South Health and Policy. 2023; 2:50
doi: 10.56294/shp202350

REVIEW

Basic surgery. Asepsis and antisepsis. Concepts. Surgical bacteriology. Sterilisation and maintenance of sterilisation equipment

Cirugía Básica. Asepsia y antisepsia. Conceptos. Bacteriología Quirúrgica. Esterilización y Mantenimientos de los mismos

Nairobi Hernández Bridón[1], Magalys Pallerols Mir[1]

[1]Universidad De Ciencias Médicas De La Habana, Facultad de Ciencias Médicas "Julio Trigo López". La Habana, Cuba.

Cite as: Hernández Bridón N, Pallerols Mir M. Basic surgery. Asepsis and antisepsis. Concepts. Surgical bacteriology. Sterilisation and maintenance of sterilisation equipment. South Health and Policy. 2023; 2:50. https://doi.org/10.56294/shp202350

Submitted: 08-08-2022 **Revised:** 12-02-2023 **Accepted:** 22-06-2023 **Published:** 23-06-2023

Editor: Dr. Telmo Raúl Aveiro-Róbalo

ABSTRACT

Introduction: they studied basic oral surgery as a fundamental discipline of dentistry, focused on the surgical treatment of pathologies affecting teeth, jaws and surrounding tissues. They analysed how the correct application of asepsis and antisepsis was crucial to prevent infections in an environment with a high bacterial load, such as the oral cavity.
Development: they described asepsis as comprising techniques to prevent contamination by microorganisms, while antisepsis involved the use of chemicals to eliminate pathogens in living tissues. They explained the mechanisms of action of disinfectants and antiseptics, assessing factors such as toxicity, time of action and antimicrobial spectrum. They detailed various methods of disinfection (immersion, lotion, vaporisation, among others) and emphasised the need to sterilise surgical instruments correctly. They also assessed the importance of staff hygiene, operating theatre behaviour and the use of protective equipment. In addition, they recognised frequent occupational hazards - physical, chemical, biological and ergonomic - faced by professionals.
Conclusions: they concluded that basic oral surgery required not only technical skills, but also in-depth knowledge of infection control. They identified that poor oral hygiene, systemic diseases and inadequate techniques increased the risk of complications. They reaffirmed the need to follow strict biosafety protocols to protect both the patient and the clinical team. Finally, they stressed the importance of continuous training to prevent and effectively manage the risks inherent in the surgical environment.

Keywords: Asepsis; Aseptic; Antisepsis; Disinfection; Biosafety; Oral Surgery.

RESUMEN

Introducción: estudiaron la cirugía bucal básica como una disciplina fundamental de la odontología, enfocada en el tratamiento quirúrgico de patologías que afectaban dientes, maxilares y tejidos circundantes. Analizaron cómo la correcta aplicación de la asepsia y antisepsia resultó crucial para prevenir infecciones en un entorno con alta carga bacteriana, como la cavidad oral.
Desarrollo: describieron que la asepsia comprendía técnicas para evitar la contaminación por microorganismos, mientras que la antisepsia implicaba el uso de químicos para eliminar patógenos en tejidos vivos. Explicaron los mecanismos de acción de desinfectantes y antisépticos, valorando factores como toxicidad, tiempo de acción y espectro antimicrobiano. Detallaron diversos métodos de desinfección (inmersión, loción, vaporización, entre otros) y enfatizaron la necesidad de esterilizar correctamente el instrumental quirúrgico. Evaluaron también la importancia de la higiene del personal, el comportamiento en quirófano y el uso de equipo de protección. Además, reconocieron riesgos laborales frecuentes —físicos, químicos, biológicos y ergonómicos— que enfrentaban los profesionales.

