensate from ventilator circuits drain toward the patients.
- Prevent leakage of subglottic secretion into lower airway.
- Place the ventilated patient in semi-upright position around 45 degrees.
- Consider use of antiseptic oral rinse such as 0.12% Aq. Chlorhexidine at set interval for maintenance of oral hygiene.
- Stress ulcer prophylaxis.

HAND HYGIENE
INDICATIONS
- When hands are visibly dirty or contaminated with proteinaceous material or are visibly soiled with blood or other body fluids, wash hands with either a non-antimicrobial soap and water or an antimicrobial soap and water.
- Before having direct contact with patients.
- Decontaminate hands before inserting/ caring indwelling urinary catheters, peripheral vascular catheters, or other invasive devices that do not require a surgical procedure.
- Decontaminate hands after non-intact skin, and wound dressing if hands are not visibly soiled.
- Decontaminate hands if moving from a contaminated body site to a clean-body site during patient care.
- Decontaminate hands after removing gloves. Before eating and after using a restroom, wash hands with a soap & water.

**HAND-HYGIENE TECHNIQUE**
When decontaminating hands with an alcohol-based hand rub, apply product to palm of one hand and rub hands together, covering all surfaces of hands and finger, until hands are dry. Usually 2-3 ml of hand rub solution is required.

**OTHER ASPECTS OF HAND HYGIENE**
- Do not wear artificial fingernails or extenders in ICU
- Do not wear artificial nails
- Keep natural nail tips less than 1/4 – inch long
- Wear gloves when contact with blood or other potentially infectious materials, mucous membranes, and non- intake skin could occur.
- Remove gloves after caring for patient.
- Change gloves during patient care if moving from a contaminated body site to a clean body site.
- Healthcare worker educational and motivational programs.
- Monitor HCWs adherence with recommended hand hygiene practices.

**ADMINISTRATIVE MEASURES**
Make improved hands hygiene adherence an institutional priority and provide appropriate administrative support and financial resources. Implement a multidisciplinary program designed to improve adherence of health personnel to recommended hand hygiene practice.
As part of a multidisciplinary program to improve hand hygiene adherence, provide HCWs with a readily accessible alcohol-based hand rub product. To improve hands-hygiene adherence among personnel in ICU make an alcohol-based hand rub available at the bed side as well as in other convenient locations.

**PERFORMANCE INDICATORS**
Periodically monitor and record adherence as the number of hands – hygiene episodes performed by personnel/ number of hand – hygiene opportunities. Monitor the volume of alcohol-based hand rub per 1,000 patient days.

**URINARY TRECT INFECTION**
Urinary tract infections (UTIs) are the most common type of nosocomial infections, accounting for 40% of all infections in hospital per year. Almost 80% of these infections are due to instrumentation or catheterization.
Organisms attacking any portion of the urinary system cause urinary tract infections.
Kidneys (pyelonephritis)
Bladder (cystitis)
Prostate (prostatitis)
Urethra (urethritis)
Urine (bacteriuria)

Once bacteria infect any site, all other areas are at risk. The diagnosis of lower UTIs (cystitis and urethritis) is usually made on the basis of signs and symptoms and then confirmed by culture. Most
episodes of short-term catheter-associated bacteriuria (greater than $10^5$ organisms per mL of urine), however, are without symptoms. Most nosocomial UTIs are caused by gram-negative coli form bacteria, particularly Escherichia coli, pseudomonas species, and organisms from the enterobacter group. Collectively they account for more than 80% of culture-positive UTIs; the most common organism is E.coli.

- Female gender
- Postpartum status.
- Older age
- Severe underlying illness an
- High blood creatinine level.
- The wrong reason for catheterization,
- Contamination during insertion,
- Errors in catheter care
- Use of antibiotics.

Organisms may reach the bladder in two ways:

a) Through the inside of a catheter (i.e. the backward flow of urine)

b) By travelling up the space between the outer surface of the catheter and the urethral mucosa.

Therefore, once the catheter is inserted, any back-and-forth movement of the catheter (e.g. raising the collection bag above the level of the bladder), or allowing urine to be collected in an open drainage system (bag or container) should be avoided because each of these activities potentially enables organism to enter the bladder. The first way (backward flow of urine in the catheter) is the more common infection is men. The second (Organisms migrating into the bladder along the outside of the catheter) is more common in women in part because of their shorter urethra. Placement of an indwelling catheter should be performed only when other methods of emptying the bladder are not effective, and it is particularly important to limit the duration.

