

# **Transmission**

**Infectious Disease Epidemiology**



# **Mode of Transmission**

## **Classification by portal of entry**

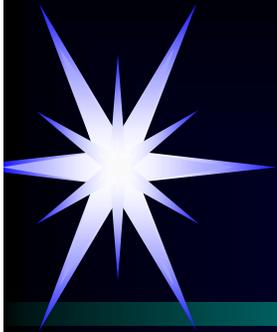
- **Respiratory**
- **Gastrointestinal**
- **Skin**
- **Genital**
- **Intrauterine or transplacental**
- **Urinary**
- **Personal contact**
- **Water and food**
- **Arthropod borne**



# Transmission: Source of Infectious Material

Blood, internal fluids and genital fluids do contain blood borne pathogens (HIV, HBV, HCV, CMV)

- **Blood:** splashed on medical employee...
- **Internal Body fluids** (cerebrospinal, pericardial, pleural, peritoneal, synovial, amniotic): medical setting.
- **Genital fluids** (vaginal, prostatic secretions, semen): sexual contact  
HBV, HSV to the newborn occurs during delivery.
- **Transplacental transfer** of blood: syphilis.
- **Secretions:** saliva, nasal discharge, sweat, tear, breast milk
- **Excretions:** urine (schistosomiasis, leptospirosis), feces (numerous enteropathogens)
- **Mucosal membranes** (nasal, oropharyngeal, rectal, genital): sexual contact, delivery
- **Skin,** squames
- **Tissue:** Transplant, grafts, blood transfusion, blood components
- **Bites**



# Gastro Intestinal / Fecal Oral Route (Contact)

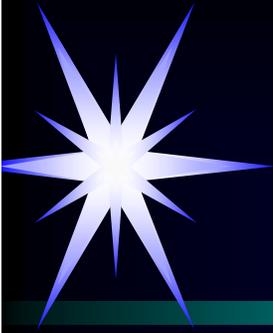
**Transmission by the fecal-oral route is the second most important mode of transmission after the respiratory tract**

- **excreted by the feces**
- **transmitted to the oral portal of entry through**
  - **contaminated food,**
  - **contaminated water, milk, drinks**
  - **hands**
  - **flies**
- **Site of entry:**
  - **oropharynx for some microorganisms**
  - **intestinal tract for most viruses.**
- **Surviving through the upper GI tract is essential.**

**Viruses with envelopes do not survive exposure to hydrochloric acid in the stomach, bile acids in the duodenum, salts and enzymes of the gut.**

**Small enterovirus without envelope (Norovirus, rotavirus, polio & coxsackie) able to resist.**

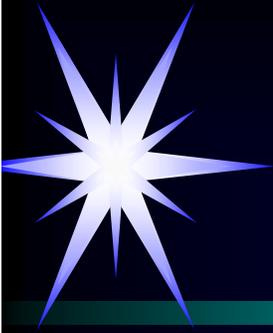
**Hepatitis A and E also transmitted by fecal oral route.**



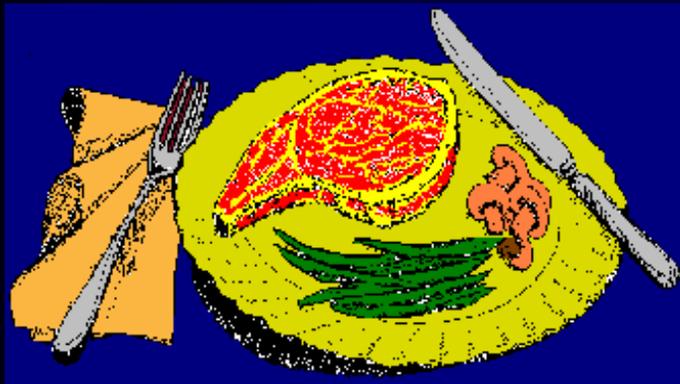
## Transmission by gastrointestinal route Fecal oral route

