

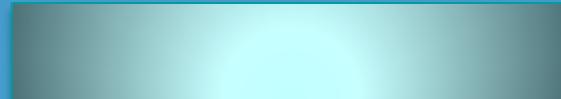


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# VAP Leading Cause Of Mortality in ICU



# Overview

- **Describe what is Ventilator Associated Pneumonia (VAP)**
- **Describe the epidemiology of Ventilator Associated Pneumonia (VAP)**
- **Describe the physiopathology of VAP**
- **Identify risk factors and intervention strategy for VAP**

# VAP



## WHY IT IS IMPORTANT?

- \*VAP..... 25% of all HAI infections in ICU.
- \*VAP..... 10 -25% of all mechanical ventilated patients.
- \*VAP ..... 20-50% morbidity and mortality.
- \*VAP..... is a preventable disease.

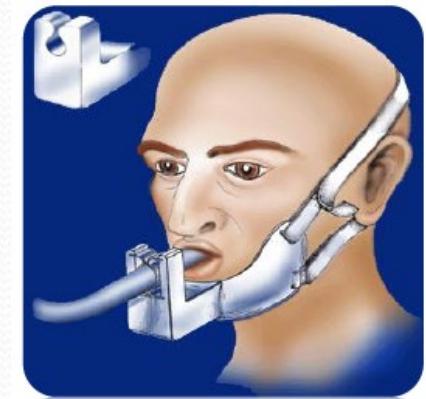
# Definition:

- Clinically defined pneumonia.
- It is associated with ventilation (by endotracheal or tracheostomy).
- Pneumonia occurs 48hrs or more after being placed on ventilator.
- Pneumonia occurs 48hrs after extubation.

# What is a Ventilator-Associated Pneumonia (VAP)?

- Ventilator Associated Pneumonia (VAP) is pneumonia occurring in a patient within 48 hours or more after intubation with an endotracheal tube or tracheostomy tube and which was not present before. It is the most common and fatal infection of ICU

**Use CDC Criteria for Identification**



# Epidemiology of Ventilator Associated Pneumonia (VAP)

## Pneumonia

- Second most common healthcare acquired infection in critically ill patients
- Affects 27% of all critically ill patients in US
- 86% of healthcare acquired pneumonias are associated with mechanical ventilator

# Epidemiology of Ventilator Associated Pneumonia (VAP)

- Incidence of VAP increases with the duration of mechanical ventilator
- 10% - 20% of patients undergoing ventilation developed VAP
- Estimated rates based on usage
  - 3% per day for the first 5 days
  - 2% per day for days 6-10
  - 1% per day after day 10

# Clinically Defined Pneumonia Diagnosis:

**Two or more serial x-ray with at least one of the following:**

- New or progressive and persistent infiltrate.
- Consolidation .
- Cavitation.

**At least one of the following:**

- Fever (>38 with no other recognized cause).
- Leucopenia (<4,000 WBC/mm<sup>3</sup>) or
- Leukocytosis(>12,000WBC/mm<sup>3</sup>).
- For adults > 70y altered mental status with no other recognized cause.

# Clinically Defined Pneumonia Diagnosis (cont.)

*And at least two of the following:*

- New onset of purulent ,or change in character of sputum or increased respiratory secretion.
- New onset of cough , dyspnea ,tachypnea.
- Rales or bronchial breath sounds.
- Worsening gas exchange ,increased oxygen requirements, or increased ventilator demand.

