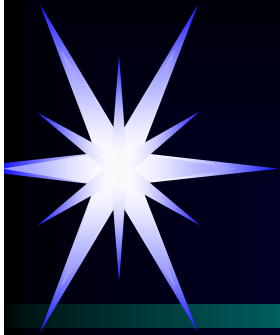


Transmission

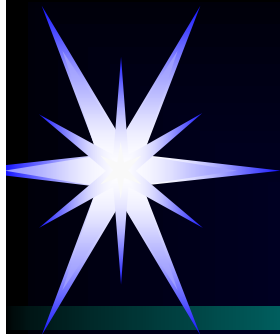
Infectious Disease Epidemiology



Mode of Transmission

Classification by portal of entry

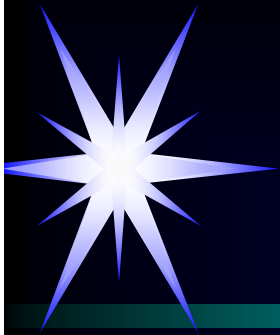
- **Respiratory**
- **Gastrointestinal**
- **Skin**
- **Genital**
- **Intrauterine or transplacental**
- **Urinary**
- **Personal contact**
- **Water and food**
- **Arthropod borne**



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



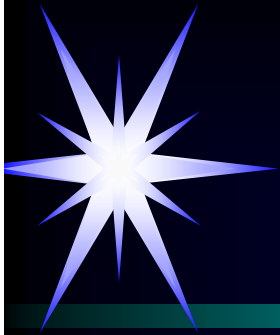
Infections transmitted

- **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.



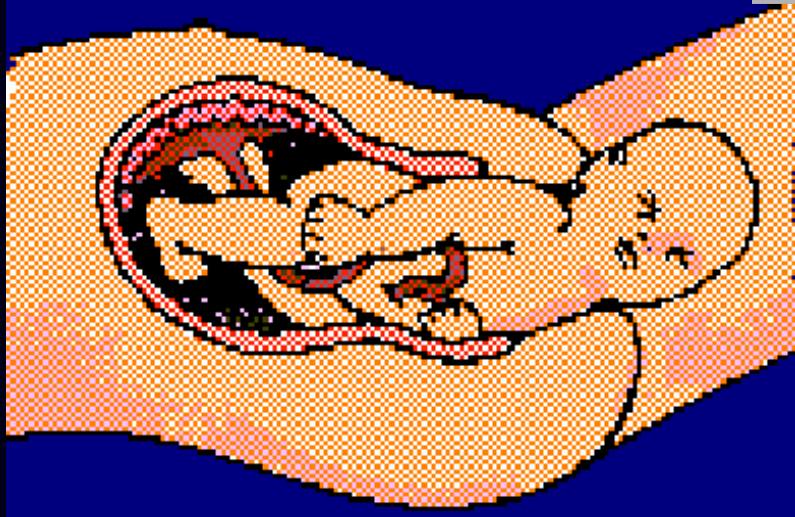
Sexual transmission (mucous membrane transmission)

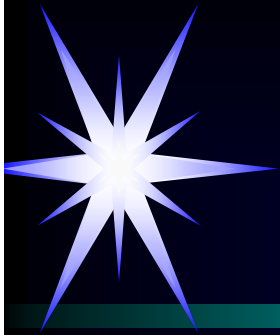
- **Neisseria gonorrhoeae, Chlamydia trachomatis**
- **Treponema pallidum**
- **Hemophilus ducreyi**
- **Mycoplasma hominis, Ureaplasma urealyticum**
- **Calymnatobacterium granulomatis**
- **± Shigella spp, Campylobacter spp**
- **± Group B streptococci**
- **± Bacterial vaginosis associated bacteria**
- **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

