Sterilisation and cross-infection control in the dental practice

Sterilisation and cross-infection control is a core compulsory or recommended dental CPD (continuing professional development) topic in most European countries.

Educational aims

The overall aim of this module is to inform and educate the dental professionals on the basic principles of cross-contamination barriers and infection control measures in the dental health care facility.

Expected outcomes

On completion of the module, the dentist will:

- have knowledge of the importance of appropriate protection of the dental personnel through meticulous hand washing, gloving and dental clothing
- be able to perform the best practice techniques related to the management of contaminated surfaces and instruments
- be able to apply appropriate cleaning, decontamination and sterilisation protocols
- fully understand the importance of cross-contamination barriers on overall patient safety
- be informed on the currently existing protocols on the issues of sterilisation & cross-infection control
1. **Taking protection measures prior to beginning treatment**

The dental staff must do the following before performing any dental work:

- Get vaccinated against hepatitis B – **It is an imperative/mandatory.**
- Take a detailed medical history. This is necessary to find out if the patient has been through some kind of active contamination or other diseases indicating immunosuppression or other systemic illnesses. Independently of the information you have collected from your patient, you must consider him/her **potentially contaminated and take the precautions advised for all patients.**
- Make sure all the instruments are sterilised. Any instruments used to penetrate soft tissues or bones, such as tweezers, chisels, scalers, curettes, must be sterilised after use.
- Protect working surfaces.
- Make sure they have at their disposal all the disinfectant fluids and waste containers necessary.

2. **Hand washing**

Hand washing is central to the ‘patient – doctor – auxiliary staff’ protection circle aiming at the prevention of cross infection.

The dental personnel are obliged to wash their hands **before and after coming into contact** with the patient (or the instruments used) independently of wearing gloves or not during the operation.

Hand washing must be performed meticulously so that every hand surface is adequately cleaned. Special attention must be paid to hand surfaces usually neglected when washed.

The images illustrate the areas requiring special attention so that hands are properly cleaned.
After removing the gloves, hands must be carefully washed as very often there are pores in latex allowing the penetration of contaminating matter.

Although frequent hand washing is a necessity, sometimes problems may appear such as dry skin and dermatitis. To avoid such problems special moisturising lotions are recommended. These lotions,
moisturising creams etc. should be applied at the end of the day as they may cause the gloves to develop pinholes, due to their chemical composition, in which case no protection is offered by the gloves.

In most kinds of dental work, **water and soap** followed by an antimicrobial solution are sufficient. In case of an injury, scratch or exudative injury, the person could postpone treating patients until the wound is healed. If this is not possible, the use of a double pair of suitable and tolerable gloves is recommended. As regards to antimicrobial solutions, although their use is not required, solutions with prolonged action are preferable.

*Their contribution to hand antisepsis is significant as pinholes may pre-exist or develop when the gloves are in use allowing the penetration of oral fluids and blood. When an antimicrobial solution remains effective for a long time after its application, adequate hand protection from the development of micro-organisms on the skin surface below the gloves is provided.*

Using antimicrobial solutions without prior meticulous hand washing is considered to be a defective and inefficient procedure.

Alcohol antiseptic solutions or gels are effective in destroying the micro-organisms on the hand surface, provided that their use is preceded by adequate cleaning.

It should be noted that a solution can have a prolonged antiseptic action only if it contains an antiseptic agent such as chlorhexidine, quaternary ammonium compounds, octenidine or triclosan.

- Hand washing before and after patient contact is absolutely necessary
- Antimicrobial solutions contribute to hand antisepsis
- Solutions are not used as the only means of asepsis; they complement hand washing
3. **Gloves**

Medical and auxiliary staff are obliged to always wear latex (or vinyl or nitrile where latex allergy has been demonstrated) gloves during any dental procedure which involves contact with blood or saliva containing blood or mucus. These gloves should not necessarily be sterilised unless a surgical operation is going to take place, particularly when operating on patients with HIV infection.

**Hands must be meticulously washed before wearing gloves.**

The same procedure must be followed after removing gloves. Gloves are used during any dental procedure, for a single patient only. Afterwards, they are removed and discarded.