Conclusiones: concluyeron que la cirugía bucal básica no solo exigía habilidades técnicas, sino también conocimientos profundos sobre el control de infecciones. Identificaron que una higiene oral deficiente, enfermedades sistémicas y técnicas inadecuadas aumentaban el riesgo de complicaciones. Reafirmaron la necesidad de seguir protocolos estrictos de bioseguridad para proteger tanto al paciente como al equipo clínico. Finalmente, destacaron la importancia de una formación continua para prevenir y gestionar eficazmente los riesgos inherentes al entorno quirúrgico.

Palabras clave: Asepsia; Antisepsia; Desinfección; Bioseguridad; Cirugía Bucal.

INTRODUCTION

Basic oral surgery is one of dentistry's oldest and most fundamental disciplines. It is responsible for the diagnosis and surgical treatment of pathologies, anomalies, and lesions that affect not only the teeth but also the jaws, soft tissues, and adjacent structures. Its practice involves a series of technical and clinical procedures that must be performed in as sterile an environment as possible to minimize the risk of infection and ensure the safety of both the patient and the practitioner.[1]

In this context, asepsis and antisepsis play an essential role in the prevention of microbial contamination. Asepsis refers to the techniques used to maintain an environment free of microorganisms. At the same time, antisepsis is based on using chemical substances capable of eliminating or inhibiting the growth of pathogens in living tissues. The correct disinfection and sterilization of surgical instruments, as well as the personal hygiene of the practitioner, are fundamental practices to avoid postoperative complications and the spread of diseases.[2,3]

Likewise, knowledge of the mechanisms of action of disinfectants and antiseptics allows the appropriate selection of products according to their efficacy, toxicity, action time, and compatibility with materials or tissues. Oral surgery, having direct contact with an anatomical region with a high bacterial load, such as the oral cavity, requires additional precautions. Factors such as systemic diseases, pre-existing infections, or poor hygiene can significantly increase the risk of infectious complications.[4]

In addition, the surgical environment must meet strict biosafety and hygiene standards, from space design to staff behaviors, including proper use of personal protective equipment, air quality control, and systematic cleaning of surfaces. Added to this is the need to recognize the occupational hazards to which professionals in the field are exposed, physical, chemical, biological, and ergonomic, which must be managed by implementing appropriate safety protocols.[5,6]

In summary, basic oral surgery requires technical skills and a thorough knowledge of infection control principles, the rational use of antiseptics and disinfectants, and rigorous compliance with preventive measures to ensure clinical efficacy and protect public health.

DEVELOPMENT

Basic Oral Surgery is the oldest recognized specialty of dentistry. It concerns the diagnosis and surgical treatment of diseases, anomalies, and lesions of the teeth, mouth, jaws, and their adjacent tissues.[7,8,9]

Asepsis[10]

A set of measures and techniques aimed at preventing contamination (the proliferation of infectious micro-organisms) in the use of materials, in the hospital environment, and patients and healthcare personnel.

All the precautions and actions we take to achieve asepsis using sterile material are fundamental to protect against contamination and reduce the risk of infection.

An object is considered septic when its surface is contaminated or dirty (even if it is apparently 'clean'). A material is sterile or aseptic when any form of life on its surface has been destroyed, implying that it is disinfected. Asepsis prevents a safe object from becoming contaminated.

Antisepsis[11]

Antisepsis refers to the state achieved after the application of antiseptics. It consists of using chemicals (disinfectants) to destroy contaminating microorganisms. In practice, it is synonymous with disinfection. When a disinfectant can be applied to living tissue, it is called an antiseptic.

Disinfectants and antiseptics: Mechanisms of action of disinfectants.

Disinfectants[12,13]

These chemicals are capable of destroying pathogenic microorganisms on the surfaces of materials or on the skin of living organisms.

The main characteristics of a good disinfectant are:

- High disinfectant power. It must be able to 'kill' the micro-organisms.

- Short action time. The fastest-acting disinfectant is the best.
- Stability. It must not suffer alterations nor modify its power when it comes into contact with the surfaces to be disinfected.
- High solubility. Usually, the manufacturer recommends diluting the disinfectant in water or alcohol to a specific concentration.
- Non-toxic and non-irritant for the user, and non-corrosive for the material and fabrics.
- To be biodegradable. To avoid environmental pollution. It is low-cost, easy to maintain, and has a pleasant smell.