- Typhoid fever
- Shigella
- Cholera
- Polio
- Coxsackie, Echo, Reo
- Norwalk agent
- Rotavirus
- Hepatitis A, Hepatitis E





## **Gastro intestinal transmission / Animal Host and Contaminated food product**



### **Infections transmitted**

- **Salmonella**
- **Campylobacter**
- **Yersinia**
- **Listeria**

**Salmonellas infect a wide variety of domestic animals, birds and other wildlife.**

**Food derived from salmonella infected animal (eggs, dairy product, meat) are the major source of infection if improperly prepared.**

**Salmonella is less often transmitted by water or direct contact.**



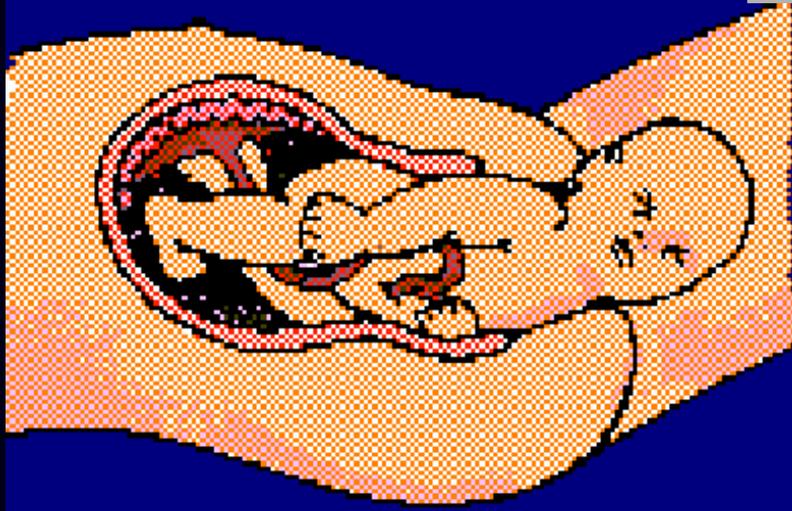
## **Sexual transmission (mucous membrane transmission)**

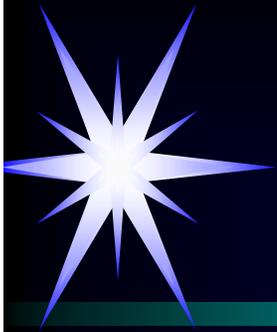
- **Neisseria gonorrhoeae, Chlamydia trachomatis**
- **Treponema pallidum**
- **Hemophilus ducreyi**
- **Mycoplasma hominis, Ureaplasma urealyticum**
- **Calymnatobacterium granulomatis**
- **± Shigella spp, Campylobacter spp**
- **± Group B streptococci**
- **± Bacterial vaginosis associated bacteria**
- **HSV Herpes simplex virus 1 and 2**
- **CMV Cyto megalovirus or herpes virus 5**
- **Hepatitis B virus**
- **Human papilloma virus**
- **Molluscum contagiosum virus**
- **HIV Human immunodeficiency virus 1 and 2**
- **Trichomonas vaginalis**
- **± Entamoeba histolytica, Giardia lamblia**
- **Phthirus pubis**
- **Sarcoptes scabiei**

# Perinatal transmission (mucous membrane transmission)

Infections occur when the newborn goes through the birth canal, from the cervix or vagina to the newborn.

- **Neisseria gonorrhoeae**
- **Chlamydia trachomatis**
- **HBV**
- **HSV**





# Transplacental transmission or vertical transmission

## Microorganisms

present in the blood of the  
mother

go through the placenta to  
infect the fetus.

**In some cases it is difficult  
to differentiate between  
perinatal or transplacental  
transmission, since both  
modes of transmission are  
known to occur.**

- Syphilis
- Toxoplasma
- CMV, HBV
- HIV
- HSV
- Rubella, Varicella



## **Sexual transmission (mucous membrane transmission)**

- **Bacteria and viruses present in the genital fluids and on the mucosal membranes.**
- **Transmitted to the mucosal membranes of the partner during sexual acts: membranes involved**
  - **vagina,**
  - **penis,**
  - **anus and rectum**
  - **oropharynx.**

# Arthropod borne transmission

may transmit infections by two mechanisms:

- **Passive transmission:**

- the insect acts as a live syringe
- no incubation time,
- no multiplication while carried by the arthropod
- not specific, wide variety of microorganisms
- not very inefficient.

