Infection control in health care settings
Hospital acquired infection
Infection precautions
Tools processing

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Basics of Nursing, February 2012

Infection control in the health care settings

- ✓ about 5-10 % of patients admitted to hospitals develop particular infections that are normally related to a procedure or treatment used to diagnose or treat the patient's illness or injury,

- ✓approximately 25% of these infections can be prevented by healthcare professionals taking proper precautions when caring for patients,

- ✓for these reasons it is necessary to comprehend some basics related to the infection process.

Definitions of key terms

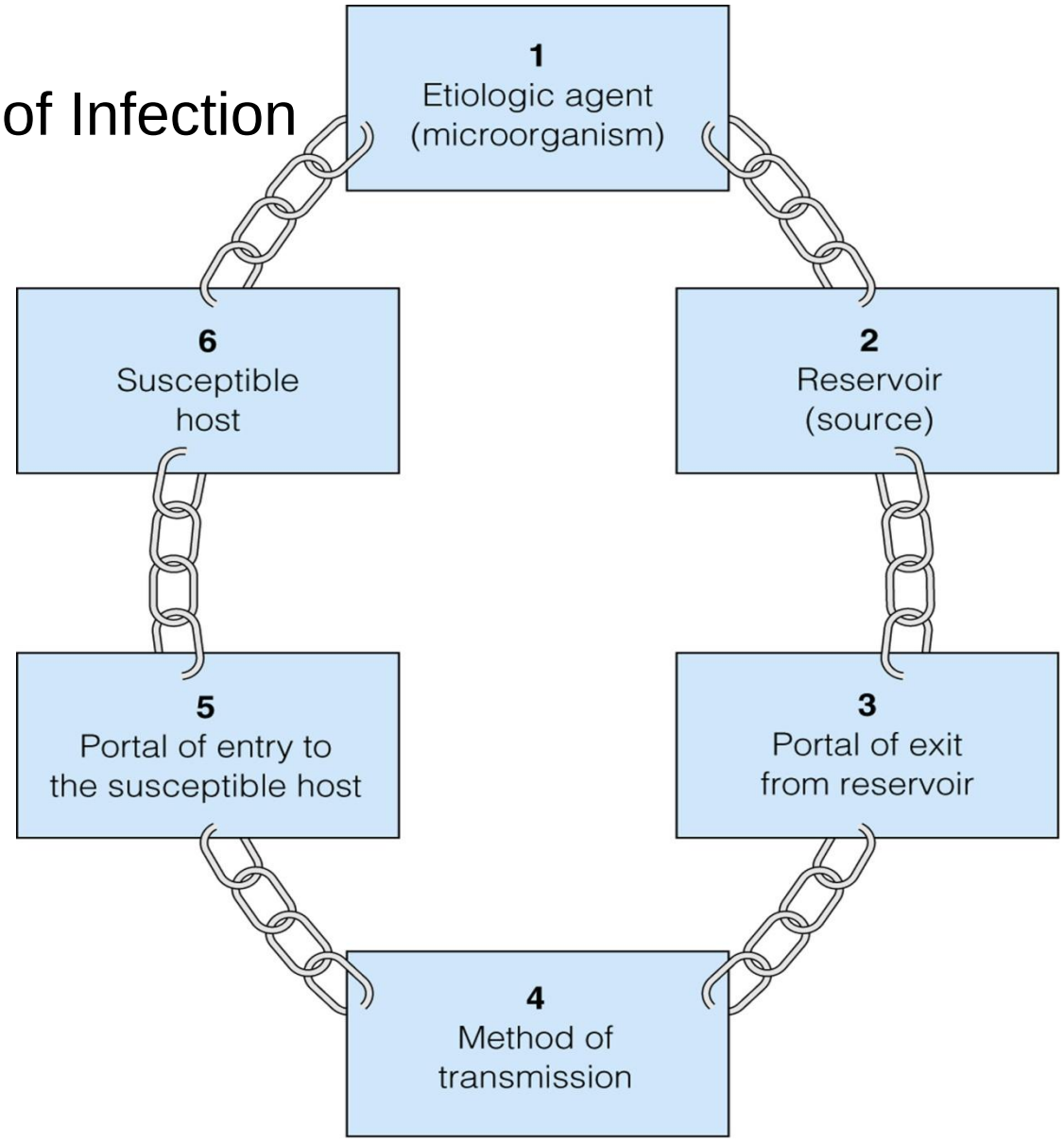
- ✓ **Microorganisms** are the causative agents of infection**.** They include bacteria, viruses, fungi and parasites.

- ✓ **Resident microorganisms** (normal resident flora) are not harmless either beneficial, because they perform essential function of the body.

- ✓ **Colonization** means that pathogenic (illness or disease causing) organisms are present in a person (i.e. they can be detected by cultures or other tests) but are not causing symptoms or clinical findings (i.e. cellular changes or damage).

- ✓ **Infection** means that the colonizing organisms are causing an illness or disease (cellular response) in the person. Coming in contact with and acquiring new organisms, while increasing the risk of infection, usually does not lead to infection because the body's natural defence mechanisms, including the immune system, are able to tolerate and/or destroy them.

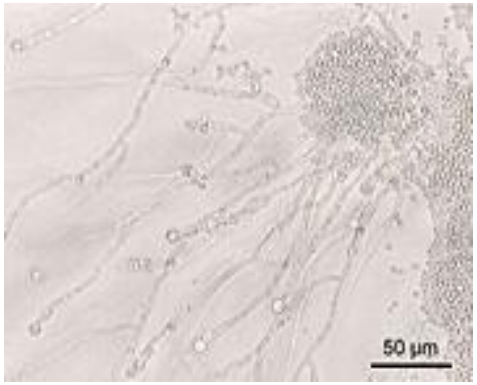
The Chain of Infection



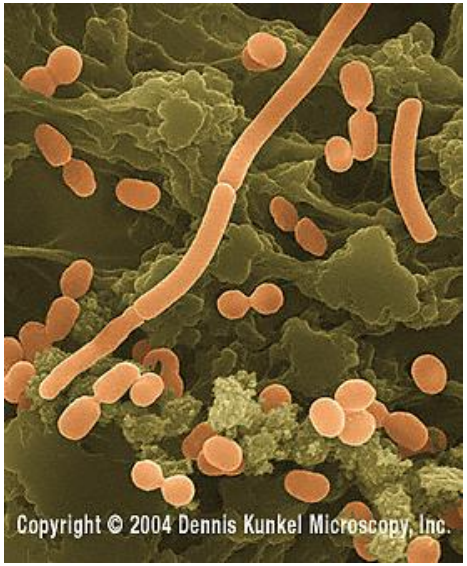
The microbial agent

- ✓ bacteria,
- ✓ viruses,
- ✓ funghi,
- ✓ parasites.

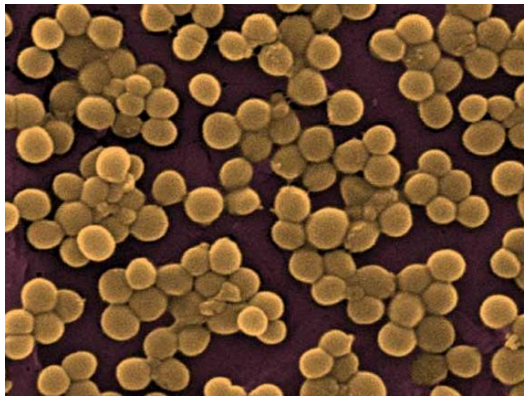
Candida albicans/Yeast



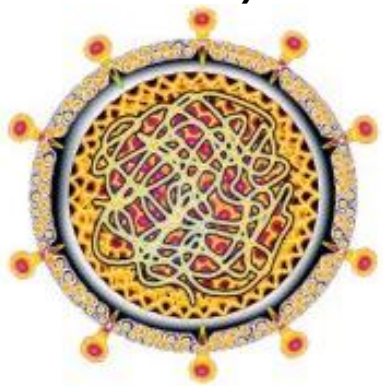
Grammnegative bacteries



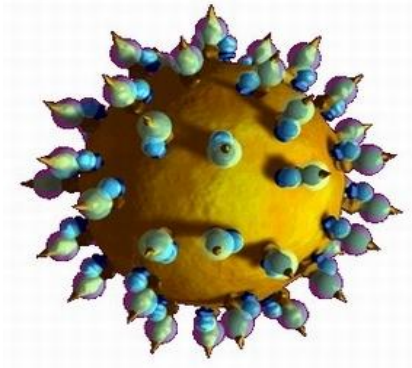
Infections may be caused by a microorganism acquired from another person in the hospital (**cross-infection)** or may be caused by the patient's own/resident flora (**endogenous** infec