As there is no ideal disinfectant, the manufacturing industries tend to associate two or more disinfectants to obtain a product, which, adding their advantages and, without increasing the disadvantages, can act in an energetic, fast, and effective way. A good disinfectant is broad-spectrum, non-toxic, non-corrosive, low-cost, pleasant smelling, biodegradable, and can be diluted in water or alcohol. They can be bactericidal (kill) or bacteriostatic (inhibit the growth) of bacteria. A disinfected material is not sterilized; disinfection does not eliminate all microorganisms and their forms of resistance (spores). It may surprise that the same product can act as an object disinfectant and as a living tissue disinfectant (antiseptic). This is because it depends on the concentration in which it is prepared.[14,15]

Antiseptics

Antiseptics are chemicals that prevent or retard the growth of germs and are generally used on the surface of the human body (skin and mucous membranes). They are characterized by their low or non-toxic and non-irritant action. Asepsis is a set of techniques, and antiseptic is a type of disinfectant. The most common antiseptics, such as Betadine, Povidone iodine / Bleach = Sodium hypochlorite / Hydrogen peroxide = Hydrogen peroxide / Hibitane = Chlorhexidine / Formaldehyde = Formaldehyde / Istrunet sporicide = Association of phenols.[9,15]

Mechanisms of action of disinfectants[1,2,3]

Disinfection is a decontamination technique that destroys the vast majority of microorganisms but is not capable of destroying spores. We must know the general methods and recommendations for disinfection in order to effectively implement them.

The action of disinfectants is very simple: they kill or prevent microorganisms from reproducing. As microorganisms can only live for a short time, a few minutes of exposure to the disinfectant will be enough to kill most of them.

There are many mechanisms of action because there are many types of disinfectants, but they will always do one or more of the following:

- Disrupt the transport mechanisms of the membranes (essential for the proper functioning of cells) of micro-organisms; if their transport mechanisms do not work, they cannot live.
- Alter the proteins that form part of the structure of the micro-organism. When the structure is altered, they can no longer carry out the function they used to perform, so it will directly affect the survival of the micro-organism.
- Altering the formation of copies of nucleic acids to reproduce.

Depending on the technique used, we can distinguish several types of disinfection:

- Immersion consists of immersing instruments in a disinfectant solution for a specific period.
- Lotion: Wipes are soaked in a solution and then used for wiping.
- Vaporisation and fumigation: This involves producing vapors or gases capable of impregnating the air and surfaces.
- Mists or aerosols: An aerosol of microscopic droplets is formed which, due to their lightweight, remain suspended in the atmospheric air for a specific period.
- Atomisation: Formation of larger droplets than in the previous case. Due to their weight, they fall quickly.

Disinfectants do not penetrate but act by contact. For a disinfectant to act on a surface, it must come into contact with it. If there is a dirt stain, it will not be able to do so because it cannot penetrate through the thickness of the stain.

Rules should always be considered when cleaning materials and instruments

I. The cleaning process should begin immediately after the material has been used.
II. Always clean away from patients, personnel, and sterile storage areas.

III. Precautionary measures should be used in manual cleaning to avoid risks to handlers (HAT). As a minimum, gloves and an apron or gown should be worn. If we do not know the origin of the material or we know for sure that it was used on patients with HIV (AIDS), hepatitis, or tuberculosis, we should wear double gloves, a mask, and eye protection. Remember that aerosol can be created during brushing that suspends small droplets of water and detergent in the air where microorganisms may be present.

So, to avoid aspirating them and preventing them from contacting your skin and mucous membranes, it is best to protect yourself.

