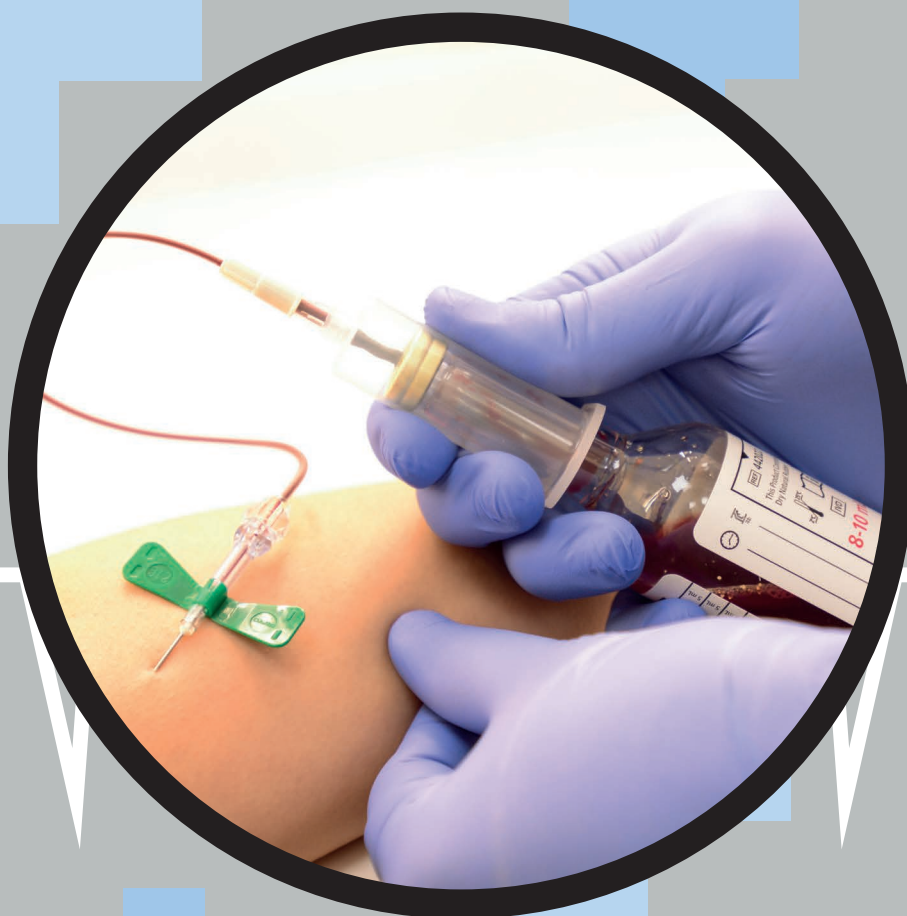


NURSING CLINICAL PRACTICE GUIDE

ON  
**B**LOOD **C**CULTURE**S**

Spanish Institute of Nursing Research

2018-2019



SPANISH GENERAL COUNCIL OF  
NURSING



INSTITUTO ESPAÑOL  
DE INVESTIGACIÓN  
ENFERMERA



**NURSING CLINICAL PRACTICE GUIDE**  
**ON**  
**BLOOD CULTURES**



This CPG is intended to provide assistance in healthcare decision-making. It is not mandatory and does not replace the healthcare staff's clinical judgement.

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## PRESENTATION

Clinical Practice Guides (CPGs) answer the main questions that nursing professionals can have when dealing with a patient from whom a blood culture must be drawn, and provide the best scientific evidence as recommendations ranked on the basis of the supporting studies. We are aware that CPGs facilitate healthcare planning and prioritisation on an everyday basis, and that they are a tool to improve healthcare outcomes. The Spanish Research Institute, in partnership with BD, supports their drafting, dissemination, and use, while ensuring that the CPGs used in Spain are of high quality.

In 2003, the Spanish Interterritorial Council of the National Health System created the GuíaSalud project, whose ultimate goal is to improve clinical decision-making based on scientific evidence through training activities and the creation of a CPG registry in the National Health System. Since then, the GuíaSalud project has assessed dozens of CPGs in accordance with explicit criteria generated by its scientific committee, which has recorded them and published them online. In early 2006, the National Health System Directorate-General for the Quality Agency drafted the Quality Plan for the National Health System, which takes the form of twelve strategies. The purpose of this plan is to increase the National Health System's consistency and help to ensure the maximum quality of healthcare for all patients, regardless of where they live. The tenth strategy in the plan addresses the Improvement of Clinical Practice, and its goals include decreasing variability in clinical practice and promoting the creation and use of CPGs. As regards the creation of a registry, training, and dissemination and implementation of the CPG Programme to create new guides, the Spanish Institute of Nursing Research is meeting the goals established in that quality plan.

In 2016, the Spanish Health Ministry commissioned the drafting of eight CPGs. In addition, a common methodology for the creation of CPGs within the National Health System was to be defined (1). This commission materialised in a Methodological Manual for the Creation of CPGs, which has been available to all professionals since November 2007, and which is the methodological reference for this guide. With this first guide, we intend to start a series of healthcare practice guides based on the best evidence available, prepared by specialist and expert nurses.

This first CPG on blood cultures is part of this series of guides. This project is intended to provide in-depth knowledge of the care provided by nurses when taking blood cultures. It also emphasises the dissemination and implementation of the CPG to encourage its use, as well as in the evaluation of public health outcomes.

This CPG has been created by a team of professionals from various fields, who have made a significant effort to write an evidence-based guide and explicit recommendations for the most frequent clinical situations faced by nurses when taking a blood culture. The external review process has also been multidisciplinary and healthcare system users have given their

views. We hope that this project will contribute in an effective way to ensure high-quality healthcare and to prevent the contamination of blood specimens. These are key factors to stop the advance of this health problem.

Documenting variability in clinical practice, analysing its causes, and implementing strategies to eliminate it have proven to be initiatives that encourage effective, patient-focused decision-making by healthcare professionals. These strategies include the writing of this CPG in order to optimise healthcare for patients. It is in this context that this Clinical Practice Guide on Blood Cultures has been written.

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These individuals have externally reviewed this CPG. However, this does not imply that they agree with this document in its entirety.

## Scientific Partners

Catalonian Society of Nurses for Infection Control (**ACICI**).

Spanish Society of Preventive Medicine, Public Health, and Hygiene (**SEMPH**). Spanish Society of Infectious Diseases and Clinical Microbiology (**SEIMC**). Spanish Society of Internal Medicine (**SEMI**).

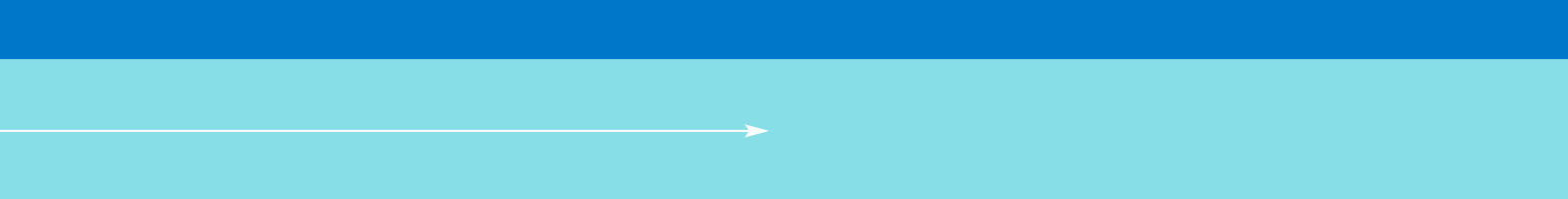
Madrid Association of Preventive Nursing (**AMEP**).

Spanish Association of Nurses for the Prevention and Control of Infections (**AEEPICI**).

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Association against leukaemia and blood diseases (**ASCOL**).





Federation of Diabetes Associations of the Canary Islands (**FAdiCAN**).  
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Members of these societies and associations have served as authors, collaborators, and external reviewers of this CPG.

Declaration of interest: all the members of the Working Group, as well as the individuals who have served as expert collaborators and external reviewers have made the declaration of interest given in **Appendix 5**.

#### Public Exhibition

This CPG has been subject to a process of public exhibition.

## Endorsements



**AEEPyci**  
Asociación Española de Enfermería de  
Prevención y Control de Infecciones



Associació catalana d'infermeres de  
control d'infecció



LOS PROFESIONALES DEL ENFERMO CRÍTICO



sepsis



SOCIEDAD ESPAÑOLA DE MEDICINA INTERNA



**Sociedad Española**  
de Medicina Preventiva  
Salud Pública e Higiene



Sociedad Española de  
Medicina de Urgencias  
y Emergencias



**AMEP** Asociación Madrileña de Enfermería Preventiva



**seimc** Sociedad Española de Enfermedades  
Infecciosas y Microbiología Clínica

## QUESTIONS TO BE ANSWERED

After the first meeting, the Working Group decided to remove sections 1, 2, 3, 5, and 8 and leave sections 4,6, and 7 below for analysis.

### Section 4. Procedure to take blood cultures

Several factors in the drawing process can result in better test performance and a lower rate of contaminated blood cultures. In this section, we will review key questions that should be answered when faced with a patient from whom a blood culture must be taken.

#### Questions to be answered

##### Section 4. 1 Hand hygiene

1. At what point does hand hygiene occur when taking blood cultures?
2. Which products should be used for hand hygiene?
3. Which hand hygiene method should be applied before the procedure?
4. Is hand hygiene necessary between each pair of blood cultures drawn from the same patient?

