



## Review Article

# A literature review on sterilisation in dentistry: The basic

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## ABSTRACT

The basic knowledge of sterilization and disinfection is the key to control the spread of infection from dentist to the patient, and vice versa from patient to the dentist. In the process of sterilisation complete removal of all the spores done where as complete removal of spores is not accomplished with the process of disinfection.

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## 1. Introduction

The basic concept of sterilisation and its key role in the prevention of infection or spread of infection was introduced nearly two centuries ago. A Hungarian Gynecologist put forward the basic principle of asepsis in Europe in early 1850, namely Ignaz Semmelweis. After this principle was accepted after Joseph Lister's studies on prevention of wound infection. He initially used phenols, while working on antiseptics, for the cure of contaminated wound.

Further development occurred with the invention of instrument used for sterilisation that works on the principle of moist heat sterilisation. The prime most function of infection control is to inhibit the spread of infection causing microorganism or the pathogens.<sup>1</sup>

There are two types of infection transmission, first one is the vertical transmission and the second one is horizontal or lateral transmission. There occurs transmission of microorganisms from one generation to the other in case of vertical transmission and in case of horizontal transmission there occurs spread of infection causing microorganism to the surrounding.

The spread of vertical transmission can be prevented by the use of appropriate antibiotics, while the spread of lateral transmission can be prevented by management of proper hygiene in our surrounding. Both the processes i.e. disinfection and sterilization kill the pathogens. But the key difference lies between the disinfection and sterilisation is the removal of endospores.

In the process of disinfection all the infection causing microorganisms/pathogens are removed, but, disinfection is not able to remove the endospores, on the other hand in case of sterilisation complete removal of

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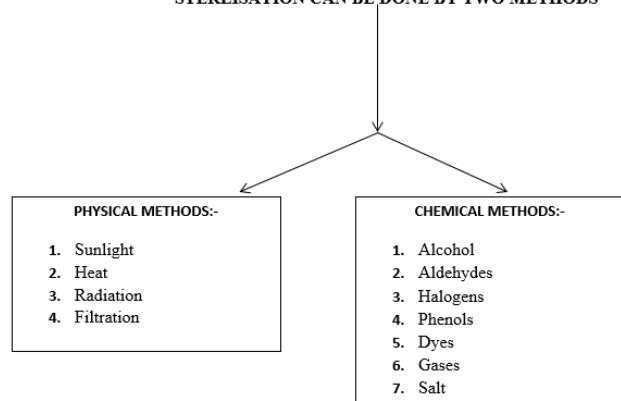
microorganisms/pathogens whether in the vegetative form or in the spore form are destroyed completely<sup>2</sup> or in other words sterilisation is defined as a process which destroys both pathogenic or non-pathogenic organisms present on the surface of the material to be sterilised<sup>3</sup> and a sterile product is the one which is free from all the living microorganisms that are capable of spreading infection.<sup>4</sup> The process of sterilisation should be performed with a standardisable method.<sup>5</sup>

Earle H. Spaulding in the year 1939 has given Spaulding classification, it helps us to determine, whether to go for disinfection or sterilisation according to the use of type of medical instrument.

1. **Non critical items:** Constitutes of the instruments, that came in contact only with the intact skin. These instruments usually requires low level of disinfection solution.
2. **Semi critical items:** Constitutes of instruments that came in contact with the mucous membrane or with the skin which is incised. They must undergo very high level of disinfection.
3. **Critical items:** Constitutes of the instrument that came in contact with those areas, where earlier no microorganism exist. They should be sterilized unconditionally.<sup>6</sup>

The process of sterilisation or disinfection is used to sterilise different materials, different instruments that can be used for surgical purpose or for diagnostic purpose. Sterilisation or disinfection can be used for sterilisation of different reagents or media, culture that are used in microbiology laboratory.

#### STERILISATION CAN BE DONE BY TWO METHODS



### 1.1. Physical Methods

#### 1.1.1. Sunlight

It is totally a natural method of physical sterilisation of water that is preserved in water tanks or in lakes. Due to the content of ultraviolet rays present in the sunlight, it has its prime action of germicidal effect. Direct sunlight as in

tropical countryside where it is not filtered by impurities in the atmosphere, has an active germicidal effect due to combined effect of ultraviolet and heat rays.

#### 1.1.2. Heat

One of the commonly used method for sterilisation, heat sterilisation can be divided in to two types of heat sterilisation i.e. dry heat sterilisation and moist heat sterilisation. The basic principle that involves in the process of dry heat sterilisation is by denaturation of the bacterial proteins and the basic principle that involved in the process of moist heat sterilisation is coagulation of bacterial proteins along with denaturation of the same.