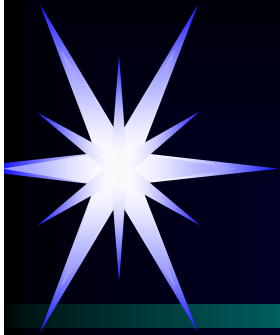
Microorganisms

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

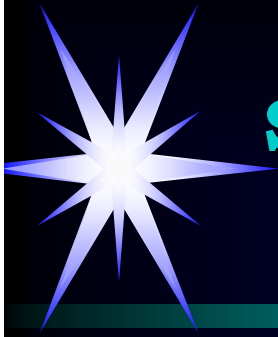


Food Poisoning

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

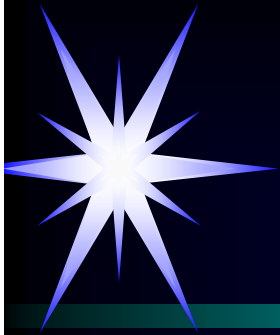
DROPLET

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

CONTACT

Direct

Indirect



Droplet Transmission

A droplet of

100 μm

40 μm

20 μm

10 μm

5-10 μm

$\leq 5 \mu\text{m}$ Droplet nuclei May be inhaled
to alveoli

will fall in

10 seconds

1 minute

4 minutes

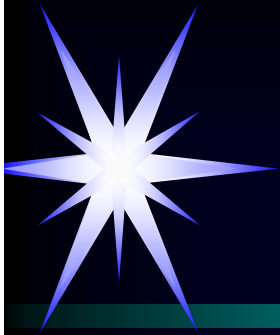
20 minutes

30-45 minutes

**Direct hit
3 ft**

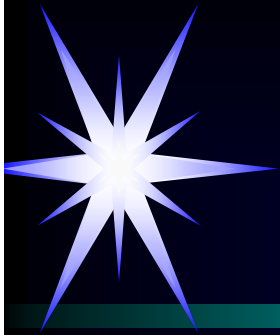
Droplets above 10 μm are trapped in the nose and usually do not make it to the bronchi

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 μ 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

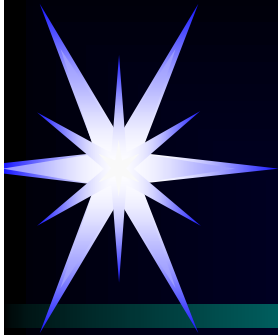


- **Cough**

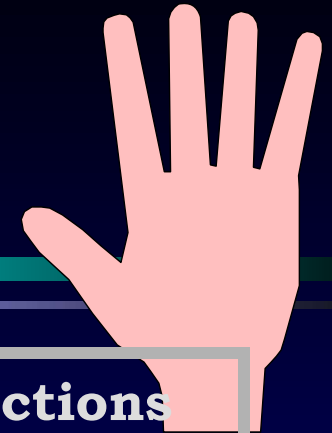
- 1 good cough produces 465 DN
- after 30 minutes left: 228 DN (49%)

- **Speech:**

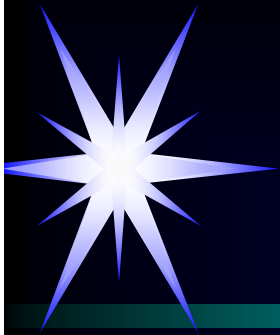
- count from 1 to 100
1764 DN
- after 30 minutes left 106 DN (6%)



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**



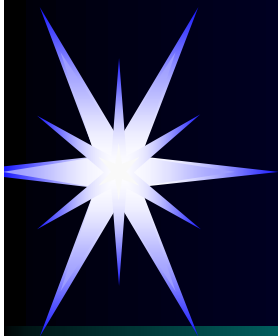
BBP & Skin Penetration

- 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 (\pm).
- 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,