- **Active transmission:**

- multiplication of microorganisms in arthropod
- may be very effective: multiplied 1000 to million
- requires a period of multiplication in the arthropod
- very specific: some microorganisms & arthropods

Mosquitoes,  
flies, fleas,  
true bugs,  
ticks, lice



# Food Poisoning

**Food poisoning overlaps both classes of gastrointestinal transmission.**

- **food from infected animal & improperly prepared: eggs, chicken with Salmonella, listeria in unpasteurized milk**
- **food contaminated in environment: Vibrio vulnificus or Vibrio cholerae in raw oysters,**
- **food contaminated during preparation from an infected food item: potato salad contaminated by Salmonella from raw chicken**
- **food contaminated by human source: typhoid fever carrier.**





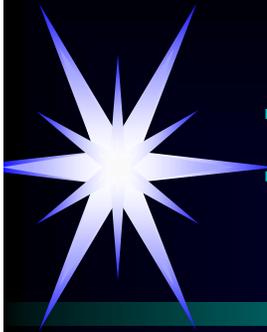
# **Skin or mucous membrane transmission**

**Transmission through the skin is the third most common mode of transmission of infection. Penetration through the intact skin is unlikely.**

**Break in the skin barrier may result from:**

- **Needle injection, cut during a surgical procedure, accidental cut, crushing injury...**
- **Bite: rabies**
- **Arthropod bite for vector borne infections: malaria, filariasis...**

**Some parasites are able to penetrate directly through the intact skin: larvae of hookworm, cercariae of schistosoma.**



# Main Modes of Transmission

Isolation guidelines in Institutions are based on these

**AIRBORNE**

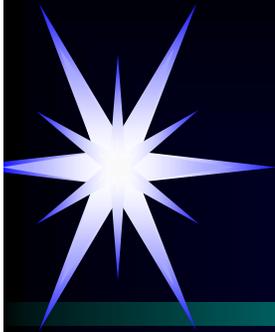
**DROPLET**

**AND Vectorborne,  
Common source:  
Water, Food,  
Equipment, Rx**

**CONTACT**

**Direct**

**Indirect**



# Droplet Transmission

A droplet of

100  $\mu\text{m}$

40  $\mu\text{m}$

20  $\mu\text{m}$

10  $\mu\text{m}$

5-10  $\mu\text{m}$

$\leq 5 \mu\text{m}$  Droplet nuclei

will fall in

10 seconds

1 minute

4 minutes

20 minutes

30-45 minutes

May be inhaled  
to alveoli

**Direct hit  
3 ft**

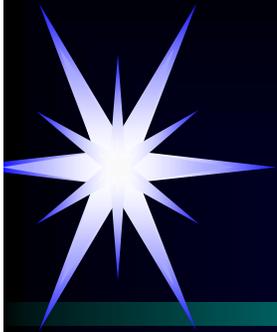
**Droplets above 10  $\mu\text{m}$  are trapped in the nose and usually do not make it to the bronchi**

**May reach lower respiratory tract**



# Transmitted by Droplets

- **Hemophilus influenzae**
- **Meningococci**
- **Pneumococcal infections (invasive, resistant)**
- **BACTERIAL RESPIRATORY Infections**
  - **Diphtheria, Pertussis, pneumonic plague, Mycoplasma pneumoniae**
  - **Strepto pharyngitis, pneumonia, scarlet fever**
- **VIRAL RESPIRATORY Infections**
  - **Adenovirus, Influenza, Mumps, Parvovirus, Rubella**
- **ANY PAROXYSMAL COUGH (Pertussis?)**