PREVENTING INFECTIONS IN CATHETERIZED PATIENTS

- Remove the catheter as soon as possible.
- The Catheter collection systems should remain closed unless absolutely necessary for diagnosis or therapeutic reasons.
- Caution the patient against pulling on the catheter. Urine flow through the catheter should be checked regularly to ensure that the catheter is not blocked.
- Avoid raising the collection bag above the level of the patient’s bladder. If it becomes necessary to raise the bag above the level of the patient’s bladder during transfer of the patient to a bed or stretcher, clamp the tubing.
- Before the patient stand up, drain all urine from the tubing into the bag. The urine drainage (collection) bags should be emptied aseptically, touching the tip of the emptying tube to the side of the collection bag or permitting the tip to touch the urine in the vessel should be avoided.
- Replace bags with new or clean containers when needed.
- If the drainage tubing becomes disconnected, do not touch the ends of the catheter or tubing. Wipe the ends of the catheter and tubing with an antiseptic solution before reconnecting them.
- Wash the head of the penis and urethral opening (men) or the tissue around the urethral opening (women) after a bowel movement or if the patient is incontinent.
- Avoid irrigation, if frequent irrigation is required, the catheter should be changed.
INTRAVASCULAR CATHETER RELATED INFECTION
Intravascular catheters are integral part of modern ICU care. Infectious complications include local site infection, catheter related blood stream infection (CRBSI), septic thrombophlebitis, endocarditis & other common pathogens leading to CRBSI are coagulase nestive staphylococci, Staphylicoccus Aureus, enterococci, candida etc. Recently there is increasing percentage of Enterobacteriaceae isolates from ICU’s producing ESBL, particularly Klebsiella pneumonia. Such organisms are resistant to cephalosporins & other antibiotics. 1. The material of which device is made; (Teflon, silicon & polyurethane is superior) 2. Intrinsic virulence of an infective organism.

PREVENTIVE STRATEGY
Site: Subclavian vein is preferred site for central venous cannulation. The other sites in descending order of preference are Jugular & Femoral.
Material: Catheter made up of Teflon or polyurethane has lesser infection incidence in comparison to PVC or polyethylene.

Strict aseptic precaution while cannulation

Transparent dressing: secures the dressing and allow quick inspection of catheter site & less frequent changes in comparison to standard gauze dressing.

Use of anticoagulant may have some role by preventing the deposition of fibrin & thrombi and thus preventing bacterial colonization.

Daily inspection & changing CVC if signs of local infections appear.

SURGICAL SITE INFECTION (SSI)
Either an incisional or organ/space infection occurring within 30 days after operation or within 1 year if an implant is present, incisional SSIs are further divided into
a) Superficial incisional( only involves skin and subcutaneous tissue)
b) Deep incisional (involves deeper soft tissue, including fascia and muscle layers.) most SSIs, the source of the pathogen(s) comes from the patient skin mucous membranes or bowel and rarely from another infected site in the body (endogenous sources) while exogenous sources. of SSI pathogens are occasionally responsible. e.g. Contaminated surface or instrument, or from member of surgical team. Antibiotics prophylaxis should be given to the patient undergoing surgery. The dose of the antibiotics must be administered within 60 minute prior to incision, to achieve adequate concentration at surgical site.

References
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Key Words
HAI-Hospital acquired infection
ICU–Intensive Care Unit
UTI-Urinary tract infection
MDRO-Multidrug Resistant Organisms
SSI-Surgical Site infection.

Abstract
Hospital acquired infections (HAIs) are common in intensive care unit (ICU) patient and are associated with increased morbidity and mortality. The main reason being severity of illness, interruption of normal defense mechanism (e.g. mechanical ventilation), malnutrition & inability to ambulate make it more susceptible to multi drug resistant organism (MDRO). UTI is the most common type of nosocomial infection accounting for 40% of all infections in hospital /year followed by intravasculatcatheters, Ventilator associated pneumonia and surgical site infections. Last few years have revealed numerous strategies for infection control such as monitoring hand hygiene, update on isolation prevention, new methods on environmental cleaning, prevention of device related infections, prevention of multidrug resistant and Clostridial difficile infection and have also developed VAP prevention protocol.