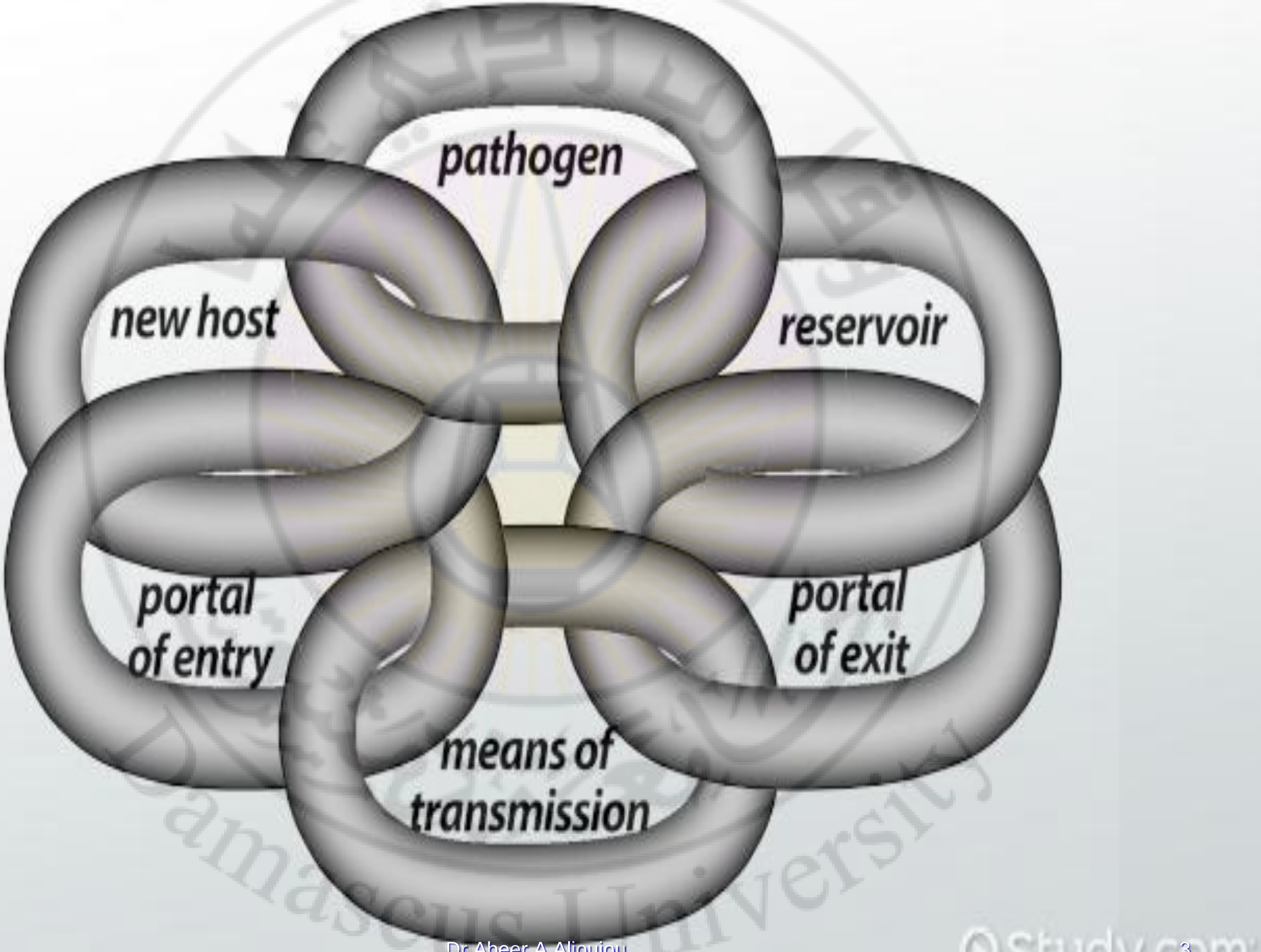
Blood-borne transmission diseases

Dr. Abeer Ahmad Aljoujou
PhD. Oral Medicine

Infection Prevention and Control

DEFINITION: THE CHAIN OF INFECTION



- An infectious agent is a microorganism with the ability to cause an infectious disease.
- The greater the organism’s **virulence**(ability to grow and multiply), **invasiveness** (ability to enter tissue) and **pathogenicity** (ability to cause disease), the greater the possibility the organism will cause an infection. Infectious agents are bacteria, virus, fungi and parasites

- **Reservoirs** : are a place within which microorganisms can thrive and reproduce. For example, microorganisms thrive in human beings, animals, and inanimate objects such as water.

- **Susceptible Host** : is a person who is susceptible to the disease, lacking immunity or physical resistance, to overcome invasion by the microorganism.

- Infectious diseases: are caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another.
- Zoonotic diseases :are infectious diseases of animals that can cause disease when transmitted to humans.

- Among the almost infinite varieties of microorganisms, relatively few cause disease in otherwise healthy individuals.
- Microorganisms that cause disease are known as pathogens

- There's a distinct difference between **infection** and **disease**.
- Infection, often the first step, occurs when pathogens enter the body and begin to multiply.
- Disease occurs when the cells in the body are damaged —as a result of the infection — and signs and symptoms of an illness appear.

Mode of transmission :

- There are three general modes by which a pathogen can be transported from one host to another:
- Direct
- Airborne
- Indirect

Five major routes of transmission

1. Contact:
   - Direct (person-person)
   - Indirect (through an object)
2. Droplet
3. Airborne
4. Common vehicle
5. Vector borne

The same organism may be transmitted by more than one route

- **Direct transmission**:
- By direct or immediate transfer of the agent to an appropriate portal of entry by personal contact, e.g. touching, biting….
- By the direct projection of droplets onto the new host (through sneezing, coughing), but this must occur over a very short distance (1 meter or less) to be considered direct.

- **Airborne transmission:**
- Transfer of an infectious agent via air over longer distances (greater than 1 meter)
- Results when the agent can remain suspended in the air for longer periods of time and/or over larger areas
- Occurs when agents are suspended in either droplet (fluid) or attached to dust particles

- Microorganisms transmitted by this route are carried by dust or other small particles floating in the air and are <5 microns in size. These microorganisms remain suspended in the air and are widely dispersed by air currents. Susceptible hosts, who may be some distance away from the source resident, even in different rooms inhale these microorganisms. Control of airborne transmission is the most difficult, as it requires control of airflow through special ventilation systems.

- Airborne infectious diseases :

- Anthrax الجمرة الخبيثة.
- Chickenpox الجدري.
- Influenza.
- Herpes Zoster الحلأ النطاقي.
- Measles الحصبة.
- SARS (severe acute respiratory syndrome)
- Tuberculosis السل

- **Indirect transmission :**

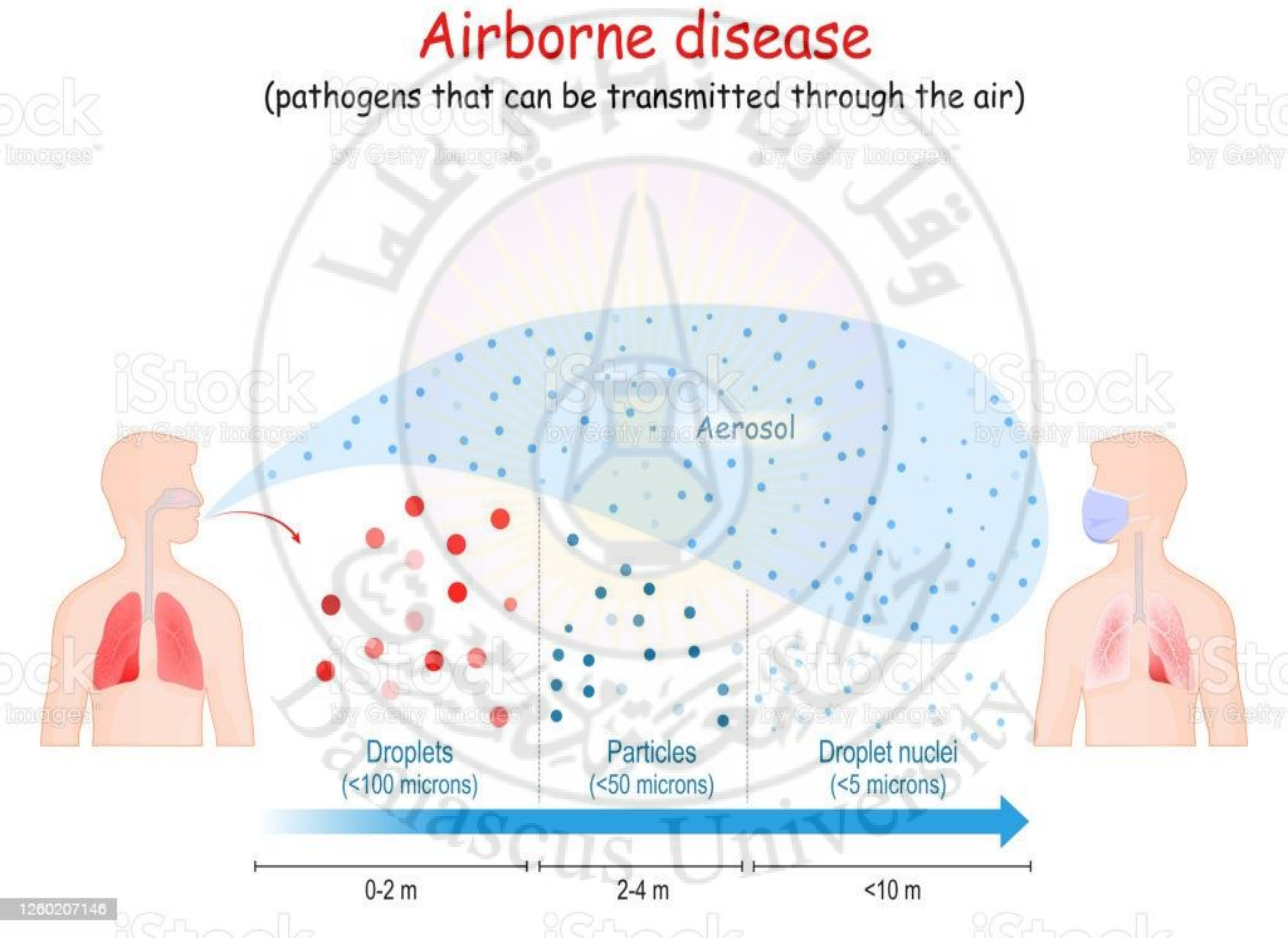
- requires less intimate contact with the source

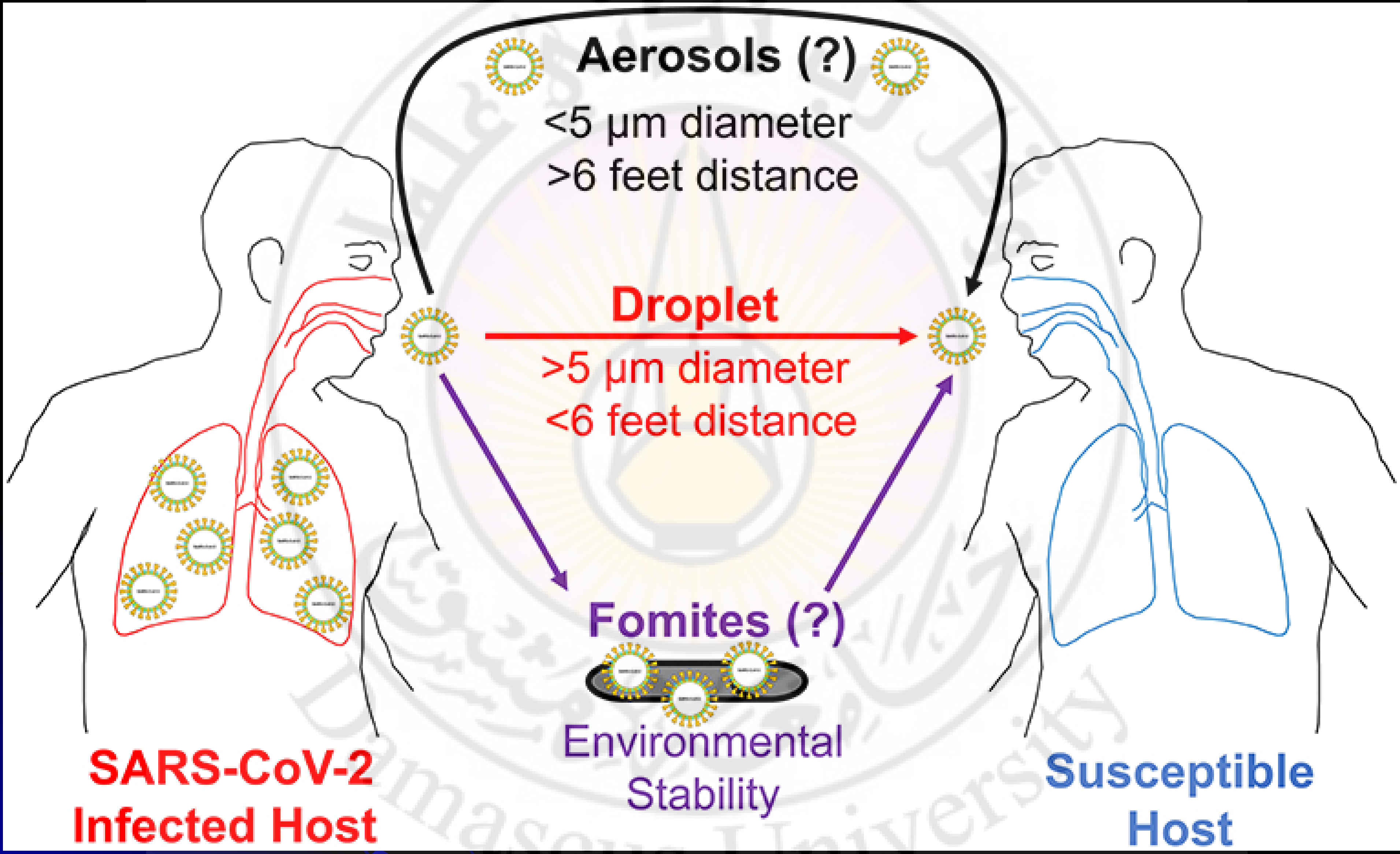
- Two major types of indirect transmission are:
- Vehicle-borne وسط ناقل للعوامل الممرضة
- Vector-borne كائن حي حامل للمرض ميكانيكياً أو بيولوجياً

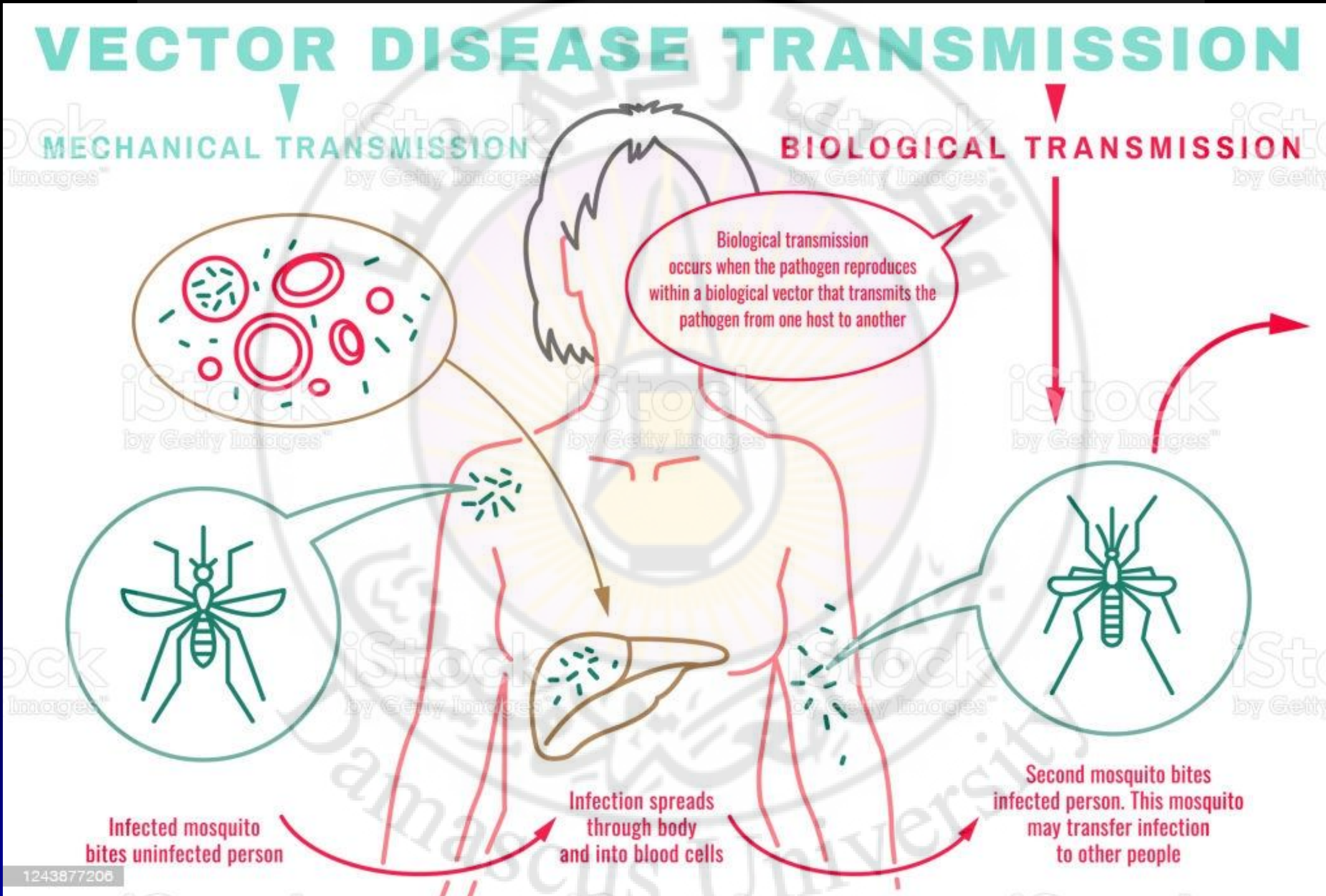
- Common vehicle transmission refers to transmission through a contaminated source. Examples include food, medication, intravenous fluid, or shared equipment that transmits infection to multiple hosts. This transmission may result in a large-scale outbreak

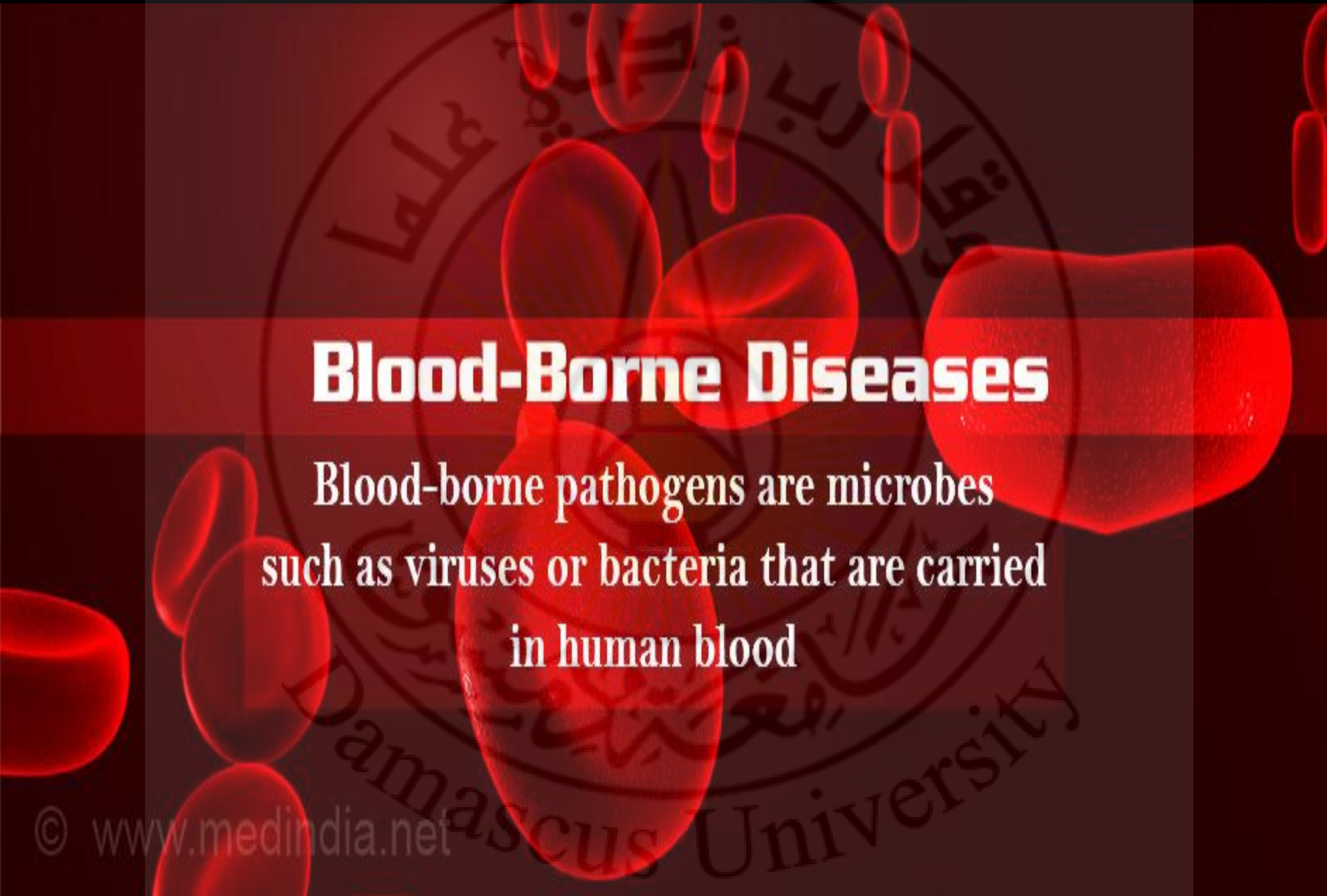
- Vector-borne transmission refers to infections caused by animals and insects. Examples of these infections include, West Nile Virus and Dengue Fever.
- Appropriate facility construction and maintenance, closed or screened windows, and proper housekeeping prevent Vectorborne transmission

- Indirect transmission :
- Waterborne : hepatitis A.
- food borne: salmonella.
- Vectors : malaria


Airborne disease
(pathogens that can be transmitted through the air)
Aerosol
Droplets
(<100 microns)
Particles
(<50 microns)
Droplet nuclei
(<5 microns)
0-2 m
2-4 m
<10 m
1260207146


Aerosols (?)
<5 µm diameter
>6 feet distance
Droplet
>5 µm diameter
<6 feet distance
Fomites (?)
Environmental Stability
SARS-CoV-2 Infected Host
Susceptible Host


VECTOR DISEASE TRANSMISSION
MECHANICAL TRANSMISSION
BIOLOGICAL TRANSMISSION
Biological transmission occurs when the pathogen reproduces within a biological vector that transmits the pathogen from one host to another
Infected mosquito bites uninfected person
Infection spreads through body and into blood cells
Second mosquito bites infected person. This mosquito may transfer infection to other people
1243877206


Blood-Borne Diseases
Blood-borne pathogens are microbes
such as viruses or bacteria that are carried
in human blood
© www.medindia.net

- A blood-borne disease is one that spreads mainly through contamination of blood and other body fluids such as semen, vaginal secretions, amniotic fluid and in some cases, saliva.

- Universal precautions should be taken when workers are exposed to blood or the following bodily fluids:

- Serum, plasma
- Saliva that is or could be contaminated with blood
- Semen
- Vaginal secretions
- Synovial fluid (in the joints)
- Cerebrospinal fluid (in the brain and spine)

- Pleural fluid (in the lungs)
- Peritoneal fluid (in the abdomen)
- Pericardial fluid (around the heart)
- Amniotic fluid (in the amniotic sac around an unborn baby)
- Organs and tissues

- The infection may occur through:

1- transfusion of blood or blood products.

2- sexual contact.

3- contaminated IV drug use.

4- occupational exposure especially in health-care workers.

5- from mother to the baby.

Bloodborne Diseases

- Hepatitis B (HBV)
- Hepatitis C (HCV)
- Human Immunodeficiency Virus (HIV)
- Acquired Immunodeficiency Syndrome (AIDS)

How are Blood-Borne Infections Spread?

- Transmission of blood-borne pathogens has been reported from:

- patient to patient
- patient to health care workers
- and rarely, from health care workers to the patient.

- The transmission may occur due to following reasons:

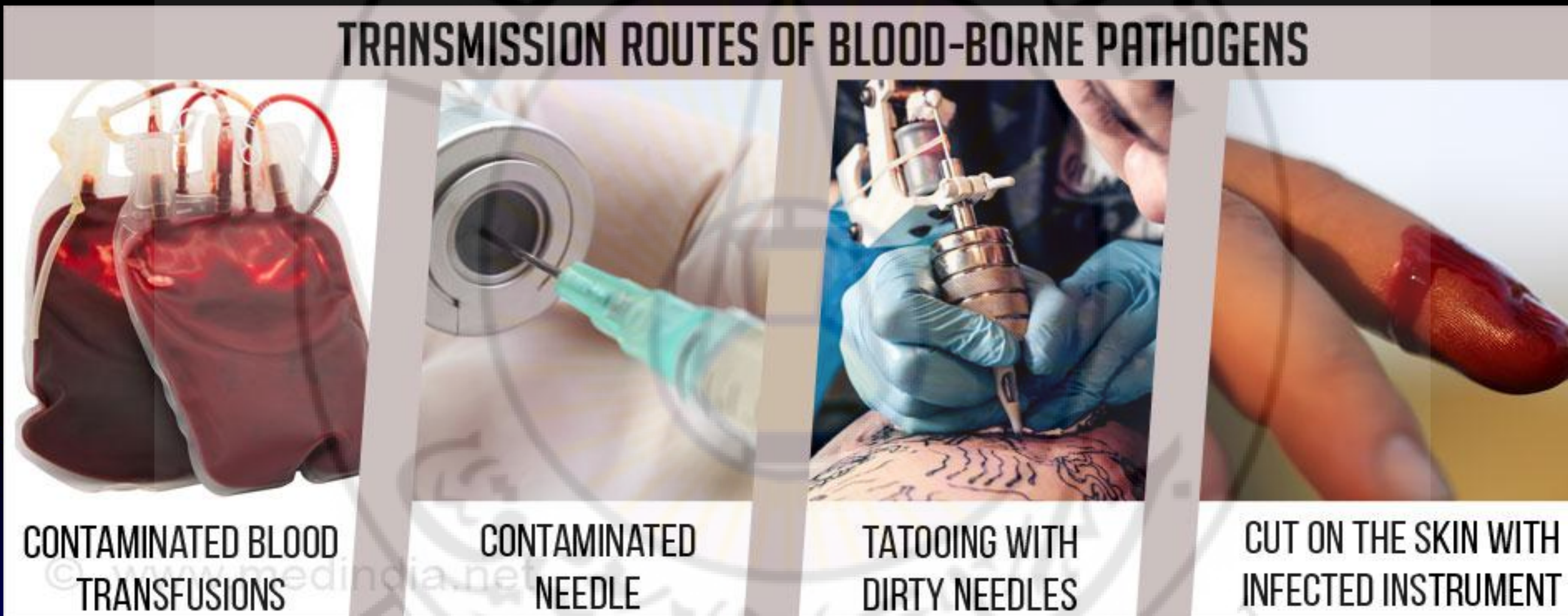
1- Contaminated blood transfusions - The risk of infection after receiving large volumes of infected blood, e.g., from transfusions, is extremely high.