Staphylococcus aureus



Viruses
Hepatitis C



Viruse
Hepatitis B

Assessment Interview

CLIENT AT RISK FOR INFECTIONS

- When were you last immunized for diphtheria, tetanus, poliomyelitis, rubella, measles, influenza, hepatitis, and pneumococcal pneumonia?
- When did you last have a tuberculin skin test?
- What infections have you had in the past, and how were these treated?
- Have any of these infections recurred?
- Are you taking any antibiotics, anti-inflammatory medications such as aspirin or ibuprofen, or medications for cancer?
- Have you had any recent diagnostic procedure or therapy that penetrated through your skin or a body cavity?
- What past surgeries have you had?
- How would you describe your eating habits? Do you eat a variety of different types of foods?
- Do you take vitamins?
- On a scale of 1 to 10, how would you rate the stress you have experienced in the last 6 months?
- Have you experienced any loss of energy, loss of appetite, nausea, headache, or other signs associated with specific body systems (e.g., difficulty urinating, urinary frequency, or a sore throat)?

Note: As with all history taking, the nurse must individualize the specific terms used, examples given to the client, and teaching techniques used to validate agreement on the meaning of words according to the client's culture, language spoken, and education or intellectual abilities.

Methods of transmission

- ✓ **airborne:** through the air (chicken pox or mumps);

- ✓ **blood** or **body fluids**: if blood or body fluids contaminated with HBV or HIV comes in contact with another person, such as through a needlestick, he/she may become infected;

- ✓**contact:** either direct (touching an open wound or draining pustule) or indirect (touching an object contaminated with blood or other body (fluids);

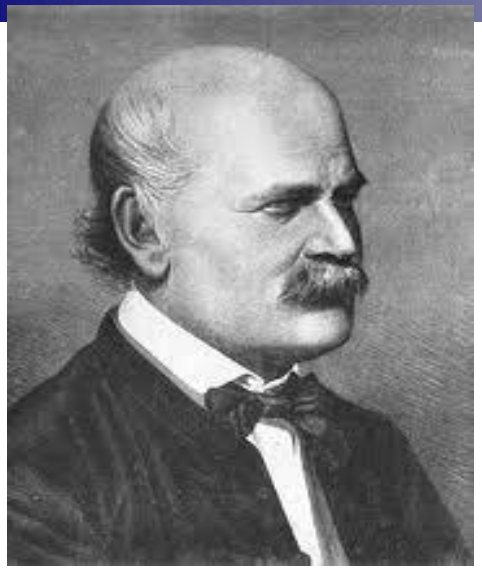
- ✓ **faecal-oral:** swallowing food contaminated by human or animal faeces (e.g. putting your fingers in your mouth after handling contaminated objects without first washing your hands);

- ✓ **foodborne:** eating or drinking contaminated food or liquid that contains bacteria or viruses (hepatitis A from eating raw oysters);

- ✓ **animal or insect-borne:** contact with infected animals or insects through bites, scratches, secretions or waste.

Protective barriers

- ✓all health care professionals and other staff are responsible for conducting infection prevention regimen (also the students, using medical environment for educational purposes
- ✓ factors associated to the infection will be controlled
- ✓ patient is not exposed to infectious dangerous
- ✓ patient will not develop signs or symptoms of infection during staying in health care settings.



- ✓ Up to 25% mothers delivering in hospitals died due to infection
- ✓ He set up **hand washing** with chlorinated lime solution for interns who had performed autopsies.....

Ignaz Semmelweis *(1818-1865)*
„ Defender of Motherhood “

Nosocomial infections caused death in 10% of surgeries.

- ❑ In mid 1800s Semmelweiss and Lister helped developed **aseptic techniques** to prevent contamination of surgical wounds.

Joseph Lister
(1827 -1912)

Definition - nosocomial infections

- ✓ hospital-acquired infections,
- ✓ definitions to identify nosocomial infections have been developed for specific infection sites (e.g. urinary, pulmonary),
- ✓nosocomial infections should encompass infections occurring in patients r receiving treatment in any health care facility.
- ✓ infections acquired by staff or visitors to the hospital or other health care facility may be also considered to be nosocomial infections
- ✓ the major causes of death and increased morbidity among hospitalized patients

WHO referred in 2002 that over 1.4 million people worldwide suffer from infectious complications acquired in hospital

Nosocomial infections are infections of:

- ✓ surgical wounds,
- ✓ urinary tract infections,
- ✓ lower respiratory tract infections.

The highest prevalence of nosocomial infections occurs in intensive care units and in acute surgical and orthopaedic wards.

Infection rates are higher among patients with increased susceptibility because of:

- ✓ old age
- ✓ underlying disease or treatment - especially chemotherapy and immunosupression.

Impact of nosocomial infections

- ✓ NI add to functional disability and emotional stress of the patient and they may in some cases, lead to disabling conditions that reduce the quality of life
- ✓ are also one of the leading causes of death,
- ✓ the economic costs are considerable especially due to increased length of stay of infected patients, use of drugs, the need for isolation and the use of additional laboratory and other diagnostic studies,

Factors influencing the development of nosocomial infections

Many factors promote infection among hospitalized patients:

- ✓ decreased immunity among patients;
- ✓ increasing variety of medical procedures and invasive techniques creating potential routes of infection;
- ✓ the transmission of drug-resistant bacteria among crowded hospital populations,
- ✓ poor infection control practices

Bacterial resistance

Multiresistant Klebsiella,
Pseudomonas aeruginosa
MRSA (Methicilin-resistant staphylococcus)


A TB/AIDS patient at Accra Teaching Hospital in a TB ward.
WHO/TDR/Crump

This problem is particularly critical in:

- ✓ developing countries where more expensive second-line antibiotics may not be available or affordable
- ✓ a high frequency of nosocomial infections is the evidence of poor quality of health service delivery
- ✓ nosocomial infections and many of them are hardly manageable
- ✓ environment - all they may facilitate the transmission of microorganisms among patients.

While progress in the prevention of nosocomial infections has been made, changes in medical practice continually present new opportunities for development of infection.

TABLE 29–3 Human Body Area Reservoirs, Common Infectious Microorganisms, and Portals of Exit

Body Area	Common Infectious Organisms	Portals of Exit
Respiratory tract	Parainfluenza virus	Nose or mouth through sneezing, coughing, breathing, or talking
	Mycobacterium tuberculosis	
	Staphylococcus aureus	
Gastrointestinal tract	Hepatitis A virus	Mouth: saliva, vomitus; anus: feces; ostomies
	Salmonella species	
Urinary tract	*Escherichia coli* enterococci	Urethral meatus and urinary diversion
	Pseudomonas aeruginosa	
Reproductive tract	*Neisseria gonorrhoeae*	Vagina: vaginal discharge; urinary meatus: semen, urine
	Treponema pallidum	
	Herpes simplex virus type 2	
	Hepatitis B virus (HBV)	
Blood	Hepatitis B virus	Open wound, needle puncture site, any disruption of intact skin or mucous membrane surfaces
	Human immunodeficiency virus (HIV)	
	Staphylococcus aureus	
	Staphylococcus epidermidis	
Tissue	*Staphylococcus aureus*	Drainage from cut or wound
	Escherichia coli	
	Proteus species	
	Streptococcus beta-hemolytic A or B	

Urinary infections

✓ NI - 80% of infections are associated with the use of an indwelling bladder catheter.

✓ Urinary infections are associated with less morbidity than other nosocomial infections, but can occasionally lead to bacteraemia and death.

✓ Infections are usually defined by microbiological criteria: positive quantitative urine culture ($\geq 10^5$ microorganisms/ml, with a maximum of 2 isolated microbial species).

✓ The bacteria responsible arise from the git flora, either normal Escherichia coli) or are acquired in hospital (multiresistant Klebsiella).

Surgical site infections

• the incidence varies from 0.5 to 15%. It depends on the type of operation and underlying patient status.