**Washing the gloves and performing any dental procedure on another patient is strictly forbidden.**

Sterilising examination gloves is also not allowed as manufacturally there is no guarantee of the protection of their integrity. Disinfection fluids, essential oils, acrylic monomers, various dental materials and instruments, several skin soaps and lotions may distort the cohesion of the glove material.

In patients with confirmed HIV or HBV and HCV infection, it is recommended that consideration should be given to the use of **double gloves**, for the protection of the surgeon. If during any dental procedure it is necessary to use an extra device or material, gloves should be covered with an extra pair of nylon gloves so that contamination of those surfaces is prevented.

Anaphylactic responses, at various levels, have been recorded due to latex gloves.

*In such cases the exact cause of this response must be researched (latex, talc, maize powder) considering, also, agents facilitating anaphylactic responses (humidity). In such situations, appropriate hypoallergenic gloves or vinyl/nitrile gloves should be provided. If there are injuries, scratches or exudative injuries and the operation cannot be avoided, double gloving is recommended for extra protection. Double gloving, however, can significantly reduce tactile sensation which itself may facilitate glove penetration.*

- Hand washing is necessary before wearing gloves
- Gloves are discarded after each patient
- Double gloves are recommended for patients with HIV, HBV, HCV infection
4. **Mask and glasses**

During the examination or any dental procedure, an appropriate mask and eye protectors are necessary. These masks must follow certain specifications regarding the size, the thickness and the material, excluding those designed for structural or technical occupations to counteract intense particle penetration ability.

Masks must be able to withhold at least 95% of the microorganisms.

In case where the dental patient suffers from an airborne disease (tuberculosis), the mask must be enhanced and fully adaptable to the wearer’s face. Also, it must be able to withhold particles and microorganisms with a diameter up to $1\mu m$, at a percentage of 95% (aspirator N95, FFP3). If the mask gets wet it must be immediately discarded and replaced.

Eye protectors may include various types of glasses or plastic masks or shields made of transparent materials. The side frame should be wide enough to adequately cover the eye. These protectors must be rinsed with abundant water and get disinfected in case they get contaminated in between the patients.

- Masks and eye protectors enhance dentist and patient safety
5. **Dental clothing & Surface coverings**

Dental blouses (work shirts/tops etc) should cover the majority of the dentist’s body and arms.

They must be changed on a daily basis and definitely as soon as they get stained.

If the operative procedure is expected to involve a large amount of bleeding or the patient is likely to be seropositive, it is highly recommended that specially designed single-use clothing be used.

Reusable clothing must be washed in a machine washer at an appropriate temperature, using a detergent and always separately from domestic and non-medical clothing.

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**Surface coverings**

Any surfaces, devices, electric switches, door handles, drawer knobs, taps, handles and device tubing which is not possible to sterilise or disinfect, should be meticulously covered with appropriate materials, such as:

- special rollers and plasticised paper sheets,
- cellulose film,
- aluminium foil,
- self-adhesive films,
- nylon cases,
latex and vinyl cases.

These protective coverings should be replaced after every contact and every patient

Surfaces not covered by protective films have to be cleaned, decontaminated and disinfected even when non visually detectable bioburden exists, after each patient’s session.
Initially, the surfaces must be cleaned with an ordinary household surface cleaner and wiped off with clean paper towel.
This should be followed by application of an appropriate surface disinfecting solution (i.e. polyalcoholic with q-ammonium compounds) which should be applied either by a spraying process or using moistened wipes. Once applied to the surface, the disinfectant must be left for the time suggested by the manufacturer.