IV. Before any manipulation, the material must be classified into three large groups:

1. General instruments. It is washed by immersion (manually or with a washing machine).
2. Microsurgical instruments and dental drills must be washed using ultrasonic technology.
3. If this is not possible because the system is unavailable, manual immersion cleaning shall be carried out.

Sterilization[4]

The destruction of all forms of life by physical or chemical means.

Surgical bacteriology[8,9]

In surgical bacteriology applicable to the oral cavity and its adjacent structures, uncountable microorganisms that are normal inhabitants of this region must be considered—the most common bacteria found in the mouth.

They include streptococci A and B, non-hemolytic streptococci, Staphylococcus aureus, Staphylococcus albus, Vincent's spirochetes, and fusiform basils. The number of these bacteria and their virulence are generally controlled in the oral cavity by the mild bactericidal effect of saliva and swallowing oral fluids into the stomach, where the pH level is sufficient to destroy most of the bacteria and digest those that remain. These two factors are not always enough to abort an infectious process; therefore, those contributing to an inflammatory reaction should be considered first.

Local and general patient factors must also be taken into account:

Local, a mouth that is chronically infected with large deposits of tartar, root debris, and necrotic gingivitis is a poor field for a surgical procedure, as chronic irritation damages the tissues to the point that normal resistance is markedly diminished, and the area is, therefore, more prone to infection, a surgical procedure performed under these conditions endangers the general health of the patient, not only because of localized infection and pain in the operative field but also because the aponeurotic spaces of the head and neck can be easily invaded and generalized septicemia results if the bacteria are of sufficient virulence.

Another important factor is the organism's general resistance to infection. It should also be noted that there are predisposing factors such as diabetes and suppression of immunity by corticosteroids. The local wound factor also influences susceptibility. For example, wound infection is more common after devitalization of the tissue, as can happen with accidental trauma or careless surgical technique.

General factors include chronic diseases, blood dyscrasias, malnutrition, etc.

Physiology of Infection[1,11]

Microorganism invasion is a frequent cause of acute inflammation in the oral cavity and adjacent structures. Inflammation is the physiological response to infection. The nature of the inflammatory reaction depends, in turn, on the bacteria's site, type, and virulence. In addition, the physical state of the host may determine the degree of inflammation, which in turn depends on local and systemic factors that have already been considered.

Inflammation is the body's reaction to irritants, the most common of which are bacteria. The classic signs and symptoms of inflammation are Pain, flushing, swelling, warmth, and functional impotence. The degree and frequency of these signs and symptoms vary depending on the virulence of the bacteria and their location.

The signs and symptoms of inflammation can be explained by understanding the tissue response to an irritant. Initially, there is a marked dilatation of the vascular bed, which is accompanied by a slowing of blood flow, resulting in an increased volume of the vascular bed. The increased capillary volume is responsible for the cardinal signs of flushing, tumor, and warmth. As blood flow slows, leukocytes begin to penetrate the vascular walls into the surrounding tissues, which is accompanied by extrusion of blood plasma through the walls, resulting in inflammatory edema. This tissue distension produces pressure against the neurogenic fibers and may cause their destruction. This pressure phenomenon and the release of histamine by the damaged cells play a fundamental role in the appearance of the fourth classic sign of inflammation, pain.

Different types of inflammation are seen, depending on the tissue involved, the type of bacteria, and the host resistance. The important ones are pyogenic, serous, catarrhal, fibrinous, hemorrhagic, and necrotizing. The most frequent type of infection found in oral surgery is 'pyogenic,' which means pus-forming.

Source Of Infection: The main sources of infection that contaminate or infect wounds in the operating room are considered to be the following:

The skin of the patient, the nose and throat of people inside the operating room, the hands of the surgeons, the air in the operating room, surgical instruments, and ligation and suture materials.

Rules of behaviour in the operating theatre[8,9]

It is mandatory that every intelligent precaution be taken to avoid wound contamination in all surgeries, including oral surgery.