*(the National Healthcare Safety Network)*

# Risk Factors of VAP:

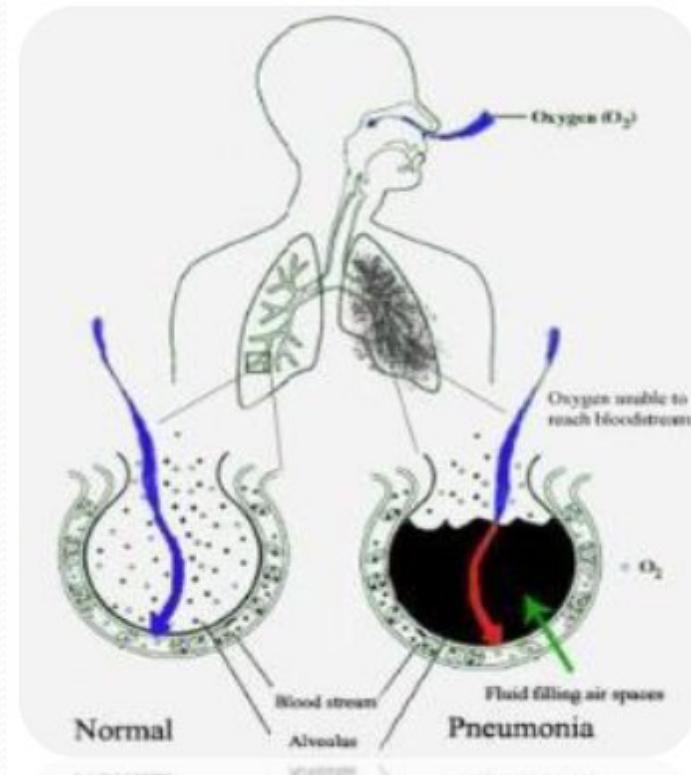
- \* Length stay in ICU.
- \* Presence of multiple central venous catheter.
- \* Prophylactic antimicrobial therapy.
- \* Depressed consciousness, Glasgow coma scale score of less than 9/15.
- \* Massive gastric aspiration.
- \* Enteral nutrition.
- \* Reintubation after weaning.
- \* Transfer from another hospital ward .
- \* Tracheostomy . \* Steroid therapy.

# The Most Frequent Isolated Microorganism :

- \* *Staphylococcus aureus* (MSSA or MRSA).
- \* *Streptococcus pneumonia*.
- \* *Hemophilus influenza*.
- \* *Pseudomonas aeruginosa*.
- \* *Acinetobacter*.
- \* *Enterobacter*.

# Pathophysiology of Pneumonia

- Colonization
- Bacteria invasion of lower respiratory tract
- Host immune response overwhelmed



# **Pathophysiology of Pneumonia**

- Oropharyngeal or tracheobronchial colonization begins with the adherence of the microorganisms to the host's epithelial cells.

## **Adherence affected by**

- Type of bacteria
- Host cell
- Environmental (e.g., pH and presence of mucin in respiratory secretions)

# Pathophysiology of Pneumonia

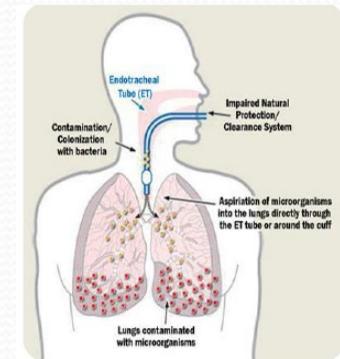
- Host substances (e.g., Fibronectin) can inhibit the adherence of Gram negative bacilli to host cells
- Conditions can increase adherence of gram-negative bacteria
  - malnutrition
  - severe illness
  - post-operative state
  - **Endotracheal intubation**

# **Pathophysiology of Pneumonia**

- When gastric pH increases to >4, microorganisms are able to multiply to high concentrations in the stomach
  - Advanced age
  - Low or absent production of gastric acid
  - Ileus
  - Upper gastrointestinal disease
  - Patients receiving enteral feeding, antacids, or histamine-2 (H-2) antagonists
  - Pathophysiology of Pneumonia

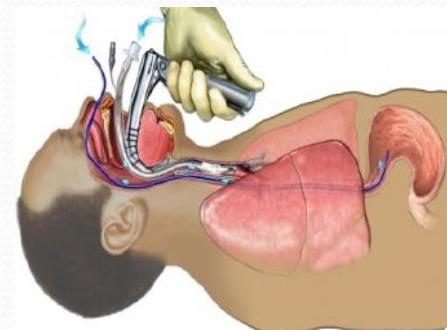
# Pathophysiology of Pneumonia

- Bacteria invade the lower respiratory tract by
  - Micro- or bolus-aspiration of oropharyngeal or stomach organisms
  - Inhalation of aerosols containing bacteria
  - Less frequently, by hematogenous spread from a distant body site
- Micro-aspiration is the most important factor for both healthcare associated and community-acquired pneumonia
- 45% of healthy adults were found to aspirate during sleep



# Interventions of VAP

- Core recommendations are designed to interrupt the 3 most common mechanisms by which VAP develops:
  - Aspiration
  - Colonization
  - Use of contaminated equipment



# **Interventions of VAP**

## **General Recommendations:**

- **Conduct active surveillance for VAP**
- **Adherence to hand-hygiene guidelines (WHO)**
- **Use noninvasive ventilation whenever possible**
- **Minimize the duration of ventilation**
- **Perform daily assessments of readiness to wean and use weaning protocols**
- **Educate healthcare personnel who care for patients underlying ventilation about VAP**

# Bundles Methodology

- \* Bundles are group of intervention related to a disease that when institutes together give better outcomes than when done individually.
- \* Provide a mechanism to enhance teamwork and enhance outcome.
- \* The guideline become as road map to enhance outcome.