- Dental blouses (shirts, tops) are changed daily and washed separately
- Surfaces which are not able to be sterilised are covered with appropriate material
- Surfaces not covered by protective films are cleaned, decontaminated and disinfected after each patient’s session
Headrest cover

Handpiece cover

Air-water syringe cover
6. Management of dental unit waterlines

Microorganisms found in the water supply system of the dental practice may originate from not only the water distribution system and new connections but also from small contaminated amounts penetrating during a dental procedure. The issue of the presence of pathogens in the water supply system of the dental practices has recently returned to the foreground as the pathogen *Legionella pneumophila* was detected on the biofilms in the interior of the dental unit pipes. These biofilms serve as germ reservoirs despite the fact that the original source of the germs is the place(s) where water is supplied and distributed at an urban or municipal level. *Legionella pneumophila* is an extremely hazardous pathogen causing severe problems mainly to the respiratory system affecting people with a weak immune system. In many countries whose supply systems are often contaminated by *Legionella* several techniques are recommended such as independent safe water reservoirs, chemical processing of dental unit water, water filtering, combinations of the above, frequent change of microducts, flow through the sink, the spittoon and the handpiece tubing for at least 1 minute every day at the beginning of the first day session or after a long recess and, finally, the use of sterilised water in case of bloodied surgeries.

7. Cleaning and Sterilisation of dental instruments

Any dental hand instrument used during a dental procedure must undergo a cleaning and sterilisation procedure.

**Step 1.** Immediately after the completion of a dental procedure (examination, restoration, surgery) the instruments must be discarded in a special plastic container filled with an appropriate disinfectant solution or enzyme solution with a proteolytic action.

**Step 2.** After leaving the instruments within the solution for as long as the manufacturer recommends, they are transferred to the machine washer where they undergo thorough mechanical cleaning using the appropriate detergents. If dental materials (cements, pastes, oxides, etc) remain attached to the instruments, the latter must be cleaned with ultrasonic devices and appropriate solutions.
Manual cleaning is not recommended due to the high risk involved in causing injuries and because it is inferior to mechanical cleaning in terms of quality.

**Step 3.** After the instruments have been cleaned, they are packaged in special bags or perforated cassettes and they are taken to the **autoclaves** to be sterilised.

The autoclave is programmed to operate depending on the packaging of the instruments and according to the default parameters set by the manufacturer, e.g. 134°C for 3 minutes or 121 °C for 20 minutes or 134°C for 13 minutes, etc. It should be noted that these times do not include warm up or air removal. The completion of the cycle and the sterilisation process is confirmed through electronic instrument indications as well as changes in the color or shape of the indicators.
7a. Single use instruments

These instruments are divided into two categories:

- **Obligatory single use instruments.** They can only be used once and be discarded afterwards. Anesthetic needles, scalpel blades, suture needles, saliva ejectors, dental cups, surgical suction nozzles, pulp instruments, wedges, rubber cups, matrix bands, fluoride gel trays, disposable burs.

- **Optimally single use instruments**
  Certain mirrors, matrix bands, napkin holders, various types of burs, impression trays, material mixing pads, low speed handpieces for polishing after cleaning, high speed handpieces for cavity and restorative core preparations in seropositive patients.
Disposable single use examining set

Single use wood wedges

Single use brushes

Disposable single use examining set
7b. Use and care of sharp instruments and needles

Sharp instruments, having been in contact with blood and saliva, should be handled with special care so that injuries are prevented.

Place any surgical blade and needle within a solid, hard plastic container for sharp instruments. Do not cap, bend or destroy the needles before you discard them. Do not overfill the plastic container, close tightly and, finally, discard.

*Used needles must not be re-sheathed with both hands or any other technique and care must be taken so that the needle does not point towards the body. The ‘one hand’ technique to re-sheath the needle or a mechanical means designed to hold the cap should always be used. Recently, the use of needle destroyers which melt the metallic edge of the instrument has been suggested.*

- Dental instruments must undergo a cleaning and sterilisation procedure
- Sharp instruments and needles must be managed with special care and the latter should be disposed of immediately in a “sharps” disposal container
8. **Sterilisation of handpieces and burs**

Low and high speed handpieces as well as various burs used in everyday clinical practice should be sterilised before use so that all conditions ensuring harmless dental care provided to all population groups are met.

Sterilising the handpieces requires special attention and suitable preparation so that any damage to their interior mechanisms are avoided and, consequently, defective operational and financial burden is prevented.