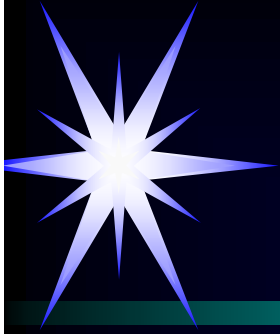
- HBV 30%
- HCV 3%
- HIV 0.3%



Isolation

Precaution

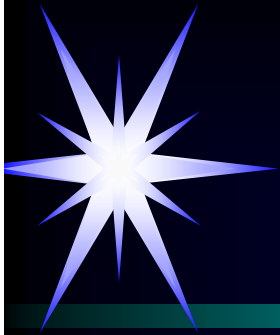
Infectious Disease Epidemiology



Isolation Precaution System for Institutions

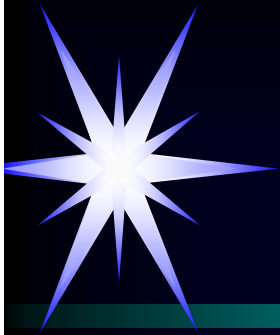
Standard Precautions

**IS AN EXPANSION OF
UNIVERSAL PRECAUTIONS**



Standard Precautions

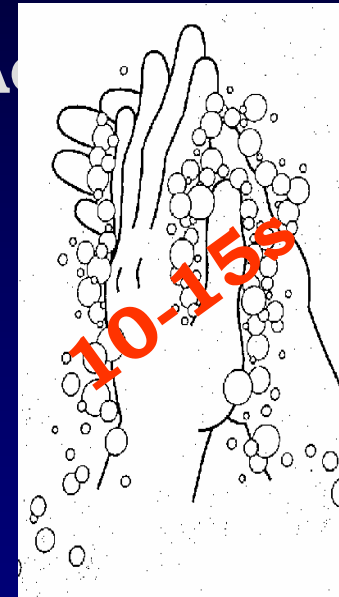
- **Same concept as UNIVERSAL PRECAUTIONS**
 - **Precautions should be taken for any contact with Blood and Body Fluid (UP)**
 - **AND for any contact with secretions and excretions, mucous membranes, damaged skin, contaminated environment and equipment**



Handwashing

10-15\$

- 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

10-15\$

Activity	Number of Klebsiella on nurse's hand
----------	--------------------------------------

Pulse /Blood pressure	100 - 1,000
-----------------------	-------------

Touching hand	10 - 100
---------------	----------

Touch shoulder	7,000
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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)