- usually acquired during the operation itself;
- exogenously (e.g. from the air, medical equipment, surgeons and other staff),
- endogenously from the flora on the skin or in the operative site, or, from blood used in surgery
- type and location of surgery
- antibiotics received
- quality of surgical technique
- presence of foreign bodies including drains,
- to use of preoperative shaving
- the experience and professionalism of the surgical team.

Nosocomial pneumonia

✓Patients on ventilators in intensive care units - 3% per day
✓Microorganisms colonize the stomach, upper airway and bronchi and cause infection in the lungs (pneumonia).

Risk factors for infection include :
✓the type and duration of ventilation,
✓ the quality of respiratory care,
✓ severity of patient's condition
✓ previous use of antibiotics.

Apart from ventilator-associated pneumonia, patients with seizures or decreased level of consciousness are at risk for nosocomial infection, even if not intubated:
✓ viral bronchiolitis (respiratory syncytial virus, RSV) is common in children's units
✓ influenza and secondary bacterial pneumonia (hypostatic, due to inappropriate ventilation of basal parts of lungs) may occur in institutions for the elderly
✓Highly immunocompromised patients, *Legionella* spp. and *Aspergillus* pneumonia may occur.

Nosocomial bacteraemia

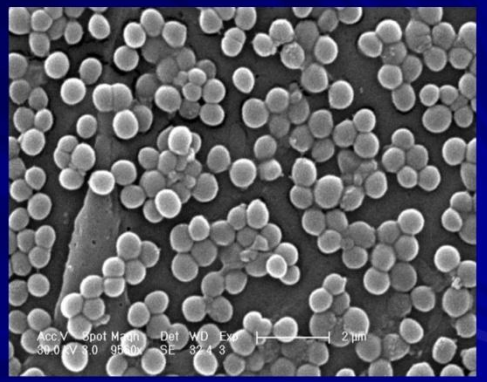
•represent a small proportion of NI (approximately 5%) but case fatality rates are high – more than **50%** for some microorganisms.
Infection may occur :

- at the skin
- entry site of the intravascular device
- in the subcutaneous path of the catheter (tunnel infection).
- organisms colonizing the catheter within the vessel may produce
- bacteraemia without visible external infection.

The resident or transient cutaneous flora is the source of infection.
The main risk factors are :

- the **length of catheterization**,
- level of asepsis at insertion
- continuing catheter care.

Staphylococcal bacteremia



Shannon Galvin, M.D.
August 2006

Other nosocomial infections

TABLE 29-6 Nursing Interventions that Break the Chain of Infection (continued)

Link	Interventions	Rationale
Susceptible host	Maintain the integrity of the client's skin and mucous membranes.	Intact skin and mucous membranes protect against invasion by microorganisms.
	Ensure that the client receives a balanced diet.	A balanced diet supplies proteins and vitamins necessary to build or maintain body tissues.
	Educate the public about the importance of immunizations.	Immunizations protect people against virulent infectious diseases.

Prevention of hospital acquired infection

- ✓ **limiting transmission** of organisms between patients in direct patient care through adequate hand washing and glove use and appropriate aseptic **practice**, **isolation strategies**, **sterilization** and **disinfection** practices **and laundry,**
- ✓ **controlling environmental risks** for infection,
- ✓ **protecting patients** with appropriate use of prophylactic antimicrobials,nutrition and vaccinations,
- ✓ **limiting the risk of endogenous infections** by minimizing invasive procedures and promoting optimal antimicrobial use,
- ✓ **surveillance** of infections, identifying and controlling outbreaks,
- ✓**prevention of infection in staff** members,
- ✓enhancing staff patient care practices and continuing **staff education.**

Infection control is the responsibility of all health care professionals – physicians, nurses, therapists, pharmacists as well as managers and others ike medical or nursing students, who use hospital setting for educational reasons.

Preventing transmission from the environment, instruments and tools

- ✓ **Routine cleaning of the hospital environment** is necessary to ensure a hospital environment which is visibly clean and free from dust and soil.
- ✓ Almost 90% of microorganisms are present within “visible dirt” and the purpose of routine cleaning is to eliminate this dirt.

Decontamination

✓ is the first step in **processing** soiled (contaminated) surgical **instruments**, gloves and other items, especially if they will be cleaned by hand (e.g. briefly soaking contaminated items in 0.5% chlorine solution or other locally available disinfectants, making them safer for handling during cleaning).
✓ Larger surfaces, such as examination and operating tables, laboratory bench tops and other equipment that may have come in contact with blood or other body fluids also should be decontaminated.
✓ Wiping with a suitable disinfectant (e.g. 0.5% chlorine solution or 1–2% phenol) is a practical, inexpensive way to decontaminate them.
✓After instruments and other items have been decontaminated, they need to be cleaned and finally either sterilised or high-level disinfected.

Disinfection

Disinfection is the process used to reduce the numbers of micro-organisms by boiling, steaming or the use of chemical disinfectants, but which may not destroy bacterial spores or some viruses. Disinfection is considered to reduce the numbers of micro-organisms to a level that is safe for the purpose for which the piece of equipment is intended.

High-level disinfection (HLD) is the process that eliminates almost **all** microorganisms **except some** bacterial endospores from inanimate objects.

Antiseptics are chemical preparations used on skin or tissue.

Chemical disinfectants

- baktericidal
- fungicidal
- virucidal (HIV, HBV, rotaviruses)
- tuberculocidal
-- sporocidal

Chemical disinfection

Chemical disinfectants can be used for:

- blood and body fluid spillage ,
- hard surface/equipment decontamination,
- disinfection of equipment that is damaged by heat (e.g. lexible endoscopes),
- hand and skin disinfection (prior to invasive procedures), environmental disinfection (e.g. during and after outbreaks of infection).

- **Phenolics**, the mechanism of these agents is referred as the cause of cytoplasmic membrane disruption and coagulation of proteins of vegetative cells.

- Examples: phenol (carbolic acid), hexachlorophene, O-phenylphenol.

- **Oxidizing agents** destroy the cell membrane of a microorganism and thus cause the lysis and death of a cell.
- The strong oxidizers are chlorine and oxides.

  In clinical use there is a hydroxide peroxide, per-acetic acid, chlorine dioxide.

  Mechanisms of effect - vegetative cells are killed by coagulation and oxidation of cellular proteins.
- Chlorine examples: Chlorine gas, Clorox and other hypochlorite bleaches (NaClO)..

Quaternary ammonium compounds (Quats)

act as low-level disinfectants.
They are effective against bacteria but do not kill Pseudomonas aeruginosa and bacterial spores.
They are used for skin disinfection.
Effect is caused by cytoplasmic membrane disruption of vegetative cells.
Examples: Zephiran and other quaternary ammonium compounds.

Alcohols (ethanol, isopropanol) are usually used as **antiseptics.**

Alcohols like etanol (60-90%), 1-propanol (60-70%) and 2-propanol/isopropanol (70-80%) are used to disinfect skin before injections.
Vegetative cells are killed by coagulation of proteins as well as dehydration and lipid solvation by effect of alcohols.

Examples: Ethyl alcohol and isopropyl alcohol are used in concentrations of 70% to 90%. The alcohols exhibit reduced efficacy as disinfectants when used at concentrations above 90%. At concentrations below 45%, the alcohols are ineffective as disinfectants.

Alkylating agents

Formaldehyde provides for **disinfection** when used as a ***solution*** (formalin) or ***sterilization*** when used as a gas. This agent produces protein coagulation.
Glutaraldehyde provides for either **sterilization** or **disinfection** depending upon the concentration. This agent produces protein coagulation.
Example: Cidex, Ethyleneoxide gas.

Iodine is used for skin and wound disinfection. It is usually water-based solution that contains povidone-iodine (Betadine). It is far better tolerated than previous alcohol-based solutions. The great advantage of iodine
antiseptics is the widest scope of antimicrobial activity, killing even endospores. The mechanism of killing of vegetative cells is provided by protein coagulation.
Examples: Tincture of iodine, Betadine, Isodine.