2- Percutaneous exposures - The spread of a blood-borne infection can result from an injection with a contaminated needle or a cut on the skin with any other sharp contaminated instrument.

3- Improper disinfection or sterilization of instruments/equipment after each patient.

4- reuse of single-use items such as needles or blades which can't be properly cleaned and sterilized, and lack of proper regulations of procedures like skin piercing and tattooing can spread the infection.

5- Sharing items such as razors or toothbrushes with an infected person.


TRANSMISSION ROUTES OF BLOOD-BORNE PATHOGENS
CONTAMINATED BLOOD TRANSFUSIONS
CONTAMINATED NEEDLE
TATOOING WITH DIRTY NEEDLES
CUT ON THE SKIN WITH INFECTED INSTRUMENT
© www.medindia.net


HEMODIALYSIS UNITS REQUIRE
SPECIFIC PRECAUTIONS
TO PREVENT BLOOD-BORNE
INFECTIONS
© www.medindia.n

Some of the other Blood-Borne Diseases

- Cytomegalovirus
- Human T-cell lymphotrophic viruses (HTLVs).
- Dengue fever (DF).
- Hebatitis A.
- West Nile virus.

- **Bacterial Infections** : Bacteria are a common cause of infections transmitted through blood transfusion.
- Gram positive bacteria like:

\- *Staphylococcus aureus* المكورات العنقودية الذهبية

\- *Staphylococcus epidermidis* المكورات العنقودية البشروية

- gram negative bacteria like *Escherichia coli* can contaminate blood used for blood transfusion.

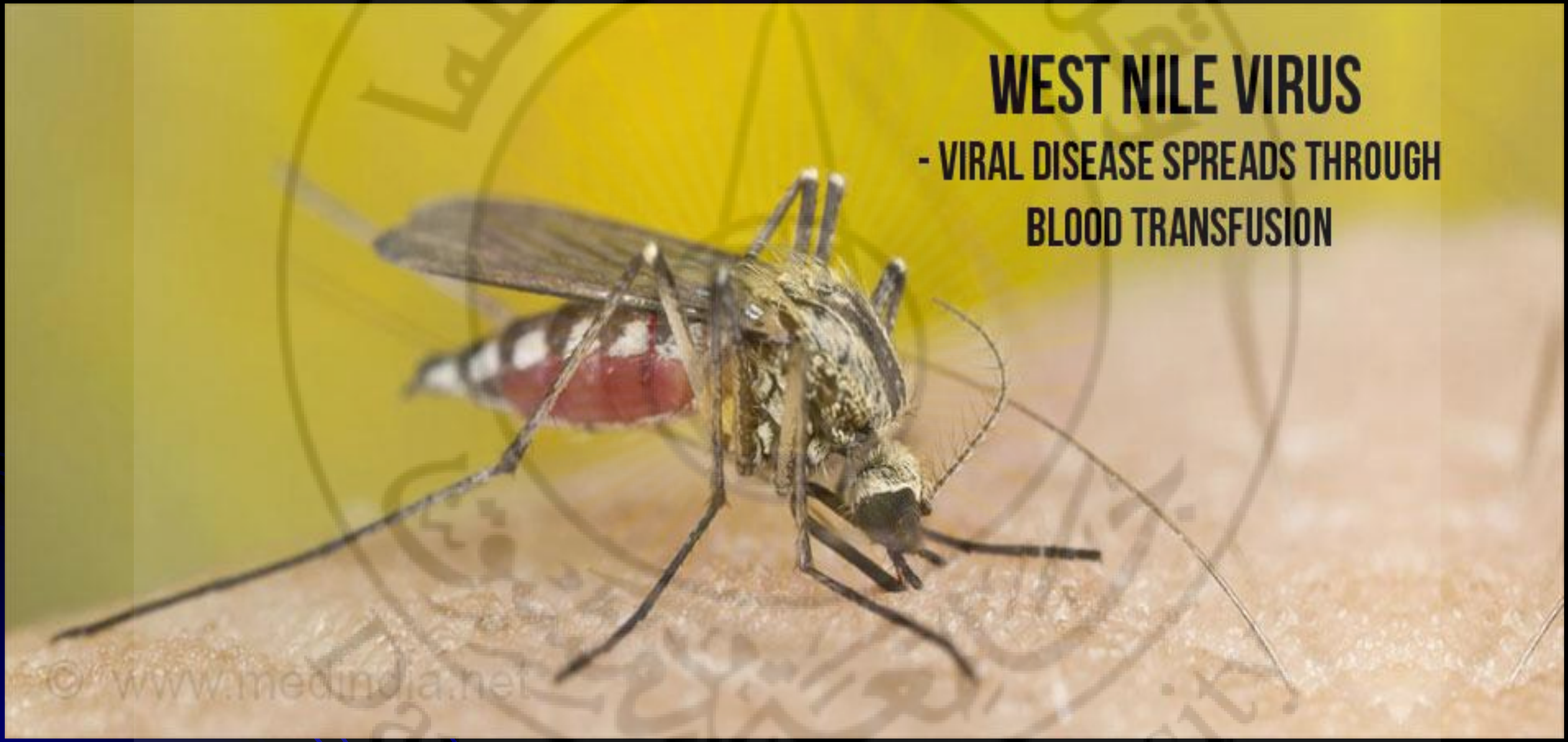
- Other organisms that may rarely be spread through blood transfusion are:
- **Parasitic Diseases :** Transmission of parasitic infections through blood donation is very rare but not impossible.

- Babesiosis .

- Chagas disease

- Leishmaniasis

- Malaria


WEST NILE VIRUS
- VIRAL DISEASE SPREADS THROUGH
BLOOD TRANSFUSION
© www.medindia.net

Hepatitis B virus (HBV)

- Hepatitis B is a viral infection that attack the liver and can cause both acute and chronic disease .
- It is an important occupational hazard for health workers.
- Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus.
- However it can be prevented by currently available safe and effective vaccine.

epidemiology

- An estimated 257 million people are living with hepatitis B virus infection (defined as hepatitis B surface antigen positive).
- In 2015, hepatitis B resulted in 887,000 deaths, mostly from complications (including cirrhosis and hepatocellular carcinoma).

- Hepatitis B virus (HBV) has long been recognized as an occupational risk for health-care personnel (HCP).
- The virus remains infectious for prolonged periods on environmental surfaces and is transmissible in the absence of visible blood.

- **How long does HBV survive outside the body?**

HBV can survive outside the body at least 7 days and still be capable of causing infection

What are the signs and symptoms of HBV infection?

- The presence of signs and symptoms varies by age. Most children under age 5 years and newly infected immunosuppressed adults are asymptomatic, whereas 30%–50% of persons aged ≥5 years have initial signs and symptoms:

signs and symptoms for can include

- Fever
- Fatigue
- Loss of appetite
- Nausea
- Vomiting
- Abdominal pain
- Dark urine
- Joint pain
- Jaundice

- **What is the incubation period for hepatitis B?**

Symptoms begin an average of 90 days (range: 60–150 days) after exposure to HBV.

- **When symptoms of acute hepatitis B occur, how long do they usually last?**

- Symptoms typically last for several weeks but can persist for up to 6 months.

- **How serious is acute HBV infection?**

- Acute infection ranges from asymptomatic or mild disease to — rarely — fulminant hepatitis (acute liver failure). Disease is more severe among adults aged >60 years. The fatality rate among acute cases reported to CDC is 0.5%–1%.

- The likelihood that infection becomes chronic depends upon the age .
- Children less than 6 years of age who become infected with HBV are the most likely to develop chronic infections.
- In adults : less than 5% of healthy persons who are infected will develop chronic infection .
- approximately 95% of adults recover completely from HBV infection and do not become chronically infected.

HBV-HIV coinfection

- About 1% of HBV patients (2,7 million) are also infected with HIV.
- The global prevalence of HBV infection in HIV infected persons is 7,4%.

How is HBV infection treated?

- For acute infection, no medication is available; treatment is supportive.
- There are several antiviral medications for persons with chronic infection. Persons with chronic HBV infection require linkage to care with regular monitoring to prevent liver damage and/or hepatocellular carcinoma.

Geographical distribution

- Hepatitis B prevalence is highest in the WHO Western Pacific Region and the WHO African Region, where 6.2% and 6.1% respectively of the adult population is infected. In the WHO Eastern Mediterranean Region, the WHO South-East Asia Region and the WHO European Region, an estimated 3.3%, 2.0% and 1.6%% of the general population is infected, respectively. 0.7% of the population of the WHO Region of the Americas is infected

Diagnosis

- It is not possible, on clinical grounds, to differentiate hepatitis B from hepatitis caused by other viral agents and, hence, laboratory confirmation of the diagnosis is essential. A number of blood tests are available to diagnose and monitor people with hepatitis B. <u>They can be used to distinguish acute and chronic infections</u>.

diagnosis

- Laboratory diagnosis of hepatitis B infection focuses on the detection of the hepatitis B surface antigen HBsAg.
- WHO recommends that all blood donations be tested for hepatitis B to ensure blood safety and avoid accidental transmission to people who receive blood products.

- Acute HBV infection is characterized by the presence of HBsAg and immunoglobulin M (IgM) antibody to the core antigen, HBcAg. During the initial phase of infection, patients are also seropositive for hepatitis B e antigen (HBeAg). HBeAg is usually a marker of high levels of replication of the virus. The presence of HBeAg indicates that the blood and body fluids of the infected individual are highly infectious.

- Chronic infection is characterized by the persistence of HBsAg for at least 6 months (with or without concurrent HBeAg).
- Persistence of HBsAg is the principal marker of risk for developing chronic liver disease and liver cancer (hepatocellular carcinoma) later in life.

Treatment

- There is no specific treatment for *acute* hepatitis B. Therefore, care is aimed at maintaining comfort and adequate nutritional balance, including replacement of fluids lost from vomiting and diarrhoea.

Treatment

- *Chronic* hepatitis B infection can be treated with medicines, including oral antiviral agents. Treatment can slow the progression of cirrhosis, reduce incidence of liver cancer and improve long term survival.

- WHO recommends the use of oral treatments - tenofovir or entecavir, because these are the most potent drugs to suppress hepatitis B virus. They rarely lead to drug resistance as compared with other drugs, are simple to take (1 pill a day), and have few side effects so require only limited monitoring.

- In most people, however, <u>the treatment does not cure hepatitis B infection</u>, but only suppresses the replication of the virus. Therefore, most people who start hepatitis B treatment must continue it for life.

prevention

- The hepatitis B vaccine is the mainstay of hepatitis B prevention. WHO recommends that all infants receive the hepatitis B vaccine as soon as possible after birth, preferably within 24 hours. The low incidence of chronic HBV infection in children under 5 years of age at present can be attributed to the widespread use of hepatitis B vaccine.

Hepatitis C

- The hepatitis C virus is a bloodborne virus and the most common modes of infection are through exposure to <u>small quantities of blood</u>.
- Hepatitis C virus (HCV) causes both acute and chronic infection. Acute HCV infection is usually asymptomatic, and is only very rarely associated with life-threatening disease.

- About 15–45% of infected persons spontaneously clear the virus within 6 months of infection without any treatment
- The remaining 55–85% of persons will develop chronic HCV infection. Of those with chronic HCV infection, the risk of cirrhosis of the liver is between 15–30% within 20 years.

Geographical distribution

- Hepatitis C is found worldwide. The most affected regions are WHO Eastern Mediterranean and European Regions, with the prevalence of 2.3% and 1.5% respectively. Prevalence of HCV infection in other WHO regions varies from 0.5% to 1.0%.

Transmission

- injecting drug use through the sharing of injection equipment;
- the reuse or inadequate sterilization of medical equipment, especially syringes and needles in healthcare settings; and
- the transfusion of unscreened blood and blood products.
- HCV can also be transmitted sexually and can be passed from an infected mother to her baby; however these modes of transmission are much less common.
- Hepatitis C is not spread through breast milk, food, water or by casual contact such as hugging, kissing and sharing food or drinks with an infected person.

Symptoms

- The incubation period for hepatitis C is 2 weeks to 6 months. Following initial infection, approximately 80% of people do not exhibit any symptoms. Those who are acutely symptomatic may exhibit fever, fatigue, decreased appetite, nausea, vomiting, abdominal pain, dark urine, grey-coloured faeces, joint pain and jaundice (yellowing of skin and the whites of the eyes).

Screening and diagnosis

- Due to the fact that acute HCV infection is usually asymptomatic, few people are diagnosed during the acute phase. In those people who go on to develop chronic HCV infection, the infection is also often undiagnosed because the infection remains asymptomatic until decades after infection when symptoms develop secondary to serious liver damage.

Screening and diagnosis

- HCV infection is diagnosed in 2 steps:

- Screening for anti-HCV antibodies with a serological test identifies people who have been infected with the virus.

- If the test is positive for anti-HCV antibodies, a nucleic acid test for HCV ribonucleic acid (RNA) is needed to confirm chronic infection because about 15–45% of people infected with HCV spontaneously clear the infection by a strong immune response without the need for treatment. Although no longer infected, they will still test positive for anti-HCV antibodies.

- After a person has been diagnosed with chronic hepatitis C infection, they should have an assessment of the degree of liver damage (fibrosis and cirrhosis). This can be done by liver biopsy or through a variety of non-invasive tests

- In addition, these people should have a laboratory test to identify the genotype of the hepatitis C strain. There are 6 genotypes of the HCV and they respond differently to treatment. Furthermore, it is possible for a person to be infected with more than 1 genotype. The degree of liver damage and virus genotype are used to guide treatment decisions and management of the disease

Treatment

- Hepatitis C does not always require treatment as the immune response in some people will clear the infection, and some people with chronic infection do not develop liver damage. When treatment is necessary, the goal of hepatitis C treatment is cure. The cure rate depends on several factors including the strain of the virus and the type of treatment given.

Treatment

- The standard of care for hepatitis C is changing rapidly.
- Sofosbuvir
- daclatasvir
- and the sofosbuvir / ledipasvir combination are part of the preferred regimens in the WHO guidelines, and can achieve cure rates above 95%. These medicines are much more effective, safer and better-tolerated than the older therapies

World Health Organization

ACCESS TO HEPATITIS C TREATMENT 2016

With a 3-month treatment, over 95% of people infected with chronic hepatitis C can be cured.

Prevention

Primary prevention

- There is no vaccine for hepatitis C, therefore prevention of HCV infection depends upon reducing the risk of exposure to the virus in health-care settings and in higher risk populations, for example, people who inject drugs, and through sexual contact

Prevention

- **Secondary and tertiary prevention**

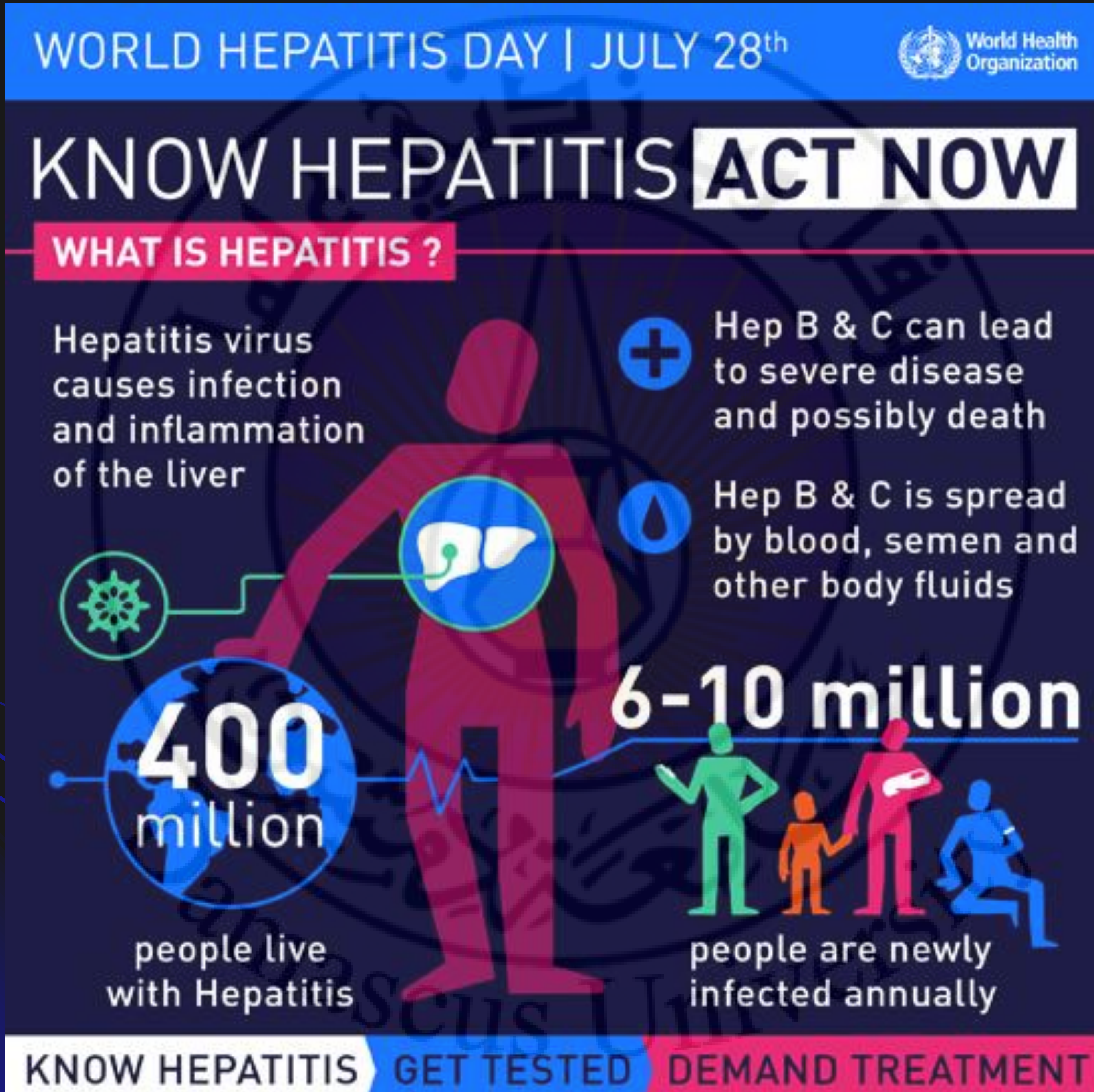
- For people infected with the hepatitis C virus, WHO recommends:

- education and counselling on options for care and treatment;

- immunization with the hepatitis A and B vaccines to prevent coinfection from these hepatitis viruses and to protect their liver.

- early and appropriate medical management including antiviral therapy if appropriate; and

-regular monitoring for early diagnosis of chronic liver disease.



WORLD HEPATITIS DAY | JULY 28th
World Health Organization
KNOW HEPATITIS ACT NOW
WHAT IS HEPATITIS ?
Hepatitis virus causes infection and inflammation of the liver
Hep B & C can lead to severe disease and possibly death
Hep B & C is spread by blood, semen and other body fluids
400 million
people live with Hepatitis
6-10 million
people are newly infected annually
KNOW HEPATITIS
GET TESTED
DEMAND TREATMENT

BOX 2. Factors to consider in assessing the need for follow-up of occupational exposures

- **Type of exposure**
  - Percutaneous injury
  - Mucous membrane exposure
  - Nonintact skin exposure
  - Bites resulting in blood exposure to either person involved

- **Type and amount of fluid/tissue**
  - Blood
  - Fluids containing blood
  - Potentially infectious fluid or tissue (semen; vaginal secretions; and cerebrospinal, synovial, pleural, peritoneal, pericardial, and amniotic fluids)
  - Direct contact with concentrated virus

- **Infectious status of source**
  - Presence of HBsAg
  - Presence of HCV antibody
  - Presence of HIV antibody

- **Susceptibility of exposed person**
  - Hepatitis B vaccine and vaccine response status
  - HBV, HCV, and HIV immune status

HIV/AIDS

- HIV continues to be a major global public health issue, having claimed more than 35 million lives so far. In 2016, 1.0 million people died from HIV-related causes globally.
- There were approximately 36.7 million people living with HIV at the end of 2016 with 1.8 million people becoming newly infected in 2016 globally.

- The Human Immunodeficiency Virus (HIV) targets the immune system and weakens people's defence systems against infections and some types of cancer. As the virus destroys and impairs the function of immune cells, infected individuals gradually become immunodeficient. Immune function is typically measured by CD4 cell count.

- Immunodeficiency results in increased susceptibility to a wide range of infections, cancers and other diseases that people with healthy immune systems can fight off.
- The most advanced stage of HIV infection is Acquired Immunodeficiency Syndrome (AIDS), which can take from 2 to 15 years to develop depending on the individual. AIDS is defined by the development of certain cancers, infections, or other severe clinical manifestations.

Signs and symptoms

- The symptoms of HIV vary depending on the stage of infection. Though people living with HIV tend to be most infectious in the first few months, many are unaware of their status until later stages. The first few weeks after initial infection, individuals may experience no symptoms or an influenza-like illness including fever, headache, rash, or sore throat.

- As the infection progressively weakens the immune system, an individual can develop other signs and symptoms, such as: swollen lymph nodes, weight loss, fever, diarrhoea and cough.
- Without treatment, they could also develop severe illnesses such as :

- Tuberculosis
- cryptococcal meningitis
- severe bacterial infections and cancers such as lymphomas and Kaposi's sarcoma, among others.

Transmission

- HIV can be transmitted via the exchange of a variety of body fluids from infected individuals, such as blood, breast milk, semen and vaginal secretions. Individuals cannot become infected through ordinary day-to-day contact such as kissing, hugging, shaking hands, or sharing personal objects, food or water.

Risk factors

- Behaviours and conditions that put individuals at greater risk of contracting HIV include:
- having another sexually transmitted infection such as syphilis, herpes, chlamydia, gonorrhoea, and bacterial vaginosis;
- sharing contaminated needles, syringes and other injecting equipment and drug solutions.
- receiving unsafe injections, blood transfusions, tissue transplantation, medical procedures that involve unsterile cutting or piercing.
- experiencing accidental needle stick injuries, including among health workers.

Diagnosis

- Most individuals develop antibodies to HIV within 28 days of infection and therefore antibodies may not be detectable early, during the so-called **window period**. This early period of infection represents the time of greatest infectivity; however HIV transmission can occur during all stages of the infection.

diagnosis

- No single HIV test can provide an HIV-positive diagnosis. It is important that these tests are used in combination and in a specific order that has been validated and is based on HIV prevalence of the population being tested

Prevention

Individuals can reduce the risk of HIV infection by limiting exposure to risk factors.

- **Antiretroviral ART drug use for prevention**
- In 2011 trials have confirmed that if an HIV-positive person adheres to an effective ART regimen, the risk of transmitting the virus to their uninfected sexual partner can be reduced by 96%. The WHO recommendation to initiate ART in all people living with HIV will contribute significantly to reducing HIV transmission.

Treatment

- HIV can be suppressed by combination ART consisting of 3 or more ART drugs. ART does not cure HIV infection but suppresses viral replication within a person's body and allows an individual's immune system to strengthen and regain the capacity to fight off infections.

- In 2016, WHO released the second edition of the Consolidated guidelines on the use of antiretroviral drugs for treating and preventing HIV infection. These guidelines recommend to provide lifelong ART to all people living with HIV, including children, adolescents and adults, pregnant and breastfeeding women, regardless of clinical status or CD4 cell count. By July 2017, 122 countries already have adopted this recommendation by mid-2017, which covers more than 90% of all PLHIV globally.

Immunization & Vaccines

- A vaccine is a biological preparation that improves immunity to a particular disease. A vaccine typically contains an agent that resembles a disease-causing microorganism, and is often made from weakened or killed forms of the microbe, its toxins or one of its surface proteins.
- The agent stimulates the body's immune system to recognize the agent as foreign, destroy it, and "remember" it, so that the immune system can more easily recognize and destroy any of these microorganisms that it later encounters.