##### Section 4. 2 Protection equipment

5. Should sterile gloves be used?
6. Is a surgical mask necessary to take blood cultures?

##### Section 4. 3 Antisepsis when taking blood cultures

7. Which antiseptic is adequate for skin disinfection?
8. Which is the best method to apply the skin disinfection antiseptic before taking blood cultures?
9. Can the puncture site be palpated with a sterile glove or disinfecting the finger before taking the blood culture?

##### Section 4. 4 Technique

10. Can blood cultures be taken from the central venous lines which have been previously inserted in the patient?

11. Can blood cultures be taken from the peripheral venous lines which have been previously inserted in the patient?

If so,

12. When taking blood cultures from the central venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?

13. When taking blood cultures from the peripheral venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?

14. If blood cultures and blood specimens for analysis are to be taken at the same time, what would the order be?

15. Which anatomical site is most suitable?

16. What is the recommended number of blood specimens?

17. What volume should be drawn to inoculate in blood culture bottles?

18. What is the most suitable time to take blood cultures?

19. Should 20 or 30 minutes elapse after taking the first specimen to take the next one?

20. Should the puncture site change in each pair of blood specimens for blood cultures?

21. Should blood cultures be taken before or after administering antipyretic drugs and antibiotics?

22. Is the introduction of air in the bottle for anaerobic germ cultures indicated?

23. Should the needle used to draw blood for blood cultures be replaced by a new one for inoculation into the bottle so as to decrease contamination levels?

24. Should the rubber cap of the bottle be disinfected with antiseptics?

25. Should the blood culture bottles be shaken after the blood specimen has been inoculated?

26. Using a vacuum system, which blood culture bottle (aerobic/anaerobic) should be filled first?

27. Using a needle syringe system, which blood culture bottle (aerobic/anaerobic) should be filled first?

28. Could covering the puncture site with a gauze while removing the needle used to draw the specimen for blood cultures increase the risk of contamination?

29. Can the first blood cultures be taken while channelling a peripheral line?

The correct answer to these questions will make it possible to establish the most suitable procedure to take blood cultures.

## Section 6. Specimen transportation and storage

Once the specimen has been taken and inoculated into the blood culture bottles, the bottles should be properly labelled with the patient's data and the pairs of bottles for each blood culture should be identified. In this section, we review key questions that must be answered:

### Questions to be answered

30. How should recently collected blood cultures be stored before sending them to the laboratory?
31. What is the best way to store blood cultures in the laboratory?
32. Would leaving them in an incubator connected to the laboratory in those services in which delivery of blood cultures is delayed lower the contamination rate?

The correct answer to these questions will make it possible to establish the most suitable method for storage and preservation for the blood cultures until they are processed.

## Section 7. Nursing registration when taking blood cultures

In this section, we review key questions that must be answered to ensure adequate registration.

### Questions to be answered

33. What information is crucial to make a good nursing record when taking blood cultures?
34. What benefits does explaining the technique and purpose of the test to the patient provide?

Answering these questions correctly will make it possible to establish the minimum information to be recorded by a nurse after taking blood cultures.

## EVIDENCE LEVELS AND RECOMMENDATION DEGREES

Evidence quality has been evaluated and recommendations have been graded by means of the GRADE system (Grading of Recommendations of Assessment Development and Evaluations) (Appendix 1). The recommendations given in this CPG are given below.

**Table 1 Classification of evidence quality in the GRADE system**

Classification of evidence quality in the GRADE system(2)			
Evidence quality	Study design	Decrease quality if:	Increase quality if:
High	RCT	Design limitation Significant (-1) Very significant (-2) Inconsistency (-1)	<b>Association</b> • Scientific evidence of strong association (RR>2 or <0.5 based on observational studies with no confounding factors (+1)
Moderate		Direct evidence Some uncertainty (-1) High level of uncertainty (-2)	• Scientific evidence of very strong association (RR>5 or <0.2 based on studies with no possible bias (+2)
Low	Observational studies	Imprecise data (-1) Publication bias High likelihood (-1)	<b>Dosage gradient response (+1)</b>
Very Low	Other types of design		<b>All potential confounding factors could have reduced the effect observed (+1)</b>

**Table 2 Implications of the strength of recommendation in the GRADE system**

<b>Implications of the strength of recommendation in the GRADE system(2).</b>		
<b>Implications of a strong recommendation</b>		
<b>Patients</b>	<b>Clinicians</b>	<b>Managers/Planners</b>
The vast majority of people would agree with policy the recommended action and portion would not.	Most patients should receive the intervention recommended.	The recommendation can be implemented as healthcare in most situations. only a small
<b>Implications of a weak recommendation</b>		
<b>Patients</b>	<b>Clinicians</b>	<b>Managers/Planners</b>
Most people would agree with the recommended action but a significant number would not.	It acknowledges that different options would be appropriate for different patients and that the physician must help each patient to make the decision that is most consistent with their values and preferences.	There is a need for significant discussion and stakeholder involvement.

## CPG RECOMMENDATIONS

### Blood culture collection procedure

#### 1. At what point does hand hygiene occur when taking blood cultures?

##### Recommendation:

- Strong** It is recommended that, following the hand hygiene indications given in the WHO “Five Moments” model, we must perform 3 hand hygiene actions when taking blood cultures:
- 1st hand hygiene action: MOMENT 1, BEFORE CONTACT WITH THE PATIENT
  - 2nd hand hygiene action: MOMENT 2, BEFORE A CLEAN/ASEPTIC PROCEDURE
  - 3rd hand hygiene action, bringing two indications together: MOMENT 3, AFTER RISK OF EXPOSURE TO BODILY FLUIDS AND MOMENT 4, AFTER CONTACT WITH THE PATIENT

#### 2. Which products should be used for hand hygiene?

#### 3. Which hand hygiene method should be applied before the procedure?

##### Recommendation:

- Strong** Hand hygiene by rubbing with an alcohol solution for 20-30 seconds is recommended as the preferred method. Hand rubbing with alcohol-based products should be maintained until the hands are completely dried. However, if the hands are visibly dirty with blood or other bodily fluids, hand hygiene with water and soap for 40-60 seconds is recommended, the time necessary for rinsing and later drying.



#### 4. Is hand hygiene necessary between each pair of blood cultures drawn from the same patient?

##### Recommendation:

**Strong** Hand hygiene between each blood culture set is recommended. In these cases: Hand hygiene action: MOMENT 2, BEFORE A CLEAN/ASEPTIC PROCEDURE (taking blood cultures). Hand hygiene action, MOMENT 3, AFTER THE RISK OF EXPOSURE TO BODILY FLUIDS.

## Protection equipment

#### 5. Should sterile gloves be used?

##### Recommendation:

**Strong** Using sterile gloves when taking blood cultures is recommended, as they can decrease blood culture contamination.

#### 6. Is a surgical mask necessary to take blood cultures?

##### Recommendation:

**Weak** Using a surgical mask necessary when taking blood cultures on a routine basis is not recommended.

## Antisepsis when taking blood cultures

#### 7. Which antiseptic is adequate for skin disinfection?

##### Recommendation:

**Strong** 2% alcoholic chlorhexidine for skin antisepsis before puncture when taking blood cultures in patients older than 2 months is recommended. The

solution should be rubbed on a 2-3 x 2-3 cm area, and left to act for at least 3-5 minutes so that it completely dries.

- √ Using 2% aqueous chlorhexidine is recommended in children younger than 2 months, allowing the antiseptic to completely dry for at least 3-5 minutes. In children younger than 32 weeks or under 48 hours, 1% aqueous chlorhexidine could be used. Both solutions should be used with "mild or minimal rubbing".

### 8. Which is the best method to apply the skin disinfection antiseptic before taking blood cultures?

#### Recommendation:

- Strong The use of one-dose 2% alcoholic chlorhexidine dispensers is recommended, rubbing the indicated area for 30 seconds and allowing it to dry for at least 3-5 minutes.

### 9. Can the puncture site be palpated with a sterile glove or disinfecting the finger before taking the blood culture?

#### Recommendation:

- Strong Palpating the puncture site for phlebotomy after antisepsis is not recommended. If necessary, a new sterile glove should be worn. In the event of accidental contact (with a gloveless hand or with a previously worn glove), disinfect the skin again with the same product used in the initial disinfection.

## Technique

### 10. Can blood cultures be taken from the central venous lines which have been previously inserted in the patient?

#### Recommendation:

- Strong It is recommended to take blood cultures by means of phlebotomies carried out at that time in two separate anatomical sites, rather than from

a central catheter. But a previously inserted central catheter can be used (and, should it be a multiple-line catheter, using some of the lines not used until then), provided that another series of blood cultures are also taken by means of a phlebotomy from a peripheral vein in another anatomical site in the patient.

### 11. Can blood cultures be taken from the peripheral venous lines which have been previously inserted in the patient?

#### Recommendation:

Weak      Using previously inserted peripheral catheters to take blood cultures is not recommended, unless they are taken upon insertion.

### 12. When taking blood cultures from the central venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?

#### Recommendation:

Strong      It is recommended not to discard the blood taken from the central venous catheter prior to inoculation into the blood culture bottle.

### 13. When taking blood cultures from the peripheral venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?

#### Recommendation:

Weak ✓      It is suggested not to discard the blood drawn from a recently inserted peripheral venous line. If specific devices are available, 1-2 ml blood are automatically discarded before inoculation into the blood culture bottles.

**14. If blood cultures and blood specimens for analysis are to be taken at the same time, what would the order be?****Recommendation:**

**Weak** It is suggested, when drawing blood for different laboratory specimens, always to draw the blood culture specimen first.