# Airborne Transmission

- **Droplet nuclei = droplets less than 5  $\mu$  in diameter**
  - from evaporation of larger droplets
  - or from direct formation during coughing, speaking, singing
- **Transmission may occur over long distance**

## **Transmitted by D.N.**

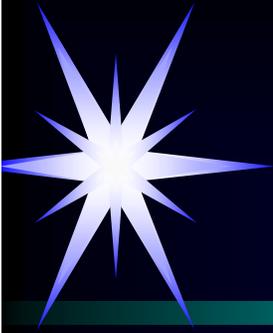
- **Tuberculosis (Infectious)**
- **Suspects of TB: request sputum smear**
- **Measles**
- **Varicella**
- **Smallpox (hemorrhagic)**



# Cough produces good droplet nuclei



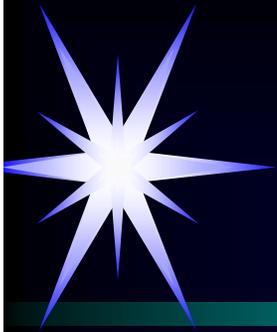
- **Cough**
  - 1 good cough produces 465 DN
  - after 30 minutes left: 228 DN (49%)
- **Speech:**
  - count from 1 to 100 1764 DN
  - after 30 minutes left 106 DN ( 6%)



# Transmitted by Contact



- **Gastrointestinal, respiratory, skin, wound infections**
- **Colonization with multidrug resistant bacteria**
- **Enteric infections, enteroviral infections in infants**
- **RSV, parainfluenza,**
- **Infectious skin infections: HSV, impetigo, cellulitis, scabies, staphylococcal furunculosis,**
- **Viral hemorrhagic conjunctivitis, viral fevers**
- **Some respiratory infections, bronchiolitis in infants, children**
- **Abscess, draining wound**



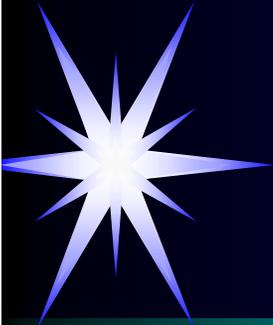
# BBP & Skin Penetration

- **Blood borne pathogens ( HBV, HCB, HIV) does not penetrate if blood was splashed exclusively on intact skin.**
- **Need injury to the skin: with a hollow bore needle or other sharp object (lancet, glass, scalpel) contaminated with blood to cause an infection.**
- **Solid needle do not carry sufficient quantities of blood to cause an infection ( ± ).**
- **Viral titer is best predictor of risk of infection.**
- **Mucosal membranes allow BBP penetration.**

**Data from 21 studies worldwide on mucosal membrane exposure of 1107 HCW to HIV showed only one conversion: risk of 0.09%, 95%CI = 0.006% to 0.5%.**

**Risk of infection after percutaneous exposure to blood from infected patients,**

- **HBV 30%**
- **HCV 3%**
- **HIV 0.3%**



# **Isolation**

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# **Precaution**

**Infectious Disease Epidemiology**



# Isolation Precaution System for Institutions

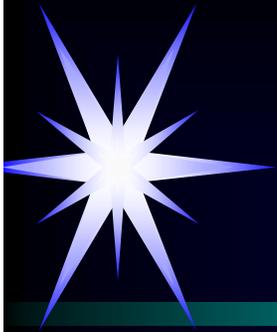
**Standard Precautions**

**IS AN EXPANSION OF  
UNIVERSAL PRECAUTIONS**



# Standard Precautions

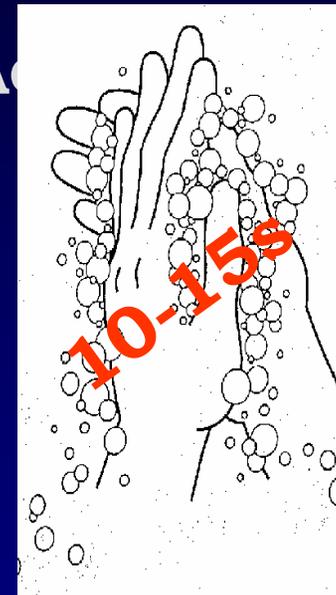
- **Same concept as UNIVERSAL PRECAUTIONS**
  - **Precautions should be taken for any contact with Blood and Body Fluid (UP)**
  - **AND for any contact with secretions and excretions, mucous membranes, damaged skin, contaminated environment and equipment**