Vaccine-preventable diseases and immunization

- Avian influenza
- Cholera
- Diphtheria
- Encephalitis, viral
- *Haemophilus influenzae*
- Hepatitis
- Measles

- Meningococcal disease
- Mumps
- Pandemic influenza
- Pertussis
- Pneumococcal disease
- Poliomyelitis
- Rotavirus gastroenteritis
- Rubella/congenital rubella syndrome
- Rabies
- Smallpox

- Tetanus
- Tuberculosis
- Typhoid fever
- Yellow fever

WHO Recommendation: Routine Immunizations for Children

- **Recommendations for all children:**

1- BCG

2- hepatitis B

3- polio (bOPV + IPV)

4- DTP-containing vaccine

5-Haemophilus influenzae type b

6- Pneumococcal (Conjugate)

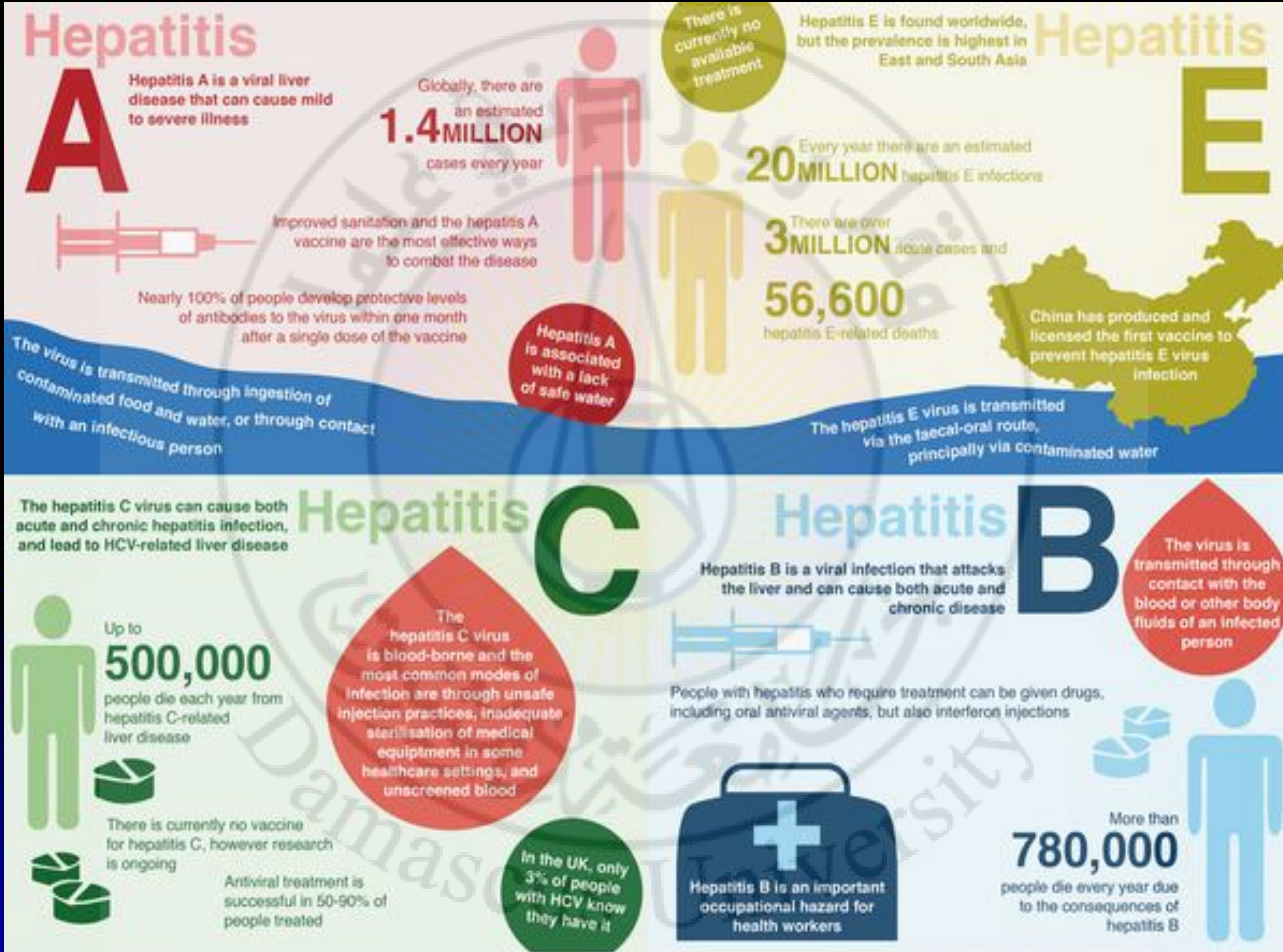
7- Rotavirus

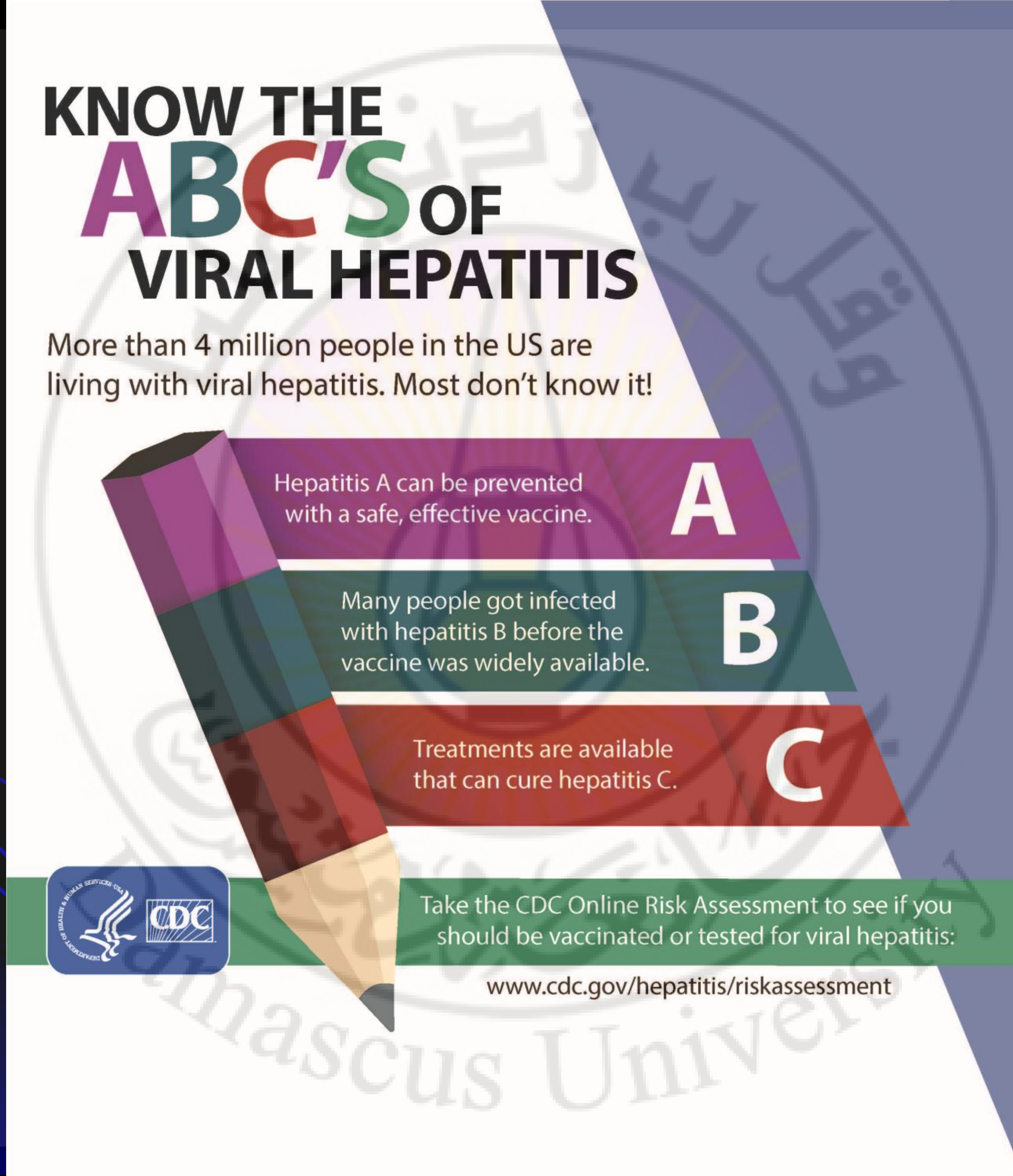
8- Measles

9-Rubella

10- HPV

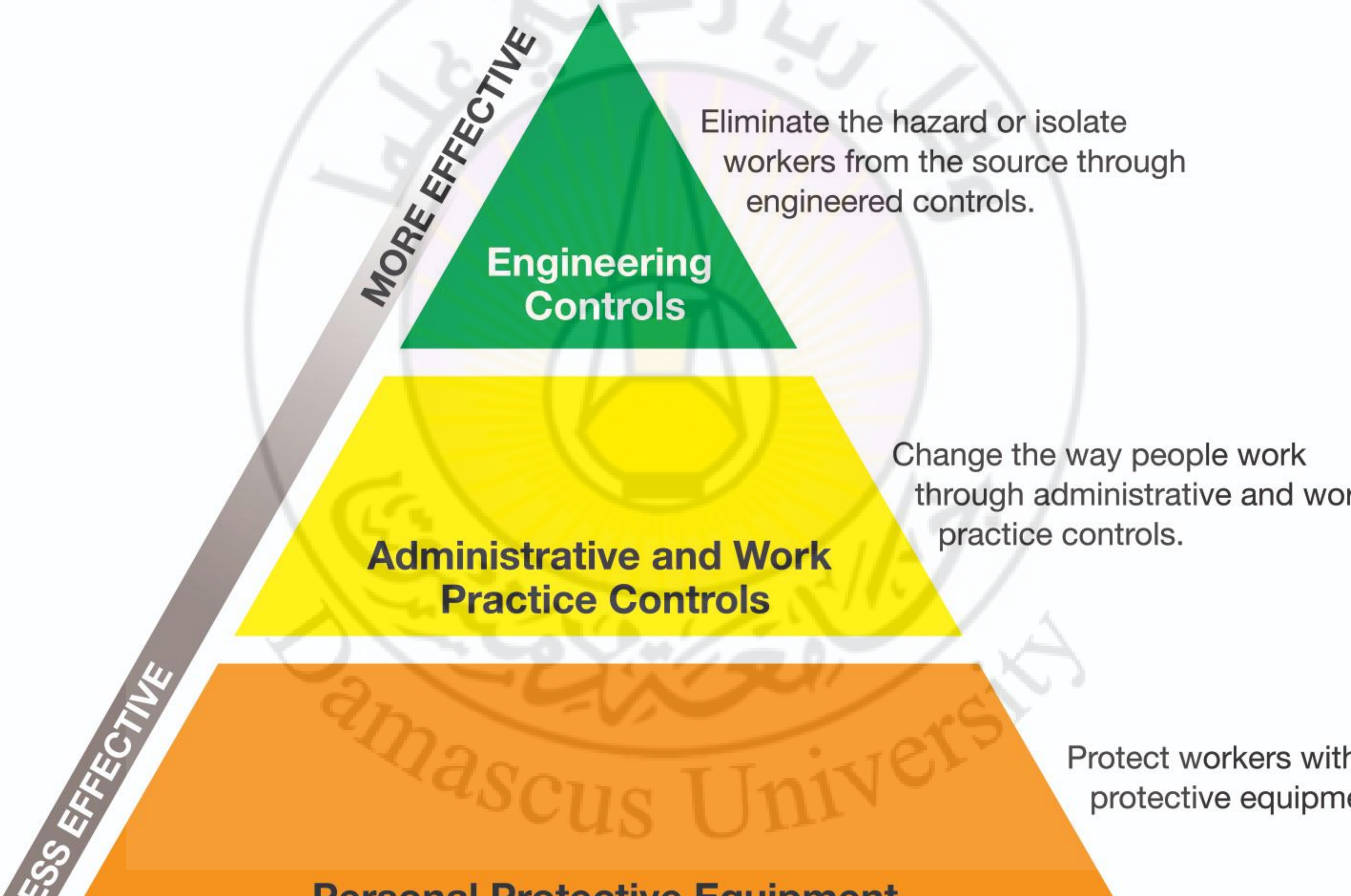
- **Recommended Immunization Schedule for Children and Adolescents Aged 18 Years or Younger, United States, 2018**


Hepatitis A
Hepatitis A is a viral liver disease that can cause mild to severe illness
Globally, there are an estimated 1.4 MILLION cases every year
Improved sanitation and the hepatitis A vaccine are the most effective ways to combat the disease
Nearly 100% of people develop protective levels of antibodies to the virus within one month after a single dose of the vaccine
Hepatitis A is associated with a lack of safe water
The virus is transmitted through ingestion of contaminated food and water, or through contact with an infectious person
There is currently no available treatment
Hepatitis E is found worldwide, but the prevalence is highest in East and South Asia
Hepatitis E
Every year there are an estimated 20 MILLION hepatitis E infections
There are over 3 MILLION acute cases and
56,600 hepatitis E-related deaths
China has produced and licensed the first vaccine to prevent hepatitis E virus infection
The hepatitis E virus is transmitted via the faecal-oral route, principally via contaminated water
The hepatitis C virus can cause both acute and chronic hepatitis infection, and lead to HCV-related liver disease
Hepatitis C
Up to 500,000 people die each year from hepatitis C-related liver disease
The hepatitis C virus is blood-borne and the most common modes of infection are through unsafe injection practices, inadequate sterilisation of medical equipment in some healthcare settings, and unscreened blood
There is currently no vaccine for hepatitis C, however research is ongoing
Antiviral treatment is successful in 50-90% of people treated
In the UK, only 3% of people with HCV know they have it
Hepatitis B
Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease
The virus is transmitted through contact with the blood or other body fluids of an infected person
People with hepatitis who require treatment can be given drugs, including oral antiviral agents, but also interferon injections
Hepatitis B is an important occupational hazard for health workers
More than 780,000 people die every year due to the consequences of hepatitis B


KNOW THE
ABC'S OF
VIRAL HEPATITIS
More than 4 million people in the US are living with viral hepatitis. Most don't know it!
Hepatitis A can be prevented with a safe, effective vaccine.
A
Many people got infected with hepatitis B before the vaccine was widely available.
B
Treatments are available that can cure hepatitis C.
C
CDC
Take the CDC Online Risk Assessment to see if you should be vaccinated or tested for viral hepatitis:
www.cdc.gov/hepatitis/riskassessment


INFECTION
CONTROL
Disease
Care

OSHA’s Three Lines of Defense



Dental Environmental Surfaces Disinfecting

&

steam sterilization

Dr. Abeer Ahmad Aljoujou
PhD. Oral Medicine

Types of dental environmental surfaces related to disease spread

1. **Clinical contact surfaces**

environmental surfaces susceptible to contamination during patient care activities are *classified as follows* :

a- (touch surfaces) Surfaces touched frequently during patient care (chair control buttons, light handels, bracket table, drawer handles, x-ray exposure buttons).

b- (transfer surfaces)Contact instrument, devices,

(shade guide, mirror handles, supply bottles, X-ray unit handle and cone, light curing handle …).

C- (aerosol surfaces) Surfaces become contaminated with aerosol or spatter , include all surfaces in the treatment room other than touch or transfer surfaces (headrest on chair, countertops,….).

(need to be treated before the next patient)

2- **Housekeeping surfaces**

(can be treated at the end of the day)

Types of environmental surfaces related to disease spread

- Clinical contact surfaces
  - Aerosol surfaces
  - Touch surfaces
  - Transfer surfaces
- Housekeeping surfaces

approaches to surface asepsis

To prevent the surface or item from becoming contaminated by use of

surface cover

To pre-clean and disinfect the surface after contamination and before reuse by use of

disinfectant

Surface Covers

Types of surface covers:

- Plastic wrap
- Bags (e.g., to cover the headrest)
- Plastic-backed paper (patient bibs,…)
- Preshaped plastic (hose covers,…)
- Plastic with sticky substance on one side to hold them on the surface
- Plastics have a natural clinging ability on contact with a smooth surface (e.g., some food wraps).


ECO


ECO

- **The best way**
- **No need for cleaning and disinfection.**
- **Electric switches, intraoral camera,… shoud be covered rather than disinfected.**
- **Preclean and disinfect contaminated surfaces before applying the surface covers.**
- **Protect the entire surface.**
- **Wear gloves during removal of contaminated covers.**
- **Remove covers without touching the underlying surface.**
- **Barriers must be single-use.**

Pre-cleaning

- **Rationale: precleaning remove organic material in blood and saliva.**
- **Put PPE .**
- **We can Preclean the surface with paper towels.**
- **Use detergents or regular soap and water.**
- **In some instances, a surface may require scrubbing with a brush (better to use covers)**

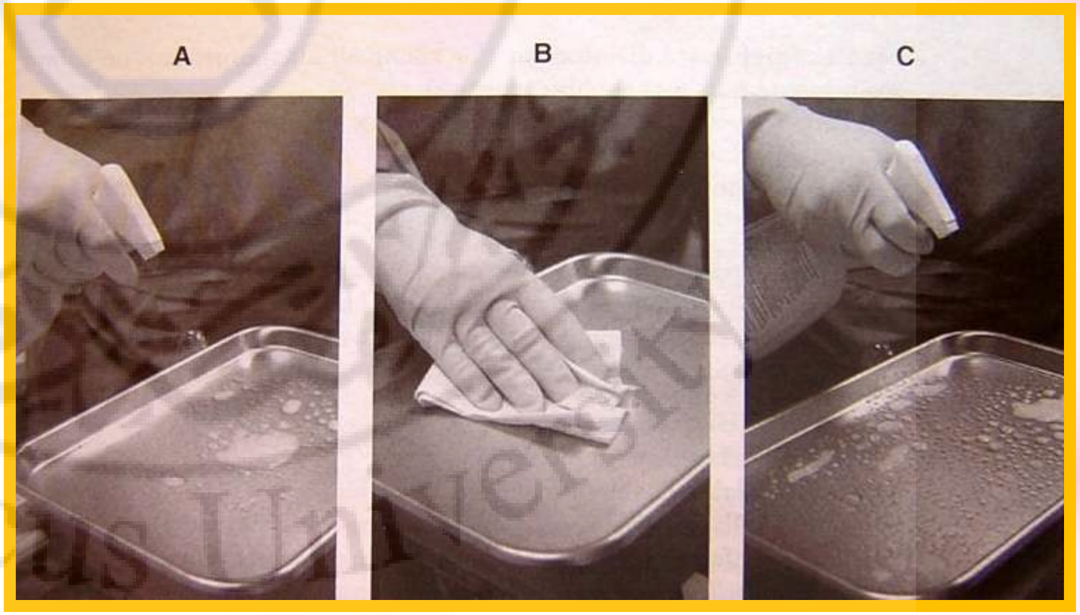
disinfection

A good disinfectant is the one that:

- Broad spectrum.
- Time → Rapidness is very important.
- Do not damage the contact surfaces (Material compatibility).
- Reaches every part of the involved surface.
- Safe use
- Non toxic.

Spray-wipe-spray technique

1- spray surfaces. spray the disinfectant onto the environmental surface to initially clean visible gross debris.



- 2- wipe surfaces. To remove gross soil, debris. Use 10 X 10 gauze squares or paper towels in overlapping strokes in a systematic pattern to wipe all surfaces.

- 3- spray surfaces again. then reapply the disinfectant to have appropriate contact time.


1


2


3

advantages	Disadvantages
Surface covers	
Prevents contamination- protects surfaces that are difficult to - preclean less time consuming- reduces handling of chemicals-	1- purchase a variety of sizes and types 2- adds nonbiodegradable plastic to the environment 3- esthetically unattractive 4- more expensive
Precleaning and disinfection	
1- Purchase fewer items 2- not add plastic to the environment 3- does not change the esthetic appearance 4- less expensive	Time consuming- cannot verify microbes killing- some surfaces difficult to clean- some chemicals may damage surfaces- some disinfectant prepared fresh daily -

Surface covers versus precleaning and disinfection

- **General types of antimicrobial chemicals :**

1. **Antibiotics**

   (killing microorganisms in the body)

2. **Antiseptics**

   (killing microorganisms on the skin and mucous membranes)

3. **Disinfectants**

   (killing microorganisms on environmental surfaces)

4. **Sterilant**

   (killing all microorganisms)

Categorization of disinfectants based on their microbial spectrum activity :

- **Sterilant .**

  For killing all microorganisms, including high numbers of bacterial spores. (e.g., glutaraldehyde for longer time,….).

- **High-level disinfectant .**

  For killing all microorganisms on subjects that are heat sensitive (e.g., glutaraldehyde,….).

- **Intermediate-level disinfectant** .

  For killing bacteria, most fungi, viruses, and M. tuberculosis (tuberculocidal ,e.g., iodophore) .

- **Low-level disinfectant**. For killing most bacteria, some fungi, and some viruses (not tuberculocidal, e.g: quaternary ammonium compounds) .

- General properties of disinfectants:

- **Virucidal**. Kills at least some viruses.
- **Bactericidal**. Kills at least some bacteria.
- **Fungicidal** . Kills at least some fungi.
- **Tuberculocidal**. Kills the tuberculosis bacterium.
- **Sporicidal**. Kills bacterial spors, which means it is sterilant.
- **Hospital disinfectant**. Shown to kill the three representative bacteria: staphylococcus aureus, salmonella choleraesuis, and pseudomonas aeruginosa .

- **Hospital disinfectant**: Shown to kill the three representative bacteria الاخماج المشفوية:

- staphylococcus aureus المكورات العنقودية الذهبية
- salmonella choleraesuis السلمونيلا المعوية
- pseudomonas aeruginosa الزائفة الزنجارية .

glutaraldehydes

- **High-level / sterilants disinfectant.**
- **Glutaraldehyde fumes are highly toxic, thus more be used for processing instruments with closed container. Disinfection time takes from 10 to 90 minutes. Sterilization takes 6 to 10 hours, which may not be practical.**
- **Glutaraldehydes retain efficacy for 28 days from the time of mixing, even if not used.**

Sodium hypochlorite

- **Intermediate level disinfectants (Tuberculocidal).**
- **Usually supplied in a concentration of (5,25 %)**
- **For general-purpose disinfection, one may use a 1:10 dilution.**
- **Prepare the solution fresh daily**
- ***Problems*: can damage fabrics and metal surfaces, and its activity is reduced in the presence of organic material, and is irritating to the skin and eyes .**

iodophors

- It is a mixture of iodine with certain organic materials.
- Intermediate level disinfectants (Tuberculocidal).
- Problems : slightly corrosive, cause slight staining with repeated use on light-coloured surfaces, they also have a short life span and must be changed as often as every 3 days.
- Iodophors may also be used for dental instrument processing, requiring from 5 to 25 minutes upon contact.

alcohols

- **At 50% to 70% rapidly kills many organisms**
- **Tuberculocidal.**
- **Problems : evaporate rapidly, reduction in activity by organic material, corrosive, and dry out the skin.**
- **Usually as surface disinfectant alcohol is an important component of some disinfectant preparations.**

- In the healthcare setting, “alcohol” refers to two water-soluble chemical compounds: ethyl alcohol and **isopropyl alcohol** that have generally underrated germicidal characteristics .
- FDA has not cleared any liquid chemical sterilant or high-level disinfectant with alcohol as the main active ingredient.
- These alcohols are rapidly bactericidal rather than bacteriostatic against vegetative forms of bacteria; they also are tuberculocidal, fungicidal, and virucidal but do not destroy bacterial spores.
- Their cidal activity drops sharply when diluted below 50% concentration, and the optimum bactericidal concentration is 60%–90%

Equipment decontamination

Disposable item	discard
Not disposable	Cover
Not be covered	sterilize
Not heat stable	disinfect
Not be disinfect	Do not use

Aseptic distribution of dental supplies

- A major challenge to infection control.
- E.g., cotton rolls, articulating paper, orthodontic wire, composite tubes, bottles of dental materials,……..

How supplies are obtained

Aseptic retrieval

- Rather than saliva-coated gloved fingers.
- Use sterile forceps.

Unit dosing

- Unit dosed means supplies are packaged in small numbers sufficient for care of one patient.
- expensive .

housekeeping

- Work site (floor, walls,sinks,..) should maintained in a clean and sanitary condition.

- What disinfectant must be used ?

  - usually low level disinfectant (has a HIV and HBV claim).

  - or intermediate-level can be used (has a tuberculocidal claim).

  - but clinical surfaces should be disinfected with intermediate-level agent .

- When the cleaning must be done ?
- ✓ After completion of procedures
- ✓ Immediately or as soon as feasible when surfaces are overtly contaminated
- ✓ At the end of the work shift

steam sterilization

Steam sterilization (autoclaving)

- standard cycle -

- Sterilization that uses time, moist heat, and pressure to kill all forms of microbial life. It involves heating water to generate steam in closed chamber pushing the cooler air out of an escape valve, which then closes and allows a buildup of pressure.

- there are four parameters of steam sterilization: steam, pressure, temperature, and time.

- The **most widely used** types of sterilization in dental practices.
- Steam must **penetrate** all surfaces of the instrument.
- **The heat, not pressure kills microorganisms.**

Mode of Action

- Moist heat destroys microorganisms by the irreversible coagulation and denaturation of enzymes and structural proteins. In support of this fact, it has been found that the presence of moisture significantly affects the coagulation temperature of proteins and the temperature at which microorganisms are destroyed.

- For more effectiveness (same temp. at all surfaces) Some steam sterilizers have presterilization vacuum cycle to force out the air before sterilizing cycle because air pockets in the chamber cannot reach sterilizing temperatures.
- Other sterilizers have several purges of steam to help force out the air before the sterilizing portion of the cycle begins.

- **Set time :**

  121 ̊C / 1 – 1,2 bar (15 psi) / 15-20 min

  134 ̊C / 2 – 2,2 bar (30 psi) / 3-5 min

  - follow the manufacturer`s instruction

  - this time includes extra time to insure microbial killing (safety factor).