**15. Which anatomical site is most suitable?****Recommendation:**

**Strong** In adult patients, it is recommended to draw blood from an upper limb, from an antecubital vein through direct venipuncture. In children, it is recommended to use the upper limbs, preferably using the antecubital region, but, if this is not possible, the lower limbs can be used, or the scalp (in newborns and infants).

**16. What is the recommended number of blood specimens?****Recommendation:**

**Strong** It is recommended to take at least two blood culture sets, where each set comprises an aerobic blood culture bottle and an anaerobic blood culture bottle.  
In the case of children, it is recommended to take only one paediatric bottle (volume suited to weight and age).

**17. What volume should be drawn to inoculate in blood culture bottles?****Recommendation:**

**Strong** It is recommended to draw 10-15 ml of blood for each blood culture bottle in adult patients, always following the manufacturer's recommendations. In children, it is recommended to draw 1-2 ml. However, volume should

be adjusted to weight and age.

### 18. What is the most suitable time to take blood cultures?

#### Recommendation:

- |        |  |
|--------|--|
| Strong | It is recommended to take blood cultures before the start of antibiotic therapy, if sepsis and other infections of unknown origin are suspected. |
| Weak   | It is suggested that the patient need not present with a spiking fever coinciding with the collection of the blood culture.                      |

### 19. Should 20 or 30 minutes elapse after taking the first specimen to take the next one?

#### Recommendation:

- |      |  |
|------|--|
| Weak | It is suggested that, if the patient is in a serious situation, blood cultures can be taken from two different sites within a very short time interval or even simultaneously. |
| Weak | It is suggested that, if allowed by the patient's clinical situation, the interval between blood cultures can range from minutes to hours.                                     |

### 20. Should the puncture site change in each pair of blood specimens for blood cultures?

#### Recommendation:

- |      |  |
|------|--|
| Weak | It is suggested to draw the blood for each pair of blood cultures from different anatomical sites. |
|------|--|

**21. Should blood cultures be taken before or after administering antipyretic drugs and antibiotics?****Recommendation:**

- Weak      It is suggested to take the blood cultures before the start of antibiotic therapy. In children, it is suggested that, if an antibiotic dose has been administered, it is advisable to take a blood culture immediately before the next dose.
- √      There are no clear recommendations regarding the time to take the blood culture with respect to the administration of antipyretic drugs.

**22. Is the introduction of air in the bottle for anaerobic germ cultures indicated?****Recommendation:**

- Weak      Avoiding introducing air when taking the specimen to detect anaerobic germs is suggested.

**23. Should the needle used to draw blood for blood cultures be replaced by a new one for inoculation into the bottle so as to decrease contamination levels?****Recommendation:**

- Strong      It is recommended not to change the needle between venipuncture and inoculation into the blood culture bottle, as the risk of injury through needle puncture increases, even though contamination rates slightly decrease. It is recommended to puncture the vein by means of vacuum blood drawing systems.

#### 24. Should the rubber cap of the bottle be disinfected with antiseptics?

##### Recommendation:

**Weak** It is suggested to use both blood culture bottles (aerobic and anaerobic), removing the plastic cap and disinfecting the cap with a 2% alcoholic chlorhexidine wipe for 15 seconds, allowing it to dry before the blood is inoculated.

#### 25. Should the blood culture bottles be shaken after the blood specimen has been inoculated?

##### Recommendation:

**Strong** Gentle shaking or mixing by upturning the bottles after inoculation is recommended.

#### 26. Using a vacuum system, which blood culture bottle (aerobic/anaerobic) should be filled first?

#### 27. Using a needle syringe system, which blood culture bottle (aerobic/anaerobic) should be filled first?

##### Recommendation:

**Weak** It is suggested that, if a vacuum blood drawing kit is used, blood should be first inoculated into the aerobic bottle, to prevent the transfer of air from the device into the anaerobic bottle. If a needle and syringe are used, the blood should be inoculated into the anaerobic bottle first, to prevent air intake.

**Weak** If the amount blood drawn is lower than the recommended level, it is suggested to first inoculate the blood into the aerobic bottle.

**28. Could covering the puncture site with a gauze while removing the needle used to draw the specimen for blood cultures increase the risk of contamination?****Recommendation:**

**Weak** It is suggested not to place cotton or other non-sterile material on the needle when removing it from the vein.

**29. Can the first blood cultures be taken while channelling a peripheral line?****Recommendation:**

**Weak** It is suggested that blood specimens for culture drawn from a peripheral cannula should only be taken from recently inserted peripheral catheters, if there is no alternative to draw a blood specimen for culture through a separate venipuncture.

## Specimen transportation and storage

**30. How should recently collected blood cultures be stored before sending them to the laboratory?****Recommendation:**

**Weak** It is suggested that blood culture specimens should only be kept at room temperature for short periods of time. If they cannot be immediately sent to the laboratory, they should be kept at "room temperature". The maximum time they can remain at room temperature before entering the system has not been precisely specified, although it is recommended that it be less than 2 hours and not exceed 18 hours.



### 31. What is the best way to store blood cultures in the laboratory?

#### Recommendation:

Weak It is suggested that the best method would be the automated equipment for satellite blood cultures.

### 32. Would leaving them in an incubator connected to the laboratory in those services in which delivery of blood cultures is delayed lower the contamination rate?

#### Recommendation:

Weak It is suggested that they be immediately transported to the laboratory. If they cannot be immediately sent to the laboratory, they should be incubated in automated equipment for satellite blood cultures.

## Nursing registration in blood collection

### 33. What information is crucial to make a good nursing record when taking blood cultures?

#### Recommendation:

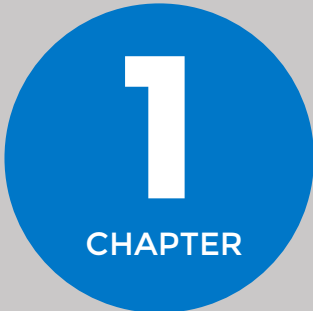
Weak It is suggested to record identification data such as the patient's full name, date, medical history number, time when the blood culture was taken, and sequence number. Upon arrival at the laboratory, check that the bottles are correctly identified regarding the patient and blood-taking they come from.

**34. What benefits does explaining the technique and purpose of the test to the patient provide?**

**Recommendation:**

Weak      It is suggested that the purpose of the test and the procedure to be followed be explained to the patient, as well as how they should cooperate and the importance of this.

INTRODUCTION Y  
JUSTIFICATION





## 1. INTRODUCTION AND JUSTIFICATION

Blood culture is a diagnostic method for the detection of bacteria and other microorganisms in the blood. It is one of the most efficient tests for bacteraemia diagnosis. Taking blood cultures is recommended when there is an infection or suspected infection in patients of all ages (newborns, adults, and elderly patients). A positive culture provides crucial information for infection diagnosis and treatment: firstly, it is a definitive diagnosis of infection, and secondly, it makes it possible to establish a specific antimicrobial treatment for the microorganism detected. Moreover, the analysis of culture results for our population provides an epidemiological pattern of antimicrobial resistance.

Even though this diagnostic test is simple, there is a risk of contamination (i.e. false positives) due to inadequate drawing and/or processing of the blood specimen. Thus, taking a blood culture requires a thorough preparation and implementation technique to prevent contamination by microorganisms, as well as potential consequences for the patients and for the healthcare service.

To prevent and/or reduce antibiotic resistance, and thus the negative impact on patient health and on healthcare costs, various projects have been launched in Spain and internationally. For example, in Spain, the *Quality Plan for the National Health System* (3) has improved health outcomes through the implementation of safe clinical practices. The Bacteraemia Zero project, promoted by the Ministry of Healthcare, Social Services, and (4)(MSSSI) in partnership with the World Health Organisation and led by SEMICYUC in coordination with regions, is a programme launched to reduce bacteraemia from central vein catheters in ICUs all over Spain. Internationally, for example, the British Health Department also launched a strategy to “save lives” through the implementation of good practice guides on blood culture collection (5).

Thus, the detection of bacteraemia is a priority in healthcare services all over the world, due to its diagnostic and prognostic importance, given that it is associated with a high mortality rate and high healthcare costs. It should be pointed out that a contaminated blood culture causes an average extension in hospitalisation by 4 to 5 days, and an added treatment cost of € 4,000, according to the blood-taking protocol of the Andalusian Health Council (6). Along these lines, Alahmadi et al (7) conducted a retrospective case and control study in which 142 cases of false positives in blood cultures were made to coincide with the corresponding controls (patients whose cultures were reported as true negatives). The research comprised a period of 13 months (from July 2007 to July 2008).

The results indicated that the mean differences between cases and controls, for the duration of hospitalisation and the total costs were 5.4 days ( $P < 0.001$ ) and 5,001.5 pounds sterling ( $P < 0.001$ ), respectively. Patients with false positives in blood cultures added 1,372 days of extra hospitalisation and incurred additional hospital expenses for 1,270,281 pounds per year.

A recent study, whose goal was to assess the nurses' technique to take blood cultures in an A&E unit in a Spanish hospital, identified technical deficiencies in the procedure, which partly accounted for the high contamination rate registered in the service the year prior to the study (8). One of the causes for contamination when taking the blood culture specimen is due to incorrect skin disinfection prior to drawing blood (9, 10). The presence of *Staphylococcus epidermidis* in the skin is a significant cause of nosocomial infection and a common blood culture pollutant (11). For this reason, nurses, who are usually the professionals in charge of taking blood specimens, should be informed and trained on the need for adequate skin antisepsis before drawing blood.