# **IPC.39 The hospital implements evidence-based interventions to prevent ventilator-associated pneumonia.**

**IPC.39.1** The hospital adopts and implements care bundle for prevention of ventilator-associated pneumonia (VAP) consistent with recognized professional practices

**IPC.39.2** Data on the care bundle for prevention of ventilator-associated pneumonia are regularly collected, analyzed, and evaluated. Improvement interventions are taken accordingly.

# VAP Bundle

- \*Elevation of the bed between 30-45 degree at all time (unless contraindicated).
- \*Deep venous thrombosis (DVT) prophylaxis (unless contraindicated).
- \*Peptic ulcer disease (PUD) prophylaxis.
- \*Sedation interruption.
- \*Mechanical ventilation weaning protocol.
- \*Oral care.

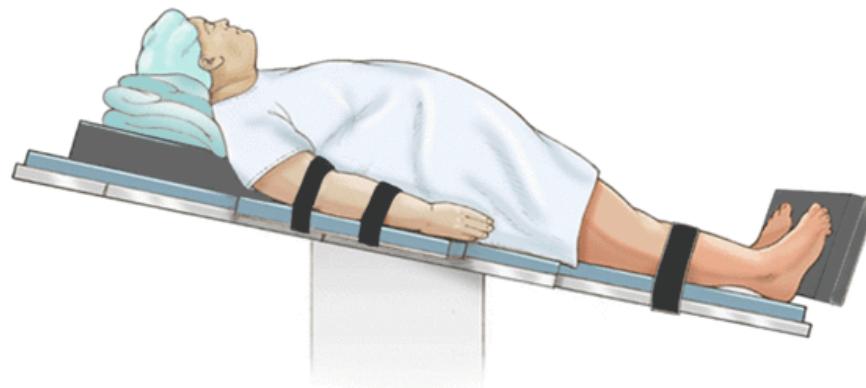
*(Chlebicki, Crit Care Med, 2007)*

# Elevation of The Head of Bed (HOB):

- \* Please remember to elevate the HOB>30 degree , and raise knees for all ventilated patients unless contraindicated .
- \*Elevation of HOB has been correlated with reduction in the rate of the ventilator associated pneumonia.

*(Drakulovic Lancet, 1999)*

- Alternative for patients with problems in the cervical spine. Reverse trendelenburg position.



## 2. Daily Sedation Vacation to assess for daily Weaning

- Implement a protocol to lighten sedation daily at an appropriate time to assess for neurological readiness to extubate. – Include precautions to prevent self-extubation such as increased monitoring and vigilance during the trial.
- Include a sedation vacation strategy in your overall plan to wean the patient from the ventilator – if you have a weaning protocol, add "sedation vacation" to that strategy.

### 3. Ventilator Weaning or Extubation Protocol

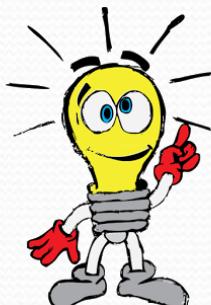
- The term "weaning" is used to describe the gradual process of decreasing ventilator support. It is estimated that 40% of the duration of mechanical ventilation is dedicated to the process of weaning.

# WEANING PREDICTORS

1. Heart rate variability
2. Sleep quality
3. Hand grip strength
4. Diaphragmatic dysfunction

## 4. Mouth Care

Frequency of care should be based on the condition of the oral cavity and the patient's level of comfort. Unconscious or intubated patients are provided oral care as often as every 1 to 2 hours.



Lack of effective oral hygiene, dental plaque deposits develop on the teeth within 72 h which could be reservoirs for potential respiratory pathogens.

## 5. Prophylaxis for DVT

- Venous thromboembolism (VTE), including deep vein thrombosis (DVT) and pulmonary embolism (PE), are frequent complications encountered in critically ill patients admitted to an intensive care unit (ICU) leading to increased rates of morbidity and mortality within this patient population.