Chemical disinfectans (solution)

Antiseptics

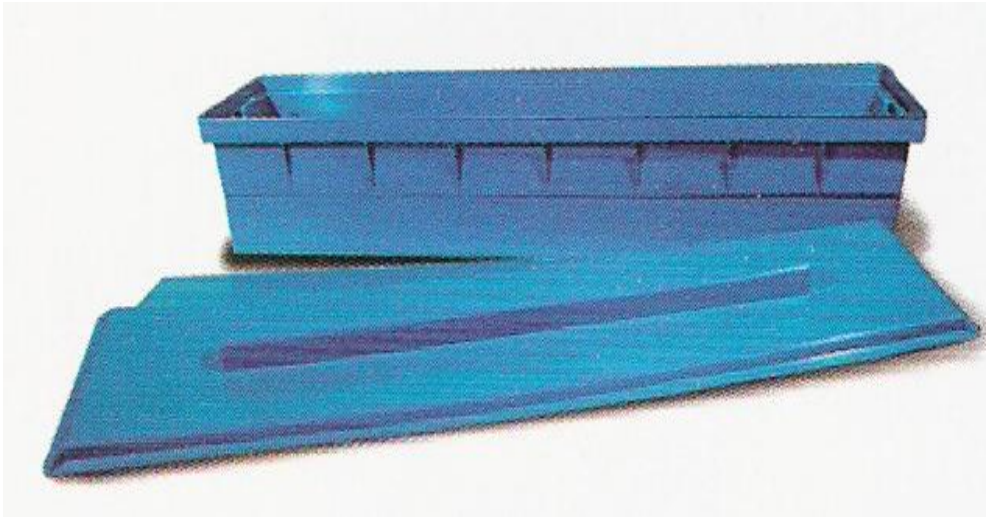
Chemical disinfectans (powder)

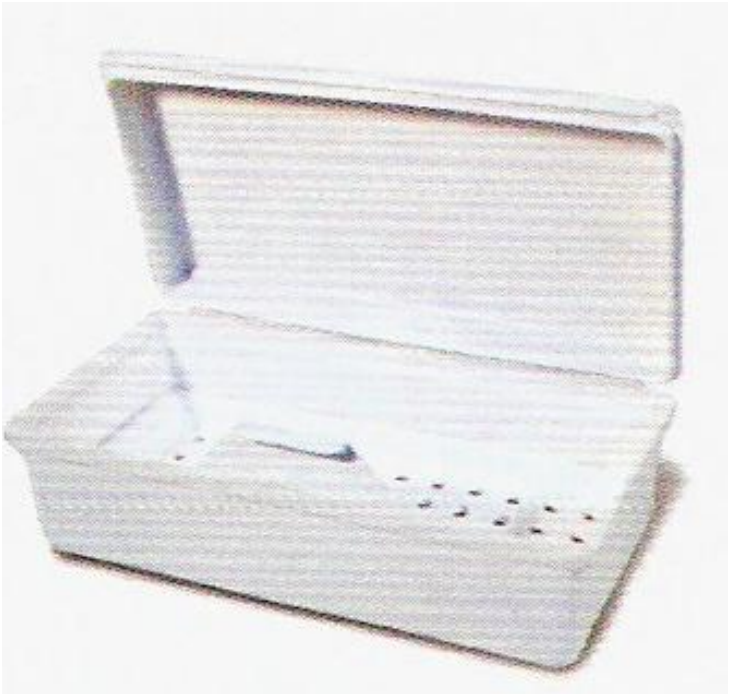
Methods of disinfection and type of disinfectants

The two main methods of disinfection are the use of an automatic washer disinfector or the use of chemical disinfectants.

Automatic washer-disinfectors

Disinfective tubes





Sterilization

is the process that eliminates **all** microorganisms (bacteria, viruses, fungi and parasites) **including** bacterial endospores from inanimate objects by:

- high-pressure steam (autoclave),
- dry heat (oven),
- chemical sterilants
- radiation.

Physical sterilization

Autoclaves

Dry heat

Temperature (^{0}C)	Exposure (min)
160	60
170	30
180 a viac	20

Gas sterilization

Gas autoclaves use a vapour solution to sterilize its contents. The unsaturated chemical vapour method is a low-humidity process and because of the low moisture content, instruments do not corrode and drying time is not required.Common sterilizing agents include **formaldehyde gas** and **ethylene oxide.**

Ethylene oxide gas sterilisators are fully automatic devices that sterilise, either resistant to heat or not, any kind of plastic, rubber, sensitive, metal, mechanic or electromechanical medical and surgical materials (including gloves, catheters, tubes, endoscopic instruments etc.) and laboratory equipment by applying the anti-bacteriologic agent, 100% ethylene oxide
(EO) at a low temperature of 54°C.
After sterilisation, products are transferred to an aeration cell, where they remain until the gas disperses and the product is safe to handle.

Plasma sterilization

Department of Central Sterilization

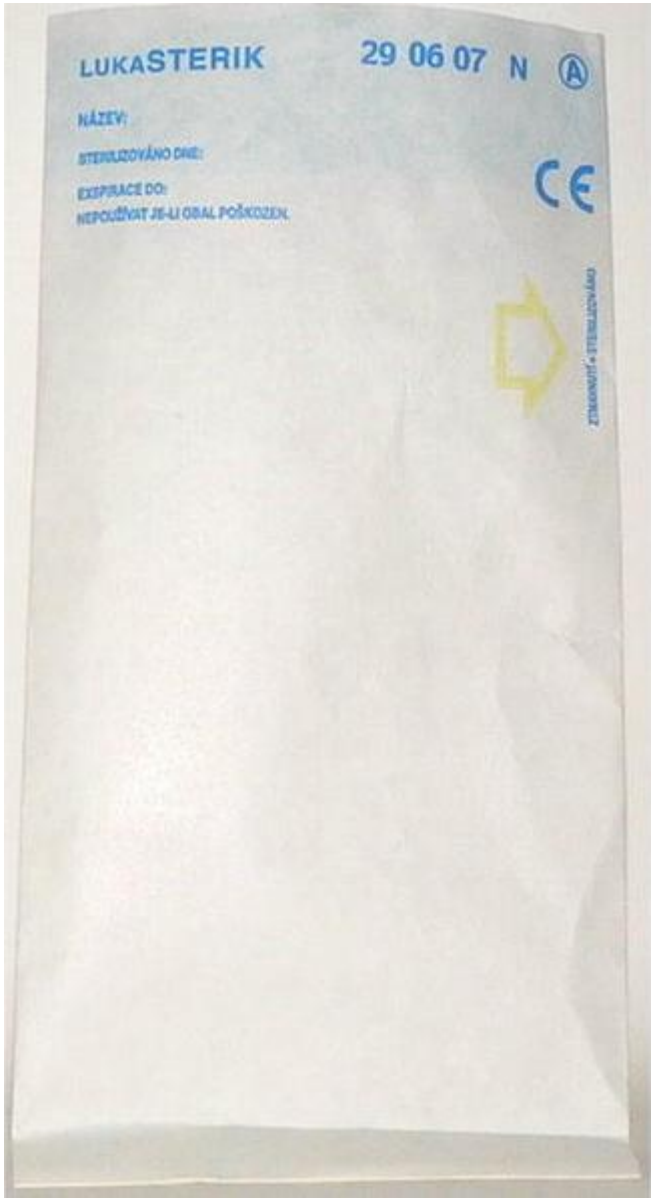
Preparing material and instruments for sterilization