Although the means to provide strictly aseptic oral surgery do not yet exist, there is no reason to abandon an aseptic routine altogether. For oral surgery, it markedly eliminates some of the pathways of cross-infection: infection of the practitioner by the patient, infection of the patient by the practitioner, or infection of the patient by another patient through the practitioner or instruments.

Wherever surgery is performed, in the hospital's operating theatre or in the clinic, the surgeon should wear a naso-buco, a surgical cap, and disposable surgical clothing.

The surgeon's hands should be properly brushed, and sterile gloves should be used in all surgical procedures.

Brushing technique: first, one hand and then the other, then the palms of the hands, fingers, nails, and interdigital, the forearm up to two centimeters above the elbow, iodized alcohol or alcoholic habitant is applied to the hands. Nowadays, brushing can be dispensed with by adding hexachlorophene G11 to liquid soaps, the use of which replaces brushing when the lather is maintained for four minutes.

Salons should be equipped with ultraviolet lamps to reduce germs. Rooms should be designed on higher floors, where dust precipitation is lower.

Antiseptic solutions[10]

Disinfectants are agents that prevent the growth of micro-organisms on inanimate objects, e.g., Cresol 50 % solution.

Glutaral (Sonacide) is a bactericidal disinfectant that affects gram-positive and gram-negative germs, fungi, and viruses, including hepatitis B, herpes simplex, and HIV.

Sterilization of medical and dental instruments, plastic equipment, and other instruments that cannot be steam sterilized.

Antiseptics are disinfectants that are applied to living tissues. Chlorhexidine (aqueous and alcoholic Hibitane, Hibiscrub).

Surgical hand disinfection, pre-operative patient preparation, and post-surgical skin preparation, as well as for skin and oral cavity wounds 0,1 and o,2 % solutions.

Precautions: Avoid contact with the eyes, brain, meninges, and middle ear. Use chlorhexidine Gluconate 4 % for hand and skin washing in general.

For antisepsis, 0,05 % gluconate solution and 0,1 or 0,2 % for buccal swabs.

Benzalkonium: for skin, mucosa, and wounds at 0,01 and 0,02 % (1;5000 bottles.)

Most commonly used surgical instruments in surgery. Suture Materials. Different types of sutures. Suture removal. Suture technique[1,2,3,4,8,9]

Instruments

The number of instruments is countless, in addition to those specific to each specialty. We will, therefore, only refer to the basic instruments. The scalpel is the most important of them; it is the emblem of surgery. Its function is to cut, and its most valuable quality is good cutting edge. In oral surgery, the most commonly used scalpel blades are number 15 and 10, and for incision and drainage, 11. Scalpels can have a fixed or detachable blade; the latter's advantage need not be mentioned. The scalpel handles for the blades 10, 11, 12, and 15 are numbers 3 and 7.

Brief overview of how to use the scalpel

The scalpel is held between the thumb and the middle, ring, and little fingers, with the index finger resting on the upper part of the scalpel. When cutting the skin, uniform and discreet pressure should be exerted, sliding the blade with a determined movement without hesitation. The section of the subcutaneous tissues shall be made using minor soft cuts and deepening in plans. Haemostasis shall be performed as the scalpel advances to avoid the accumulation of blood that hinders a good view of the operative field.

The sharp-pointed scalpel is used when opening an abscess or draining a cavity. After penetrating the blade into the collection by applying firm pressure on its tip, the handle of the instrument is tilted away from the cutting edge to cut through the roof of the collection from the depth to the surface, thus leaving the abscess wide open.

https://doi.org/10.56294/shp202350 ISSN: 3072-7677

Hygienic and biosecure

The following recommendations should be followed for the EC to be a hygienic and biosecure site.