# 6. Prophylaxis for Stress Ulcer

- Decreasing pH of gastric contents may protect against a greater pulmonary inflammatory response to aspiration of gastrointestinal contents. The effects of aspirating acidic contents may be worse than those with a higher pH.
- Reduce volume of gastric juice
- Randomized trials of prophylaxis against stress ulcers, as compared with no prophylaxis, indicate that H<sub>2</sub>-receptor antagonists prevent clinically important gastrointestinal bleeding.
- Respiratory failure and coagulopathy are the strongest risk factors for clinically important gastrointestinal bleeding

Patient Name: \_\_\_\_\_

Medical #: \_\_\_\_\_

Admission date: \_\_\_\_\_

Date from: \_\_\_\_\_ to \_\_\_\_\_

Day Bundle Elements												
	AM	PM										
HOB elevation>30° C												
Sedative Holiday												
Assess ready to extubate												
Oral Care												
Suctioning												
PUD Prophylaxis												
DVT Prophylaxis												

<sup>1</sup> VAP: Ventilator Associated Pneumonia

<sup>2</sup> HOB: Head of Bed

<sup>3</sup> PUD: Peptic Ulcer Disease

<sup>4</sup> DVT: Deep Vein Thrombosis

## PICU VAP BUNDLE CHECKLIST (INDIVIDUAL CHECKLIST)

Patients Name: \_\_\_\_\_

Age: \_\_\_\_\_

Medical File #: \_\_\_\_\_

Weight: \_\_\_\_\_

Admission date: \_\_\_\_\_

Date From: \_\_\_\_\_

to \_\_\_\_\_

Bundle Elements	Day												
<b>Head of Bed Elevation;</b> if more than 5 years old, must be 10-15° angle using a pillow(depending on baby's weight)													
<b>Assess Ready to extubate</b> (please refer to Mechanical Ventilation weaning protocol)													
<b>Oral Care</b> will be done every 3 to 4 hours using sterile water and gauze to wipe lips and gums. All oral care products were changed to single use products.													
<b>Suctioning</b> using aseptic technique													
Ventilators circuits and oxygen therapy equipment were changed on an as needed basis for mechanical malfunctioning or when visibly soiled, rather than routinely, to reduce frequency of breaks in the system.													
CPAP systems were allowed to remain on stand-by for no longer than 12 hours with flow and heater remaining on.													
Ambubag to be prepared and stored in a zipped container labeled with date and signature. Resuscitation bags were replaced once per week.													
<i>Checked by:</i>													

VAP: Ventilator Associated Pneumonia

# The Pathogenesis of VAP:

- 1) Bacterial colonization of the stomach and oropharynx
- 2) Subsequent pulmonary aspiration of contaminated secretion

- The mechanically ventilated patients are prone to gastric bacterial colonization due to the widespread use of histamine(h<sub>2</sub>) blockers and proton pump inhibitors .....to prevent gastric ulcer.  
nasogastric and nasoenteric feeding tube which decrease competance of the lower oesphogeal sphincter....aspiration.

# Other Consideration:

- \* Proper hand washing technique.
- \* Proper care of respiratory care equipment.
- \* Proper care of all ICU equipment (monitor, lines, syringes, pumps, ect....).

# Non Invasive Ventilation (NIV):

- \* To reduce need and duration of intubation and mechanical ventilation.
- \* Many studies show a decrease in pneumonia and mortality in NIV group patients compared to invasive mechanical ventilation (Girou et al,2000).
- \* Patients population in whom NIV has been effective are:-  
COPD, pulmonary edema, hypoxemic respiratory failure.





# **Patients in whom NIV is effective are :**

**1-Acute respiratory failure**

- ~acute exacerbation of COPD.
- ~acute respiratory distress syndrome ARDS
- ~pneumonia.

**2- Acute heart failure.....decrease preload and afterload  
.....beneficial on cardiac output and blood pressure in  
addition to improved ventilation.**

**3-Weaning from mechanical ventilation.**

# **Contra- indication to NIV:**

- ~respiratory arrest
- ~inability to use mask because of trauma or surgery.
- ~excessive secretion
- ~hemodynamic instability
- ~impaired mental status



Is This Patient has  
VAP or Not?