Part of sterilization

Storeroom for germfree material and instruments

Packaging material

Wrapping paperl



Paper- folic packaging

Repetitively packaging material - containers

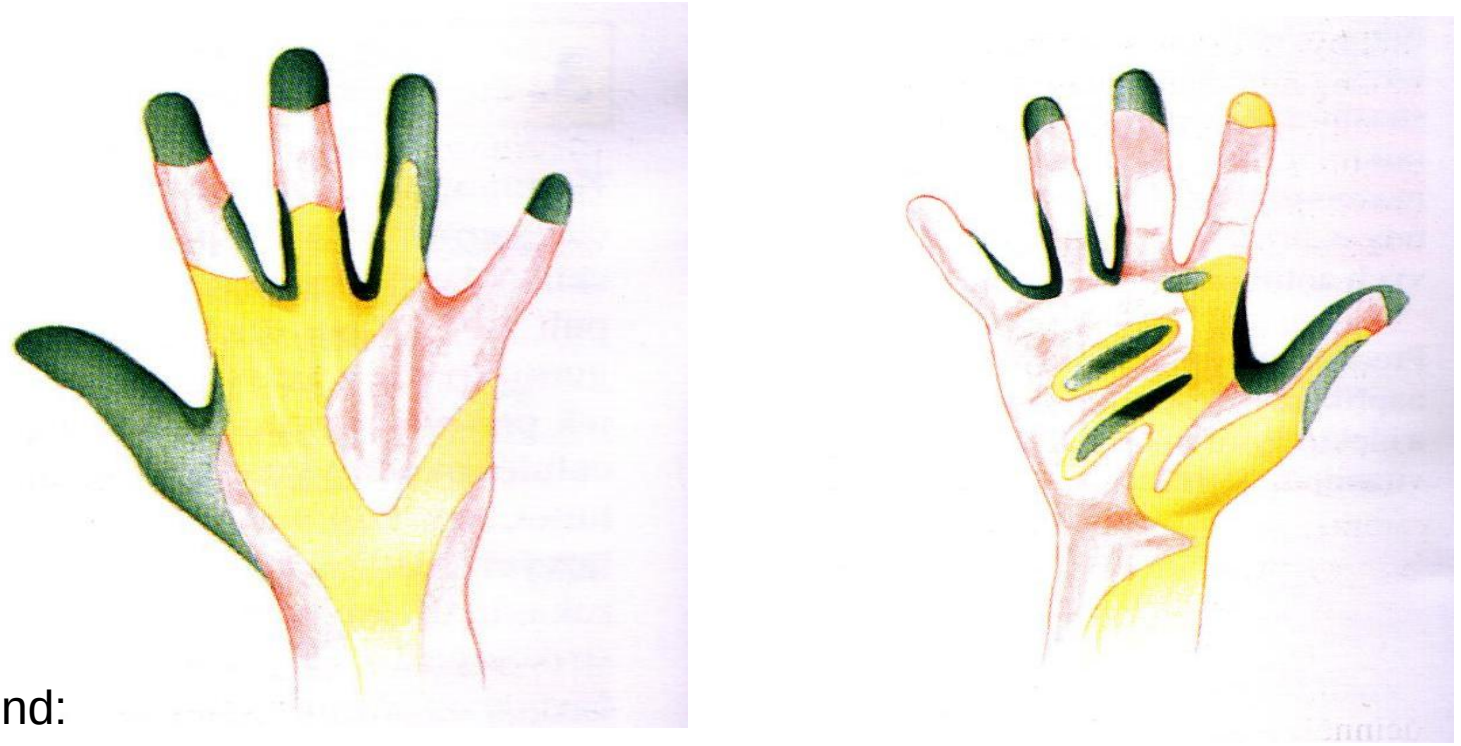
The quality control parameters of the sterilization.

-must record information on the sterilization processing cycle including:
- load number, load content,
- temperature
- time exposure record in chart and regular (at least daily) physical/chemical testing.

The chemical indicator changes colour to indicate that the item passed through the sterilisation process.
Regular (at least weekly) biological testing is provided by using of biological indicators. They should be used regularly to monitor the sterilisation process (e.g. steam processing used *Bacillus stearothermophilus* as biological indicator). Regular maintenance must be performed and documented.

The following records must be maintained for all sterilisations:
- date of service,
- model and serial number,
- location,
- descriptions of replaced parts,
- biological testing records,
- name and signature of controller.

Microflora on hands



Legend:

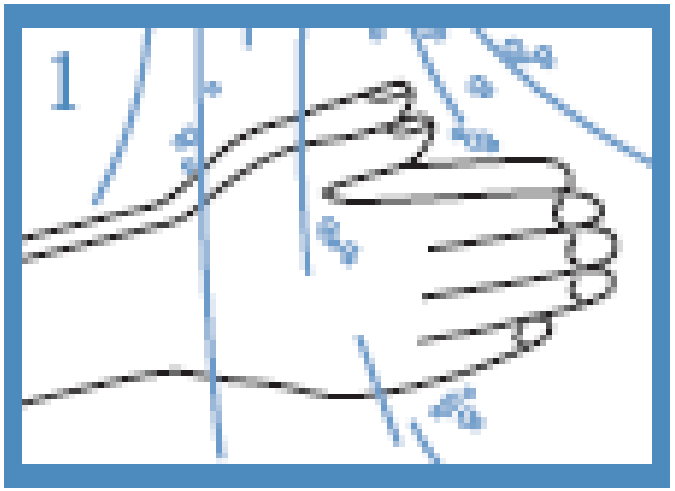
green – very often missed
Yelow – not to much washing
Pink – enough hand washing part of hands

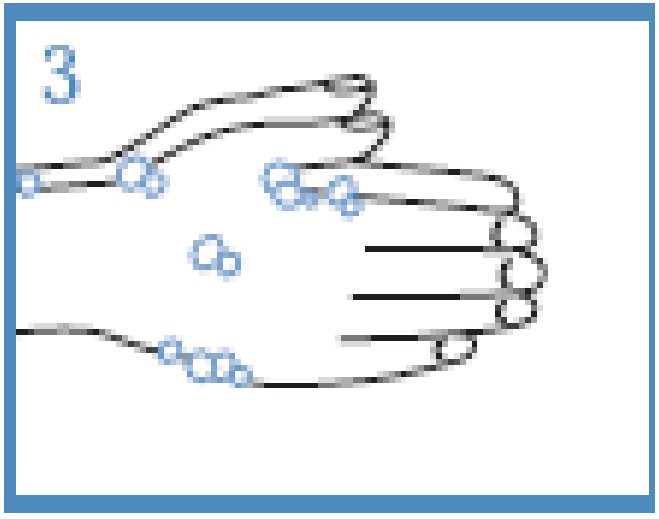
Reducing person-to-person transmission

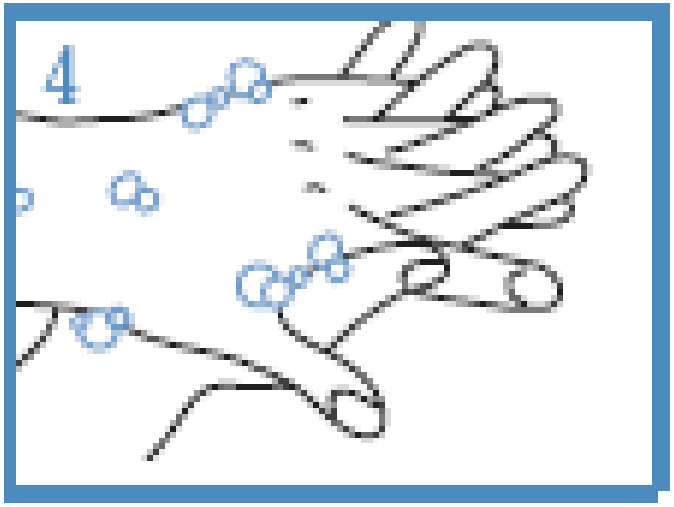
The importance of hands in the transmission of hospital infections has been well demonstrated so can be minimized with **appropriate hand hygiene** and **decontamination**.