- **Different models depending on :**

  -size

  - mechanism of air removal

  - steam generation

  - vacuum cycle

  - drying

  - temperature displays

  - recording device

There are three types of steam sterilizers based on how air leaves the unit:

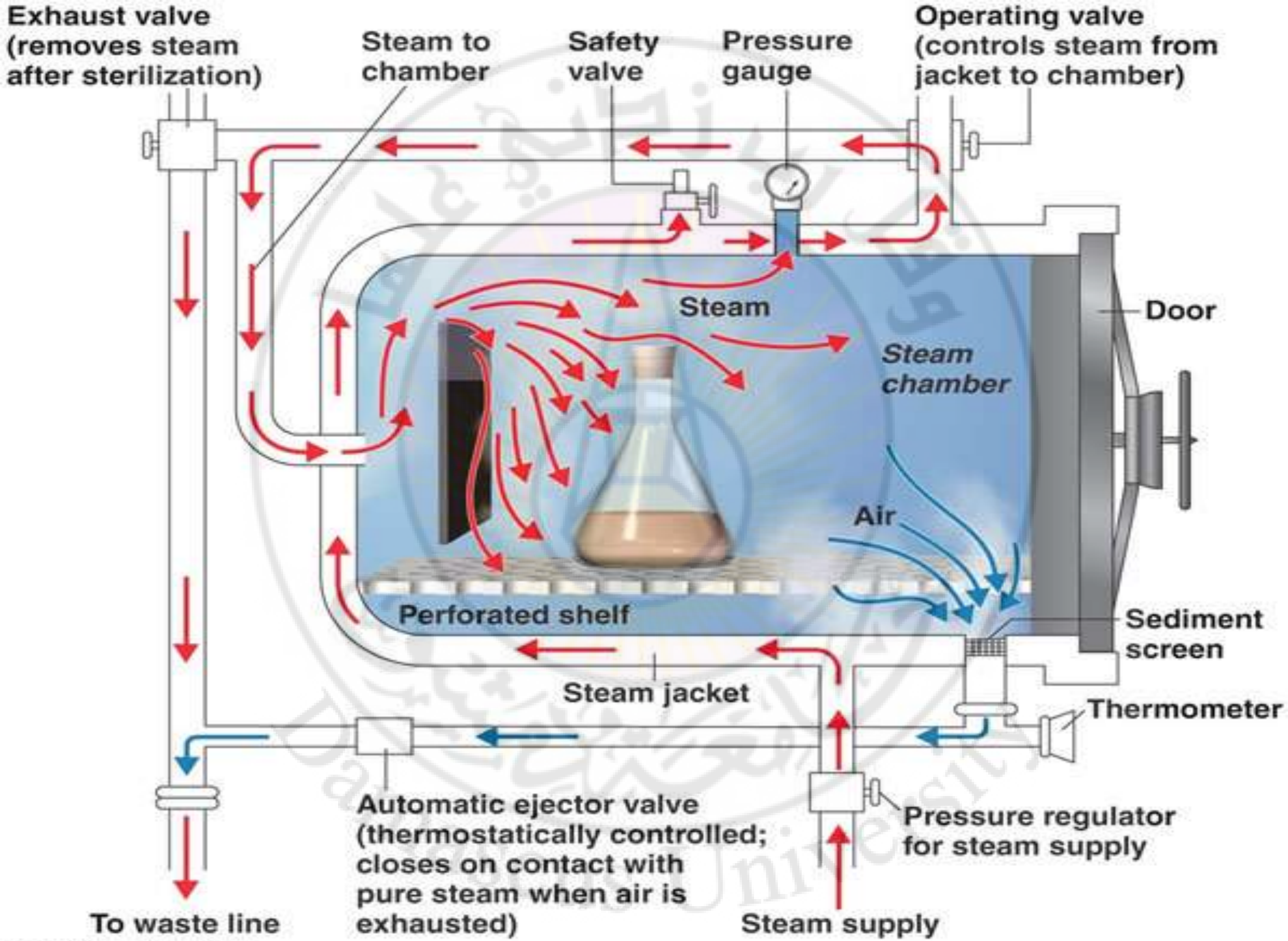
- gravity displacement (**type N** cycles), steam forces air out the bottom through a special drain(passive displacement of air).
- vacuum assisted (**type B** cycles), Prevacuum cycles evacuate air out and pull steam throughout the loaded chambers. (vacuum sterilizer).
- positive steam flush with pressure pulses (**type S** cycles). employs repeated injections of steam with associated pulses/changes in pressure (a steam-injection, positive pressure pulse displacement process).

The typical dental office steam sterilizer operates through 4 cycles

- heat-up
- sterilizing
- depressurization
- drying

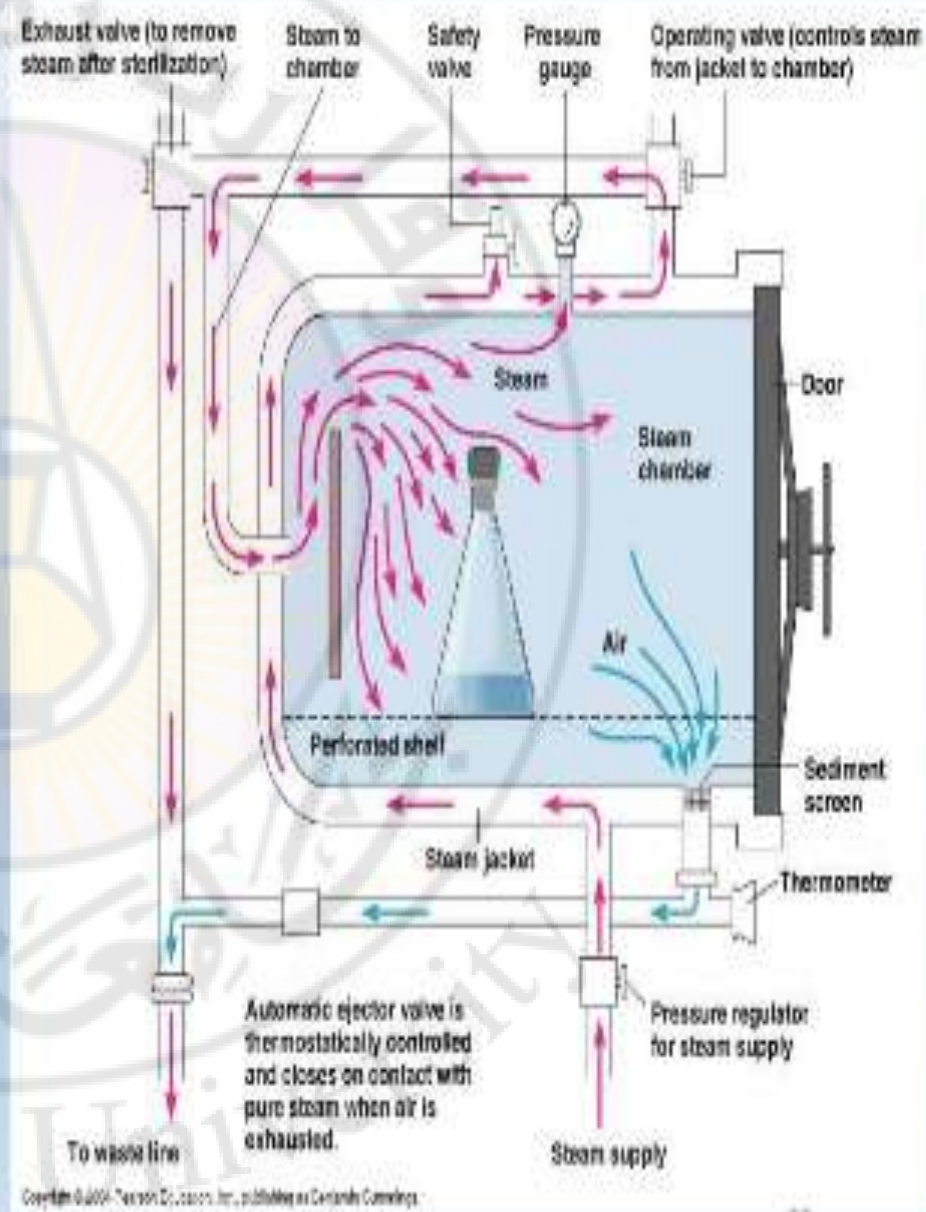
cycle

- Follow manufacturer's instruction


Exhaust valve (removes steam after sterilization)
Steam to chamber
Safety valve
Pressure gauge
Operating valve (controls steam from jacket to chamber)
Steam
Door
Steam chamber
Air
Perforated shelf
Sediment screen
Steam jacket
Thermometer
Automatic ejector valve (thermostatically controlled; closes on contact with pure steam when air is exhausted)
Pressure regulator for steam supply
To waste line
Steam supply

- **Gravity displacement autoclaves** are small, automatic bench-top autoclaves. They work on the principle of downward displacement of air as a consequence of steam entering at the top of the chamber.

- For Gravity displacement autoclaves, a sterilization cycle of 134°C for 3–4 min at 207 kPa is recommended for both wrapped and unwrapped dental instruments.

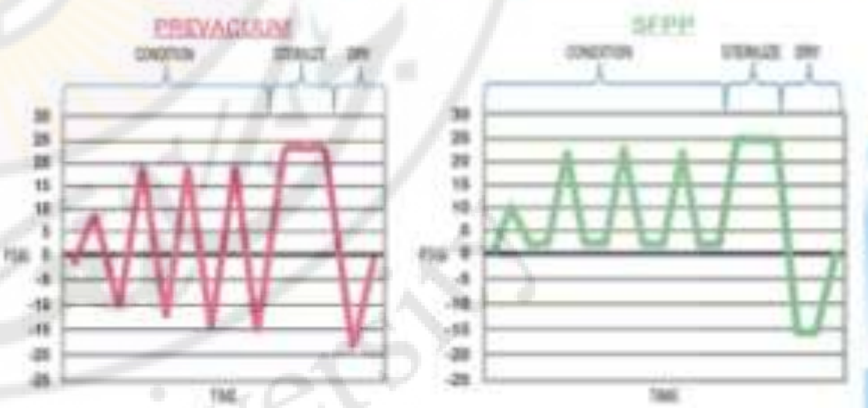


Process of Autoclave

- ***Negative Pressure Displacement*:** Air is removed from the chamber using a vacuum pump prior to the introduction of steam.

- ***Positive Pressure Displacement*:** Steam is held in a separate chamber. When sufficient steam has been accumulated it is released into the main chamber in a pressurized burst, beginning the sterilization process, or steam pulsing in to the chamber to replace the air from chamber.

SFPP- Steam Flush Pressure Pulse



Steps:

- Add water,
- load,
- close the door,
- turn on,
- heat-up cycle begins to generate the steam,
- the steam pushes out the air,
- sterilizing cycle,
- depressurization cycle,
- at the end all items are wet and drying cycle is initiated.

loading

- Never overload.
- Keep items separated from each other so that steam has access to all package surfaces
- Place items on their edges
- Not stack packages flat in layers. Stacking impedes steam circulation and air removal in the chamber.


AUTOCLAVE

Drying cycle

- One should not handle wet packages . let these packages dry inside the sterilizer before handling them.
- Drying inside the sterilizer is important. Why?

1. Handling of wet packages can easily tear the paper
2. Wicking. Wicking is process that allows bacteria and fungi to penetrate (drawn through) wet sterilization paper

Types of drying

1. Manuall open door drying cycle. Cycle that maintains heat inside the chamber to evaporate the remaining water, the door opened manually to let the vapor escape.
2. Automatic open door drying cycle.
3. Pull in fresh air through a microbial filter.
4. Poststerilization vacuum cycle.

Advantages:

1. Rapid turnaround time
2. Low cost per cycle
3. No toxic hazardous chemicals
4. Suitable for plastic, paper, cotton,….

disadvantages:

1. May corrode instruments
2. Cannot be used with many plastics
3. Dulling of some instruments

Autoclave cleaning and maintenance

- Follow the manufacturer`s instruction
- Wash the inner chamber with a mild detergent and cloth then dry daily
- The outside should be wiped clean of dust
- At least weekly, autoclave water reservoir should be drained and cleaned

- Use distilled water
- The inner shelves removed and scrubbed
- Check the rubber door gasket
- Check the temperature and pressure

Flash steam sterilization
- flash cycle -

- A form of steam autoclaving
- Smaller thus may be better suited for smaller loads or specialty items such as handpieces.
- Quickly sterilize
- *Originally were designed for use only in emergency* situations (e.g., item was dropped on the floor during patient care and will be used immediately,…).

- Usually only with distilled water be used.
- A closable cassette containing the instrument that is inserted into the sterilizer, serving as the sterilizer chamber

- 121 C° / 15 psi / 15 min

132 C° / 15 psi / 3 min (unwrapped)

132 C° / 15 psi / 8 min (wrapped)

- We should not use flash sterilization routinely, why?

- shorter time reduces “safety factor”. The exposure times are set to include extra time to ensure microbial killing (safty factor)
- Used only with unwrapped items

What is Sterility Assurance Monitoring?

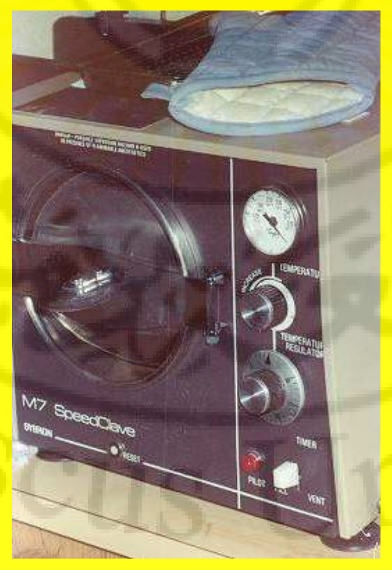
- Sterility assurance products including biological indicators (BI) and chemical indicators (CI) provide you the confidence that the sterilizer is functioning properly and cycle conditions are adequate to produce medical devices that are ready and safe for patient use after reprocessing.

Chemical vapor sterilization

- chemiclave -

- A special chemical solution in a closed chamber with pressure, producing hot chemical vapors that kill microorganisms

  (called Harvey sterilizer or chemiclave)



- The chemical solution provided by the manufacturer contains:

  0,23% formaldehyde (the active ingredient)+

  72,38% ethanol +

  acetone + ketone + water + other alcohol

- Protect skin , eyes from contact and do not breathe vapors.

- 132 C / 25 psi / 20 min

Advantages:

1. Fast cycle time
2. Less damage to carbon steel, knives, burs and other sharp instrument (not dulling of instruments)
3. does not rust instruments (rust–free process)

Disadvantages

1. Irritation to the eyes
2. Need to buy chemicals / expensive
3. Dry very carefully
4. Ventilation is required

ADA-accepted methods of heat sterilizationn

Method	temp.	Press.	cycle time	advantages	disadvan.	Spore test.
Autoclave	121 C° 134 C°	15 psi 30 psi	15-20 min. 3-5 min	Rapid low cost no toxic	rust	Geobacillus stearother-mophilus
Dry heat	160 C° 170 C°		2 hours 1 hour	no rust no toxic low cost	long time no plastic no paper	Bacillus atrophaeus (strips)
Rapid heat	121 C° 132 C°	15 psi 15 psi	15 min (wrapped items) 3 min (unwrapped)	short time dry after cycle	no plastic no paper no rubber	Bacillus atrophaeus (strips)
Chemiclave	132 C°	20 psi	30 min.	Good time less corrosive	toxic ventilation not all plastic	Geobacillus stearother-mophilus

Dental Handpieces Reprocessing

- In Spaulding’s classification , dental Handpieces are categorized with surgical instruments as critical devices requiring sterilization for each patient.
- According to the preventive policy of the “Standard Precaution ” blood , body fluids (except for sweat) ,waste , wounded skin , and mucosa of all patients ,with or without infectious disease , are assumed to be infectious .

Table 14.1: Spaulding's categorization of medical instruments

Class	Use	Processing
Critical, 'C'	Enters sterile body site or vascular system	Decontamination, cleaning followed by sterilization
Semi-critical, 'SC'	Comes into contact with intact mucous membrane or non-intact skin	Decontamination, cleaning followed by high-level disinfection (HLD)
Non-critical, 'NC'	Comes into contact with intact skin	Decontamination, cleaning followed by intermediate-level or low-level disinfection

- Dental handpieces contain many small parts and long narrow lumens.
- In addition, the dental air turbine gains torque by applying compressed air to the rotor; the rotor spins for awhile after air outflow because of the inertial force.
- This freewheeling creates negative pressure within the turbine , resulting in uptake of contaminants (e.g. saliva and blood), the so-called suck-back effect

- CDC guidelines for infection prevention and control state that, between patients, dental health care personnel (DHCP) should clean and heat-sterilize handpieces and other intraoral instruments that can be removed from the air and waterlines of dental units.
- This recommendation is based on studies that have shown that the internal components of air-driven dental handpieces (both low-speed and high-speed devices) can become contaminated with patient material during use, and this material can then be expelled into the mouth of other patients during subsequent uses.

- handpieces and other intraoral instruments should be removed from the air and waterlines of dental units, cleaned, and heat-sterilized between patients.
- Follow the manufacturer’s instructions for cleaning, lubrication, and sterilization.
- Do not surface-disinfect, submerge in liquid chemical sterilants, or barrier-protect these instruments because these methods cannot adequately clean, disinfect, or sterilize the internal components.

- These instruments include, but are not limited to, high-speed, low-speed, electric, endodontic, and surgical handpieces, as well as all handpiece motors and attachments.

Processing high-speed dental handpieces

- Expensive handpieces must be handled with great care to extend their use life
- Follow the manufacturer`s directions.
- Wear PPE.


CDC
Centers for Disease
Control and Prevention
National Center for
Health Statistics
Are you cleaning
your handpieces
properly?
Nupro
Freedom™

- procedures:

1- Some dental unit contain antiretraction valves in their water lines that prevent retraction of fluids back into the handpieces and air/water syringe when they are turned off (but they periodically fail, check them monthly).

2- Flush the high-speed handpiece, air/water syringe, and ultrasonic scalers for about 30 seconds between patients.

STERILIZATION

Never use any chemical solution for sterilization.

Brush off excess dirt and wipe clean with alcohol soaked cloth.

For autoclaving :

- Spray lubricate every time prior to autoclaving.
- Put the handpiece into a pouch and seal it completely.
- Autoclave for 20min. at 121℃, or 15min. at 132℃.

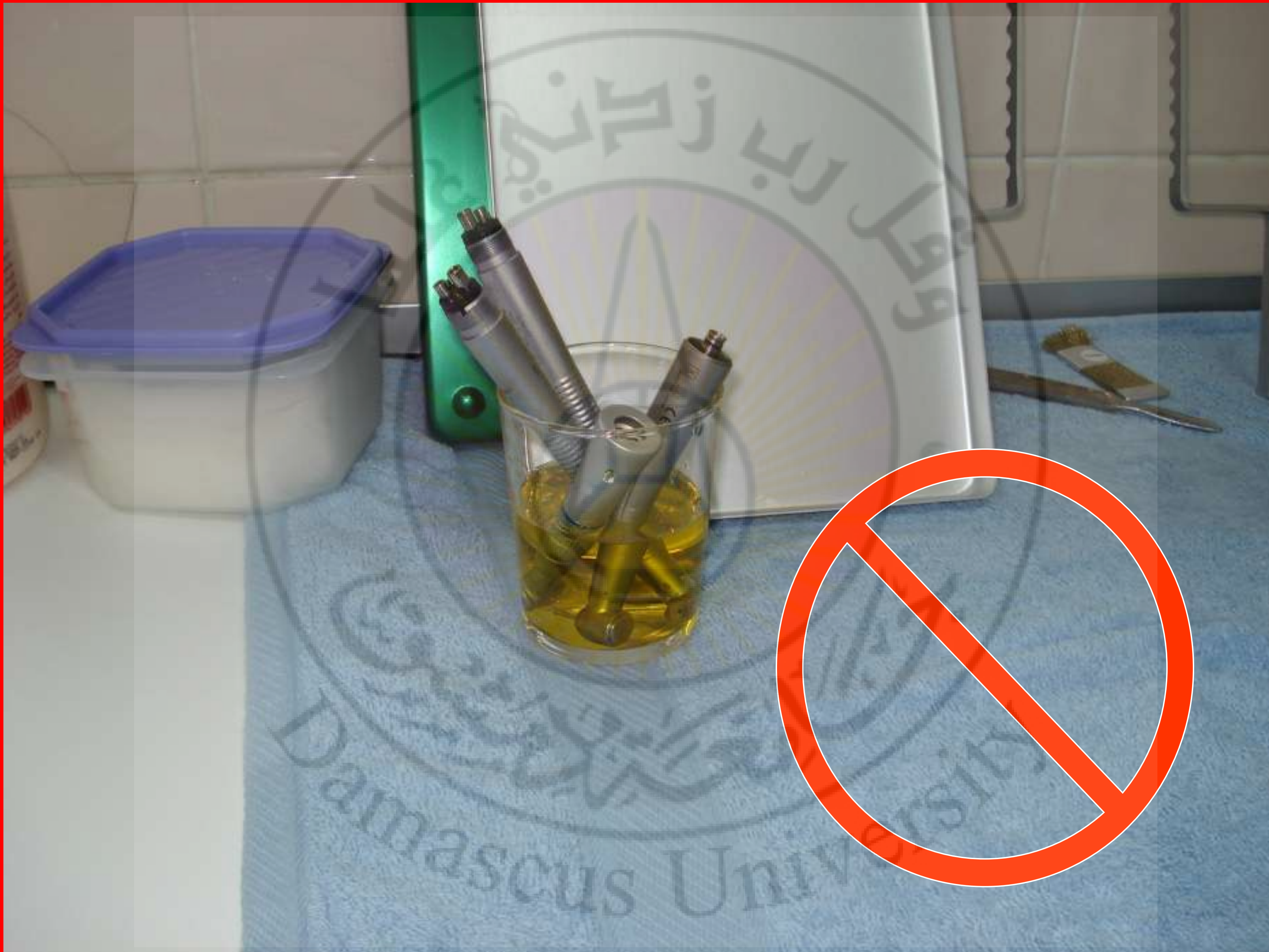
Handpiece sterlization steps:

1- flush handpiece air-water lines before removing from the hose for 20 to 30 seconds (note: leave the bur in the handpiece). And then take it out the turbine.

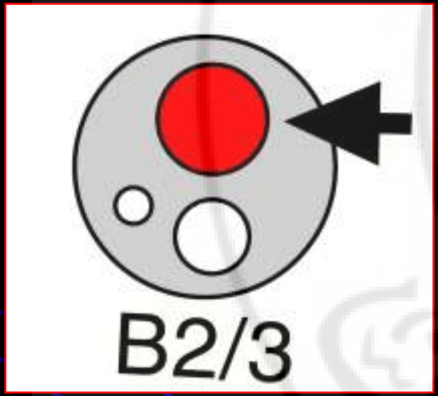
2- Wipe away visible debris .

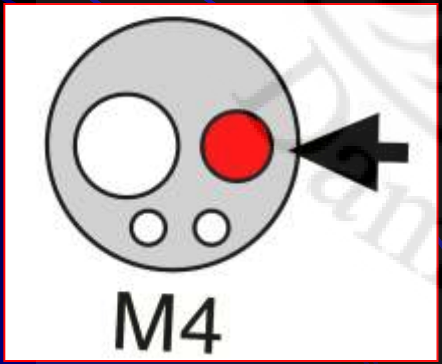
3- Remove the bur, then remove the handpiece, Using a brush and soap clean and scrub the handpiece under running water (note: do not soak the handpiece unless recommended by the manufacturer)

4- Then rinse and dry the handpiece

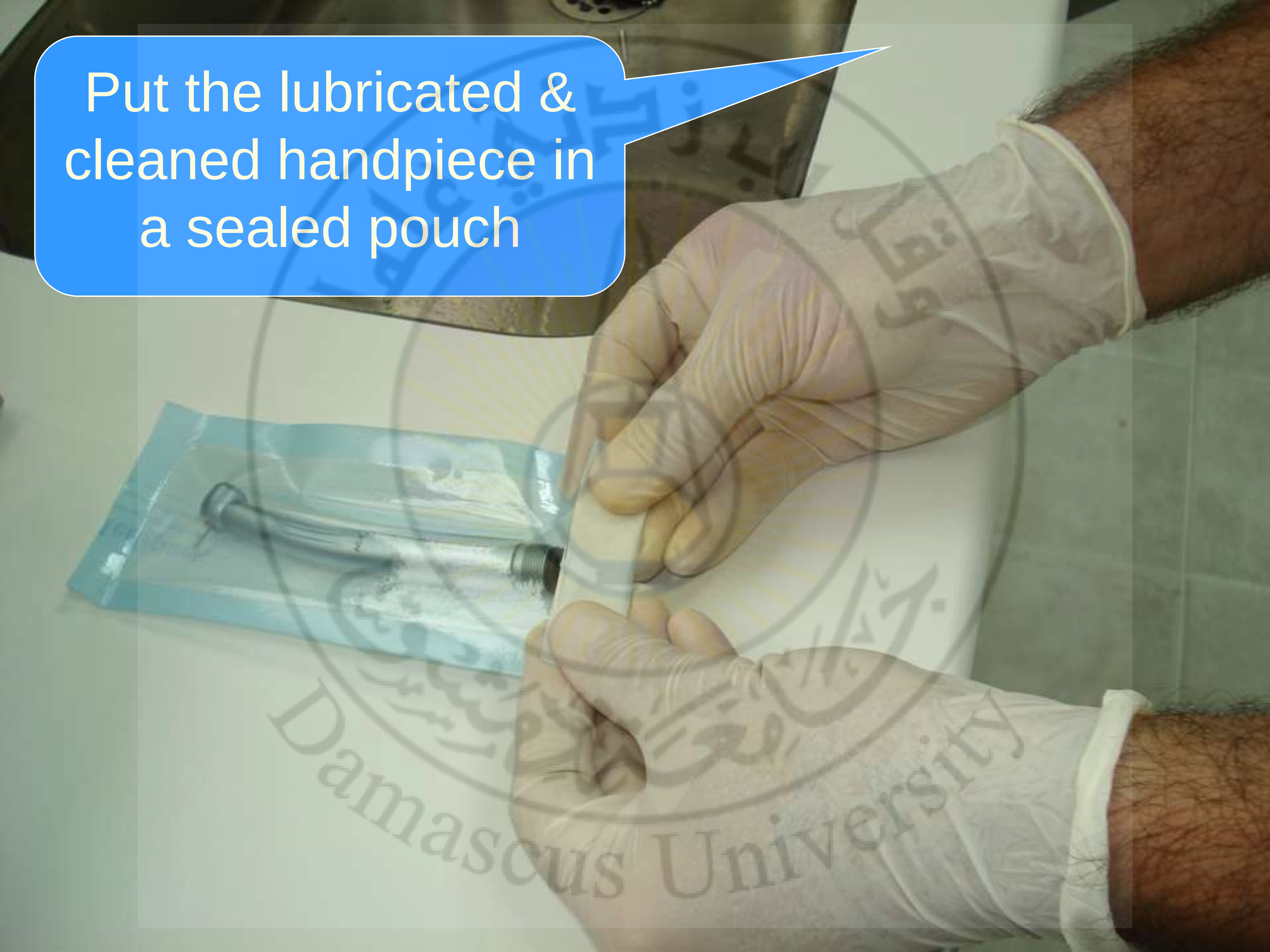


5- Apply handpiece cleaner and/or lubricant (if required by the manufacturer). You must spray to the correct hole with black nozzle on the spray. expel and wipe away excess lubricant





6- pack and heat process


Put the lubricated & cleaned handpiece in a sealed pouch


and autoclave it.

7- flush air-water lines for 20 to 30 seconds

8- then open bag and if necessary lubricate the attach handpiece to the hose

- **The updated guidance from the CDC provides a 3-point summary:**

1- Clean and heat sterilize handpieces and other intraoral instruments that can be removed from the air lines and waterlines of dental units.

2- For handpieces that do not attach to air lines and waterlines, use FDA-cleared devices and follow the validated manufacturer’s instructions for reprocessing these devices.