**Decisions based on  
clinical criteria  
resulted in inappropriate  
treatment of many patients  
without pneumonia.**

*(Fagon et al., Chest 1993).*

# Diagnosis of VAP:

VAP has been diagnosed by clinical criteria.  
These are non specific:

- \* **Fever**..... drug reaction, extrapulmonary infection, blood transfusion .
- \* **Pulmonary infiltrates**..... Pulmonary haemorrhage, chemical aspiration, pleural effusion, congestive heart failure, tumor .
- \* **Fever and pulmonary infiltrates**..... fibroproliferation of late acute respiratory distress syndrome, atelectasis, pulmonary embolism.

# **Specific Standard Criteria for Diagnosis of VAP**

Culture of tracheal aspirates are not very useful in establishing the VAP, although such cultures are highly sensitive, their specificity is low even when they are cultured quantitatively.

# **Specific Standard Criteria for Diagnosis of VAP (cont.)**

- \* Histopathologic examination of lung tissue.....lung biopsy.
- \* positive pleural fluid culture.
- \* lung autopsy.

# Bronchoscopic Diagnostic Technique:

Two Bronchoscopic techniques are used:

- 1-Protected specimen brush(PSB)
- 2-Bronchoalveolar lavage examination (BAL).

*Both techniques are effective in diagnosis of VAP as the standard specific criteria*

# AN EXAMPLE SETUP FOR OBTAINING BRONCHOALVEOLAR



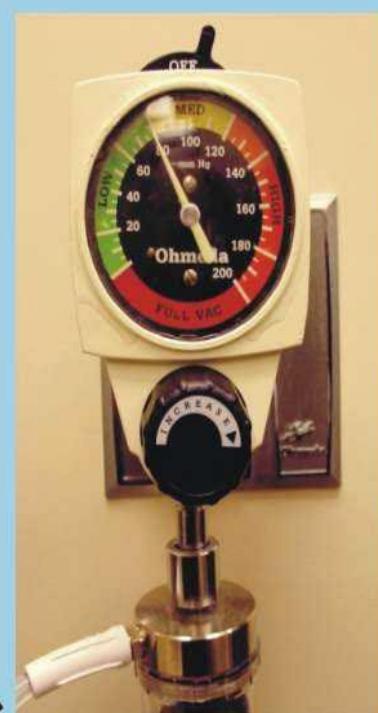
The bronchoscope is wedged at the desired location for the BAL. Tubing is connected at the instrument channel which is ...



... attached to a syringe containing the saline through a three-way stopcock. The saline is instilled into the bronchoalveolar space from here. The third port of the stopcock is ...



... attached to the trap that will collect the BAL effluent. The effluent is collected when the stopcock is turned off to the syringe which causes suction through the trap ...



... from the suction unit. The typical pressure used during BAL is  $-80 \text{ cm-H}_2\text{O}$ . Lower pressures may be used if complete collapse of the bronchus occurs preventing collection of the lavage sample.



# VAP Indicator

- **I. Ventilator Associated Pneumonia (VAP)**
- **Definition :**
- Ventilator-associated pneumonia (VAP): A pneumonia where the patient is on mechanical ventilation for >2 calendar days on the date of event, with day of ventilator placement being Day 1, AND the ventilator was in place on the date of event or the day before.
- **Formula :**

$$\frac{\text{VAP}}{\text{# of Ventilator Days}} \times 1000$$

**Target Value and Internal Benchmark for 2017:**

**Target Value: Zero if possible for 3 consecutive months**

**Internal Benchmark: 8.0 per 1,000 ventilator days**

# Efficiency results

- Average length of stay of VAP patients is:
  - 10.6 Days  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2765432/>
- Average cost of VAP patient in ICU per day:
  - 5250 SR
- Hard savings :
  - 55,650 SR /patients

# Summary

- \*VAP is an important cause of death in ICU.
- \*It is a preventable disease.
- \*VAP bundle may prevent the disease and enhance the outcome .
- \*In the past the specific diagnosis of VAP was difficult and need invasive procedures. (Lung biopsy).

# Summary

- \* Bronchoscopy .....specific and sensitive diagnosis.
- \* Antibiotics..... Empiric initial therapy Should be started immediately then tailored according to culture and gram stains.