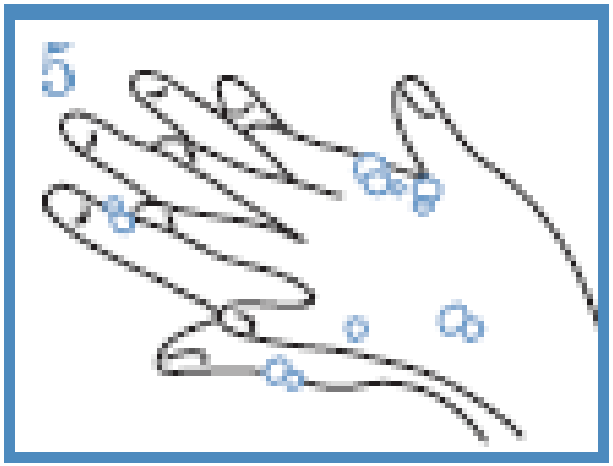
Clean Hands Save Lives

Standard of hand hygiene





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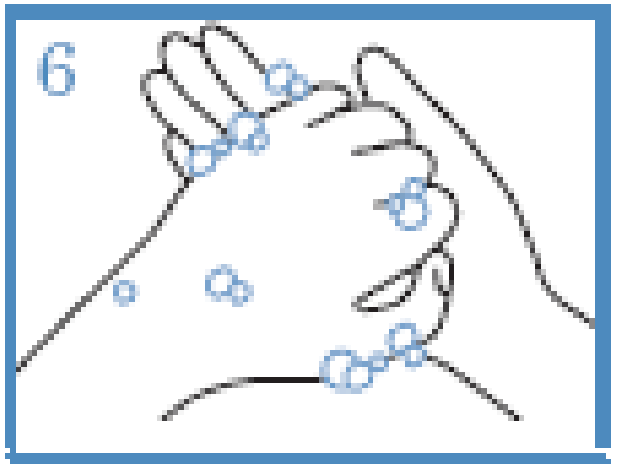
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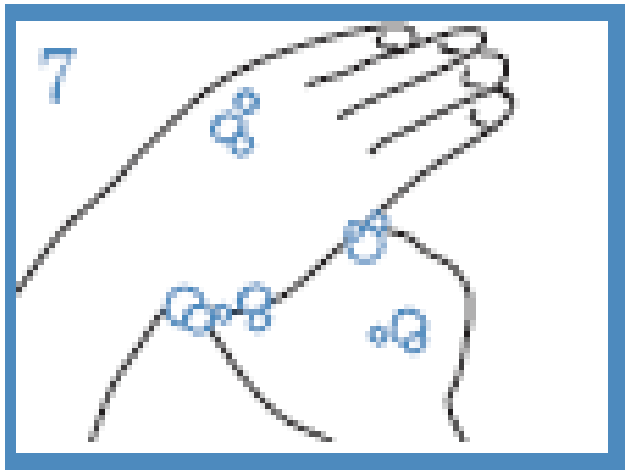
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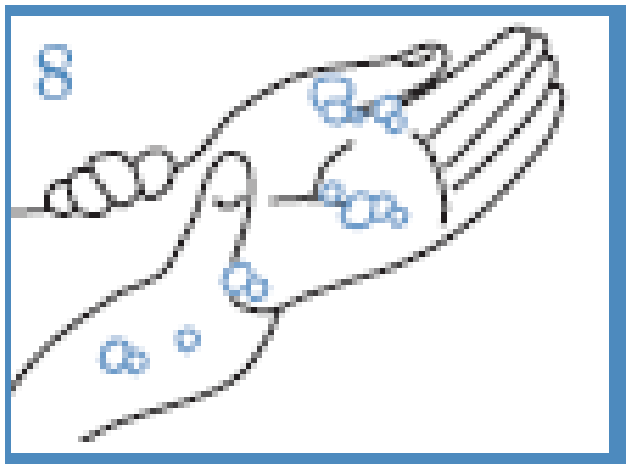
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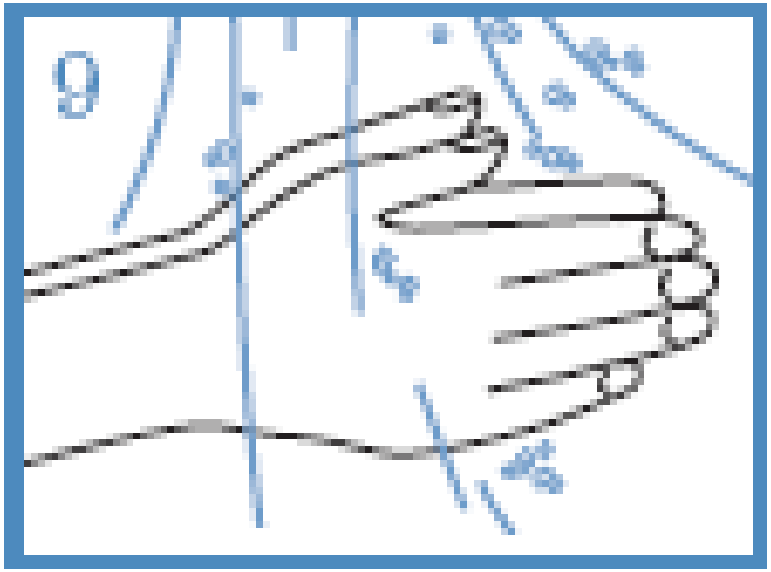
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10

Using a paper towel to grasp the handle of a hand-operated faucet.

The hands are held higher than the elbows during a hand wash before sterile technique.