Under dry heat sterilisation, red heating of inoculation wires, tips of forceps and needles can be done by holding them under the flame, till they become red hot. Flaming can also be used for scalpels, glass slides, these can pass through the flame but without allowing them to become red hot as in the case of red heat. Incineration is the other method that came under dry heat sterilisation, with the help of this method the material that is infective was turned into ashes by the use of instrument known as incinerator. Hot air oven is the other option that came under dry heat sterilisation. This is one of the most widely used method that came under the dry heating process. Material like glass syringes, flasks, pipettes, test tubes, scalpels, scissors, liquid paraffin can be sterilised by hot air oven with a holding temperature of 160°C for one hour.

Under moist heat sterilisation the most commonly used method for sterilisation is AUTOCLAVE. The basic principle behind this is, the steam that is saturated or steam above the temperature of 100°C has a better killing capacity as compared to dry heat as infection causing microorganisms are much susceptible to moist heat sterilisation because coagulation of bacterial proteins occur rapidly when moist heat sterilisation is used.

On the other hand saturated steam has higher affinity to penetrate the material which is porous as compared to dry heat sterilisation. When steam contacted the cooler surface it gets condensed in to water and result in the liberation of its latent heat to the cooler surface.

Temperature required for an autoclave is 121°C at 15lbs for 15 minutes. However autoclave can be used at higher at 126°C at 20lbs for 10 minutes or at 133°C at 30lbs for 3 minutes. Autoclave can be used to sterilise surgical gowns, dressings, gloves, culture media, for all the glass syringes material that cannot withstand higher temperature of hot air oven.

Filtration is the other method, that come under dry heat sterilisation and is used for all the materials that gets damaged by hot air oven. It can be used to obtain bacterial free filtrates of clinical samples of virus isolation, can also be used for sterilisation of hydatid fluid. Different types of filters are: earthen filters, asbestos filters, sintered glass

filters and membrane filters.

Basically two types of radiations are used one is ionizing radiation, which include x rays, gamma rays and the second type is non ionizing radiation, which include infrared radiations and ultraviolet radiations.

## 1.2. Chemical Method

### 1.2.1. Alcohol

Two most commonly used alcohols in the field of dentistry are ethyl alcohol and isopropyl alcohol. The basic mechanism of alcohol is denaturation and coagulation of proteins. They are basically used over the skin. The effective concentration of alcohol is 60-70 percent of alcohol in water.

### 1.2.2. Aldehydes

Most commonly used aldehydes are formaldehydes and glutaraldehydes. Formaldehyde is mainly effective against bacteria, viruses and can be used as aqueous solution and in gaseous form. The concentration of formaldehyde used in aqueous solution is mainly 10%. It is used in histology section for preserving the tissue for examination. Glutaraldehyde is mainly effective against viruses, fungi and M. tuberculosis. It is most commonly used as 2% of buffered solution and is less irritant when compared to formaldehyde. It is most commonly used for instruments that have delicate lenses.

### 1.2.3. Phenols

Chlorhexidine is more active against gram positive bacteria than gram negative bacteria. At higher concentration it act as bactericidal. It is very much effective against fungicidal activity. Chlorhexidine is formed when chlorine is added to bisbiguanide, chlorhexidine is positive charged, as it is positively charged it binds to the negatively charged cell wall of the bacteria, this binding results in the breakdown of the cell wall of the bacteria and results in leakage of the content of the bacteria and finally results in bursting of the bacteria.<sup>7,8</sup>

### 1.2.4. Halogens

Most commonly used halogens are chlorine and iodine. Chlorine gas was the first chemical weapon that was used in the history of the war, during the first world war by Germany and France. Halogens works by disruption of oxidative phosphorylation and results in destruction of cell wall of the microorganism, also results in destruction of its nucleic acid.<sup>9</sup> Chlorine is used in the form of bleaching powder in the water supply units, dairy units, and in swimming pools, as chlorination of water.

The disinfection is due to release of free chlorine. Most commonly used disinfectant of choice for the material infected with HIV is bleaching powder or sodium hypochlorite. On the other hand iodine solution can be used

as disinfectant over the skin and has a strong bactericidal effect.<sup>8,10</sup>

### 1.2.5. Salts

Salts have their primary mode of action as bactericidal. The heavy salts of mercury, copper, silver can be used as disinfectant.<sup>11,12</sup>

### 1.2.6. Gases

Gases namely ethylene oxide, formaldehyde gas, betapropiolactone can be used as disinfectant mainly in the fumigation of operation theatre, OPD wards of the hospitals.<sup>13</sup>

### 1.2.7. Dyes

Mainly used as disinfectant over the skin and wound. Dyes namely aniline dyes, acridine dyes extensively used in the field of dentistry. They are bacteriostatic in higher amount of concentration, but they show low bactericidal action. Both types of dyes are active against gram positive bacteria, than the gram negative bacteria.

Sterilisation of hand piece is very much essential and required, after the treatment of every patient, the hand piece that is used for the patient work should run for atleast 30 to 60 seconds for proper discharge of contaminated water from the hand piece, after the single use of hand piece over the patient.