Thank You

# SSI Prevention



Presented by Dr. Magda

# Surgical Site Infection (SSI) Burden

- An estimated 16 million operative procedures were performed in the US in 2014
- SSI's are the most common HAIs
  - Accounts for over 31% of all HAIs in hospitalized patients in the US

# Surgical Site Infection (SSI) Classified as:

## Superficial Incisional SSI

- **Involves only skin and subcutaneous tissue of the incision**

## Deep Incisional SSI

- **Involves deep soft tissues (e.g., fascial and muscle layers) of the incision**

## Organ/Spa ce SSI

- **Involves any part of the body, excluding the skin incision, fascia, or muscle layers, that is opened or manipulated during the operative procedure**

# WOUND CLASSIFICATION

## Class: I - CLEAN

- An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered.

## Class: II – CLEAN- CONTAMINATED

- Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination.

## Class: III - CONTAMINATED

- Open, fresh, accidental wounds. Operations with major breaks in sterile technique (e.g., open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non purulent inflammation is encountered are included in this category

## Class: IV – DIRTY OR INFECTED

Includes old traumatic wounds with retained devitalized tissue and those that involve existing clinical infection or perforated viscera.

# Infection Prevention and Control: Goals of Care

Preoperative Phase

Intra-operative Phase

Post-operative Phase

# Clinical Care Protocols and Best Practices to Prevent SSIs During Preoperative Care

- ***Preoperative showers or scrubs***
- **Preoperative hair removal**
- **Preoperative antibiotic prophylaxis**



# Preoperative Showers or Scrubs

- Purpose: reduce microbial counts -> lower SSI risk
- Studies:
  - CHG superior in reducing skin microorganisms
  - Preoperative disinfection showers with chlorhexidine gluconate (CHG) are microbiologically effective
  - May be effective in reducing SSI 20 studies (9,520 patients)
  - 8 of 10 studies showed sharply reduced skin flora
  - Variation in methodology: application frequency, times, rinsing, etc



# Preoperative hair removal

- **Do not remove hair unless it will interfere with surgical procedure**
- **If removal necessary use clippers**
- **Maintain skin integrity**
- **Remove hair as close to the time of surgery as possible**



# Preoperative antibiotic prophylaxis

- Antibiotics present in the tissue at the time of the incision and for a specified period of time after surgery support existing host defenses in killing microorganisms present in the wound
- Give initial dose of the IV antibiotic to provide a bactericidal level of drug in the serum and tissues when incision is made (within 60 minutes prior to the incision)
- Discontinue antibiotics within 24 hours after surgery except for cardiothoracic procedures in adult patients



# Intra-operative Infection Prevention and Control: Goals of Care

- **Minimize exposures to microorganisms**
- **Neutralize or impair the pathogenicity of microorganisms**
- **Provide an optimal environment for repair/healing**
- **Maximize host resistance**



# Minimize exposures to microorganisms

- Traffic Flow

- OT Traffic Zones

Unrestricted zones Semirestricted zones

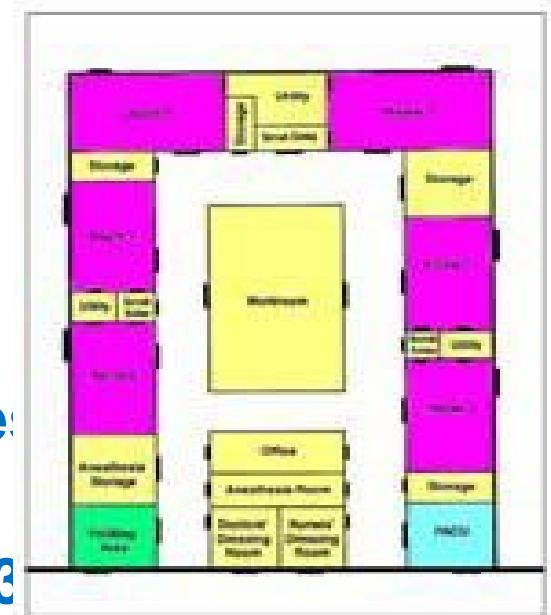
- OT Environmental Controls

- Limit number of personnel in OT

- Maintain closed doors except for necessary staff, supplies

- Temperature 20°C to 23°C (68°F and 73°F), humidity levels, at positive pressure to adjacent areas.

OT air have a minimum of 15 changes filtered air/hour



# Neutralize or impair the pathogenicity of *microorganisms*

- The prevention of SSI's encompasses:
  - Meticulous operative technique
  - Timely administration of appropriate preoperative antibiotics
  - Variety of preventive measure guidelines that aims to neutralize the threat of bacterial, viral, and fungal contamination posed by operative staff, the operating room environment, and the patient's endogenous skin flora.