Surgical disinfection of hands

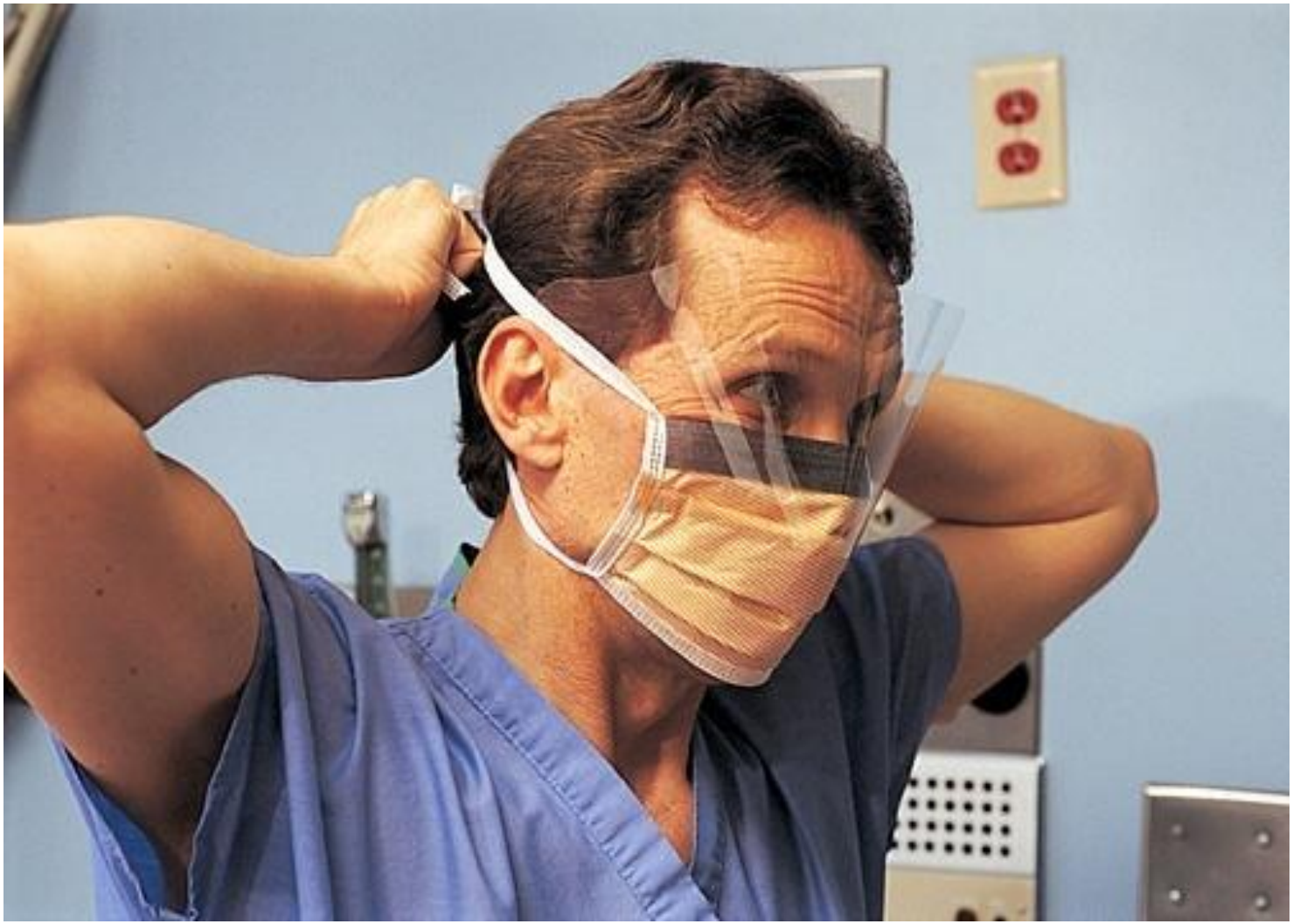
1

2

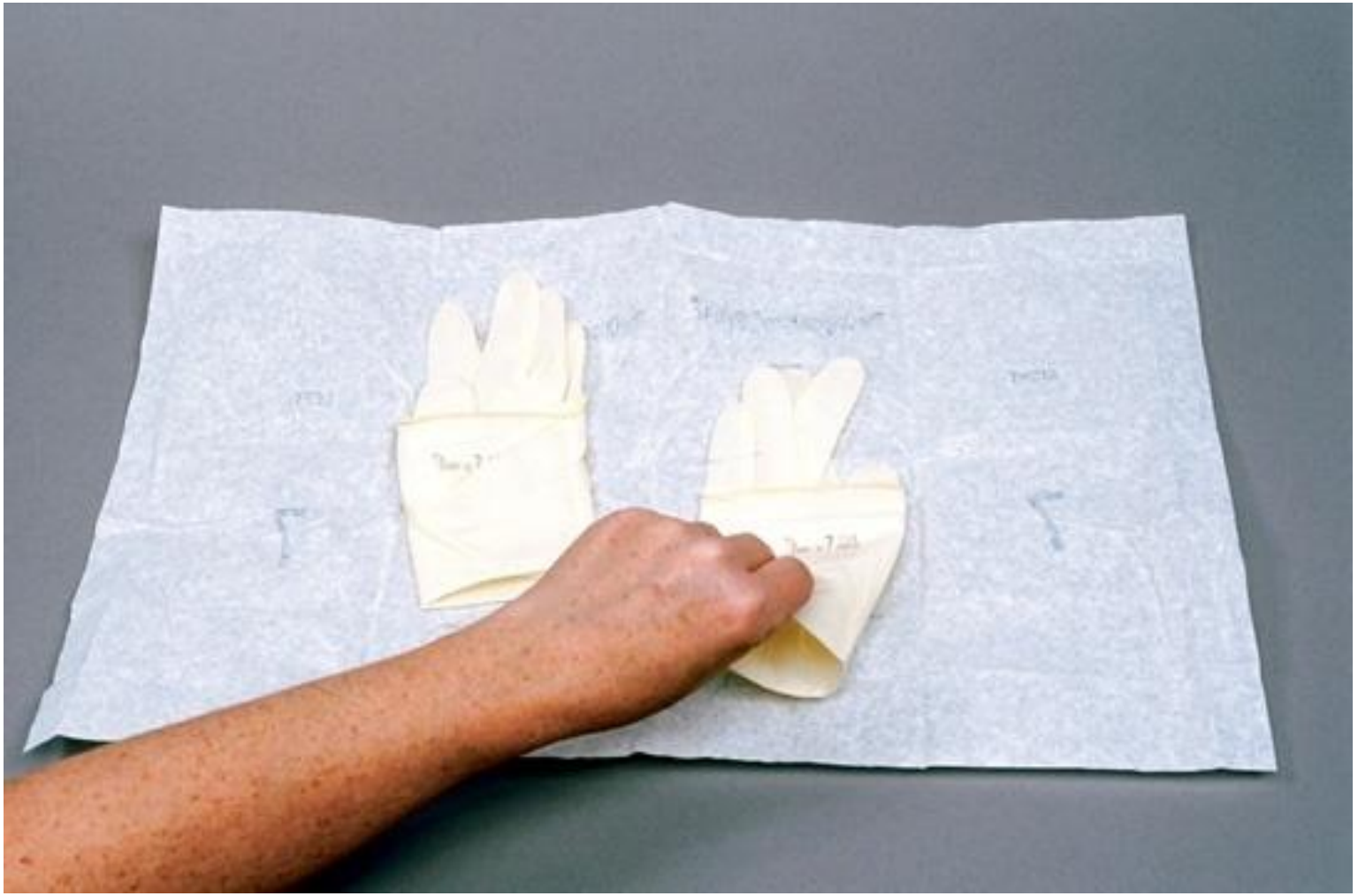
3

1. Water
2. Disinfective soap
3. Washing hand under flow water
4. Dry of hands
5. Desinfectans (2x 5 ml)

A face mask covering the nose, mouth and eyes.



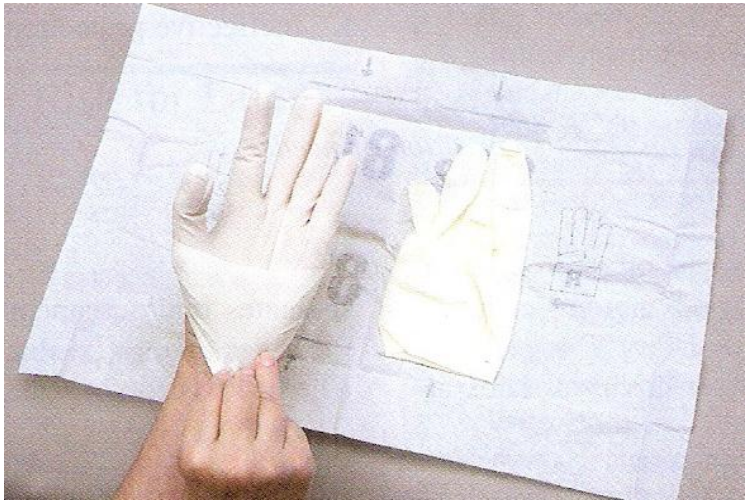
Picking up the first sterile glove.

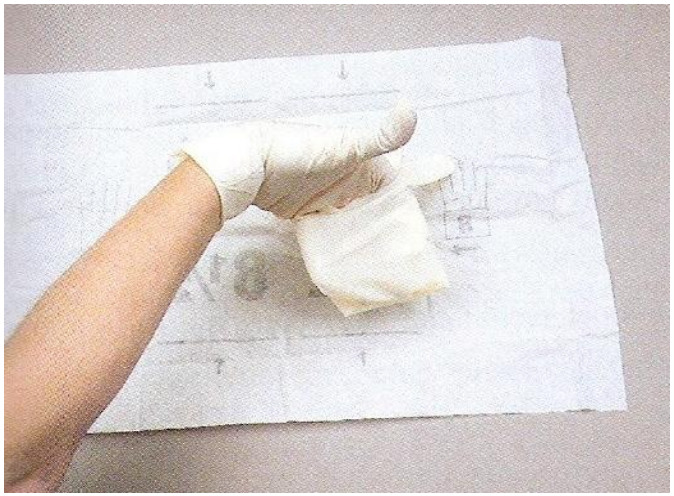


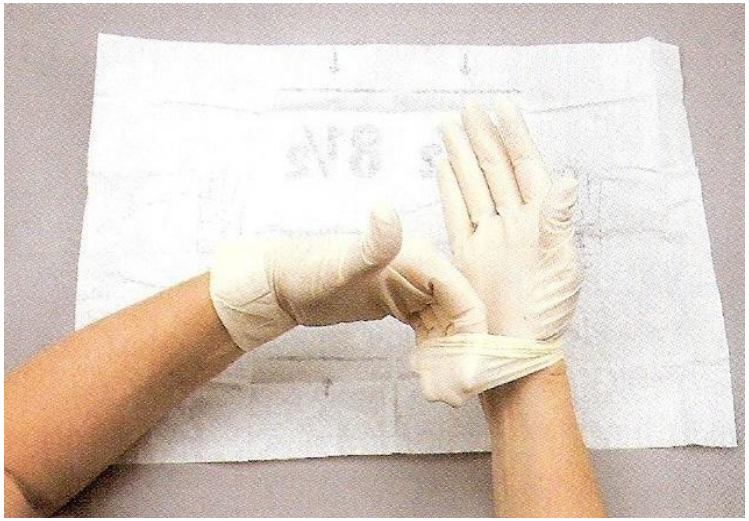
Picking up the second sterile glove.

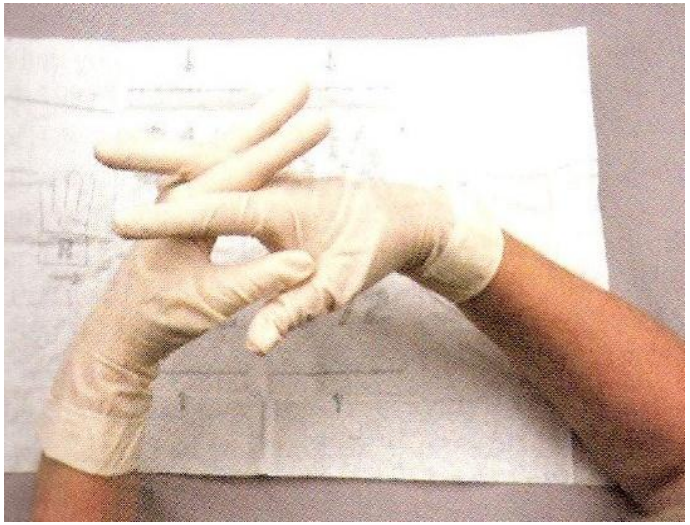
Plucking the palmar surface below the cuff of a contaminated glove.