Madeo's study (12), conducted in A&E units in a 1,500-bed university hospital in the United Kingdom, proves the positive effect on blood culture contamination rates after the use of 2% chlorhexidine gluconate (CHX) in a 70% isopropyl alcohol dispenser. The results of the study show that the ratio of blood cultures regarded as contaminated dropped from 304/4,071 (7.5%) before implementation (from January to July 2007) to 40/1,870 (2.1%) after implementation. The need for proper blood culture collection through a central catheter in critical care units has also been shown, with a training programme aimed at reducing specimen contamination in adult intensive care units having proved effective (13). A significant and lasting reduction in blood culture contamination levels has also been verified in neonatal intensive care units (14) after the implementation of a combined intervention based on healthcare staff training and skin disinfection (using sterile dispenses with 2% chlorhexidine gluconate in 70% isopropanol) before venipuncture. However, a recommendation on the safety or efficacy of chlorhexidine in babies under 2 months cannot be given (15), as more studies are needed.

Thus, these results show the need to identify the most suitable actions, mainly aimed at better compliance in the various stages of blood culture procedure: taking blood specimens, transporting the blood culture to the laboratory, blood culture reception and registration, and blood culture processing. To summarise, adequate and rigorous management of the blood culture process would decrease the likelihood of microbiological blood culture contamination.

Various blood culture protocols have been published, both for adult and children's healthcare (16). However, even though the protocols available have been of great help in systematising the blood culture procedure, there is a lack of fuller protocols, from a multidisciplinary approach, and training recommendations, encouraging the development of a rigorous and reliable procedure to collect and process blood specimens.

## Need for a clinical practice guide

Nurses play a key role in prevention, care, and monitoring of patients with infections, as they are the healthcare professionals who take blood specimens for blood cultures, and, if an

infection is diagnosed, administer the treatment. Standards or guidelines are required to unify and standardise those aspects that help to define nurses' role in the care of patients with infections or suspected infections, as a way to ensure patient safety.

Interdisciplinary work is also required to prevent and reduce blood culture contamination in any of the phases described, from the collection of the specimen to its processing.

Blood cultures yielding false positives, usually caused by malpractice, are also very frequent (2 to 6%) (17), particularly in A&E units, and they generate significant costs in terms of extended hospital stays and unnecessary treatments (5,001 pounds on average).

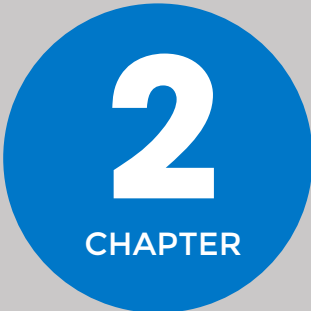
All the above requires establishing the mechanisms to improve quality of care and guarantee the clinical safety of patients with infections or suspected infections, from a multidisciplinary, competent, and effective practice.

For all these reasons, it is necessary that staff be duly motivated and trained. Hence the importance of establishing protocols or practice guides, specifying all actions in accordance with the evidence levels found.





SCOPE AND  
GOALS





## 2. SCOPE AND GOALS

CPGs are sets of instructions, guidelines, statements, or recommendations, systematically developed, whose purpose is to assist healthcare professionals and patients in making decisions on the type of suitable healthcare for specific clinical circumstances. Even though this term has been applied to various products, high-quality CPGs are documents that make specific questions and arrange the best scientific evidence available so that, in the form of flexible recommendations, they can be used in clinical decision-making. This guide has been developed in accordance with the following principles:

- Being useful and usable for all nursing professionals.
- Considering patients' views.
- Indicating the areas of uncertainty or controversy that required further research.

### 2.1. Scope

This Clinical Practice Guide (CPG) tackles aspects of blood drawing by means of a venipuncture or through an endovenous catheter in clinical situations where bacteraemia is suspected. It does not approach other questions pertaining to the taking of blood cultures in other special situations with no fever.

This CPG summarises the evidence available on the most frequent difficulties faced by professionals performing this procedure, and is intended to facilitate decision-making by means of evidence-based recommendations on the best care when taking blood cultures, while not replacing the professional's clinical judgment in any case.

It is mainly aimed at all nursing professionals who take blood cultures from patients, to whom, moreover, an adapted version of the GPCs is offered.

As this guide follows the National Health Service methodology, no specific recommendations are made for private health services, although the clinical recommendations made also apply to this sector.

### 2.2. CPG goals

The goal of this CPG is to serve as an instrument to improve blood culture collection technique.

This Clinical Practice Guide on Blood Cultures is intended to provide recommendations based on the best scientific evidence connected to the taking of blood cultures, so as to contribute to reducing false positives due to contamination caused by the wrong technique, reduce complications, improve the quality of life of patients with this clinical condition.

### 2.2.1. General goals

- To improve patient healthcare.
- To promote rationality and efficiency.
- To guarantee patient safety during the process.

### 2.2.2. Specific goals

- To establish a set of recommendations based on scientific evidence to reduce the number of false positives among individuals from whom blood cultures are taken.
- To reduce specimen contamination due to improper implementation of the procedure to take blood cultures.
- To establish indicators providing the main care variables so as to monitor the process and the outcomes of clinical practice.

## 2.3. Approach

This CPG is intended for professionals who take blood cultures.

## 2.4. Users for whom this CPG is intended

This CPG is intended for nursing professionals involved in the care of patients for whom taking blood cultures is indicated, i.e. nursing professionals who take blood cultures as part of their work, nursing experts in infection control, nurse practitioners, general practice nursing, and children's nursing.

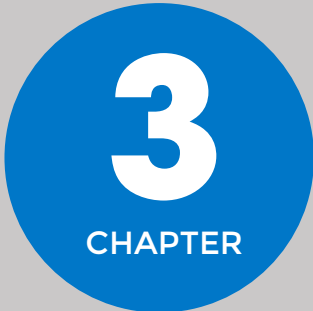
This guide is also intended for patients, relatives, educational associations, and scientific societies, as well as healthcare managers.

## 2.5. Healthcare scope

The healthcare scope includes all services and units that provide care to patients with this clinical condition: patients who may require the taking of blood cultures, at each level of care.



METHODOLOGY







## 3. METHODOLOGY

To draft this Clinical Practice Guide (CPG), the Methodological Manual “Drafting of Clinical Practice Guides in the Spanish National Health Service”, which can be viewed on the Spanish National Health Service Online Library, GuiaSalud, was used.

The steps taken were the following:

### 3.1. Creation of the group that authored this guide

The Authoring Group is a multidisciplinary team comprising experts in blood cultures with proven accreditation in and outside hospitals.

These professionals were contacted through the various Scientific Societies connected to the CPG topic. The materials for patients were supervised by various healthcare service users.

All the members of the Authoring Group declared in writing their conflicts of interest before the guide started to be written. Their declarations of interest are attached as appendix 5 to this Guide.

### 3.2. Declaration of conflict of interest

All the members of the Authoring Group signed a declaration of conflict of interest before the meetings to make recommendations started, in which they stated that they had no conflicts of interest regarding the CPG recommendations, were not involved in activities remunerated or funded by private institutions connected to the CPG in the last 24 months, were not involved as researchers in ongoing clinical trials on the topic in the last 24 months, had not received any donations or gifts from stakeholders regarding the recommendations, and were not part of professional groups with conflicts of interest. The members of the Authoring Group also transferred their copyright over this guide to the Spanish General Council of Nursing. This technical document has been funded by BD and by the Spanish General Council of Nursing.

### 3.3. Systematic reviews

The systematic reviews (SRs) conducted to draft this CPG had the following stages:

### 3.3.1. Establishment of the clinical questions

In accordance with the goals and scope of this CPG, the Authoring Group made a list of initial clinical questions and later, through regular discussions, the main questions to be faced by healthcare staff regarding the condition were included.

Once the final list of clinical questions was established, the PICO format was followed: Patient, Intervention, Comparison, and Outcome. To establish the questions correctly, in the first Authoring Group meeting the individuals involved in the process (physicians and nurses specialised in blood cultures) were provided with materials.

Finally, the Authoring Group, on the basis of the literature review and their experience, drafted a list of outcomes for each PICO question in accordance with the GRADE methodology, which were rated as follows:

- Critical or key outcomes for decision-making (7 to 9 points)
- Significant but not key outcomes for decision-making (4 to 6 points)
- Insignificant outcomes (1 to 3 points)

50

Significant and critical outcomes were selected to draft this guide. The questions and the selected outcomes for each clinical question are given in appendix 6.3.

#### 3.3.1.1. Selection of clinical questions to be answered

To define the key aspects and the questions to be made in the guide, some questions from the CPG on Intravenous Therapy with Non-Permanent Devices in Adults (1) and a document on blood culture recommendations from the Spanish Society for Infectious Diseases and Clinical Microbiology (19) were taken as the starting point. Some questions that the authoring group found of interest were added to this draft.

The proposal was sent to the selected group of blood culture expert partners, who assessed both the CPG sections and structure proposed and the questions to be discussed in each section. The proposals and comments received from the partners were examined by the Authoring Group. The answers to all the feedback given, as well as the acceptance or non-acceptance of the proposals, were recorded in a document that was sent to the partners involved in the process. This document has been included at the end of this guide as appendix 6.

Of all the questions proposed, those corresponding to sections 4, 6, and 7 were selected to be finally discussed in this guide.

### 3.3.2. Bibliographic search

A search was conducted to identify the most recent and highest quality evidence available.