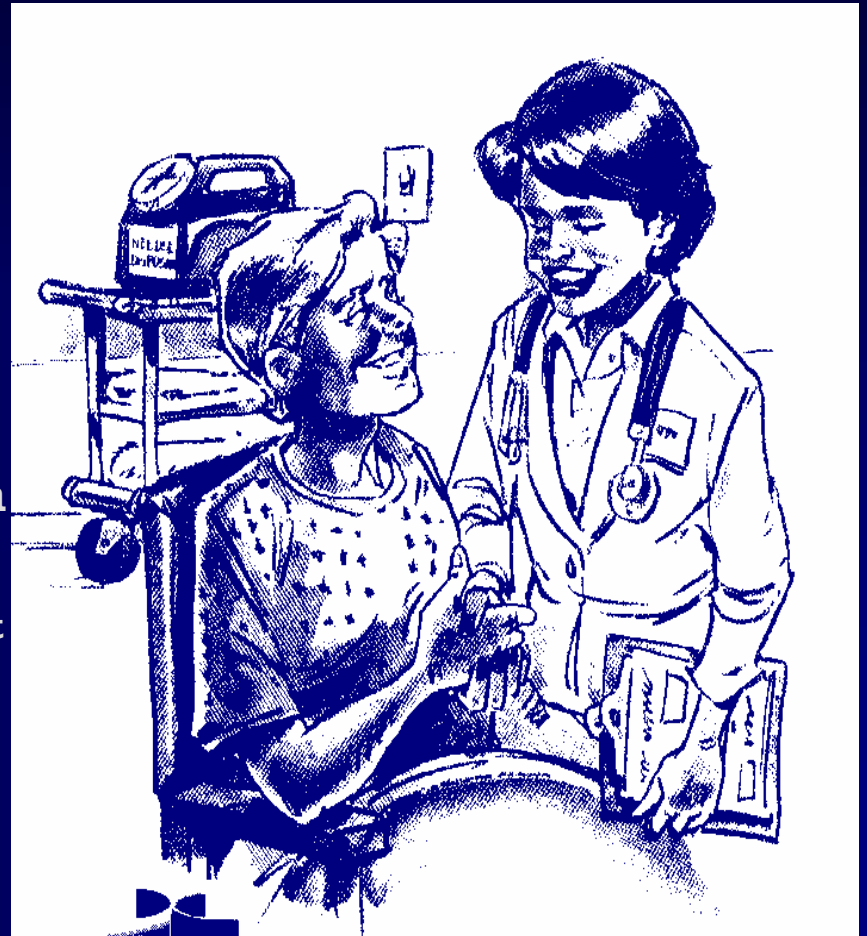
Gown

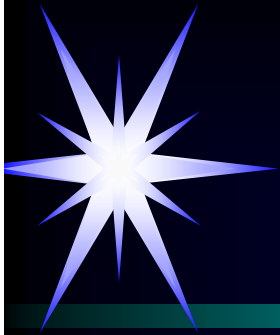


- **STANDARD PRECAUTION**
 - To protect from splashes /sprays of large quantities of BBF/S E
- **CONTACT PRECAUTION**
 - To protect contamination of personnel clothing

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

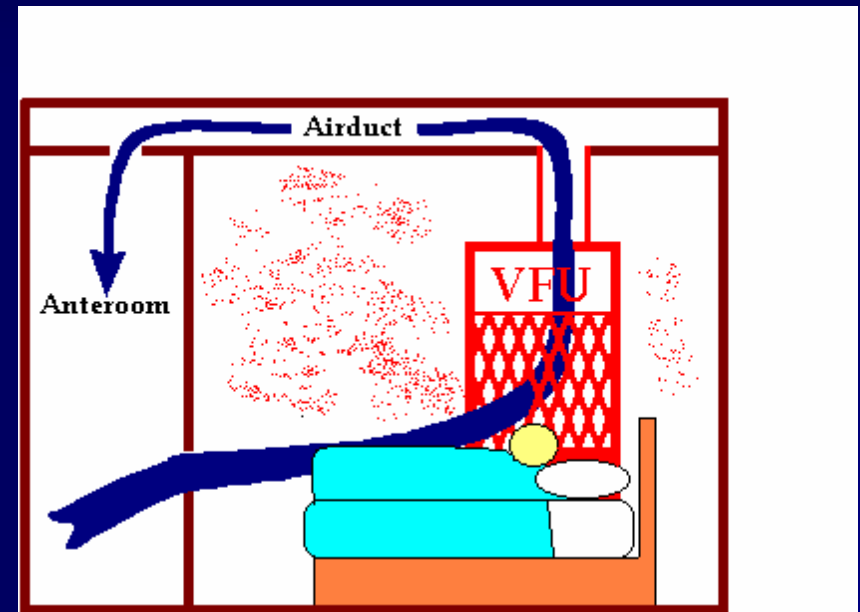


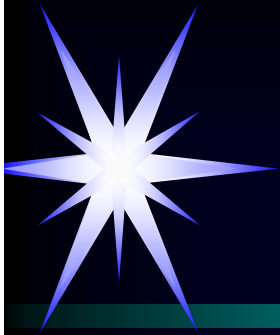


Airborne Precautions

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**

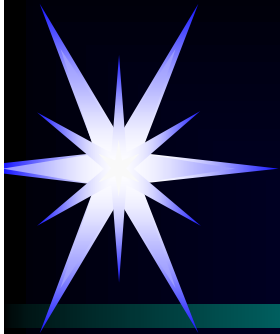
Droplet Precautions

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



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

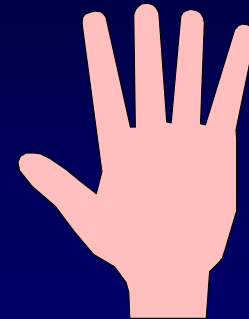
**use STANDARD PRECAUTIONS
at ALL times for ALL patients**



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**