Provide an optimal  
microenvironment for tissue  
*repair/healing*

## Surgical Safety Checklist

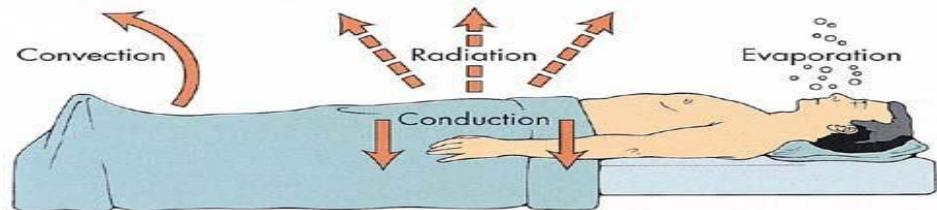
- Checklist monitors adherence to recommended processes
- “Safety first” system in which all team members are encouraged to speak up

## Key Elements for Patient Safety

- Marking, preparing the surgical site
- Handling tissues to minimize trauma
- Maintaining hemostasis to reduce blood in the wound
- Removing necrotic tissue
- Using drains when indicated to remove fluids that can serve as a site for microorganisms

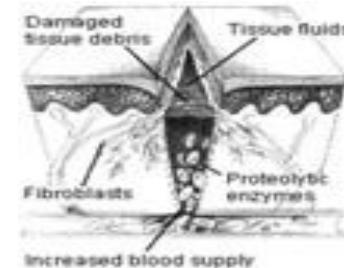
# Maximize Host Defenses

- **Controlling Glucose**
  - Hyperglycemia during perioperative time associated with increased rate of infections, mortality
- **Prophylactic Antibiotics**
  - Prophylactic antibiotic is received within 1 hour prior to surgical incision & discontinued within 24 hours after the conclusion of surgery
- **Hypothermia**
  - Associated with an increased risk of SSIs in colon surgery.
  - Increases duration of hospital stay even in uninfected patients.