The identification of systematic reviews (SRs) and other types of critical summaries of scientific literature, such as consensus documents on blood cultures and infection control were given priority. To this end, in the first stage a search was conducted for other CPGs on the topic, so as to verify which SRs were considered to support their recommendations. The main CPGs used as secondary sources (20) are given in appendix 7. Later, additional SRs were identified starting on the date when the search for the selected CPG was conducted. In this first stage, the following online databases were searched:

#### 1. Other CPGs database search engines:

- National Guideline Clearinghouse (NGC) [www.guidelines.gov](http://www.guidelines.gov)
- G-I-N international guideline library  
[www.g-i-n.net/library/international-guidelines-library](http://www.g-i-n.net/library/international-guidelines-library)
- GuíaSalud (Spain) [www.guiasalud.es](http://www.guiasalud.es)
- NICE (National Institute for Health and Care Excellence) clinical guidelines (United Kingdom)  
[www.nice.org.uk/about/what-we-do/our-programmes/nice-guidance/nice-guidelines/nice-clinical-guidelines](http://www.nice.org.uk/about/what-we-do/our-programmes/nice-guidance/nice-guidelines/nice-clinical-guidelines)
- Scottish Intercollegiate Guidelines Network (SIGN) (United Kingdom)  
[www.sign.ac.uk](http://www.sign.ac.uk)
- Tripdatabase [www.tripdatabase.com](http://www.tripdatabase.com)
- Large bibliographic databases, such as PubMed/MEDLINE [www.pubmed.org](http://www.pubmed.org) and EMBASE [www.embase.com](http://www.embase.com), applying the relevant methodological filters.
- AHRQ National Guideline Clearinghouse. <https://www.ahrq.gov/research/publications/pubcomguide/index.html>

In a second stage, an expanded search for individual studies was conducted to update the relevant SRs so as to answer the CPG questions. Mainly, randomised clinical trials (RCTs) and observational studies were identified.

The original search strategy for relevant SRs was followed. When not available, a specific strategy for each question was designed, adding in each case validated filters for the identification of RCTs and observational studies. In this stage, the following online databases were searched:

2. Large databases to identify systematic reviews (SRs) and other evidence syntheses:

- Cochrane Database of Systematic Reviews (CDSR), available at The Cochrane Library [www.thecochranelibrary.com](http://www.thecochranelibrary.com). Biblioteca Cochrane Plus [www.biblioteca-cochrane.com](http://www.biblioteca-cochrane.com) (Spanish version)
- MEDLINE (accessed through PubMed)
- TRIP Database
- EMBASE (accessed through Ovid).
- CINAHL (nursing)

All this process was completed by means of a general online search (organisations and scientific societies) and a reverse search in papers for the main studies to locate other information of interest.

The bibliographic search strategies followed are described in the document "Methodological materials", available on the GuiaSalud website: [www.guiasalud.es](http://www.guiasalud.es)

### 3.3.2.1. Search period

A linguistic limit was placed on the searches (Spanish and English). The search was conducted considering results less than 10 years old (2008 to September 2018), albeit relevant studies were found in the biomedical publications with the highest impact throughout the CPG writing process.

### 3.3.2.2. Keywords

- Blood culture
- Blood culture test
- Bacteraemia
- Skin disinfection
- Blood culture contamination
- Central line associated with bloodstream infection
- Venipuncture
- Needles

- Blood specimen collection

### 3.3.2.3. Update of the searches for each clinical question

The searches conducted to answer the guideline questions were monitored up to 2018. If papers of interest were identified, they have been described in the text.

### 3.3.2.4. Search strategy

An initial search was conducted to approach the existing literature, and later a search for independent literature was conducted for each question defined. The Authoring Group worked in partnership with the guideline coordinators to identify the relevant keywords, which included at least sepsis and blood culture combined with the relevant keywords for the specific question.

For the questions posed, an online search was conducted in at least two main databases (e.g. the Cochrane Registry, MEDLINE, EMBASE, or CINAHL) to identify relevant systematic reviews and randomised clinical trials (RCTs).

### 3.3.3. Bias risk assessment

For each of the primary studies selected, the Authoring Group determined whether a bias risk assessment was to be carried out. This assessment was in general conducted when the SR selected did not assess the studies included, or when the SR selected conducted a non-quality assessment or the assessment pertaining to various outcomes and the result of the assessment could be expected to change when focusing on the outcome being assessed (e.g. the bias risk for not blinding the evaluators would be different for the “false positive” outcome than for the “death” outcome).

### 3.3.4. Evaluation of methodological quality

The methodological quality of the CPG identified was assessed using the AGREE tool (21). Evidence quality was evaluated and recommendations were graded by means of the GRADE system (Grading of Recommendations of Assessment Development and Evaluations) (Appendix 1).

(<http://www.cc-ims.net/revman/gradepro/gradepro>). Controversial recommendations and recommendations lacking evidence were settled by Authoring Group consensus.

The quality assessment and synthesis of the evidence for each question were conducted using the GRADE Group methodology.

The scientific evidence found for each question was synthesised by outcome of interest. To do this, the Authoring Group previously defined and assessed the outcomes of interest for professionals taking blood cultures. In the case of intervention-type questions, the GRADE group found that RCTs provide “high quality” evidence, while observational studies provide “low quality” evidence. However, a number of criteria that can decrease the quality of the evidence provided by RCTs, as well as increase the quality of the evidence provided by observational studies, have been suggested.

The criteria that can **decrease** the quality of RCT evidence are the following:

- **Limitations in RCT design or implementation:** the failure to conceal the randomisation sequence, inadequate masking, significant losses, or the absence of an intention-to-treat analysis, among others, can decrease our confidence in the outcomes presented
- **Inconsistent results:** if the studies present very disparate estimates of the effect of a treatment (study heterogeneity or variability), those differences can be due to the fact that the studies include different populations or there are differences in the intervention, the outcomes of interest, or the quality of the studies. For this reason, when there is heterogeneity among the studies and it cannot be reasonably accounted for, the confidence in the global estimate for the effect decreases.
- **Lack of direct scientific evidence:** in the case of lack of direct comparisons between two treatments (there are studies that compare each treatment vs placebo, but not studies that compare both treatments to each other) or the extrapolation of the results of a study, e.g. from a certain drug to the rest of drugs in the same family when a class effect has not yet been proven, it is also regarded as indirect scientific evidence. Frequently, there are also significant differences between the population to which the recommendations will apply and that included in the studies evaluated. Finally, the potential applicability to our environment and the external validity of the scientific evidence available should also be considered. All these aspects can decrease confidence in the estimated effect due to a lack of direct evidence.
- **Imprecision:** when the studies available include relatively few events and few women, and thus have wide confidence gaps, our confidence in the estimated effect can decrease.

- **Notification bias:** in this case, the quality of or confidence in the global estimated effect can decrease if there is reasonable doubt regarding the inclusion by the authors of all the existing studies (e.g. the publication bias in the context of a SR) or whether the results for all the relevant outcomes have been included (outcome reporting bias).

The criteria that can **increase** confidence in the results of observational studies are the following:

- **Significant effect:** when a strong ( $RR > 2$  or  $< 0.5$ ) or very strong ( $RR > 5$  or  $< 0.2$ ) and consistent association (obtained from studies that have no confounding factors), the confidence in the estimated effect can increase from low to moderate, or even high.
- **The presence of a dose-response gradient** can increase the confidence in the global estimated effect.
- **Situations in which all the possible confounding factors could have reduced the association observed:** e.g. when the women receiving the intervention of interest present with a worse prognosis, and even so display better results than the control group, it is likely that the real observed effect is greater, so the quality of the evidence could be increased.

On the basis of the assessment of all these criteria, the quality of or confidence in the evidence found for each outcome of interest is classified as very low, low, moderate, or high. In the guidelines, the quality of the evidence found for each outcome of interest is displayed on the margin to the right of the text.

The global quality of the evidence on which each clinical question is based depends on the individual quality obtained for the outcomes regarded as critical for that question. Thus, global quality is defined by the critical outcome for which the lowest evidence level is obtained.

#### *3.3.4.1. Literature review and evaluation*

Search for guidelines, systematic reviews, and individual studies. To search and review the literature, a mixed tiered strategy, comprising the following stages, has been followed:

- a) Search for CPGs on the collection of blood cultures, nationally and internationally, to be used as systematic reviews.
- b) Search for current systematic reviews (SRs) and/or evaluation reports that consistently answer the questions posed since the publication of the selected

guidelines, if necessary.

- c) Search for original studies specific to each question when no secondary studies have been found or when it must be considered whether new studies have been published since the date of publication of the secondary studies identified.

The approach to each clinical question has depended on whether the guidelines identified included the question or on the existence of systematic reviews that answered it.

**Table 3 Adaptation of the proposal to decide the strategy to be followed with each question (2)**

Type of approach	Situation
<b>Adopt CPG/Systematic review</b>	Question included in guidelines, with no need for update, consistency, strong recommendation, or updated Cochrane review
<b>Partial elaboration</b>	The scientific evidence is not sufficiently up to date (inclusion of new evidence can modify the content or strength of the recommendations)
<i>Update</i>	
<i>Search and abbreviated critical evaluation</i>	Question partially discussed (specific aspects of the questions that are not discussed in the guidelines)
<i>Critical evaluation</i>	Inconsistencies between guidelines or between the scientific evidence and the recommendations  Not discussed in the guidelines
<b>Elaboration de novo</b>	New questions with very recent publications  Questions discussed but only in a narrative or consensus form (frequent in diagnosis, natural history, and prognosis issues)



Free-text searches were conducted and the bibliographic contributions from the working group were considered, as well as the contributions from the expert partners.