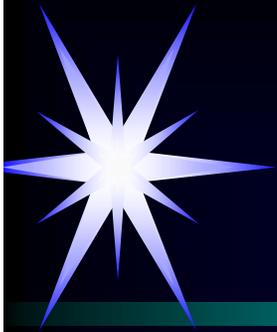


# Handwashing

10-15s

- **BEGINNING AND END OF DAY**
- **BEFORE & AFTER EACH PATIENT CONTACT**
- **BEFORE AND AFTER GLOVING**
- **ANYTIME AFTER CONTACT WITH**
  - **BLOOD & BODY FLUID**
  - **SECRETIONS /EXCRETIONS**
  - **MUCOUS MEMBRANES**
  - **DAMAGED SKIN**
  - **CONTAMINATED ENVIRONMENT**
  - **CONTAMINATED EQUIPMENT**





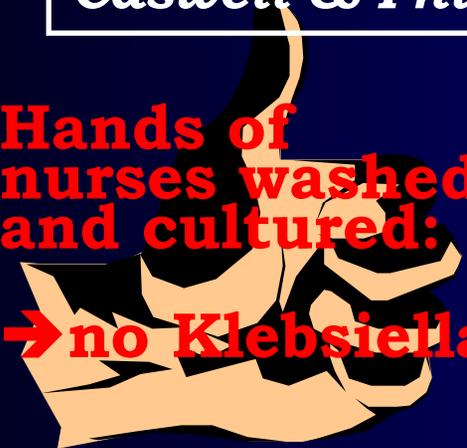
# Handwashing

10-15s

Activity	Number of Klebsiella on nurse's hand
Pulse /Blood pressure	100 - 1,000
Touching hand	10 - 100
Touch shoulder	7,000
Oral Temperature	100 - 1,000

*Caswell & Phillips, British Med J Nov 1977: 1316*

**Hands of  
nurses washed  
and cultured:  
→ no Klebsiella**



Patient  
care  
Activity

**Klebsiella  
cultured**





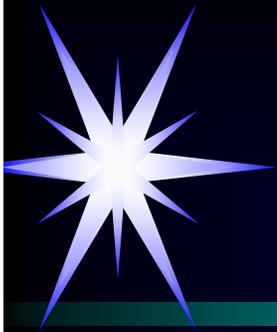
# Gloves

- **FOR ANY CONTACT WITH**
- **Blood and Body Fluids**
- **Secretions & excretions**
- **Mucous membranes**
- **Damaged skin**
- **Contaminated environment or equipment**

**If it is wet, red or dirty**

**Wash, glove then wash**





# Eye Protection Face Shield

- **RISK OF SPRAY**
- **RISK OF SPLASH**
- **of blood, body fluid, secretion or excretion**
- **in FACE OR EYE**



# Surgical Masks



- **STANDARD PRECAUTIONS**
  - For personnel to protect from splashes /sprays of BBF/ S E
- **DROPLET PRECAUTIONS**
  - to prevent large droplets ( $>5\mu$ ) on/from patient
- **For patients**
  - to prevent emission of droplet (large and droplet nuclei)