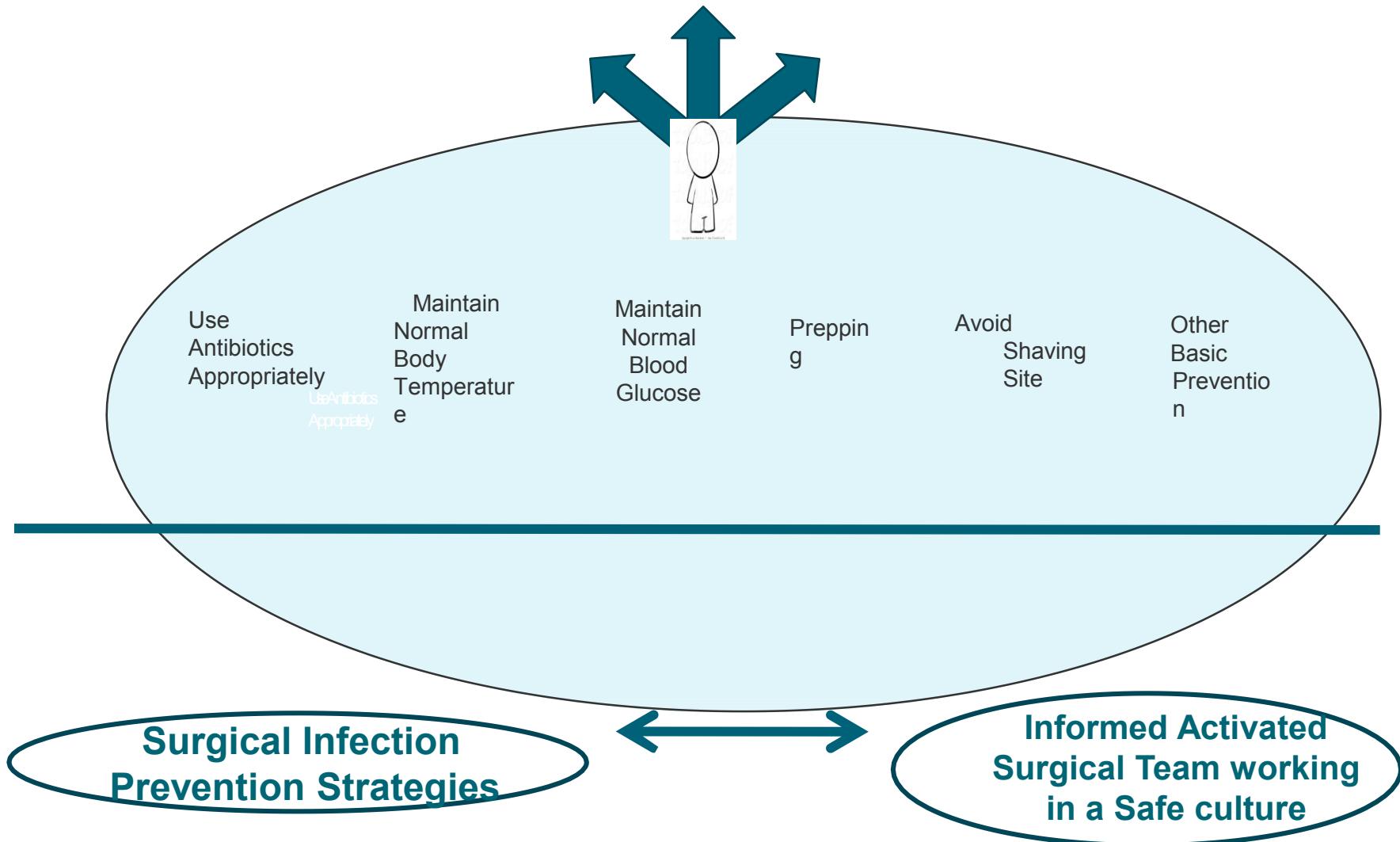


# Post-operative Infection Prevention and Control: Goals of Care

- Ensure safe healing of the surgical wound
- Prevent infection ,wound dressing using aseptic technique
- Provide education to patient and family in infection prevention methods



# Surgical Site Infection (SSI) Care Bundle



**KEY STRATEGIES FOR IMPLEMENTATION**

# Standard Operating Procedure

Surgical Site Infection Prevention Bundle –Standard Operating Procedure	
<b>Statement</b>	Surgical site infections arise when the host's defences are overwhelmed by micro-organisms that come from the patient, disseminated from staff in the operating theatre or from inadequately decontaminated instruments. Procedures undertaken in the ward pre and post operatively, and in the theatre peri-operatively must be designed to negate, or minimise as far as is possible, the risk of surgical site infection.
<b>Objectives</b>	<b>Objectives:</b> 1.To optimise peri-operative care minimising the risk of surgical site infections. 2.To be able to demonstrate quality peri-operative care in <b>OUR</b> clinical area
<b>Requirements</b>	<b>Before the SSI prevention bundle is performed.</b> Signed commitment from the clinical team: consultants; junior doctors, ward manager and nurse team to optimising SSI prevention care. The data required for this bundle should be collected and documented on every patient. Analysis of compliance can be through the analysis of data (if there is ongoing surveillance), or via a weekly analysis of a selection of patients' peri-operative records
<b>Procedure</b>	For weekly analysis review of notes 1.Perform hand hygiene. 2.On each ward select notes from 7 patients who underwent operations. 3.Check to see if the appropriate bundle criteria were recorded in the patients' notes. 4.Record findings on the SSI bundle prevention data collection sheet.
<b>After care</b>	Complete form. Give it to: Discuss and display the data when it has been returned.(Keep bundle forms for xx time).

# Bundle Checklist

SSI Prevention  
IPC.40

**The hospital implements evidence-based interventions to prevent surgical site infection.**

# IPC.4

## ***The hospital implements evidence-based interventions to prevent surgical site infection***

To optimize peri-operative, intra-operative and post-operative care, the risk of surgical site infections (SSI) should be reduced to the minimum. To be able to verify patient safety and demonstrate quality of operative care among surgical patients, the hospital should have a policy for SSI prevention & care bundle, the concerned hospital staff must be fully educated by the elements of adopted care bundle. The hospital should regularly collect and analyze the data and assess bundle compliance rate for performance improvement.

# IPC.4

## Relevant sub-standards

IPC.40.1	<p><b>The hospital adopts and implements care bundle for prevention of surgical site infection consistent with recognized professional practices.</b></p>
IPC.40.2	<p><b>Data on the care bundle for prevention of surgical site infection are regularly collected, analyzed, and evaluated. Improvement interventions are taken accordingly</b></p>

Thank you