The keywords and search strategies used are available in the methodological document for the project, and are available in the Clinical Practice Guidelines Programme section on the National Health Service's GuiaSalud website.

### *3.3.4.2. Classification of the relative importance of outcome variables*

In this stage, the GRADE system recommends that, in the initial phase of the establishment of the clinical questions, the authoring group explicitly establishes the outcome of interest variables for the questions and classifies their relative importance. The outcomes of interest proposed to the Authoring Group are described in appendix 6.3. It is recommended to classify their importance by means of the following nine-point scale:

- 1-3: Insignificant outcome variable. It should not be included in the quality or outcome assessment table. These outcome variables play no significant role in the establishment of recommendations.
- 4-6: Significant but not key outcome variable in decision-making.
- 7-9: Key outcome variable in decision-making. The relative importance of the outcome variables is established by consensus.

### 3.3.5. Data mining

Performed by the authors.

### 3.3.6. Evidence tables

The evidence tables are given in the document "Methodological materials", available on the GuiaSalud website: [www.guiasalud.es/egpc/index.html](http://www.guiasalud.es/egpc/index.html). The GRADE system (Grading of Recommendations of Assessment Development and Evaluations) was used with the GRADE Working Group's software, GRADEpro (<http://www.cc-ims.net/revman/gradepro/gradepro>).

### 3.4. Recommendations

The graduation of the strength of the recommendations is relatively simple, as it considers two categories only: strong and weak recommendations (appendix 1). In the strong recommendations, the authoring group trusts that the beneficial effects outweigh harmful ones, or vice versa, the damages outweigh the benefits. In the former case, the recommendation for is strong. In the latter, the recommendation against is strong. Weak recommendations can also be for or against. A recommendation for is weak when the authoring group concludes that the beneficial effects of following the recommendation most likely outweigh harmful ones, even though it is not completely sure. By contrast, a recommendation against is weak when the adverse effects probably outweigh beneficial ones.

To establish the recommendations, the GRADE structured framework known as EtR - Evidence to Recommendation - has been followed, considering the following factors:

- Risk-benefit balance: To adequately assess the risk-benefit balance, the baseline risk of the population targeted by the recommendation and its effect, in relative and absolute terms, should be considered.
- Quality of the scientific evidence: before making a recommendation, the confidence in the estimated observed effect should be known. If the quality of the scientific evidence is not high, confidence in the results decreases, and thus so does the strength of a recommendation.
- Use of resources: unlike other outcomes of interest, costs vary depending on the time, location, and other factors. A high cost will probably reduce the strength of a recommendation, so context is critical in the final assessment.
- Equity, acceptability, and feasibility: uncertainty regarding the values and preferences of the GPC target population is another factor to consider. The values and preferences of healthcare staff, women, and society as a whole must be reflected, which will influence the graduation of recommendations.

Thus, the recommendations made may be strong or weak, depending mainly on the Authoring Group's confidence in the evidence identified. In both cases, recommendations can be for or against what is considered in the clinical question.

For interventions for which no evidence is available and the Working Group wishes to highlight a specific result, recommendations based on the clinical experience and consensus of the authoring group are made which are identified by the  $\surd$  symbol.

To make the good clinical practice (GCP) recommendations and points, the Authoring Group presented its evidence online and held regular meetings, in which the evidence collected

for each of the clinical questions was presented, on the basis of which the clinical experts established the recommendations. When consensus regarding a recommendation was not reached, the Authoring Group discussed the existing bibliography, provided evidence, and reached a consensus on those aspects that differ from healthcare practice. If there was no consensus, a vote was cast considering the benefits and drawbacks of the question.

For this CPG, the Authoring Group found that it was not imperative to conduct systematic searches for costs, patient values and preferences, or feasibility of implementation, as they did not reach a consensus regarding their interest for the purposes of this guide.

Following the GRADE methodology, the sense (for or against) and strength (strong or weak) of each recommendation (22, 23) (22) was established and displayed on this table:

**Table 4 Meaning of strength and sense of the recommendations**

Strength and sense of the recommendation		Meaning
<b>Strength of the recommendation</b>	Strong recommendation	The Authoring Group believes that all or almost all the professionals reviewing the evidence available would follow this recommendation. The phrase "it is recommended"/"is recommended" is used in the text of the recommendation.
	Weak recommendation	The Authoring Group believes that the majority of professionals reviewing the evidence available would follow this recommendation, but a group of professionals would not follow it. The phrase "it is suggested"/"is suggested" is used in the text of the recommendation.
<b>Sense of the recommendation</b>	For	Performing a certain action is recommended
	Against	Performing a certain action is not recommended

Finally, certain GCL (√ Good clinical practice) points were established by the Authoring Group, which issues them on the basis of their clinical experience and by group consensus. Point 6 of the guidelines summarises the main GCP recommendations regarding blood cultures. For any questions that, in the Authoring Group's view, could not be answered by the current evidence, no recommendations were made, but rather GCP points, marked by the "√" symbol.

A GCP would be appropriate, for example, when the benefit or harm is unequivocal, but the evidence is hard to summarise or assess using the GRADE methodology.

### 3.5. External review of the contents of the CPG

The external review of the contents of the CPG draft on blood cultures has been conducted from experts from different specialities and Scientific Societies which are also represented by members of the authoring group and reviewers.

The materials that specify in detail the information on the CPG methodological process (search strategies for each clinical question, evidence synthesis tables, and formal evaluation tables) are available in the methodological manual for the project and at [www.guiasalud.es](http://www.guiasalud.es).

The feedback received was considered by the Authoring Group, which has made the relevant changes to the CPG draft. The answers to each of the comments were sent to the external reviewers. These answers are given in the CPG methodological document.

### 3.6. GPC edition

This CPG includes recommendations based on publications with "expert consensus or views", marked by the letter "D". The "√" symbol, defined as "authoring group consensus", is also used. This latter degree of recommendation is used in those cases in which there are no publications or, even though there are studies, evidence must be adapted due to the context of application. In the text, the type and level of evidence that reflects the possibility of bias in the bibliography reviewed are indicated together with the information provided by the studies. The text has been externally reviewed by a multidisciplinary group of professionals. The final version of the text of the guidelines has been reviewed and approved by the authoring group. The various Scientific Societies involved have been contacted, and they have participated through the authoring group and through external review.

Scientific Partners involved:

- Catalan Society of Nurses for Infection Control (ACICI)
- Spanish Society of Preventive Medicine, Public Health, and Hygiene (SEMPSH)
- Spanish Society of Infectious Diseases and Clinical Microbiology (SEIMC)
- Spanish Society of Internal Medicine (SEMI)
- Madrid Association of Preventive Nursing (AMEP)
- Spanish Association of Nurses for the Prevention and Control of Infections (AEEPycI)
- Spanish Society of Accident and Emergency Nursing (SEMES)
- Association against leukaemia and blood diseases (ASCOL)
- Federation of Diabetes Associations of the Canary Islands (FAdiCAN)
- Spanish Society of Intensive and Critical Medicine and Heart Units (SEMICYUC).

This document is the “complete” version of the clinical practice guide on blood cultures. The CPG is structured into chapters which answer the questions given at the start. A summary of the evidence and the recommendations are given at the end of each chapter. There is a shorter, “summary or quick” version of the GPC, with the main appendices in the “complete” version and an information guide for patients. The various versions of the CPG and the methodological materials which present the information on the CPG drafting process, the search strategy for each clinical question, and the evidence tables presented in detail are available in the methodological manual for the project and at <http://www.guiasalud.es/egpc/index.html>. Updates are intended to be made every five years, although the online version may be updated more frequently.

### 3.7. CPG updating

The guideline is intended to be updated in three to five years at the latest, or earlier if new scientific evidence that might modify any of the recommendations made becomes available. The updates will be made to the online version of the guidelines.

The materials that present the information on the CPG methodological process (search strategy for each clinical question, GRADE evidence profile tables, and EtR tables) in detail are available on the GuíaSalud website, as well as in the methodological manual for the project.

### **3.8. Considerations for implementation**

Designing a plan for dissemination and implementation in healthcare services, integrated with their quality programmes, is recommended. To facilitate its use, professionals must have easy access to the quick guide and to the appendices that illustrate the practical aspects of its use. Diagrams for use are given to schematically facilitate the decision-making point which the professional wishes to view, as part of the taking of blood cultures. The Dissemination and Implementation section in the project manual specifies strategies and tools to facilitate the use of the guide.

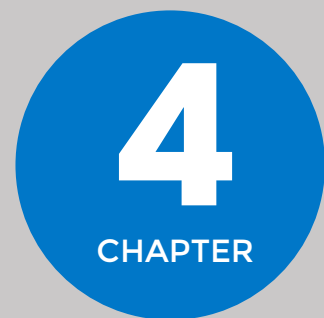
### **3.9. Professionals for whom the CPG is intended**

Nursing professionals who take blood cultures as part of their duties of care.

### **3.10. Target population**

Patients requiring the diagnosis of the microorganism causing their infection by means of a blood culture.

QUESTIONS TO  
BE ANSWERED







## 4. QUESTIONS TO BE ANSWERED

### 4.1. Blood collection procedure

Sepsis is defined as a “Systemic Inflammatory Response Syndrome” (SIRS) in the presence, or as a result, of a suspected or confirmed infection. The clinical spectrum of sepsis starts when a systemic infection (bacteraemia, viremia, fungemia) or a localised infection (meningitis, pneumonia, pyelonephritis, etc.) has a systemic impact, and can progress from sepsis to serious sepsis, septic shock, and ultimately death” (24).