After the completion of any dental procedure, the external surfaces of the handpiece that have come into contact with saliva, blood, dental tissue debris and residues of dental materials must be cleaned. However, when cavities or restorative core preparations are undertaken subgingivally, it is likely that the internal tubing of the handpieces is contaminated due to various hydrodynamic phenomena at the working end of the handpiece.

Several ways to control the spread of contaminating matter between two patients have been recommended. The most common methods of asepsis control are as follows:

- Protection from any contact with the fluids present within the oral environment
- Chemical disinfection
- Thermal sterilisation
- Disinfection using microwaves
- Disinfection via irrigation
- Single use handpieces

*Among the above techniques, moist heat using saturated water vapours (autoclave) offers the best results as regards the sterilisation of handpieces in the short time.*
8a. Sterilisation of handpieces

**Step 1.** After the end of the dental procedure the handpiece must be operated for 5-10 seconds over the wash basin or a similar container while ejecting water and air.

**Step 2.** Then, after being detached from the tubings and connections with the unit, it must be meticulously washed and brushed under running water.

**Step 3.** Then, it must be dried with an absorbent paper.

**Step 4.** After external cleaning, the handpiece is reconnected to the tubings and operated for 3-5 seconds only with air so that any water residues are removed from the interior of the tubing.

**Step 5.** Then, the handpiece is lubricated with the lubricant recommended by the manufacturer and operated again for 10-20 seconds only with air so that the lubricant is properly distributed throughout the sensitive areas of the head of the handpiece.

**Step 6.** After the end of this procedure, the handpiece along with the bur extractor are enclosed in a special pouch which is made airtight with either a self-adhesive tape or a thermosealer.

**Step 7.** The handpiece and the bur extractors are placed in the autoclave, taking care not to overpack the pouches and ensuring that the air can pass unhampered.

   The pouch with the handpiece must also include a sterilisation indicator which could be either a special tape or a vial with carbon grains. This is not necessary if the pouch includes a system controlling the length of stay and the vapour temperature within the autoclave. Depending on the manufacturer's indications, the autoclave is programmed to operate at 121°C for 20 minutes or at 134°C for 13 minutes or at 134°C for 3 minutes, in case the handpieces are not placed in a sterilisation pouch. After these cycles have finished and after the indicators have confirmed that the autoclave process worked properly, the handpieces and the bur extractors are sterilised and are ready to be used.

**Step 8.** Just before re-use, some handpieces must be lubricated again with an appropriate lubricant which this time must be either sterilised or new and generally different from the one used to lubricate the handpiece before being placed in the autoclave.
Drying with absorbent paper

Dentin debris and blood contaminated handpiece

Water flushing under the tap water stream
8b. Sterilisation of burs

Burs should be sterilised independently of their type or the area of the mouth in which they have been used.

**Step 1.** A necessary step prior to sterilising a bur is **meticulous cleaning** to remove tooth debris, residues of dental materials, blood clots or a paste-like mixture with saliva of all the above. The most widely accepted cleaning method for burs and other micro instruments are **ultrasonic devices** (baths) using suitable solutions and with the addition of enzymes with a proteolytic action. *In these baths using suitable solutions at a temperature of about 60°C, burs vibrate at a frequency of 60-80 kHz for at least 15 minutes. After the end of this procedure, burs are free from foreign matter as well as oxides which are very often deposited on their shank.*

**Step 2.** After removal from the ultrasonic bath, burs must be **dried** using absorbent paper and hot air.

**Step 3.** They must then be placed in an appropriate **device for sterilisation**, depending on the material they are made of. More specifically:

1) Burs made of common carbon steel should not be placed in the autoclave because they will undergo oxidation.
2) Burs made of stainless steel or tungsten carbide are not so affected.
3) Dry heat ovens, ovens for chemical vapour sterilization and ethylene oxide ovens are suitable for sterilising all types of burs. However, dry heat ovens, due to prolonged heating involved, may seriously damage the cutting edge of the burs.
4) Using various aldehydes and phenols for at least 30 minutes offers adequate sterilisation while after 10 hours chemical sterilisation is achieved. Nevertheless, they may damage the integrity of rotating cutting instruments.