- Appropriate measures should be taken to avoid or minimize the generation of droplets or aerosols.
- Using liquid soaps is recommended to avoid contamination and clogging of pipes.
- Wash hands before and after each procedure.
- Deposit materials in arid places.
- Avoid draughts or air movement within the EC areas.
- Comply with the institution's disinfestation program.
- Avoid all unscheduled construction or alterations in the area.
- Personnel must wear the uniform provided by the institution (ambo, cap or cap, etc.) according to EC standards.
- The use of nail polish, cosmetics, and jewelry is prohibited.
- The use of feather dusters and brooms is prohibited.
- Eat or drink only in the designated area.
- Avoid unnecessary handling of processed medical products.

Occupational hazards[14,15]

The healthcare team working in a hospital establishment is exposed to countless risks capable of causing occupational disorders or pathologies.

Sterilization services are no exception to the occurrence of occupational hazards. On the contrary, they constitute an area of work that entails a high occupational risk.

Risks may be different in etiology, the most common being:

- Physical risks: These are those caused by equipment, which entails risks such as noise and vibrations causing noise trauma and high temperatures that can cause burns.
- Chemical risks: Caused by aerosols, gases, vapors, and organic dust, which can be natural, synthetic, or inorganic. The chemical sterilizing agents with the greatest risk are ethylene oxide, glutaraldehyde, peracetic acid, hydrogen peroxide, and formaldehyde.
- Biological risks: caused by microorganisms (fungi, viruses, bacteria, etc.).
- Ergonomic risks: those directly linked to the design of equipment, stress, workloads, fatigue, repetitive work, monotony, etc.

CONCLUSIONS

Basic oral surgery represents a key discipline within dentistry. It is in charge not only of the surgical treatment of teeth and jaws but also of preserving the general health of the patient through rigorous infection control. In this sense, the concepts of asepsis and antisepsis become fundamental, as their correct application minimizes the risks of cross-contamination and postoperative complications. Asepsis involves keeping the surgical environment free of microorganisms, while antisepsis uses chemical agents to eliminate or inhibit microorganisms in living tissues.

One of the most significant challenges in oral surgery is the naturally contaminated environment of the oral cavity. This requires meticulous attention in selecting antiseptics and disinfectants, considering toxicity, spectrum of action, speed, and material compatibility. Disinfection and sterilization of instruments, staff hygiene, and implementing biosafety protocols are priority actions to avoid infections. In addition, a thorough knowledge of the mechanisms of action of disinfectants and antiseptics ensures their safe and effective use.

Local factors such as poor oral hygiene, previous infections, or the presence of tartar, as well as systemic conditions such as diabetes, immunosuppression, or malnutrition, directly influence the patient's susceptibility to infectious complications. These aspects should be assessed before, during, and after the surgical procedure to ensure a favorable outcome. Inflammation, as a physiological response to microbial invasion, manifests itself with classic signs such as pain, heat, flushing, tumour, and functional impotence, and its intensity will depend on the type of microorganism and the immunological status of the host.

Furthermore, hygienic and biosafety measures in the operating theatre, such as the correct use of uniforms, sterilization of instruments, and control of the environment, are essential to guarantee the safety of the patient and the professional. Finally, the occupational risks to which staff is exposed in the surgical and sterilization area - physical, chemical, biological, and ergonomic - must be managed through training, personal protective equipment, and compliance with safety protocols.

In conclusion, basic oral surgery requires not only technical skills but also a comprehensive approach based on prevention, infection control, rational use of antiseptic products, and strict compliance with biosafety standards to ensure patient well-being and clinical efficacy.

BIBLIOGRAPHICAL REFERENCES

1. Grupo de Trabajo Tratamiento de Instrumentos. El método correcto para el tratamiento de instrumentos.

8ª ed. 2004. Disponible en: http://www.a-k-i.org

2. International Organization for Standardization. ISO 15883-1:2006. Lavadoras desinfectadoras. Parte 1: Requisitos generales, definiciones y ensayos. Disponible en: http://normasune.blogspot.com

3. Peláez B. Procedimientos de esterilización. Conceptos básicos. En: Criado Álvarez JJ, Peláez Ros B, Fereres Castiel J, coordinadores. Esterilización en centros sanitarios. Toledo: Fundación para la Investigación Sanitaria en Castilla-La Mancha; 2008. p. 13-27.