It is important to identify patients with a suspected or diagnosed sepsis early, as this will have a crucial impact on short- and long-term mortality and morbidity rates. To this end, an effective diagnostic index or tool such as blood cultures must be available.

Blood culture is the basic microbiological study that must always be included in the initial assessment of any patient with a clinical suspicion of sepsis or septic shock, so it is important to minimise any factors that might result in a false positive (24).

Blood cultures should be taken (25) when there is a clinical need to do so in response to any of the following clinical signs suggesting sepsis and/or a deteriorating clinical picture that includes:

- Abnormal heart rate, core temperature, leukocyte count.
- Shivering.
- Other local signs of infection, such as pneumonia, septic arthritis, meningitis, urinary tract infection, including pyelonephritis and acute abdominal pathology.

Contaminated blood cultures (false positives) can cause significant diagnostic confusion and result in unnecessary or suboptimal antimicrobial therapy. This can be prevented by carefully drawing blood using a correct antiseptic technique (25).

### 4.1.1. Aspects connected to hand hygiene

#### 1. At what point does hand hygiene occur when taking blood cultures?

##### **Evidence Summary:**

Indications for hand hygiene currently follow the WHO's "Five moments for hand hygiene" model (26). These indications can be integrated in five moments while providing care. If healthcare professionals promptly identify these indications (or moments) and react by performing the adequate hand hygiene actions, infections connected to healthcare caused by cross-transmission of microorganisms can be prevented. Performing the right action at the right time is a guarantee of safe healthcare. The other studies found refer to this model.

If we follow the 5-moment model strictly:

3 hand hygiene actions when taking blood cultures are presented:

- 1st hand hygiene action: MOMENT 1, BEFORE CONTACT WITH THE PATIENT

Hand hygiene must be carried out before contact with the patient.

This is indicated when the last contact with the care area takes place, prior to contact with the patient, to prevent the transfer of germs from the care area to the patient preventing skin colonisation.

- 2nd hand hygiene action: MOMENT 2 BEFORE A CLEAN/ASEPTIC PROCEDURE - (taking of a blood culture) (critical point with risk of infection for the patient).

Hand hygiene should be performed immediately before the blood culture is taken and before the gloves are donned. It should be performed prior to any procedure that involves direct or indirect contact with the mucous membranes, broken skin, or an invasive medical device, to prevent the transfer of germs through inoculation to the patient, as well as from one point to another on the same patient's body.

- 3rd hand hygiene action, bringing two indications together: MOMENT 3, AFTER RISK OF EXPOSURE TO BODILY FLUIDS AND MOMENT 4, AFTER CONTACT WITH THE PATIENT.

Hand hygiene should be performed as soon as the task that involves the risk of exposure to bodily fluids ends (and after the gloves are removed). This is indicated when there is contact with the blood or other bodily fluids (even if it is minimal and not clearly seen), prior to the next contact with any surface, including the patient, their environment, or the healthcare area, to protect the healthcare professional from colonisation or infection by the patient's germs and to protect the healthcare environment from contamination and potential subsequent propagation.

It should be borne in mind that the indications to perform hand hygiene are independent from those that justify the use of gloves (sterile or not). Use of gloves is not modified by nor does it replace the indication or performance of hand hygiene (27):

- a) When an indication for hand hygiene precedes a task that involves contact and requires the use of gloves, hand hygiene should be performed immediately before they are donned (27).
- b) When an indication for hand hygiene follows a task that involves contact and requires the use of gloves, hand hygiene should be performed immediately after removing them (26).
- c) When it is indicated for healthcare staff to wear gloves, they must remove them to perform hand hygiene and replace them if required. The use of gloves does not change the indication of hand hygiene (27).

According to García, RA(28) et al in their multidisciplinary review of best practices, adequate hand hygiene using water and soap or an alcohol-based hand disinfectant is a cornerstone of practices for the prevention of infection. The guarantee that adequate hand hygiene is performed before blood cultures are taken reduces the risk of introducing contaminating bacteria in the bottles. The recommendations given in the CPG that apply to healthcare workers who take blood cultures include hand decontamination "before having direct contact with the patient", "before introducing peripheral vascular catheters / a surgical procedure", "after contact with the patient's intact skin", "after contact with bodily fluids", "after contact with inanimate objects" and "after removing the gloves".

**Evidence quality: Moderate****Recommendation:**

<b>Strong</b>	<p>It is recommended that, following the hand hygiene indications given in the WHO "Five Moments" model, we must perform 3 hand hygiene actions when taking blood cultures:</p> <ul style="list-style-type: none"> <li>• 1st hand hygiene action: MOMENT 1, BEFORE CONTACT WITH THE PATIENT</li> <li>• 2nd hand hygiene action: MOMENT 2, BEFORE A CLEAN/ASEPTIC PROCEDURE</li> <li>• 3rd hand hygiene action, bringing two indications together: MOMENT 3, AFTER RISK OF EXPOSURE TO BODILY FLUIDS 4, AFTER CONTACT WITH THE PATIENT</li> </ul>
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2. Which products should be used for hand hygiene?

3. Which hand hygiene method should be applied before the procedure?

**Evidence Summary:**

We found a randomised clinical trial (RCT), the WHO and CDC guidelines, and systematic reviews.

The two hand hygiene methods recommended are: hand hygiene through rubbing with an alcoholic solution and hand hygiene with water and soap. According to the WHO (29) and CDC (30) guidelines, the most effective way to ensure optimal hand hygiene is hand rubbing with an alcohol-based preparation (ABP). According to the WHO guidelines (26), when an ABP is available, it must be preferably used for routine hand antisepsis (IB category recommendation). Hand rubbing with an ABP has the following immediate advantages:

- Removal of most germs (including viruses).
- The short time required (20 to 30 seconds).
- The availability of the product at the point of care.
- Good skin tolerance.
- The fact that no specific infrastructure is required (clean water supply, sink, soap, hand towel).

Pittet et al's review (31) describes how alcohol-based products removed more microorganisms than hand hygiene with soap and water, are more effective, and better tolerated.

The randomised clinical trial by Girou, E et al (32) concludes that during routine patient care, hand rubbing with an alcohol-based solution is significantly more effective to reduce hand contamination than hand washing with antiseptic soap.

The systematic review by Picheansathian, W.A (33) states that hand rubbing with alcohol-based solutions effectively removes microorganisms, takes less time, and irritates hands less frequently than hand washing with soap or other antiseptic agents and water.

#### Evidence quality: High

##### Recommendation:

**Strong** Hand hygiene by rubbing with an alcohol solution for 20-30 seconds is recommended as the preferred method. Hand rubbing with alcohol-based products should be maintained until the hands are completely dried. However, if the hands are visibly dirty with blood or other bodily fluids, hand hygiene with water and soap for 40-60 seconds is recommended, the time necessary for rinsing and later drying.

#### 4. Is hand hygiene necessary between each pair of blood cultures drawn from the same patient?

##### Evidence Summary:

If blood cultures are taken from different points in the patient for each pair, hand hygiene is performed before blood cultures are taken, which correspond to moment 2: before a clean/aseptic procedure and moment 3: after the risk of exposure to bodily fluids (26). This question is answered in question 1.

**Evidence quality:** Moderate**Recommendation:**

**Strong** Hand hygiene between each blood culture set is recommended. In these cases: Hand hygiene action: MOMENT 2, BEFORE A CLEAN/ASEPTIC PROCEDURE (taking blood cultures). Hand hygiene action, MOMENT 3, AFTER THE RISK OF EXPOSURE TO BODILY FLUIDS.

**4.1.2. Protection equipment****5. Should sterile gloves be used?****Evidence Summary:**

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Gloves are a protective barrier to prevent hand contamination when touching blood, bodily fluids, secretions, mucous membranes, and non-intact skin.

A random crossover trial by Kim et al (34) to establish whether routine sterile gloves decrease blood culture contamination concluded that routine use of sterile gloves can decrease blood culture contamination by approximately 50%. They compared contamination rates with routine use of sterile gloves (0.6%) with optional use of sterile gloves. They described that they were only used when palpating the puncture site after skin antisepsis (1.1%). They found that routine use of sterile gloves was associated with a lower probability of blood culture contamination (OR 0.57; CI 95% [0.37; 0.87];  $p = 0.009$ ), but the decrease was small and the contamination rate extremely low. This study used 10% povidone-iodine and cleaned bottle caps with 70% isopropyl alcohol. It is the first study to evaluate the impact of sterile gloves on blood culture contamination rates.

García, R et al (28), in their 2015 review, found that using a completely sterile procedure with a standardised kit that included sterile glove and a large aperture drapes to create a sterile field resulted in relative decreases by 43% and 64%.

Bowen et al (35), in their 2016 study, also found the fundamental aspects to take blood cultures, including routine use of sterile gloves when the puncture site is palpated again.

To conclude, there are several WHO guides (36), "Glove use information leaflet" (2006) on the use of gloves, which indicate the use of sterile gloves for vascular access and vascular procedures, the Emergency Nurses Association guide (37) (2012), the technical document for microbiological diagnosis of bacteraemia and fungemia: blood cultures and molecular methods of the Spanish Society of Infectious Diseases and Clinical Microbiology (SEIMC)(38) (2017), Guide-Manual: adequate use of sanitary gloves. Osakietsa (38) (2017) describes the use of sterile gloves when taking blood cultures.

**Evidence quality:** Moderate

**Recommendation:**

Strong      Using sterile gloves when taking blood cultures is recommended, as they can decrease blood culture contamination.