3- If a dental handpiece cannot be heat sterilized and does not have FDA clearance with validated instructions for reprocessing, do not use that device.

- The guidance on reprocessing handpieces for all dental practice settings is clear.
- In order to be compliant with CDC recommendations, more than one handpiece is needed to ensure enough time for them to be heat sterilized between each patient.

- Saying it is too expensive to buy more than one handpiece is not an excuse the CDC is likely to entertain. A dental practice is a business, and to run a business there are costs. Purchasing equipment, such as handpieces, should be considered the cost of doing business.

Sterilization of heat-labile items

- According to the CDC, all patient-care items must be cleaned prior to sterilization. Following cleaning, heat-stable critical and semi-critical dental instruments must be heat sterilized before each use.

- But what if the dental instrument is not compatible with heat, which is considered the gold standard method of sterilization in a dental office?

- Heat-sensitive critical items must undergo cold sterilization while semi-critical items must at least undergo high-level disinfection.
- Heat-sensitive critical and semi-critical items can be processed by immersing them in liquid chemical germicides approved by the Food and Drug Administration (FDA) as sterilants or high-level disinfection.

- FDA-cleared chemical sterilants include :
- glutaraldehyde
- hydrogen peroxide
- peracetic actid
- and ortho-phthaldehyde (high level disinfection only).

- Shorter immersion times of the FDA-cleared chemicals can be used to achieve high-level disinfection of semi-critical instruments only.
- Note that chemical contact time is the single critical variable distinguishing the sterilization process from high-level disinfection.

- CDC strongly recommends that whenever possible, heat-stable items be used instead of those that are heat-sensitive because limitations exist with using chemical sterilization because:

1- Post-sterilization of heat-sensitive items, the items need to be:

1) rinsed with sterile water to remove chemical residues.

2) dried with sterile towels.

3) packaged or wrapped

4) handled using sterile gloves.

2- If stored before use, the items must be sterilized again just before use.

3- The sterilization process with cold sterile solutions cannot be verified with biological indicators.

4- Sterilization of heat-sensitive items requires up to 12 hours of complete immersion, and therefore are usually only used for high level disinfection of semi-critical items.

5- Manufacturer label instructions and safety precautions must be followed carefully. Misapplications include use as an environmental surface disinfectant or instrument holding solution.

6- Chemical sterilants are highly toxic, and require appropriate precautions – closed containers, proper PPE – chemical-resistant gloves and aprons, safety eyewear, face shields, safe chemical handling.

- **Some liquid chemicals can serve as a sterilant or high-level disinfectant depending on how they are used. they are:**

  - sterilant: kill high levels of bacterial spores, when used for :

  *** long *exposure time*,**

  *** and/or higher *concentrations*.**

  - high-level disinfectant: kill low levels of bacterial spores, when used for shorter exposure time, or used at lower concentrations.

- e.g., 2% to 3,4% glutaraldehyde is :

  - a sterilant when items are submerged for 10 hours.
  - a high-level disinfectant when contact time is less than 10 hours.

- For both one cannot determine microbial killing.

Infection control in the prosthodontic laboratory

Strategy to achieve infection control

- All patient must be screend
- Barriers for personal protection
- Carefull aseptic technique
- sterlization and disinfection
- Disposal of contaminated waste safely
- Laboratory asepsis

- The use of appropriate infection control precautions is important for dental laboratory technicians, as it is for the dental team.
- Improper handling of contaminated items, such as impressions, casts, and other prosthetic appliances, can result in cross-contamination and possible cross-infection to personnel.
- The first published recommendations for infection control in the dental laboratory were written by the ADA in 1978.

Occupational Risks

- Potential routes of transmission include:

- direct contact with infected saliva or blood through cuts and abrasions.
- indirect accidental percutaneous exposure when using knives and other sharps items.
- and airborne infection from microbial-laden aerosols and spatter created during laboratory procedures.

Dental laboratory technician polishing bite splint prior to delivery.

The greatest exposure risk for dental laboratory personnel is **indirect contact** through cross-contamination.

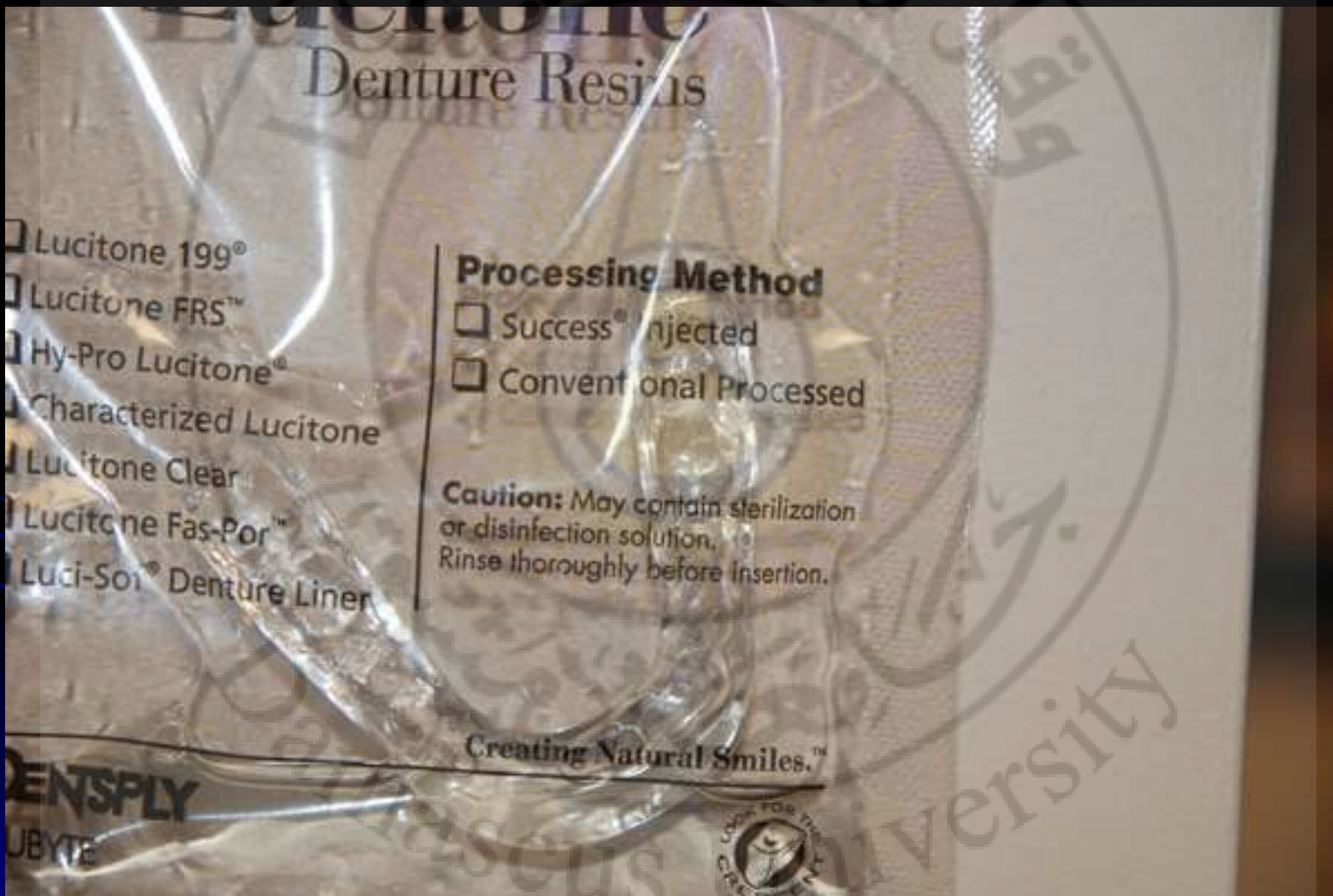
- impressions, prostheses, and appliances may be contaminated with saliva and blood and facilitate the transmission of microorganisms from operatory to laboratory.
- For example, microorganisms on a dental impression may be transferred to dental casts and remain in set gypsum for up to 7 days.

- Thus, the potential for cross-contamination may occur from dental office to laboratory, and back to the dental office.
- Cross-contamination may also crop up within the laboratory from case to case, and may also occur from surface contact, contaminated handpieces , burs, rag wheels, pumice pans and hands.

Laboratory handpieces and burs can be sources of cross-contamination

Contaminated rag wheels and pumice pans in a laboratory

the disinfection status of a bite splint



- In the dental laboratory, principles for infection control :

- appropriate immunizations for laboratory personnel.
- the use of barrier techniques, and implementation of standard precautions

/ Standard precautions: dictate that all laboratory cases are handled the same way and are treated as if contaminated and infectious/

- At-risk employees must be offered the hepatitis B vaccination, and all employees are to be provided initial and annual training regarding bloodborne pathogens.
- The dental office and laboratory must reliably communicate the disinfection status of each incoming and outgoing case.

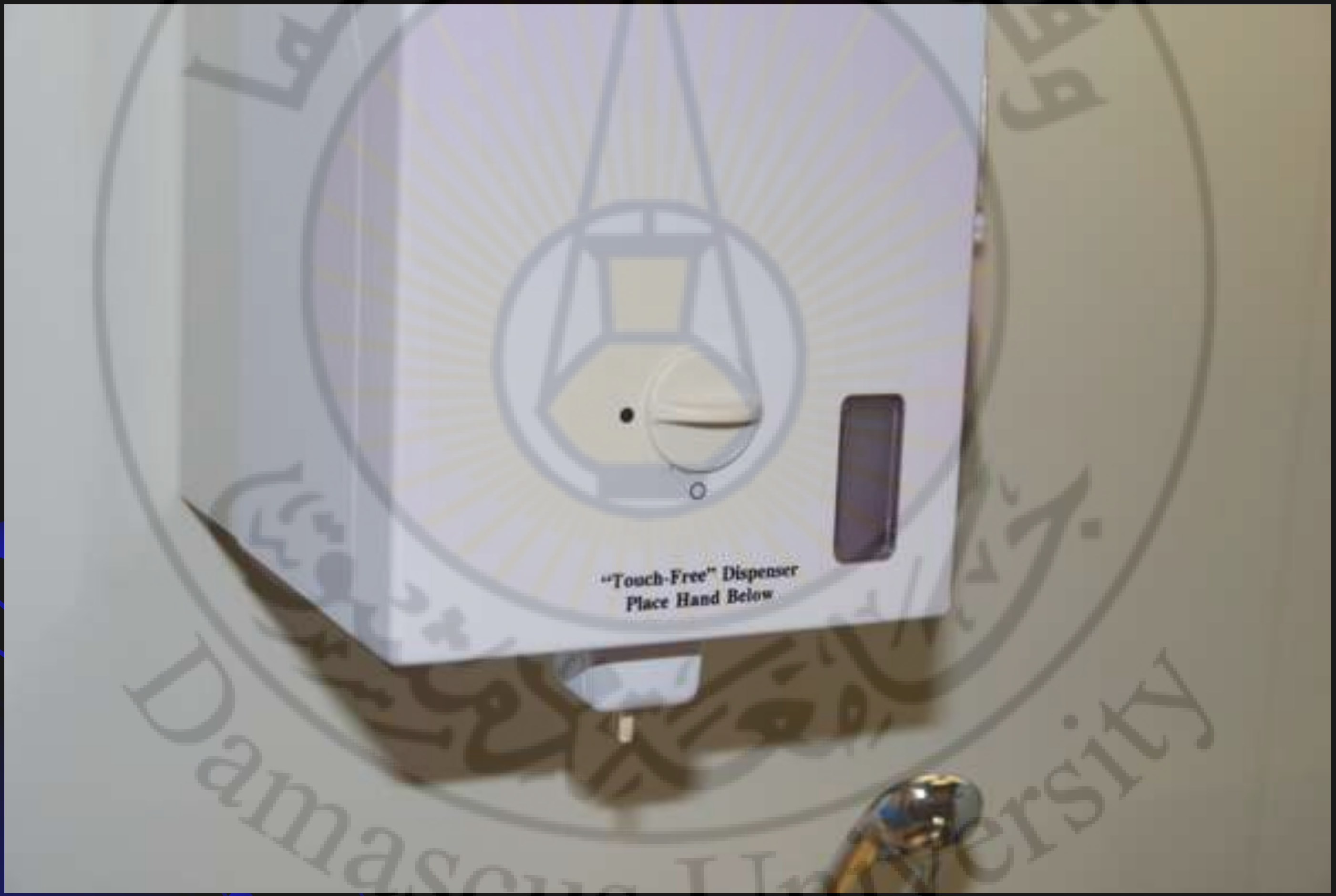
- Prevention measures include:
- organization of the dental laboratory into separate receiving, production, and shipping areas
- appropriate personal protective equipment
- frequent hand hygiene
- and proper laboratory case disinfection

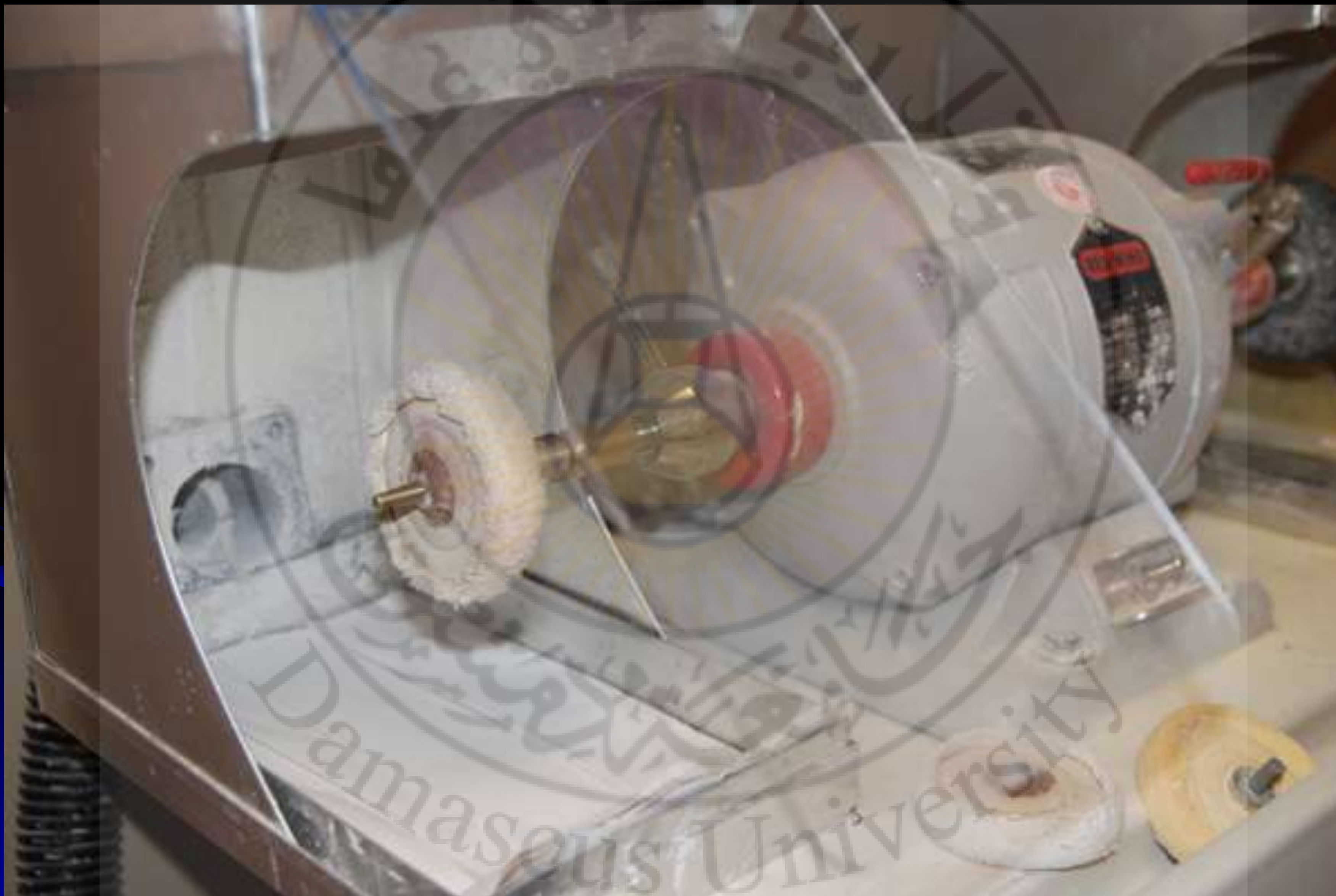
- A receiving area should handle all items entering the laboratory and ought to have running water and hand-washing facilities. Countertops in this area should be covered with impervious paper or cleaned and disinfected on a regular basis

Rinsing of dental impression prior to subsequent laboratory procedures

- The receiving area technician must wear appropriate personal protective equipment (PPE) when receiving and disinfecting laboratory cases.
- After the items have been cleaned and disinfected, they can then be safely transferred to the production area.

Representative automated hand-hygiene dispenser.





Disinfection of dental impressions by immersion before laboratory processing

- Lastly, the shipping area is designated for final inspection of items leaving the dental laboratory. This portion of the facility should be cleaned at least once a day and all case pans need to be cleaned before being used for another case.

- All clinical materials being sent to a laboratory should be cleaned and disinfected by the dental office that sent it, and identified as such.
- If the dental laboratory is uncertain about whether disinfection has been performed, the laboratory should carry out the process with an intermediate-level disinfectant following the manufacturer’s instructions.

- The chemical disinfectants must be compatible with the dental impression materials used and must not affect the dimensional accuracy or surface texture. If the accuracy of the impression is compromised, the resulting gypsum casts will also be compromised, which may result in ill-fitting and nonfunctional prostheses. No single disinfectant is compatible with all impression materials, so the manufacturer of the impression material and disinfectant should be consulted.

- Receiving dental offices should disinfect all impressions and prostheses before insertion in a patient’s mouth.

- Dental impressions are categorized under semi-critical objects in dental practice and require high level disinfection or sterilization.
- Until 1991, the recommended procedure for disinfection of impression was rinsing under running water with which only 40% of bacteria, viruses and fungi were removed and potential for transmission of microorganisms remains there.
- Disinfection of dental impression should be a routine procedure in the dental office and dental laboratory.

Type Of Disinfection	Disinfectants	Type of impression materials	Time of exposure
High level disinfection	Glutaraldehyde	Irreversible hydrocolloid	10 min
		Zinc-oxide eugenol	10 min
		Polysulfide Polyether	10 min
		Addition silicon	10 min

Intermediate Level Disinfection	Sodium hypochlorite Complex iodophors Phenols Chlorhexidine Alcohols	Irreversible hydrocolloid	10 min
		Zinc-oxide eugenol	10 min
		Polysulfide Polyether	10 min
		Addition silicon	10 min
		Impression compound	10 min
Low Level Disinfection	Quaternary ammonium compounds Simple phenols detergents	Not recommended for impression disinfection	

- Sterilization of impression:

  Various methods are available for sterilization of impressions e.g:

- exposure to UV light
- steam autoclave
- ethylene oxide gas autoclave
- and radiofrequency flow discharge

- UV rays can be used for disinfection of:
- water supplies
- laboratory equipment
- dental headpieces
- dental impression and implants.
- In one study, while comparing UV rays disinfection with Glutaraldehyde and NaOCl, UV rays exhibited maximum efficacy

- The American Dental Association’s revised guidelines recommend chemical agents that are virucidal, bactericidal and sporicidal. These chemical agents are : chlorine compounds, phenols, iodophors, formaldehyde and gluteraldehyde.
- impression Immersion in NaOCl at concentration of 1:10 (0.525%) is advised for 10 minutes.

- The Japan Prosthodontic Society has recommended the alginate impression in either 0.1-1% Naocl solution for 15-30 min or 2-3.5% gluteraldehyde solution for 30- minutes.

DENTAL PROSTHESIS AND APPLIANCES

- The ADA recommends disinfection by immersion in iodophors or chlorine compounds. Although both of these disinfectants are somewhat corrosive.
- studies have shown little effect on chrome cobalt alloy with short-term exposure (10 minutes) to iodophors or 1:10 hypochlorite.
- Damage of heat cured denture base resin has been shown to occur after only 10 minutes of immersion in a glutaraldehyde with phenol buffer, although immersion in 2% alkaline glutaraldehyde did not damage the acrylic surface.

- however iodophors or chlorine compounds are preferred for disinfection of acrylic appliances.
- Fixed metal/porcelain prosthesis may be disinfected by immersion in glutaraldehydes for the time recommended for tuberculocidal inactivation by the disinfectant manufacturer.

- Wax rims and wax bites should be disinfected by the spray wipe spray method using an iodophor as recommended by the ADA.

CONCLUSION

- The use of effective infection control procedures and universal precautions in the dental office and the dental laboratory will prevent cross contamination that could extend to dentists, dental office staff, dental technicians and patients

Dental Unit Water Asepsis


What's Lurking
in Your Waterlines?

- Water enters the dental office from municipal supplies. Then it goes into plastic water lines to be distributed to the hoses that feed various attachments such as :

- High-speed handpieces.

– Air or water syringe.

– Ultrasonic scaler.

- Water lines have a small bore (about 1/16 inch).

- The environmental protection Agency standard for the microbial quality of drinking water (called potable water) is no more than a total of 500 colony –forming units per milliliter (CFU/mL) of noncoliform bacteria.
- water that enters the dental unit usually contains just 0-500 CFU/mL, however, water exiting the dental handpiece, air/water syringe and ultrasunic scalers may contain more than 100,000CFU/mL, some studies conducted in USA found greater concentrations (1.2 million and 10 million CFU/mL)

- Although dental professionals have known waterlines harbor bacteria, until relatively recently there has been no solid evidence this contributes to the spread of infection. That changed in 2011 when an 82-year-old woman was diagnosed with and died from Legionnaires' disease following a dental appointment. Investigators found Legionella pneumophila on the dental handpiece waterline in the practice the woman had visited.

Types and importance of microorganisms in dental unit water

- The vast majority of microorganisms that was found in dental unit water are waterborne microorganisms , most of them are of low pathogenicity or are apportunistic pathogens causing harmful infections only under special conditions or in immunocompromised and elderly persons .
- Micriorganisims of main concern are species of :

- Pseudomonas الزائفة الزنجارية
- Legionella الجرثومة الفيلقية
- Mycobacterium (الجرثومة المتفطرة)

- In 2015, a CDC report concluded that a rash of Mycobacterium abscessus odontogenic infections among children in Georgia could be traced back to contaminated water used during pulpotomies. The dental units in question, the CDC said, contained an average of 91,333 CFUs/mL.

- There is no question now that dental unit waterlines can contain microorganisms well above safe levels, and these bacteria can cause deadly diseases. <u>Cleaning and maintaining waterlines is critical for every dental office</u>.

Biofilm in Dental Water Lines

- Contamination of dental water units comes from the water itself and is referred to as the **planktonic** (free-floating) or from **biofilm** that forms on the inside of the unit lines.
- Biofilm is a mass of microorganisms (bacteria, fungi, and protozoans) attached to a nonsterile surface exposed to moisture.
- Biofilms can serve as a reservoir, amplifying the numbers of free-floating microorganisms in the water.

- Biofilm forms when bacterial cells adhere to a surface using cell surface polymers (glycocalyx polymers) that give the biofilm “slimy” nature.
- Then the attached cells multiply within the glycocalyx , with continual recruitment of additional bacteria from planktonic phase until covering the whole surface.