Donning sterile gloves



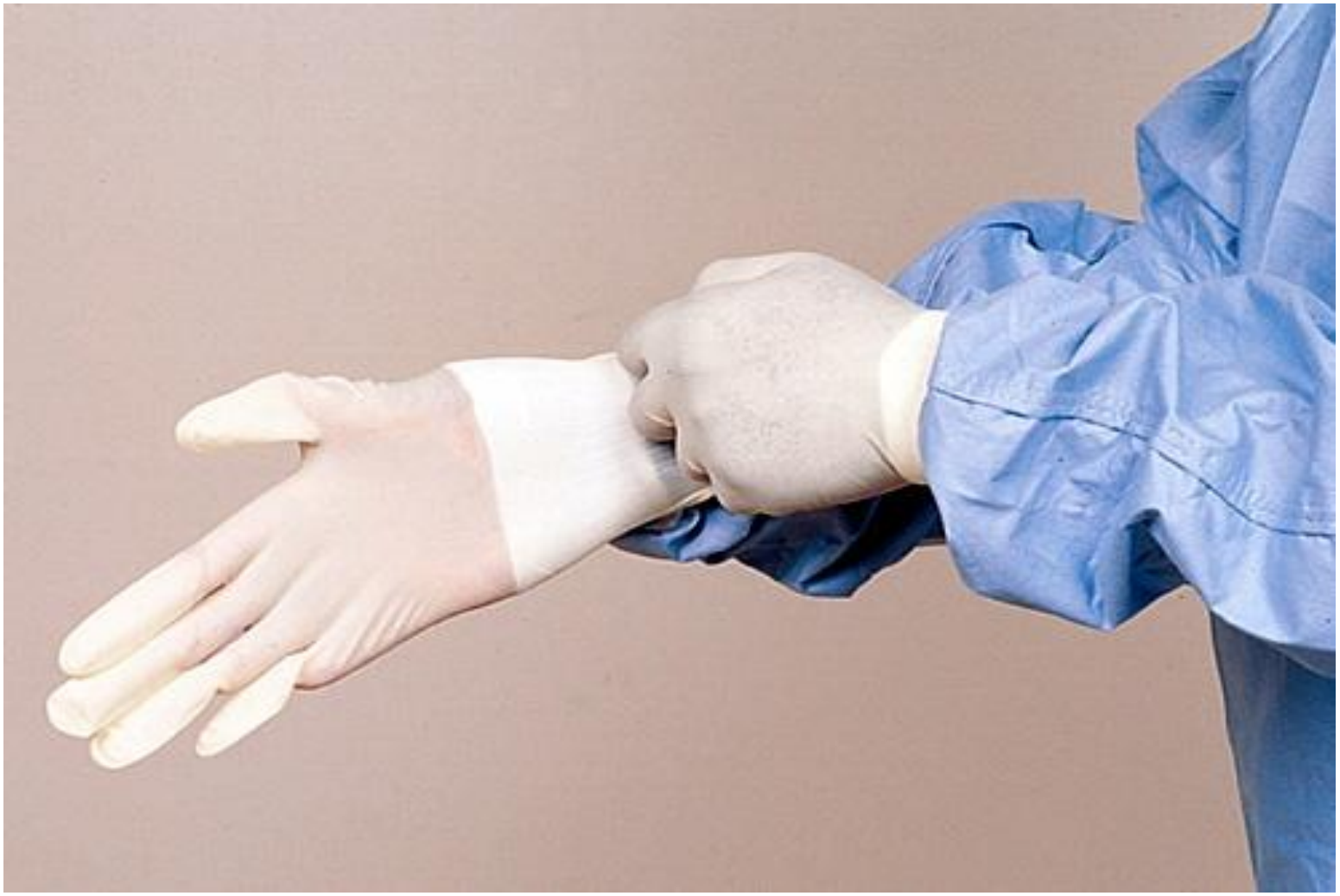






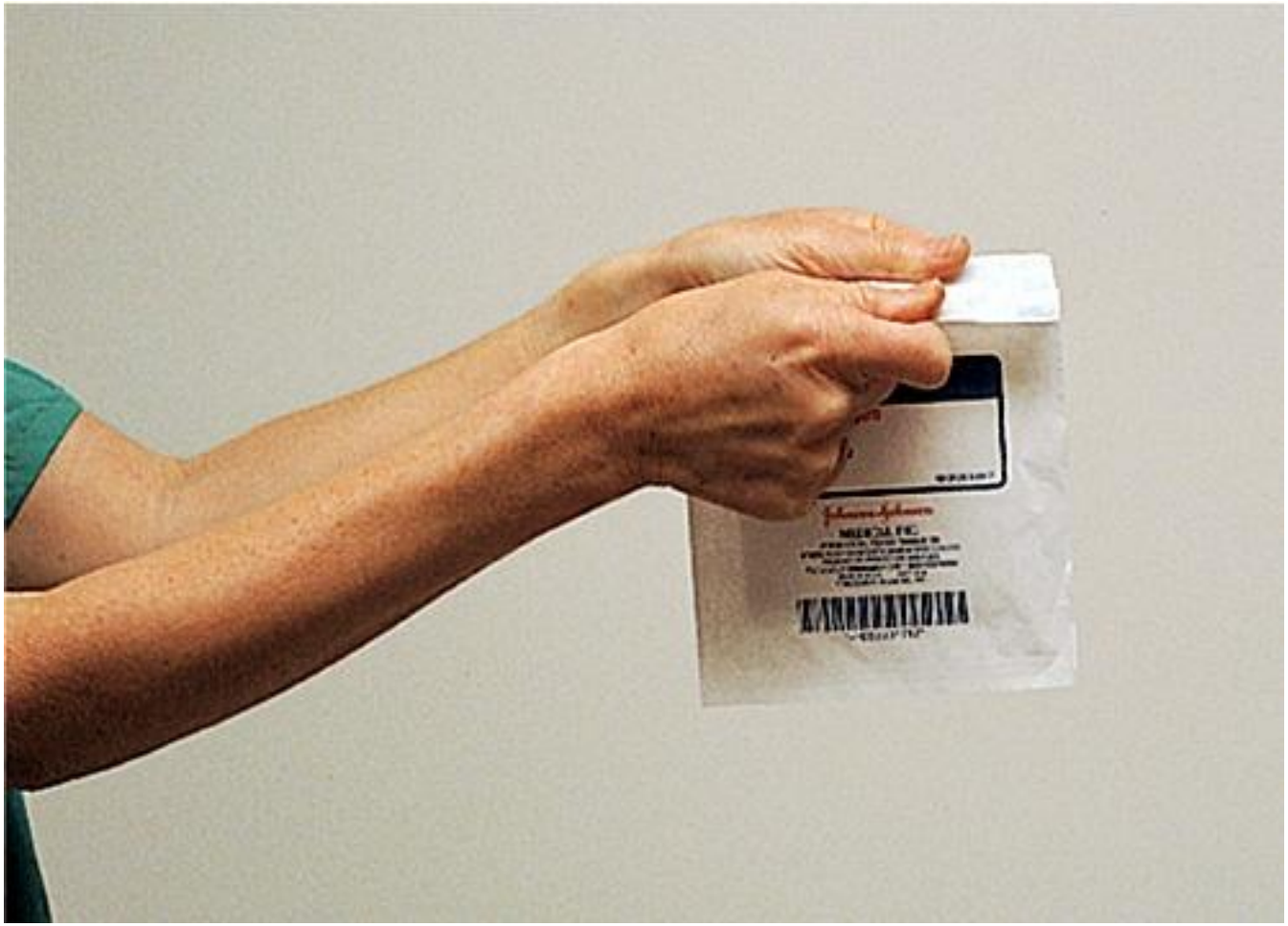
Pulling on the first sterile glove.

Extending the fingers into the second glove of the dominant hand.



Opening the first flap of a sterile wrapped package.

Opening a sterile package that has a partially sealed edge.



Adding commerically packaged gauze to a sterile field.

Thank you for your attention...

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