New burs (left) and damaged burs after repeated usage and sterilisation (right)
Mounting the burs on the stand
NOTE: It is a fact that no technique can fully remove organic debris and, therefore, result in successful sterilisation. For these reasons, burs intended for single patient use and discarded afterwards have recently been introduced.
9. **Preparing impressions for the Laboratory**

- After removing the tray from the oral cavity, all impressions must be cleaned and sterilised in an appropriate way using suitable solutions. More specifically:

  **Step 1.** After recording the impression, the tray must be transferred to the wash basin where the flow of tap water will remove any visible organic contaminants (blood, saliva etc).

  **Step 2.** Afterwards, the tray is sprayed with or immersed in a suitable disinfectant solution depending on the properties of the impression material used.

  **Step 3.** Impressions must be packaged in a suitable plastic box or a pet bag so that they can be safely transported to the dental laboratory.

![Single use plastic box for casts](image1)

![Transportation](image2)
10. **Taking protection measures after completing treatment for a patient**

- Before you clean the working surfaces, **wear thick work gloves**, so that your hands are covered and are not exposed to blood and other biological fluids left on surfaces or instruments.

- **Remove any protective cover.** If the cover has been stained with blood, place it in a waste bag indicating (by its color or otherwise) that it contains contaminated material. If the blood is completely dry or the cover has not been contaminated, place it in a regular waste bag. Use absorbent papers in case blood has penetrated the protective cover and put the absorbent papers in the “contaminated material” bag.

- **Clean and sterilise all the instruments** and **disinfect the working surfaces** with an appropriate disinfectant solution (phenolic, alcoholic, quaternary ammonium compounds).

- Sterilise in the autoclave or dry heat oven any instruments having been in close contact with tissues. A special tape indicating that they have been sterilized must be attached on the instruments so that one is sure that sterilization has been carried out. This procedure is performed by specialised personnel.

- **All handpieces must be sterilised** in between patients. Follow the instructions recommended by the manufacturers. Chemical sterilisation is not appropriate or safe. Ultrasonic handpieces, scalers, curettes and air syringes must be washed and sterilised. This procedure is performed by specialised personnel.

- **Place and remove any used waste.** All waste bags must be collected on a daily basis to prevent the spread of infectious diseases.

- **Clean and disinfect the impressions.** Any impression or other recordings should not be sent to the laboratory before being cleaned or disinfected.

- Remove your gloves and **wash your hands** with a disinfectant and water. If more patients are waiting to be examined or treated, place back the protective covers and repeat the procedure.
11. **What must be done in case of an accident and exposure to infected material**

In case of occupational blood exposure, the following actions must be taken:

- Prompt and meticulous washing of the injured area.
- Immediate placing of a gauze with an antiseptic agent on the injury (e.g. povidone iodine or 75% alcohol etc.) for at least 15 minutes.
- Each occupational exposure should be evaluated individually for its potential to transmit blood borne pathogens (HBV, HCV and HIV) and the need for further follow-up (e.g. PEP).
- The patient must be examined as soon as possible
- In case of an HIV infection, the virus can be detected in antigen presenting cells and peripheral ganglia within 72 hours after the infection while viraemia develops in about five days. The latter allows a 72-hour-period within which treatment can be provided.
- Chemoprophylaxis with antiretroviral drugs must begin as soon as possible after the incident. After 72 hours have passed, chemoprophylaxis may be provided, although the effect is uncertain.

**Post exposure prophylaxis, PEP for HIV**

- Depending on the size of the injury and the viral load of the patient, two or three antiretroviral drugs are used (two nucleosides with the addition or not of a protease inhibitor). These same drugs are used to treat HIV infected people.
- Chemoprophylaxis with antiretroviral drugs lasts four weeks and has a 80% chance of success in preventing seroconversion.

**NOTE**

1. The information on the topic may vary depending on the country that you work in. We therefore advice you to further consult local recommendations.
2. All sterilisation and cross-infection control measures described in this module reflect the scientific data on the subject at the time of development. They may be amended in the future, according to the future evidence-based scientific data.