4. Comité Europeo de Normalización (CEN). UNE-EN 556:1995. Esterilización de productos sanitarios. Requisitos para los productos sanitarios etiquetados de estéril. Madrid: AENOR; 1995.

5. Asociación Española de Normalización (UNE). UNE-EN 556-1:2002/AC:2007. Esterilización de productos sanitarios. Requisitos de los productos sanitarios para ser designados "ESTÉRIL". Parte 1: Productos esterilizados en su estado terminal. Disponible en: http://normasune.blogspot.com

6. International Organization for Standardization. ISO 17665-1:2007. Esterilización de productos sanitarios. Calor húmedo. Parte 1: Requisitos para el desarrollo, validación y control de rutina de un proceso de esterilización. Disponible en: http://normasune.blogspot.com

7. Asociación Española de Normalización (UNE). UNE-EN ISO 11135-1:2007. Esterilización de productos sanitarios. Óxido de etileno. Parte 1: Requisitos para el desarrollo, la validación y el control de rutina de un proceso de esterilización. Disponible en: http://normasune.blogspot.com

8. Comité Europeo de Normalización (CEN). CEN ISO/TS 11135-2:2015 EX. Esterilización de productos sanitarios. Óxido de etileno. Parte 2: Guía de aplicación de la norma ISO 11135-1.

9. Asociación Española de Normalización (UNE). UNE-EN ISO 11137-1:2012; -2:2007/AC:2012; -3:2012. Esterilización de productos para asistencia sanitaria. Radiación. Requisitos para desarrollo, validación y control de procesos de esterilización por radiación. Disponible en: http://normasune.blogspot.com

10. Comité Europeo de Normalización (CEN). UNE-EN 285:2007 + A2:2015. Esterilización. Esterilizadores de vapor. Esterilizadores grandes. Madrid: AENOR; 2015.

11. Asociación Española de Normalización (UNE). UNE-EN 1422:1998+A1:2009. Esterilizadores para uso médico. Esterilizadores por óxido de etileno. Requisitos y métodos de ensayo. Disponible en: http://normasune.blogspot.com

12. Asociación Española de Normalización (UNE). UNE-EN 14180:2004+A2:2015. Esterilizadores para uso médico. Esterilizadores de vapor a baja temperatura y formaldehído. Requisitos y ensayos. Disponible en: http://normasune.blogspot.com

13. Asociación Española de Normalización (UNE). UNE-EN 13060:2015+A2:2015. Esterilizadores de vapor de agua pequeños. Disponible en: http://normasune.blogspot.com

14. Criado JJ. Garantía de la efectividad de un proceso de esterilización. Sistemas de registro de los controles de rutina. En: Criado JJ, Peláez B, Fereres J, coordinadores. Esterilización en centros sanitarios. Madrid: FISCAM; 2016. p. 171-86.

15. Velasco E. El cuidado del material estéril: manipulación, transporte, almacenamiento y correcto uso. En: Criado JJ, Peláez B, Fereres J, coordinadores. Esterilización en centros sanitarios. Madrid: FISCAM; 2016. p. 127-39.

16. Borreguero M. Control de la eficacia del proceso de esterilización. En: Criado Álvarez JJ, Peláez Ros B, Fereres Castiel J, coordinadores. Esterilización en centros sanitarios. Toledo: Fundación para la Investigación Sanitaria en Castilla-La Mancha; 2016. p. 139-69.

FUNDING

None.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHOR CONTRIBUTION

Conceptualization: Nairobi Hernández Bridón, Magalys Pallerols Mir.
Research: Nairobi Hernández Bridón, Magalys Pallerols Mir.
Writing - original draft: Nairobi Hernández Bridón, Magalys Pallerols Mir.
Writing - revision and editing: Nairobi Hernández Bridón, Magalys Pallerols Mir.