- Biofilm forms inside the lines as the water is flowing through the unit, because of some factors; like :

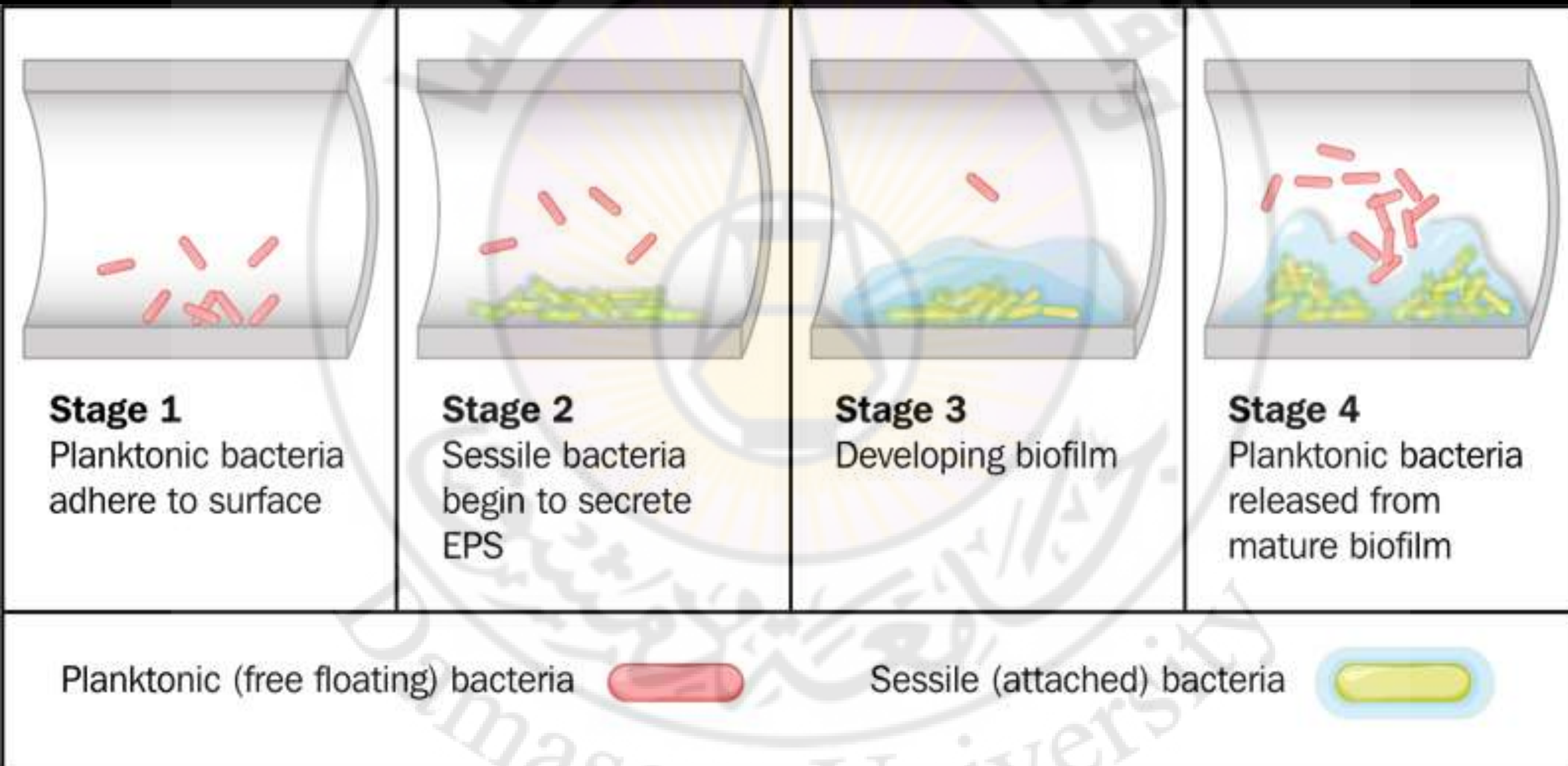
1- water stagnates (water in tubes is not under high pressure, and the water flow rate is low near the walls)

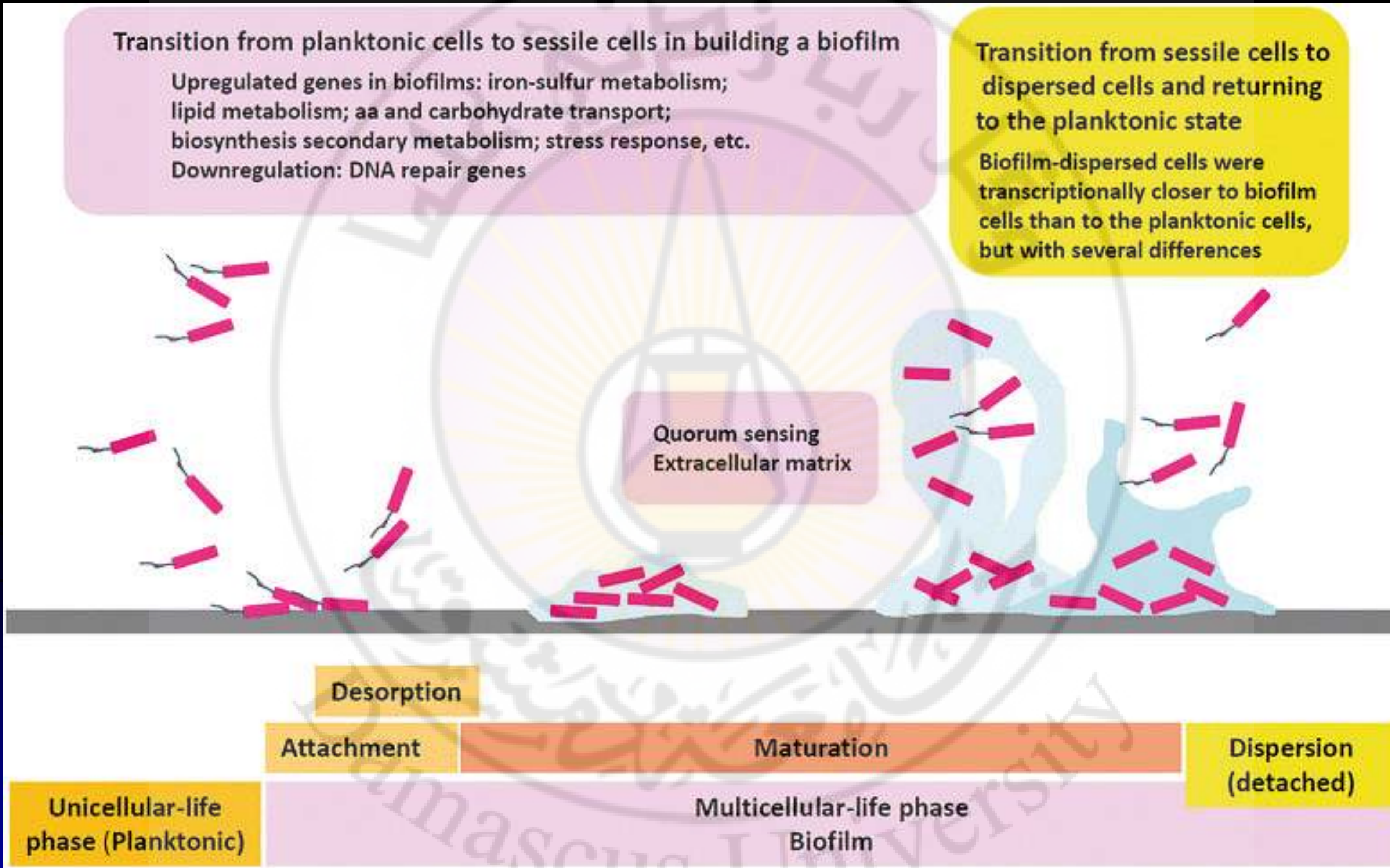
2- small- diameter tubing creates a large surface-to-volume ratio, giving bacteria a greater chance to contact an attach to the wall surface.

3- waterborne bacteria entering the system have special abilities to attach to surfaces.

4- incoming water brings a continuous source of bacteria and its nutrients .

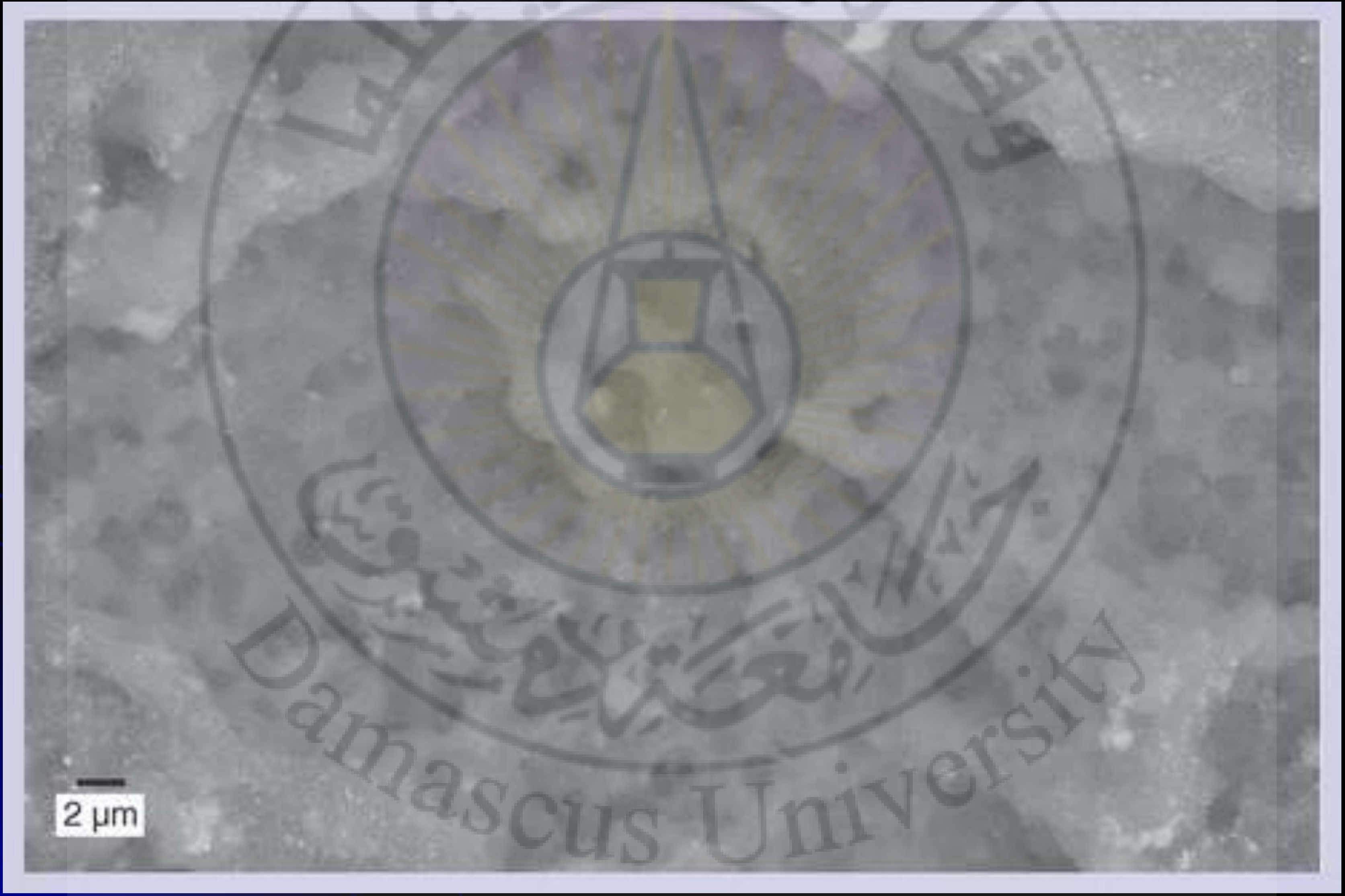
Biofilm formation in inner walls of dental unit water lines





Transition from planktonic cells to sessile cells in building a biofilm
Upregulated genes in biofilms: iron-sulfur metabolism; lipid metabolism; aa and carbohydrate transport; biosynthesis secondary metabolism; stress response, etc.
Downregulation: DNA repair genes
Transition from sessile cells to dispersed cells and returning to the planktonic state
Biofilm-dispersed cells were transcriptionally closer to biofilm cells than to the planktonic cells, but with several differences
Quorum sensing
Extracellular matrix
Desorption
Attachment
Maturation
Dispersion (detached)
Unicellular-life phase (Planktonic)
Multicellular-life phase
Biofilm

Electron micrograph of 4-week-old biofilm formed on the internal surface of a dental unit waterline taken from a dental chair unit supplied with potable quality mains water. The biofilm reached a thickness of 30 μm after 4 weeks growth.



Trustwater

Biofilm – The Problem

- dental unit waterline systems designed for general dental practice must be regularly maintained, via **water treatment** and monitoring, performed according to the manufacturer’s instructions.

Special Approaches for Surgical Procedures

- Regardless of how practices maintain their waterlines, it’s important to remember that **sterile water** – not filtered water – should always be used for **surgical procedures**. Because oral surgery raises a patient’s risk of local or systemic infections, the CDC recommends the use of sterile irrigating solutions and devices designed for the delivery of sterile irrigating fluids.

- Microorganisms not only can be introduced from the water source but can also enter the waterline from patients' mouths during treatment. Efforts to limit this means of exposure include installation of anti-retraction valves and flushing the lines between patients.
- The CDC recommends that any devices that enter a patient's mouth (e.g. handpieces, ultrasonic scalers, or air/water syringes) should be connected to the waterline and flushed for at least **20 seconds** between patients. In addition, warming dental unit water (with the intent of improving patient comfort) should be avoided because it can augment biofilm formation.

- **Flushing** water lines and handpieces between patients as recommended by CDC will not remove biofilm from lines but:

- may temporarily reduce the planktonic microbial count in the water
- and help .
- Brings a fresh supply of chlorinated water from the main water lines into the dental unit.

Approches to improve dental unit water quality

- there are several methods for improving dental unit water quality, including:

1- Independent water reservoirs

2- source water treatment systems.

3- Filtration

4- Chemical treatments “ antimicrobial agents)

5- Anti-retraction valves

6- sterile water delivery systems.

Independent water reservoirs

- Installation of a water reservoir (eg; bottle) filled with good-quality water for patient treatment.
- We can use antimicrobial agents with this system.
- And we should control biofilm in the water lines.

Antimicrobial agents

- Available to use in independent water reservoirs.
- Some agents are placed in the bottle periodically (eg; once a week), and others are added directly to the treatment water to provide continuous antimicrobial activity in the lines.

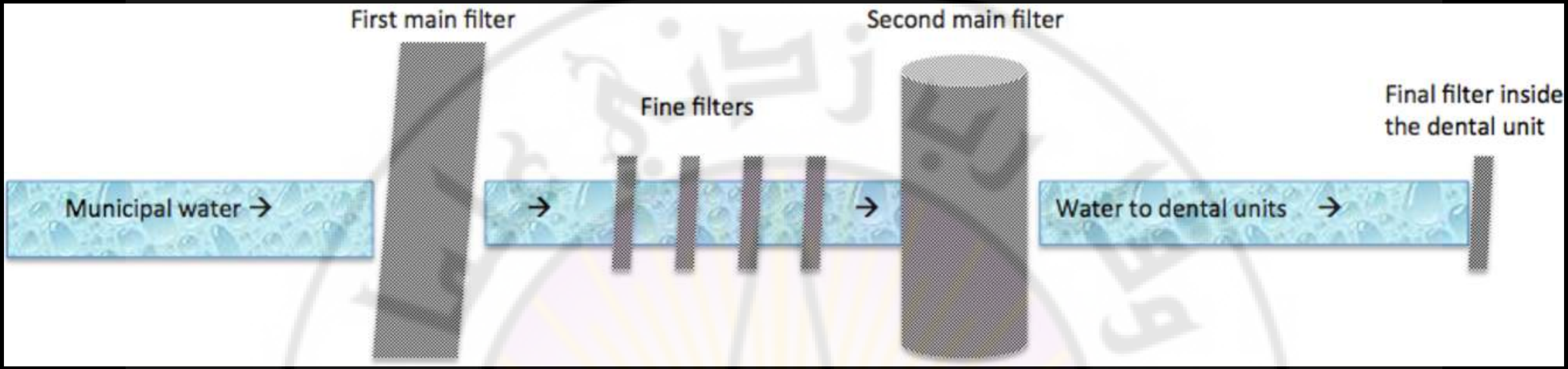
Source water treatment systems

- Treating municipal water before it enters the dental units, by several mains like:

- Ultraviolet light
- High heat
- Antimicrobial chemicals (eg; iodine,silver ions, and ozone) .

Filters

- Microbial filters are designed to remove free-floating microbes and endotoxin from the water.
- Filters placed in the water lines just before the water enters the handpiece or air/water syringe can greatly improve the water quality.


First main filter
Second main filter
Fine filters
Final filter inside the dental unit
Municipal water →
→
→
Water to dental units →

large water bottle used for storage


MicroCLEAR
DENTAL UNIT
WATERLINE CLEANER
CAUTION


DentaPure
USA
Advanced Clinical Water Treatment Technology
CROSSTEX


TEAM VISTA™
DENTAL WATERLINE CLEANER
by Hu-Friedy
Cleans and Protects Dental Unit Waterlines
Specially Design for Use in Independent Dental Water Bottle Systems
KEEP OUT OF REACH OF CHILDREN
DANGER
Product A: VistaClean Irrigant Solution Concentrate
Quan: 1 - One Ounce Bottle (Net Wt. 2 fl. Oz.) IMS-1452
Product B: VistaTab Dental Waterline Cleaner Tablets
Quan: 15 - 1.7 Gram Tablets (Net Wt. 22.5 Grams) IMS-1451
Active Ingredients: Sodium Chlorite 4.0%, Sodium Dichloroisocyanurate dihydrate 1.0%, Other Ingredients 95.0%
IMS-1450 | COMBO PACK
Hu-Friedy
VISTACLEAN™ IRRIGANT SOLUTION CONCENTRATE
by Hu-Friedy
IMS-1452

Water quality monitoring

- Testing the total bacterial counts in the water after inoculation of diluted chlorine-neutralized water samples onto R2A agar plates and incubation of the plates at room temperature for at least 1 week.


THANK YOU

Dental Handpieces Reprocessing

- In Spaulding’s classification , dental Handpieces are categorized with surgical instruments as critical devices requiring sterilization for each patient.
- According to the preventive policy of the “Standard Precaution ” blood , body fluids (except for sweat) ,waste , wounded skin , and mucosa of all patients ,with or without infectious disease , are assumed to be infectious .

Table 14.1: Spaulding's categorization of medical instruments

Class	Use	Processing
Critical, 'C'	Enters sterile body site or vascular system	Decontamination, cleaning followed by sterilization
Semi-critical, 'SC'	Comes into contact with intact mucous membrane or non-intact skin	Decontamination, cleaning followed by high-level disinfection (HLD)
Non-critical, 'NC'	Comes into contact with intact skin	Decontamination, cleaning followed by intermediate-level or low-level disinfection

- Dental handpieces contain many small parts and long narrow lumens.
- In addition, the dental air turbine gains torque by applying compressed air to the rotor; the rotor spins for awhile after air outflow because of the inertial force.
- This freewheeling creates negative pressure within the turbine , resulting in uptake of contaminants (e.g. saliva and blood), the so-called suck-back effect

- CDC guidelines for infection prevention and control state that, between patients, dental health care personnel (DHCP) should clean and heat-sterilize handpieces and other intraoral instruments that can be removed from the air and waterlines of dental units.
- This recommendation is based on studies that have shown that the internal components of air-driven dental handpieces (both low-speed and high-speed devices) can become contaminated with patient material during use, and this material can then be expelled into the mouth of other patients during subsequent uses.

- handpieces and other intraoral instruments should be removed from the air and waterlines of dental units, cleaned, and heat-sterilized between patients.
- Follow the manufacturer’s instructions for cleaning, lubrication, and sterilization.
- Do not surface-disinfect, submerge in liquid chemical sterilants, or barrier-protect these instruments because these methods cannot adequately clean, disinfect, or sterilize the internal components.

- These instruments include, but are not limited to, high-speed, low-speed, electric, endodontic, and surgical handpieces, as well as all handpiece motors and attachments.

Processing high-speed dental handpieces

- Expensive handpieces must be handled with great care to extend their use life
- Follow the manufacturer`s directions.
- Wear PPE.


CDC
Centers for Disease
Control and Prevention
National Center for
Health Statistics
Are you cleaning
your handpieces
properly?
Nupro
Freedom™

- procedures:

1- Some dental unit contain antiretraction valves in their water lines that prevent retraction of fluids back into the handpieces and air/water syringe when they are turned off (but they periodically fail, check them monthly).

2- Flush the high-speed handpiece, air/water syringe, and ultrasonic scalers for about 30 seconds between patients.

STERILIZATION

Never use any chemical solution for sterilization.

Brush off excess dirt and wipe clean with alcohol soaked cloth.

For autoclaving :

- Spray lubricate every time prior to autoclaving.
- Put the handpiece into a pouch and seal it completely.
- Autoclave for 20min. at 121℃, or 15min. at 132℃.

Handpiece sterlization steps:

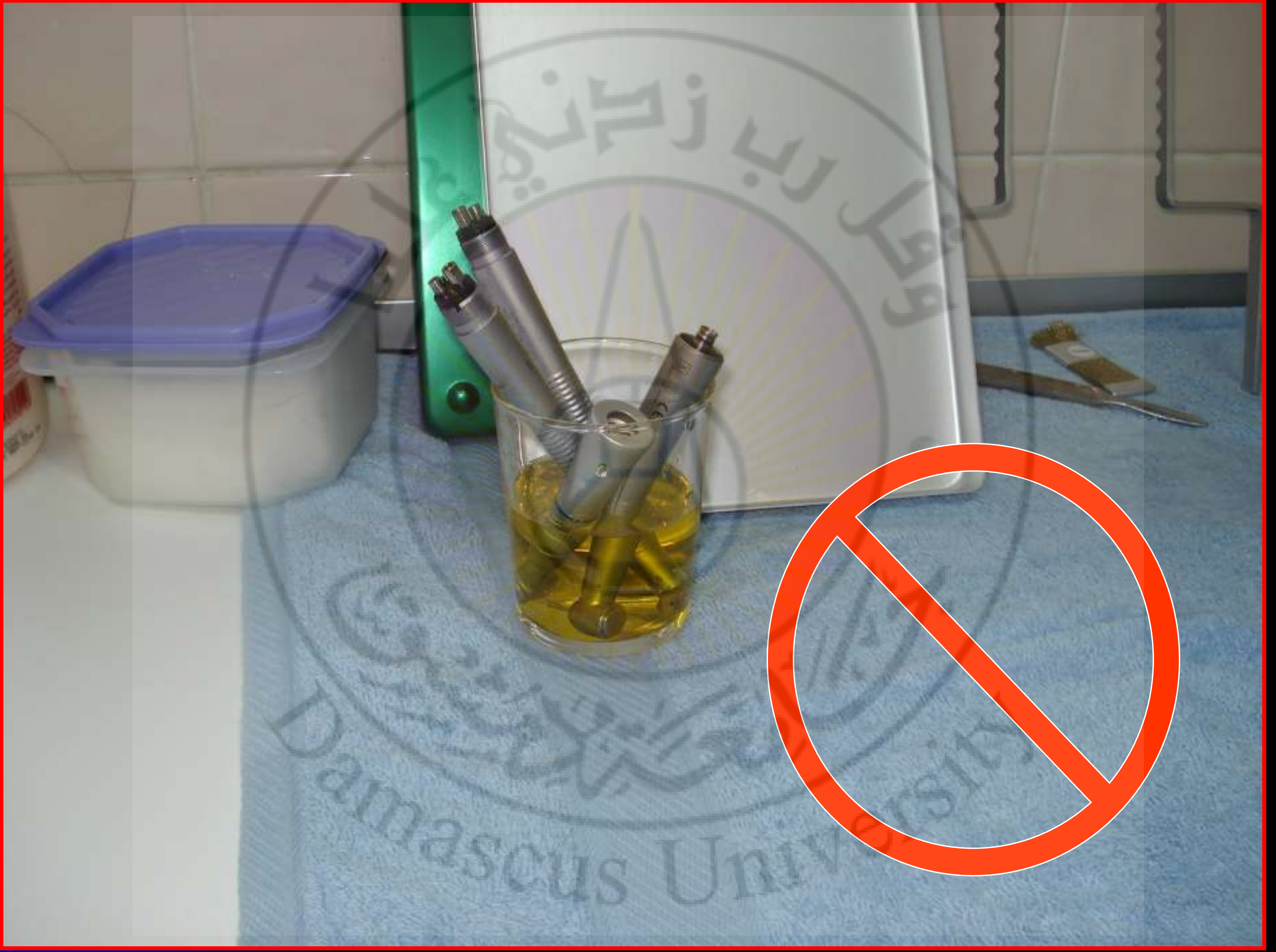
1- flush handpiece air-water lines before removing from the hose for 20 to 30 seconds (note: leave the bur in the handpiece). And then take it out the turbine.

simply take out the turbine

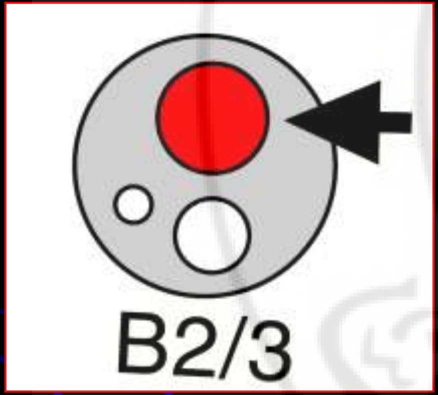
2- Wipe away visible debris .