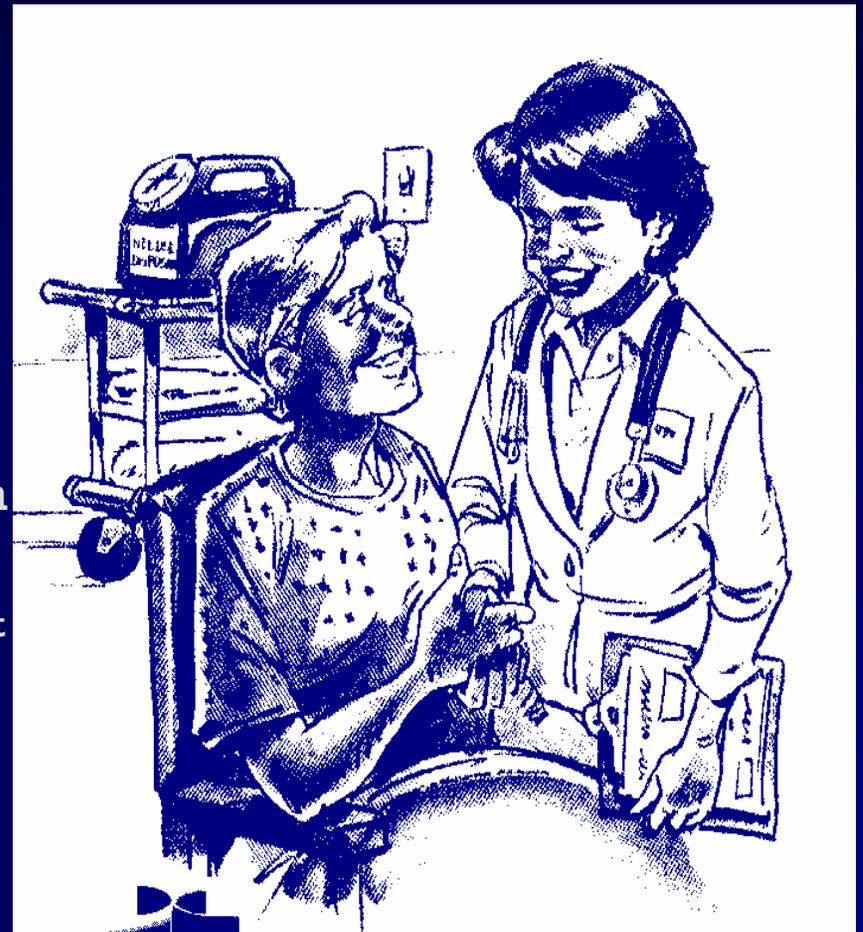
# Gown



- **STANDARD PRECAUTION**
  - To protect from splashes /sprays of large quantities of BBF/S E
- **CONTACT PRECAUTION**
  - To protect contamination of personnel clothing

# Patient Placement

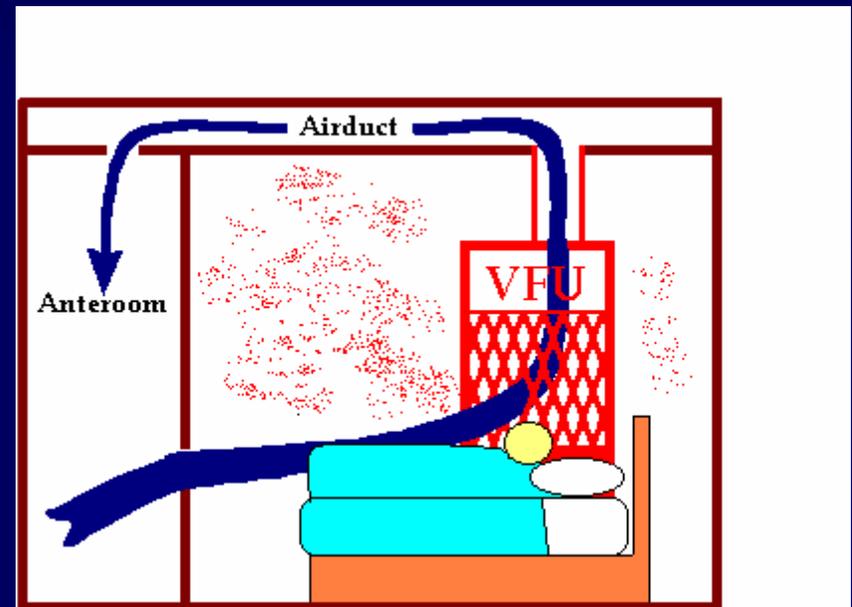
- **AIRBORNE**
  - Private room with ventilation control
- **DROPLET & CONTACT**
  - Private room preferred
  - or cohort with same infection
  - or at least 3 feet between beds
  - Use common sense: do not mix in immunocompromised patient with infected one