The bur should be left in place, while the outside of the hand piece should be cleaned with the medicated isopropyl alcohol, detergent or with warm water. Lubrication of the hand piece is quite necessary after every single use over the patient until clean oil appears from the hand piece. And at last sterilisation of the hand piece is finally done in an autoclave.

## 2. Conclusion

In the process of sterilisation, the proverb “prevention is better than the cure” well suited. A thorough knowledge of various materials that can be used in sterilisation and more over which material should be used on particular object or on skin or on the infected wound is quite necessary.

And a thorough knowledge of application on sterilisation will ensure the safety from the invisible world of infection causing pathogens or microorganisms. Hence utilization of proper sterilization, disinfection method with proper time helps us achieve the safety of our professional demand.

Hence the proper protocol of sterilisation should be maintained in the clinical practice, because in dentistry wide variety of patient came from pediatric to geriatric. So it's the prime duty of the dentist to take proper care of himself or herself and of the patient.

### 3. Some Common Definitions

1. **Sterilisation:** can be defined as the process by which an article, surface or medium is free from all living microorganisms that are capable of causing or spreading infection either in the vegetative or in the spore form.
2. **Disinfection:** It is defined as the destruction of all pathogenic organisms up to a level that seem to be no longer cause harm to the health.
3. **Contamination:** The presence of microorganisms on a body surface or on intimate articles or substances.
4. **Sanitation:** The process by which number of microorganisms on intimate objects or surface is reduced to a safer level. It is generally a cleaning process and does not imply total freedom from infection causing microorganisms.
5. **Asepsis:** A situation in which infection causing microorganisms are absent.
6. **Antiseptic:** A substance that prevents or restrict the growth of infection causing microorganisms either by inhibiting their growth or destroying them.
7. **Infection control:** The selection and use of procedures and products to prevent the spread of infectious disease.
8. **Bactericidal:** The agents that have the capacity to restrict the growth of the bacteria and kill them.
9. **Bacteriostatic:** Those agents that help inhibiting the growth or multiplication of bacteria.

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### 5. Conflict of Interest

The authors declare they have no conflict of interest.

### References

1. Yoo JH. Principle and perspective of healthcare-associated infection control. *J Korean Med Assoc.* 2018;61:5–12.
2. Centers for Disease Control and Prevention (CDC). Disinfection and sterilization. 2018; Available from: <https://www.cdc.gov/infectioncontrol/guidelines/disinfection/index.html>.
3. Sheth N, Rathod Y, Shenoi P, Shori D, Khode R, Khadse A, et al. Evaluation of new technique of sterilization using biological indicator.

- J Conserv Dent.* 2017;20(5):346–50. doi:10.4103/jcd.jcd\_253\_16.
4. Rutala WA, Weber DJ. Disinfection and Sterilization in Health Care Facilities: What Clinicians Need to Know. *Clin Infect Dis.* 2004;39(5):702–9. doi:10.1086/423182.
  5. Lacerda VA, Pereira LO, Hirata R, Perez CR. Evaluation of two disinfection/sterilization methods on silicon rubber-based composite finishing instruments. *Am J Dent.* 2015;28(6):337–41.
  6. McDonnell G, Burke P. Disinfection: is it time to reconsider Spaulding? *J Hospital Infect.* 2011;78(3):163–70. doi:10.1016/j.jhin.2011.05.002.
  7. Russell AD, Day MJ. Antibacterial activity of chlorhexidine. *J Hospital Infect.* 1993;25(4):229–38. doi:10.1016/0195-6701(93)90109-d.
  8. Kampf G, Jarosch R, Rüdén H. Limited effectiveness of chlorhexidine based hand disinfectants against methicillin-resistant *Staphylococcus aureus* (MRSA). *J Hospital Infect.* 1998;38(4):297–303. doi:10.1016/s0195-6701(98)90078-0.
  9. Yoo J. Review of Disinfection and Sterilization - Back to the Basics. *Infect Chemother.* 2018;50(2):101–9.
  10. McDonnell G. General mechanism of action. In: GE M, editor. Antisepsis, Disinfection, and Sterilization. Washington DC: ASM Press; 2017. p. 255–69.
  11. Bragg R, Jansen A, Coetzee M, Westhuizen WVD, Boucher C. Bacterial resistance to Quaternary Ammonium Compounds (QAC) disinfectants. *Adv Exp Med.* 2014;808:1–13.
  12. Cotter JL, Fader RC, Lilley C, Herndon DN. Chemical parameters, antimicrobial activities, and tissue toxicity of 0.1 and 0.5% sodium hypochlorite solutions. *Antimicrob Agents Chemother.* 1985;28(1):118–22. doi:10.1128/aac.28.1.118.
  13. Dancer SJ. Controlling Hospital-Acquired Infection: Focus on the Role of the Environment and New Technologies for Decontamination. *Clin Microbiol Rev.* 2014;27(4):665–90. doi:10.1128/cmr.00020-14.

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