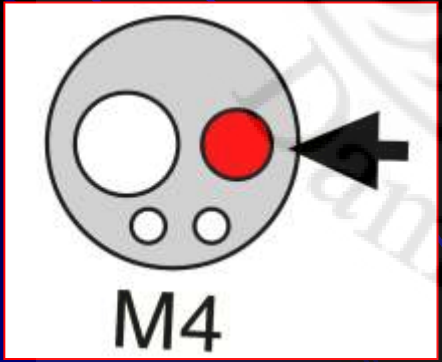
3- Remove the bur, then remove the handpiece, Using a brush and soap clean and scrub the handpiece under running water (note: do not soak the handpiece unless recommended by the manufacturer)

4- Then rinse and dry the handpiece

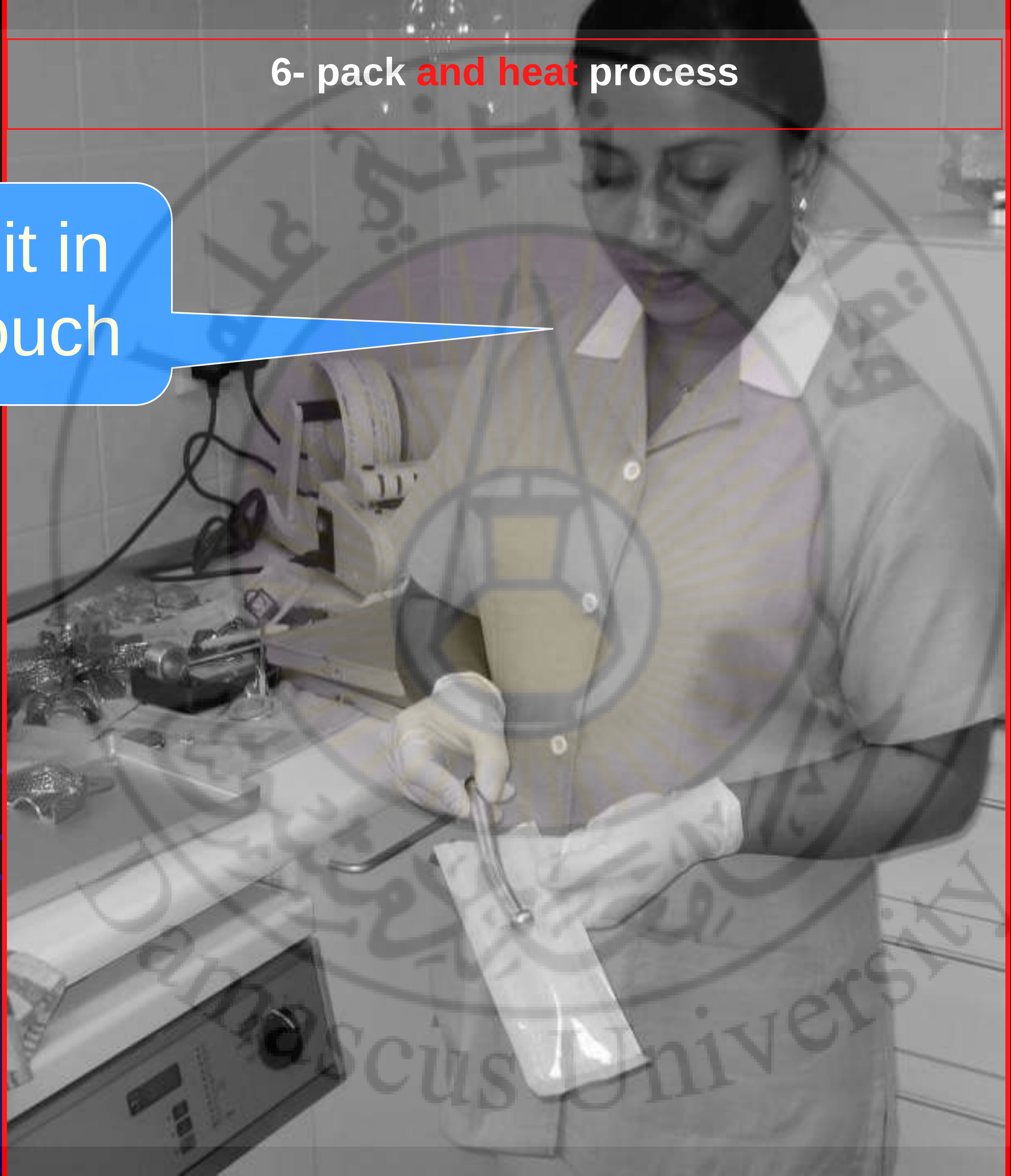


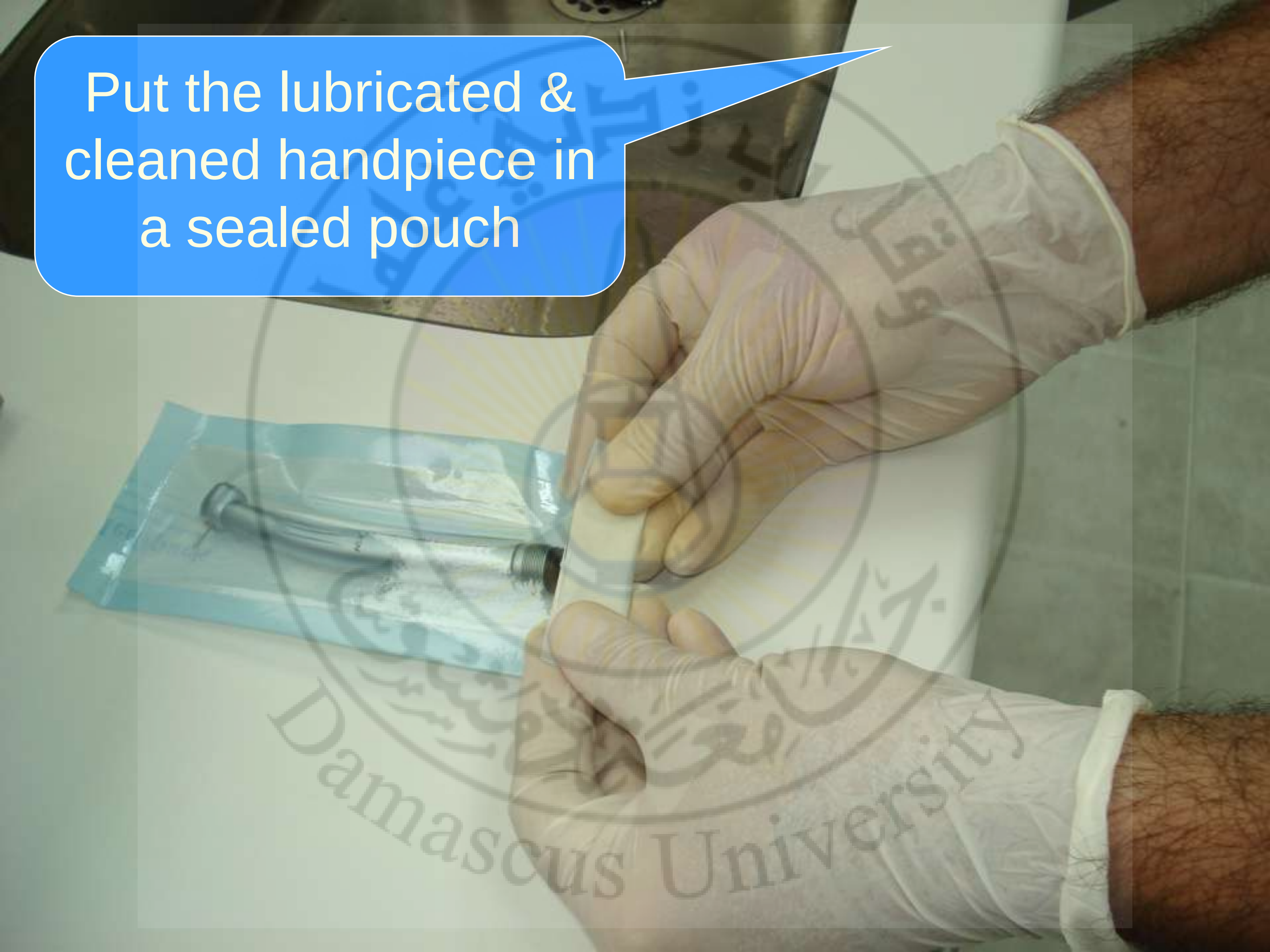
5- Apply handpiece cleaner and/or lubricant (if required by the manufacturer). You must spray to the correct hole with black nozzle on the spray. expel and wipe away excess lubricant





6- pack and heat process




Put the lubricated & cleaned handpiece in a sealed pouch


and
autoclave
it.

7- **flush** air-water lines for 20 to 30 seconds

8- then open bag and if necessary lubricate the **attach** handpiece to the hose

- **The updated guidance from the CDC provides a 3-point summary:**

1- Clean and heat sterilize handpieces and other intraoral instruments that can be removed from the air lines and waterlines of dental units.

2- For handpieces that do not attach to air lines and waterlines, use FDA-cleared devices and follow the validated manufacturer’s instructions for reprocessing these devices.

3- If a dental handpiece cannot be heat sterilized and does not have FDA clearance with validated instructions for reprocessing, do not use that device.

- The guidance on reprocessing handpieces for all dental practice settings is clear.
- In order to be compliant with CDC recommendations, more than one handpiece is needed to ensure enough time for them to be heat sterilized between each patient.

- Saying it is too expensive to buy more than one handpiece is not an excuse the CDC is likely to entertain. A dental practice is a business, and to run a business there are costs. Purchasing equipment, such as handpieces, should be considered the cost of doing business.

- Heat-sensitive critical items must undergo cold sterilization while semi-critical items must at least undergo high-level disinfection.
- Heat-sensitive critical and semi-critical items can be processed by immersing them in liquid chemical germicides approved by the Food and Drug Administration (FDA) as sterilants or high-level disinfection.

- FDA-cleared chemical sterilants include :
- glutaraldehyde
- hydrogen peroxide
- peracetic actid
- and ortho-phthaldehyde (high level disinfection only).

- Shorter immersion times of the FDA-cleared chemicals can be used to achieve high-level disinfection of semi-critical instruments only.
- Note that chemical contact time is the single critical variable distinguishing the sterilization process from high-level disinfection.

- CDC strongly recommends that whenever possible, heat-stable items be used instead of those that are heat-sensitive because limitations exist with using chemical sterilization because:

1- Post-sterilization of heat-sensitive items, the items need to be:

1) rinsed with sterile water to remove chemical residues.
2) dried with sterile towels.
3) packaged or wrapped
4) handled using sterile gloves.

2- If stored before use, the items must be sterilized again just before use.

3- The sterilization process with cold sterile solutions cannot be verified with biological indicators.

4- Sterilization of heat-sensitive items requires up to 12 hours of complete immersion, and therefore are usually only used for high level disinfection of semi-critical items.

5- Manufacturer label instructions and safety precautions must be followed carefully. Misapplications include use as an environmental surface disinfectant or instrument holding solution.

6- Chemical sterilants are highly toxic, and require appropriate precautions – closed containers, proper PPE – chemical-resistant gloves and aprons, safety eyewear, face shields, safe chemical handling.

- Some liquid chemicals can serve as a sterilant or high-level disinfectant depending on how they are used. they are:
  - sterilant: kill high levels of bacterial spores, when used for :
    - * long *exposure time*,
    - * and/or higher *concentrations*.
  - high-level disinfectant: kill low levels of bacterial spores, when used for shorter exposure time, or used at lower concentrations.

- e.g., 2% to 3,4% glutaraldehyde is :

  - a sterilant when items are submerged for 10 hours.
  - a high-level disinfectant when contact time is less than 10 hours.

- For both one cannot determine microbial killing.


THANK YOU

Sterilization of heat-labile items

Dr. Abeer Ahmad Aljoujou
PhD. Oral Medicine

- According to the CDC, all patient-care items must be cleaned prior to sterilization. Following cleaning, heat-stable critical and semi-critical dental instruments must be heat sterilized before each use.

- But what if the dental instrument is not compatible with heat, which is considered the gold standard method of sterilization in a dental office?

- Heat-sensitive critical items must undergo cold sterilization while semi-critical items must at least undergo high-level disinfection.
- Heat-sensitive critical and semi-critical items can be processed by immersing them in liquid chemical germicides approved by the Food and Drug Administration (FDA) as sterilants or high-level disinfection.

- FDA-cleared chemical sterilants include :
- glutaraldehyde
- hydrogen peroxide
- peracetic actid
- and ortho-phthaldehyde (high level disinfection only).

- Shorter immersion times of the FDA-cleared chemicals can be used to achieve high-level disinfection of semi-critical instruments only.
- Note that chemical contact time is the single critical variable distinguishing the sterilization process from high-level disinfection.

- CDC strongly recommends that whenever possible, heat-stable items be used instead of those that are heat-sensitive because limitations exist with using chemical sterilization because:

1- Post-sterilization of heat-sensitive items, the items need to be:

1) rinsed with sterile water to remove chemical residues.
2) dried with sterile towels.
3) packaged or wrapped
4) handled using sterile gloves.

2- If stored before use, the items must be sterilized again just before use.

3- The sterilization process with cold sterile solutions cannot be verified with biological indicators. ★

4- Sterilization of heat-sensitive items requires up to 12 hours of complete immersion, and therefore are usually only used for high level disinfection of semi-critical items.

5- Manufacturer label instructions and safety precautions must be followed carefully. Misapplications include use as an environmental surface disinfectant or instrument holding solution.

6- Chemical sterilants are highly toxic, and require appropriate precautions – closed containers, proper PPE – chemical-resistant gloves and aprons, safety eyewear, face shields, safe chemical handling.

- **Some liquid chemicals can serve as a sterilant or high-level disinfectant depending on how they are used. they are:**
  - **sterilant: kill high levels of bacterial spores, when used for :**
    - **long *exposure time*,**
    - **and/or higher *concentrations*.**
  - **high-level disinfectant: kill low levels of bacterial spores, when used for shorter exposure time, or used at lower concentrations.**

- e.g., 2% to 3,4% glutaraldehyde is :

  - a sterilant when items are submerged for 10 hours.
  - a high-level disinfectant when contact time is less than 10 hours.

- For both one cannot determine microbial killing.

Infection control in the prosthodontic laboratory

Strategy to achieve infection control

- All patient must be screend
- Barriers for personal protection
- Carefull aseptic technique
- sterlization and disinfection
- Disposal of contaminated waste safely
- Laboratory asepsis

- The use of appropriate infection control precautions is important for dental laboratory technicians, as it is for the dental team.
- Improper handling of contaminated items, such as impressions, casts, and other prosthetic appliances, can result in cross-contamination and possible cross-infection to personnel.
- The first published recommendations for infection control in the dental laboratory were written by the ADA in 1978.

Occupational Risks

- Potential routes of transmission include:
- direct contact with infected saliva or blood through cuts and abrasions.
- indirect accidental percutaneous exposure when using knives and other sharps items.
- and airborne infection from microbial-laden aerosols and spatter created during laboratory procedures.

Dental laboratory technician polishing bite splint prior to delivery.

The greatest exposure risk for dental laboratory personnel is indirect contact through cross-contamination.

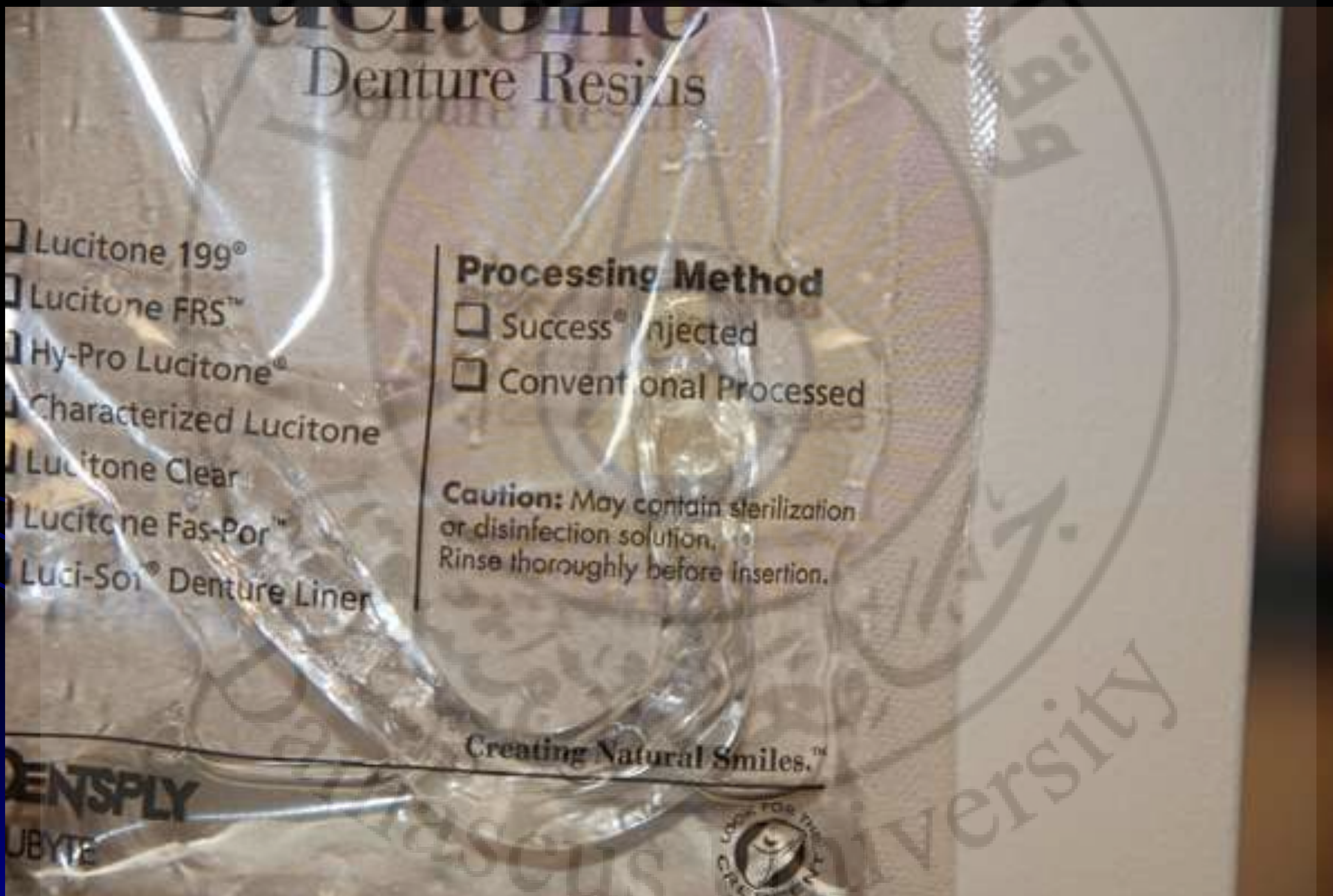
- impressions, prostheses, and appliances may be contaminated with saliva and blood and facilitate the transmission of microorganisms from operatory to laboratory.
- For example, microorganisms on a dental impression may be transferred to dental casts and remain in set gypsum for up to 7 days.

- Thus, the potential for cross-contamination may occur from dental office to laboratory, and back to the dental office.
- Cross-contamination may also crop up within the laboratory from case to case, and may also occur from surface contact, contaminated handpieces , burs, rag wheels, pumice pans and hands.

Laboratory handpieces and burs can be sources of cross-contamination

Contaminated rag wheels and pumice pans in a laboratory

the disinfection status of a bite splint



- In the dental laboratory, principles for infection control :

- appropriate immunizations for laboratory personnel.
- the use of barrier techniques, and implementation of standard precautions

/ Standard precautions: dictate that all laboratory cases are handled the same way and are treated as if contaminated and infectious/

- At-risk employees must be offered the hepatitis B vaccination, and all employees are to be provided initial and annual training regarding bloodborne pathogens.
- The dental office and laboratory must reliably communicate the disinfection status of each incoming and outgoing case.

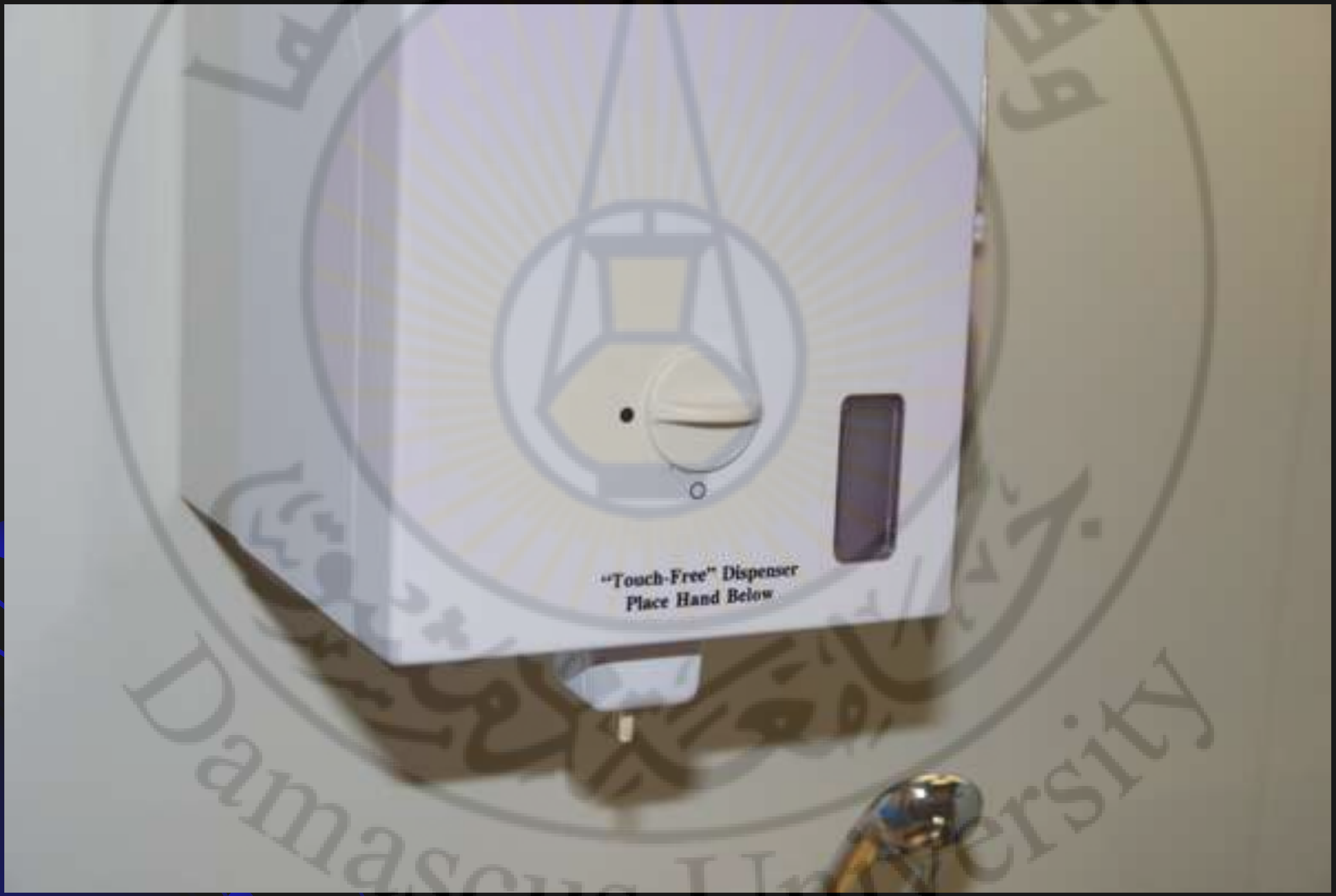
- Prevention measures include:
  - organization of the dental laboratory into separate receiving, production, and shipping areas
  - appropriate personal protective equipment
  - frequent hand hygiene
  - and proper laboratory case disinfection

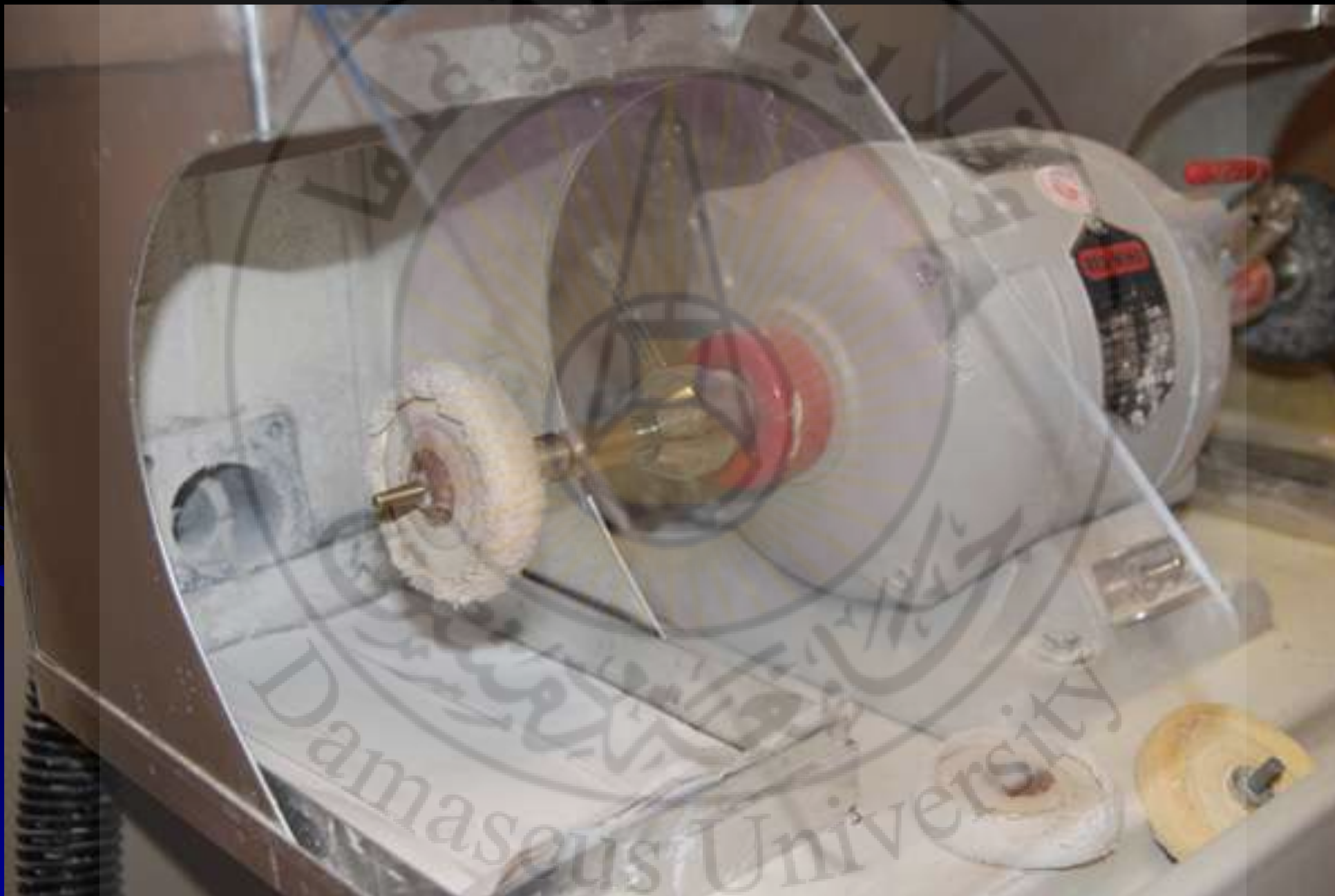
- A receiving area should handle all items entering the laboratory and ought to have <u>running water and hand-washing</u> facilities. Countertops in this area should be <u>covered</u> with impervious paper or cleaned and disinfected on a regular basis

Rinsing of dental impression prior to subsequent laboratory procedures

- The receiving area technician must wear appropriate personal protective equipment (PPE) when receiving and disinfecting laboratory cases.
- After the items have been cleaned and disinfected, they can then be safely transferred to the production area.

Representative automated hand-hygiene dispenser.





Disinfection of dental impressions by immersion before laboratory processing

- Lastly, the shipping area is designated for final inspection of items leaving the dental laboratory. This portion of the facility should be cleaned at least once a day and all case pans need to be cleaned before being used for another case.

- All clinical materials being sent to a laboratory should be cleaned and disinfected by the dental office that sent it, and identified as such.
- If the dental laboratory is uncertain about whether disinfection has been performed, the laboratory should carry out the process with an intermediate-level disinfectant following the manufacturer’s instructions.

- The chemical disinfectants must be compatible with the dental impression materials used and must not affect the dimensional accuracy or surface texture. If the accuracy of the impression is compromised, the resulting gypsum casts will also be compromised, which may result in ill-fitting and nonfunctional prostheses. No single disinfectant is compatible with all impression materials, so the manufacturer of the impression material and disinfectant should be consulted.

- Receiving dental offices should disinfect all impressions and prostheses before insertion in a patient’s mouth.

- Dental impressions are categorized under semi-critical objects in dental practice and require high level disinfection or sterilization.
- Until 1991, the recommended procedure for disinfection of impression was rinsing under running water with which only 40% of bacteria, viruses and fungi were removed and potential for transmission of microorganisms remains there.
- Disinfection of dental impression should be a routine procedure in the dental office and dental laboratory.

Type Of Disinfection	Disinfectants	Type of impression materials	Time of exposure
High level disinfection	Glutaraldehyde	Irreversible hydrocolloid	10 min
		Zinc-oxide eugenol	10 min
		Polysulfide Polyether	10 min
		Addition silicon	10 min

Intermediate Level Disinfection	Sodium hypochlorite Complex iodophors Phenols Chlorhexidine Alcohols	Irreversible hydrocolloid	10 min
		Zinc-oxide eugenol	10 min
		Polysulfide Polyether	10 min
		Addition silicon	10 min
		Impression compound	10 min
Low Level Disinfection	Quaternary ammonium compounds Simple phenols detergents	Not recommended for impression disinfection	

- Sterilization of impression:

  Various methods are available for sterilization of impressions e.g:

- exposure to UV light
- steam autoclave
- ethylene oxide gas autoclave
- and radiofrequency flow discharge

- UV rays can be used for disinfection of:
- water supplies
- laboratory equipment
- dental headpieces
- dental impression and implants.
- In one study, while comparing UV rays disinfection with Glutaraldehyde and NaOCl, UV rays exhibited maximum efficacy

- The American Dental Association’s revised guidelines recommend chemical agents that are virucidal, bactericidal and sporicidal. These chemical agents are : chlorine compounds, phenols, iodophors, formaldehyde and gluteraldehyde.
- impression Immersion in NaOCl at concentration of 1:10 (0.525%) is advised for 10 minutes.