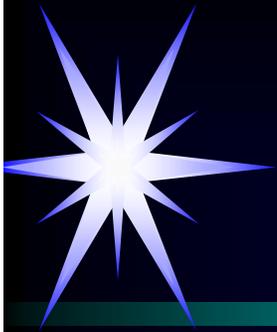


# Airborne Precautions

Small droplets ( $<5\mu$ ) emitted when coughing,  
& performance of procedures

- **ROOM WITH VENTILATION CONTROL**
  - Negative air pressure
  - $>6$  air exchange /hour
  - HEPA filtered or exhaust out
- **PERSONAL RESPIRATOR**
- **PATIENT** wears surgical mask if coughing & when transported





# Airborne Precautions Personal Respirator

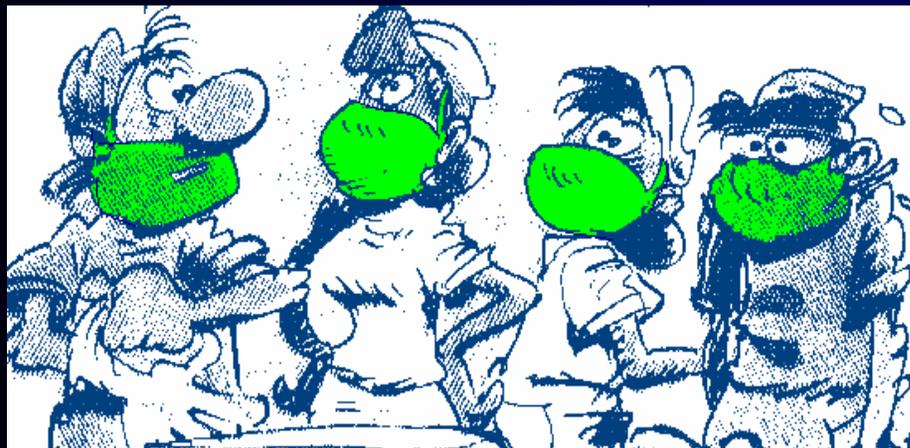


- **For Personnel**
- **In AIRBORNE ISOLATION ONLY**
- **To prevent inhalation of droplet nuclei**
- **Main leak comes from poor fit around face**



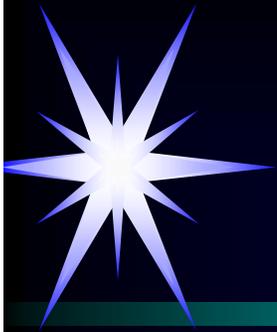
# Droplet Precautions

Large particle droplets ( $>5\mu$ ) emitted when coughing, sneezing, talking & performance of procedures

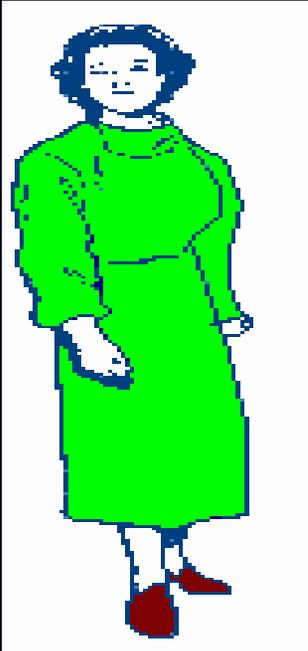


- Private room (\*)
- Mask when entering room

**use STANDARD PRECAUTIONS  
at ALL times for ALL patients**



# Contact Precautions



- **Private room (\*)**
- **Gloves when entering room,  
change glove after infectious  
contact**
- **Gown when entering room if  
substantial contact will  
occur**



**use STANDARD PRECAUTIONS  
at ALL times for ALL patients**