- The Japan Prosthodontic Society has recommended the alginate impression in either 0.1-1% Naocl solution for 15-30 min or 2-3.5% gluteraldehyde solution for 30-minutes.

DENTAL PROSTHESIS AND APPLIANCES

- The ADA recommends disinfection by immersion in iodophors or chlorine compounds. Although both of these disinfectants are somewhat corrosive.
- studies have shown little effect on chrome cobalt alloy with short-term exposure (10 minutes) to iodophors or 1:10 hypochlorite.
- Damage of heat cured denture base resin has been shown to occur after only 10 minutes of immersion in a glutaraldehyde with phenol buffer, although immersion in 2% alkaline glutaraldehyde did not damage the acrylic surface.

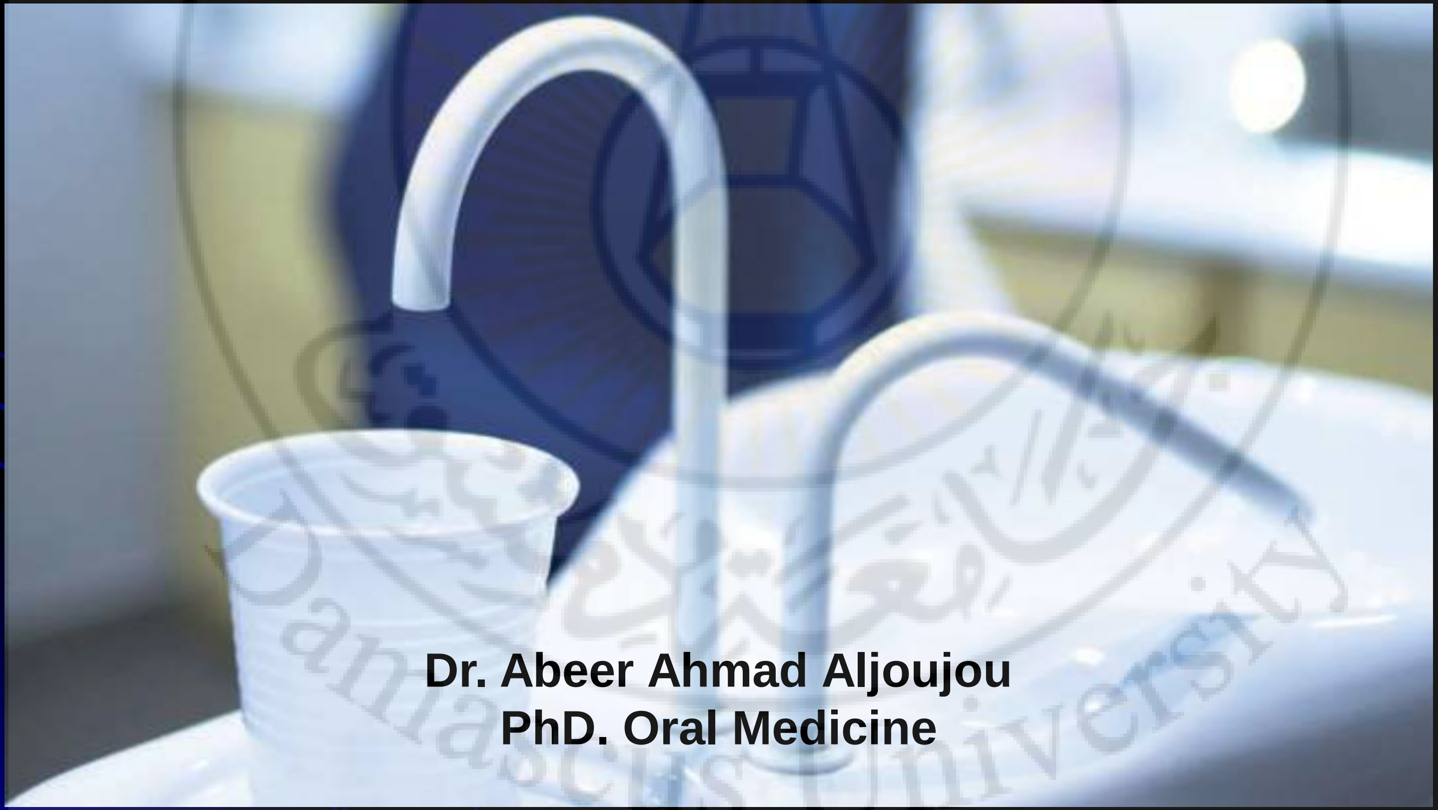
- however iodophors or chlorine compounds are preferred for disinfection of acrylic appliances.
- Fixed metal/porcelain prosthesis may be disinfected by immersion in glutaraldehydes for the time recommended for tuberculocidal inactivation by the disinfectant manufacturer.

- Wax rims and wax bites should be disinfected by the spray wipe spray method using an iodophor as recommended by the ADA.

CONCLUSION

- The use of effective infection control procedures and universal precautions in the dental office and the dental laboratory will prevent cross contamination that could extend to dentists, dental office staff, dental technicians and patients

Dental Unit Water Asepsis



Dr. Abeer Ahmad Aljoujou
PhD. Oral Medicine


What's Lurking
in Your Waterlines?

- Water enters the dental office from municipal supplies. Then it goes into plastic water lines to be distributed to the hoses that feed various attachments such as :

- High-speed handpieces.

– Air or water syringe.

– Ultrasonic scaler.

- Water lines have a small bore (about 1/16 inch).

- The environmental protection Agency standard for the microbial quality of drinking water (called potable water) is no more than a total of 500 colony –forming units per milliliter (CFU/mL) of noncoliform bacteria.
- water that enters the dental unit usually contains just 0-500 CFU/mL, however, water exiting the dental handpiece, air/water syringe and ultrasunic scalers may contain more than 100,000CFU/mL, some studies conducted in USA found greater concentrations (1.2 million and 10 million CFU/mL)

- Although dental professionals have known waterlines harbor bacteria, until relatively recently there has been no solid evidence this contributes to the spread of infection. That changed in 2011 when an 82-year-old woman was diagnosed with and died from Legionnaires' disease following a dental appointment. Investigators found Legionella pneumophila on the dental handpiece waterline in the practice the woman had visited.

Types and importance of microorganisms in dental unit water

- The vast majority of microorganisms that was found in dental unit water are waterborne microorganisms , most of them are of low pathogenicity or are apportunistic pathogens causing harmful infections only under special conditions or in immunocompromised and elderly persons .
- Micriorganisims of main concern are species of :

- Pseudomonas الزائفة الزنجارية
- Legionella الجرثومة الفيلقية
- Mycobacterium (الجرثومة المتفطرة)

- In 2015, a CDC report concluded that a rash of Mycobacterium abscessus odontogenic infections among children in Georgia could be traced back to contaminated water used during pulpotomies. The dental units in question, the CDC said, contained an average of 91,333 CFUs/mL.

- There is no question now that dental unit waterlines can contain microorganisms well above safe levels, and these bacteria can cause deadly diseases. <u>Cleaning and maintaining waterlines is critical for every dental office</u>.

Biofilm in Dental Water Lines

- Contamination of dental water units comes from the water itself and is referred to as the **planktonic** (free- floating) or from **biofilm** that forms on the inside of the unit lines.
- Biofilm is a mass of microorganisms (bacteria, fungi, and protozoans) attached to a nonsterile surface exposed to moisture.
- Biofilms can serve as a reservoir, amplifying the numbers of free-floating microorganisms in the water.

- Biofilm forms when bacterial cells adhere to a surface using cell surface polymers (glycocalyx polymers) that give the biofilm “slimy” nature.
- Then the attached cells multiply within the glycocalyx , with continual recruitment of additional bacteria from planktonic phase until covering the whole surface.

- Biofilm forms inside the lines as the water is flowing through the unit, because of some factors; like :

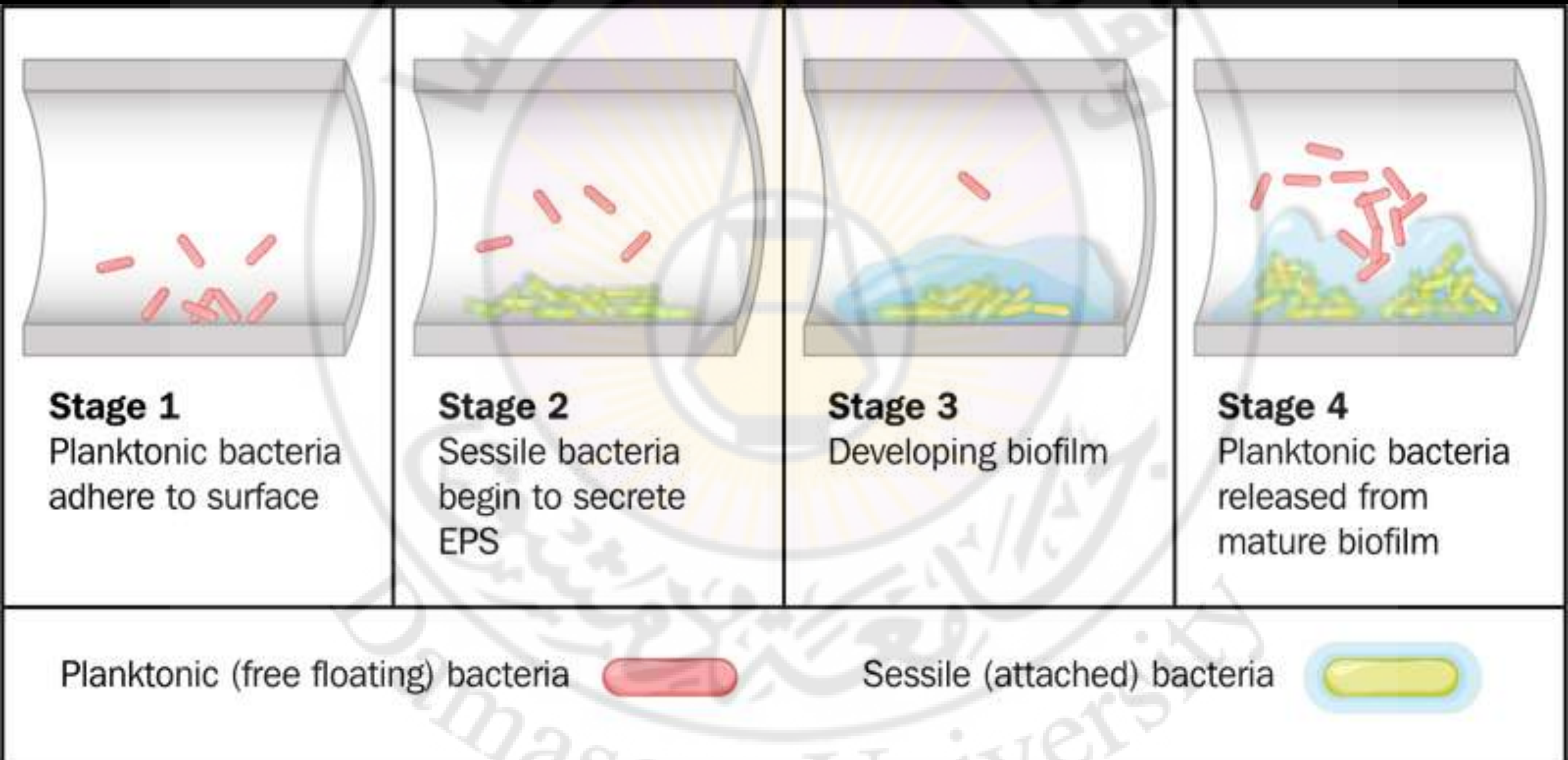
1- water stagnates (water in tubes is not under high pressure, and the water flow rate is low near the walls)

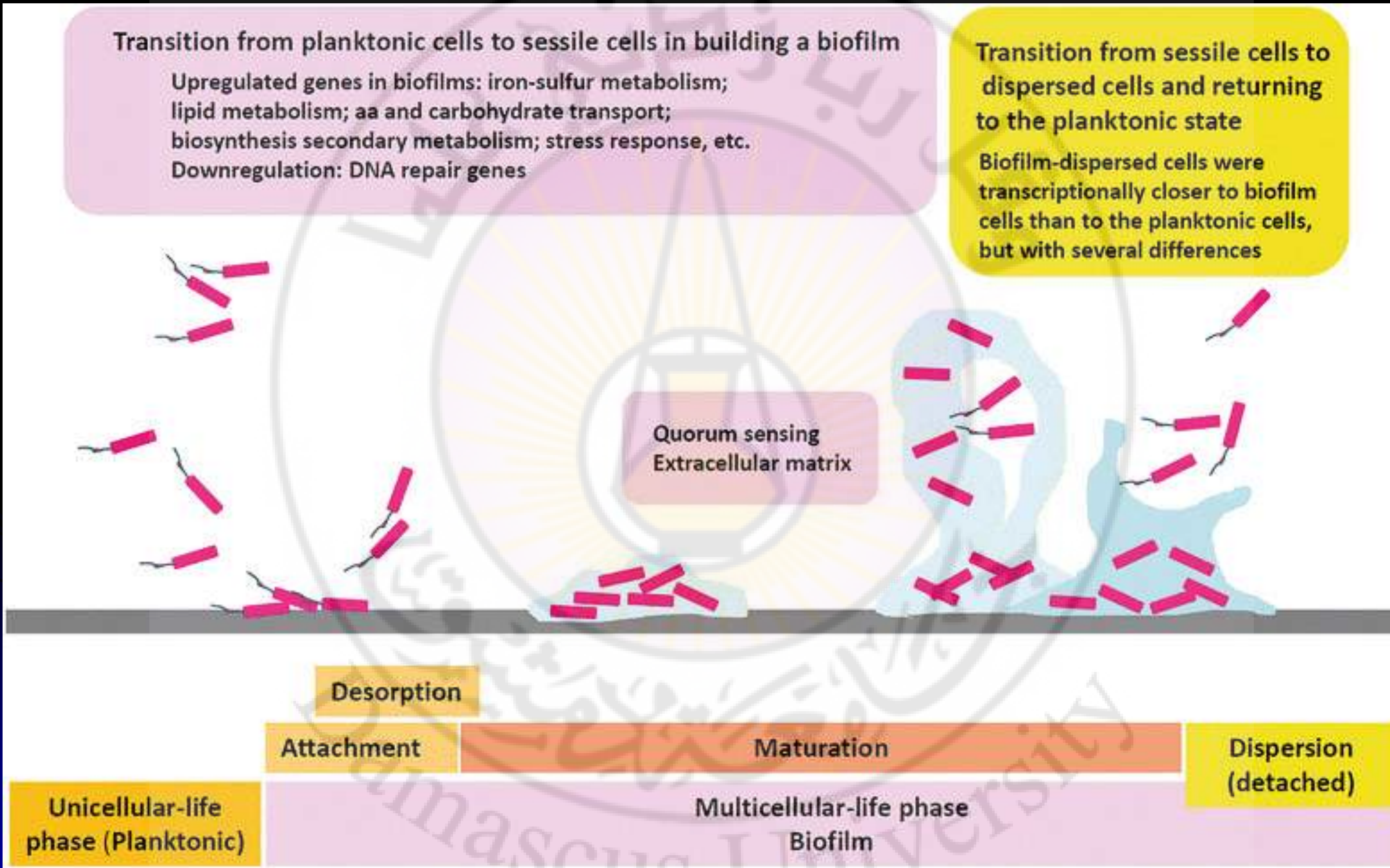
2- small- diameter tubing creates a large surface-to-volume ratio, giving bacteria a greater chance to contact an attach to the wall surface.

3- waterborne bacteria entering the system have special abilities to attach to surfaces.

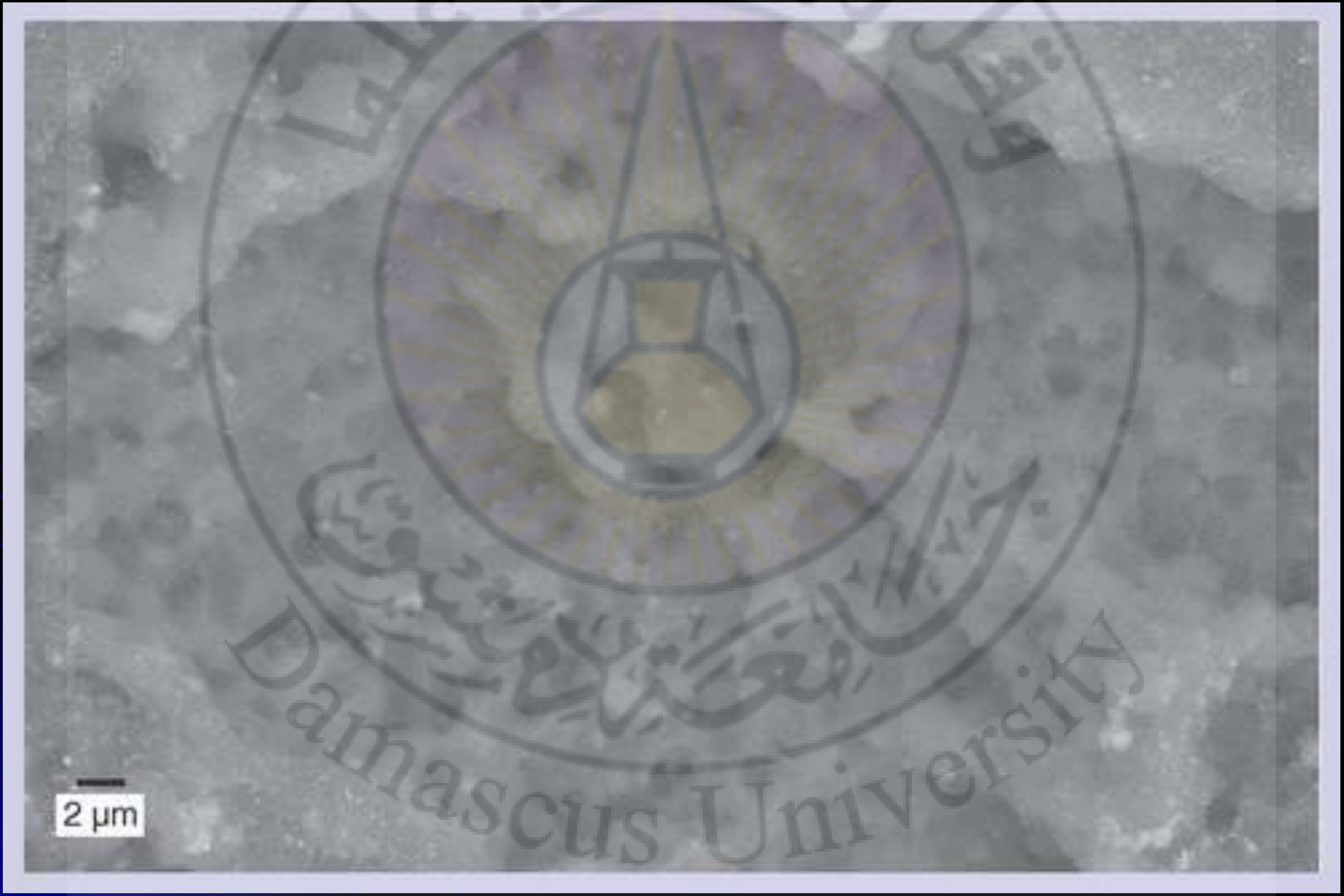
4- incoming water brings a continuous source of bacteria and its nutrients .

Biofilm formation in inner walls of dental unit water lines




Transition from planktonic cells to sessile cells in building a biofilm
Upregulated genes in biofilms: iron-sulfur metabolism; lipid metabolism; aa and carbohydrate transport; biosynthesis secondary metabolism; stress response, etc.
Downregulation: DNA repair genes
Transition from sessile cells to dispersed cells and returning to the planktonic state
Biofilm-dispersed cells were transcriptionally closer to biofilm cells than to the planktonic cells, but with several differences
Quorum sensing
Extracellular matrix
Desorption
Attachment
Maturation
Dispersion (detached)
Unicellular-life phase (Planktonic)
Multicellular-life phase
Biofilm

Electron micrograph of 4-week-old biofilm formed on the internal surface of a dental unit waterline taken from a dental chair unit supplied with potable quality mains water. The biofilm reached a thickness of 30 μm after 4 weeks growth.



Trustwater

Biofilm – The Problem

- dental unit waterline systems designed for general dental practice must be regularly maintained, via **water treatment** and monitoring, performed according to the manufacturer’s instructions.

Special Approaches for Surgical Procedures

- Regardless of how practices maintain their waterlines, it's important to remember that **sterile water** – not filtered water – should always be used for **surgical procedures**. Because oral surgery raises a patient's risk of local or systemic infections, the CDC recommends the use of sterile irrigating solutions and devices designed for the delivery of sterile irrigating fluids.

- Microorganisms not only can be introduced from the water source but can also enter the waterline from patients' mouths during treatment. Efforts to limit this means of exposure include installation of anti-retraction valves and flushing the lines between patients.
- The CDC recommends that any devices that enter a patient's mouth (e.g. handpieces, ultrasonic scalers, or air/water syringes) should be connected to the waterline and flushed for at least **20 seconds** between patients. In addition, warming dental unit water (with the intent of improving patient comfort) should be avoided because it can augment biofilm formation.

- **Flushing** water lines and handpieces between patients as recommended by CDC will not remove biofilm from lines but:

- may temporarily reduce the planktonic microbial count in the water
- and help clean the handpiece water lines of materials that may have entered from the patient`s mouth.
- Brings a fresh supply of chlorinated water from the main water lines into the dental unit.

Approches to improve dental unit water quality

- there are several methods for improving dental unit water quality, including:

1- Independent water reservoirs

2- source water treatment systems.

3- Filtration

4- Chemical treatments “ antimicrobial agents)

5- Anti-retraction valves

6- sterile water delivery systems.

Independent water reservoirs

- Installation of a water reservoir (eg; bottle) filled with good-quality water for patient treatment.
- We can use antimicrobial agents with this system.
- And we should control biofilm in the water lines.

Antimicrobial agents

- Available to use in independent water reservoirs.
- Some agents are placed in the bottle periodically (eg; once a week), and others are added directly to the treatment water to provide continuous antimicrobial activity in the lines.

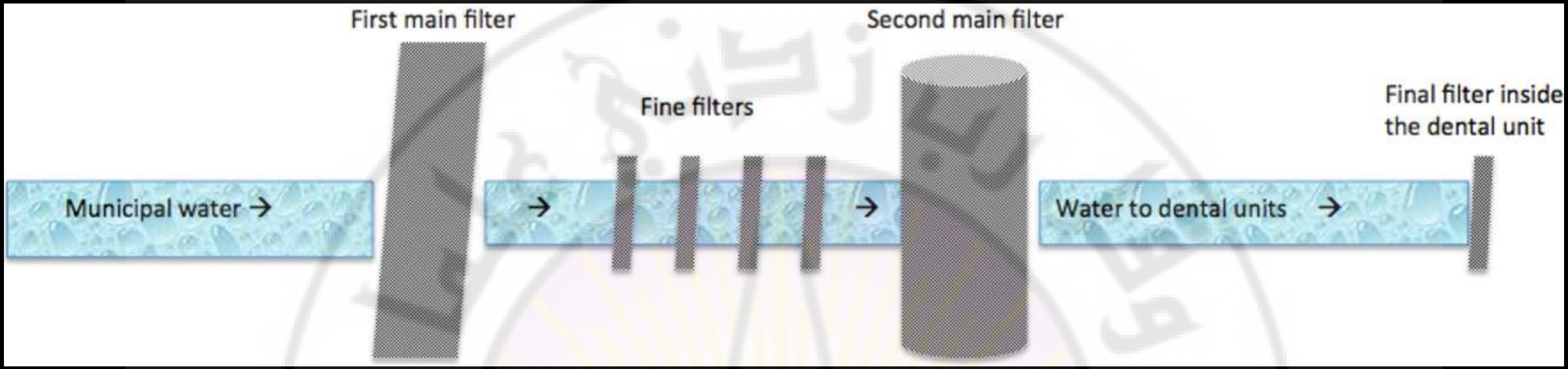
Source water treatment systems

- Treating municipal water before it enters the dental units, by several mains like:

- Ultraviolet light
- High heat
- Antimicrobial chemicals (eg; iodine,silver ions, and ozone) .

Filters

- Microbial filters are designed to remove free-floating microbes and endotoxin from the water.
- Filters placed in the water lines just before the water enters the handpiece or air/water syringe can greatly improve the water quality.


First main filter
Second main filter
Fine filters
Final filter inside the dental unit
Municipal water →
→
→
Water to dental units →

large water bottle used for storage


MicroCLEAR
DENTAL UNIT
WATERLINE CLEANER
CAUTION


DentaPure
USA
Advanced Clinical Water Treatment Technology
CROSSTEX


TEAM VISTA™
DENTAL WATERLINE CLEANER
by Hu-Friedy
Cleans and Protects Dental Unit Waterlines
Specially Design for Use in Independent Dental Water Bottle Systems
KEEP OUT OF REACH OF CHILDREN
DANGER
Product A: VistaClean Irrigant Solution Concentrate
Quan: 1 • One Ounce Bottle (Net Wt. 2 fl. Oz.) IMS-1452
Product B: VistaTab Dental Waterline Cleaner Tablets
Quan: 15 - 1.7 Gram Tablets (Net Wt. 22.5 Grams) IMS-1451
Active Ingredients: Sodium Chlorite 4.0%, Sodium Dichloroisocyanurate dihydrate 1.0%, Other Ingredients 95.0%
IMS-1450 | COMBO PACK
Hu-Friedy
VISTACLEAN™ IRRIGANT SOLUTION CONCENTRATE
by Hu-Friedy
IMS-1452
Damascus University

Water quality monitoring

- Testing the total bacterial counts in the water after inoculation of diluted chlorine-neutralized water samples onto R2A agar plates and incubation of the plates at room temperature for at least 1 week.


THANK YOU