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**6. Is a surgical mask necessary to take blood cultures**

**Evidence Summary:**

The SEIMC 207(38) blood culture collection protocol on the use of a mask states that, in order to achieve the most sterile environment possible and prevent accidental blood culture contamination, "we believe that the use of a surgical mask to take blood cultures is not indicated, given that, even though a transmission of the clinician's microbiota at the blood culture bottle point of entry or into the patient's skin seems possible, this actually does not occur". This indication derives from review studies (39-41), but this can also be deduced from the assessment of clinical trials and follow-up study bibliography, which do not include use of masks in their specimen-taking protocols.

However, as a universal precautionary measure, the healthcare staff taking the blood culture should wear a surgical mask when they have a respiratory infection, not due to the risk of contaminating the blood culture, but due to the possibility of transferring the infection to the patient. If blood cultures are taken when inserting a new central catheter, the measures to be taken are those common to the recommendations for the insertion of a central

catheter (42), which does include a mask, due to the asepsis required for the placement of the catheter.

**Evidence quality:** Low

**Recommendation:**

Weak      Using a surgical mask when taking blood cultures on a routine basis is not recommended.

### 4.1.3. Skin antisepsis when taking blood cultures

Skin asepsis (42) before blood cultures are taken is intended to prevent blood culture contamination by the skin's saprophytic flora. This asepsis is achieved with skin antiseptics, such as iodinated compounds and chlorhexidine. In the case of blood cultures, chlorhexidine should be given priority.

With a good antiseptic technique, the percentage of contaminating blood cultures should not exceed 3%.

Microorganisms such as coagulase-negative *Staphylococcus*, *Corynebacterium* spp., *Propionibacterium* spp., *Bacillus* spp., *Clostridium perfringens*, *Streptococcus viridans* and others that are part of the usual normal skin flora are regarded as contaminants, provided that they grow in a single specimen of the blood cultures taken.

## 7. Which antiseptic is adequate for skin disinfection?

**Evidence Summary:**

Indications on the ideal antiseptic to take blood cultures have changed over time, on the basis of randomised trials and meta-analysis. They can be summed up in the following points:

Caldeira et al (44), in their meta-analysis based on 6 randomised trials, found that 2% Chlorhexidine in 70% Isopropanol is superior to povidone-iodine, although no differences were found between iodinated compounds and chlorhexidine if both products are dissolved in alcohol. Something similar is described in a later meta-analysis, which includes both



Caldeira's and other works (39,45). Along these lines, Denno et al (46), in a follow-up study, confirmed a reduction in blood culture contamination when replacing povidone-iodine by chlorhexidine-isopropanol.

Story-Roller et al(47), who conducted a randomised crossover study to evaluate the application of two alcohol solutions, an iodinated one and the other with 2% chlorhexidine, with 3,000 blood cultures in either group, found no significant differences in the blood culture contamination percentage (3.9% in both) or in the microorganisms isolated in either group. Something similar was found by Washer et al (48) in almost 13,000 blood cultures, although in this work another antiseptic, povidone-iodine, was included (which was not found to be different from the two alcohol solutions). However, povidone-iodine requires a two-minute wait after application, while alcohol solutions took half that time.

Liu et al (49) conducted a meta-analysis in which no differences were found between alcoholic chlorhexidine and povidone-iodine, although they did find differences between the latter and iodine alcohol, the latter being more effective. Nor did they find significant differences between different alcoholic chlorhexidines (2% and 0.5%), or between these and non-alcoholic chlorhexidine. But there is a high degree of heterogeneity in the studies, so confidence intervals are very large and it is hard to graduate effects from stronger to weaker.

In a (blind, randomised) follow-up efficacy clinical trial with a small N (little more than 1,000 blood cultures), Martínez et al (5) compared alcohol vs alcohol-chlorhexidine, in two 1-minute applications, the first one with alcohol only and the second also with alcohol or with alcohol-chlorhexidine. They found no significant differences between the two methodologies. The protocol is also hard to follow, and all that was ascertained is that, after one first asepsis with alcohol, whether the second one is with alcohol only or with alcohol-chlorhexidine has no impact.

To conclude, there are several Clinical Guidelines (CLSI, CDC, ENA, NHS, IDSA), which indicate that any alcohol solution, be it 70% isopropanol, an iodine tincture, or 2% chlorhexidine-70% isopropanol.

Furthermore, iodinated products can alter thyroid hormones in newborns, so they would not be advisable in these patients. Moreover, according to Lamy et al's review (51), any alcohol solution might be damaging, particularly for premature children (chemical burn). To avoid this, aqueous chlorhexidine solutions (e.g. 2-5%) could be applied, but they should be left to dry for 3-5 minutes.

The CDC has given an IA Category recommendation (the highest classification) for the use of a 2% chlorhexidine preparation as superior to iodine-povidone, but this recommendation does not include newborns (15).

It should be borne in mind that not only the antiseptic selected but also the form in which it is applied and the waiting time between its application and the phlebotomy have an impact on adequate antiseptics.

**Evidence quality:** High

**Recommendation:**

- |        |   |
|--------|---|
| Strong | 2% alcoholic chlorhexidine for skin antiseptics before puncture when taking blood cultures in patients older than 2 months is recommended. The solution should be rubbed on a 2-3 x 2-3 cm area, and left to act for at least 3-5 minutes so that it completely dries.  |
| √      | Using 2% aqueous chlorhexidine is recommended in children younger than 2 months, allowing the antiseptic to completely dry for at least 3-5 minutes. In children younger than 32 weeks or under 48 hours, 1% aqueous chlorhexidine could be used. Both solutions should be used with "mild or minimal rubbing". |

**8. Which is the best method to apply the skin disinfection antiseptic before taking blood cultures?**

**Evidence Summary:**

Apply several times through hand rubbing, in an adequate area for the procedure (e.g. 2-3 x 2-3 cm of skin), back and forward, as there is no scientific basis to apply it in concentric circles, from the centre to the periphery.

The FDA suggests applying the antiseptic in several 30-second swipes, back and forward, leaving adequate drying time (e.g. 30 seconds with 2% chlorhexidine - 70% isopropanol or iodinated alcohol). In a follow-up study Denno et al (46) used a dispenser with 2% chlorhexidine in 70% alcohol, and Bowen et al (35) also did, under a slogan that can be useful to us: *"take a minute to make a difference: 30 x 2"*.

Alcohol solutions are not easily contaminated by environmental microorganisms, so they need not come in monodose bottles, but it is preferable to use them as other problems are avoided, such as spillage near the patient and greater product-patient contact.

**Evidence quality:** Moderate**Recommendation:**

**Strong** The use of one-dose 2% alcoholic chlorhexidine dispensers is recommended, rubbing the indicated area for 30 seconds and allowing it to dry for at least 3-5 minutes.

**9. Can the puncture site be palpated with a sterile glove or disinfecting the finger before taking the blood culture?****Evidence Summary:**

Denno et al (46) propose in the section on methods in their follow-up study not to palpate the vein after antisepsis, except with sterile gloves, or else “disinfecting the gloved finger before re-palpation”. The former is correct, but the latter (after “or else...”) is not acceptable, as it can never be ensured that there are no creases in the glove, and microbes are not destroyed in the areas not reached by the antiseptic, so the microbial contamination of the glove until then remains.

In another review García et al (40) indicate excluding repalpation after skin antisepsis, and, if necessary, using a newly-donned sterile glove (CLSI, ENA and NHS guides).

Bowen et al (35) give this advice in their follow-up study, and give almost ideal blood culture contamination percentages (<0.5%).

In a 5-year monitoring study, Moeller et al (41) found a 70% reduction in contamination, and state that if the puncture area is accidentally palpated before the phlebotomy, skin should be disinfected again with an alcohol solution for 30 seconds.

**Evidence quality:** Moderate**Recommendation:**

**Strong** Palpating the puncture site for phlebotomy after antisepsis is not recommended. If necessary, a new sterile glove should be worn. In the event of accidental contact (with a gloveless hand or with a previously worn glove), disinfect the skin again with the same product used in the initial disinfection.

#### 4.1.4. Technique

##### 10. Can blood cultures be taken from the central venous lines which have been previously inserted in the patient?

###### Evidence Summary:

Even though taking blood cultures from punctures made, at that time, in two separate sites is ideal according to Norberg et al (52), due to patient comfort reasons, or in children, several authors, such as Denno et al (46), Snyder et al (53), and Lamy et al (51) recommend, so as not to open new lines, taking blood cultures from previously entered central lines/. However, this can duplicate the blood culture contamination percentage according to Garcia et al's review (40).

A meta-analysis by Falagas et al (54) shows that blood cultures taken from central lines have greater sensitivity and a negative predictive value, but they lose specificity and positive predictive value, increasing the number of false positives, thus resulting in an increase in antibiotic therapy, hospital stay, microbial resistance, etc.

Another prospective observational study by Levin et al (5) describes attempts to offset these drawbacks of peripheral venipuncture, indicating that a series of blood cultures can be taken from an intravascular catheter, and, if possible, through different lumen in the lines of that central catheter, but at least another series should be taken by phlebotomy, expressly performed for that take, in another point in the patient. Rodríguez et al also reach this conclusion in their meta-analysis (56) on cancer patients.

Moreover, the Great Ormond Street Hospital (an NHS Hospital for Children) (25) also stated that in children with suspected sepsis of the central venous catheter, the blood for the blood culture can be drawn from a puncture of the peripheral vein as well as from all the lumina in the intravascular lines to identify the colonisation of the line. If bacterial endocarditis is suspected, three blood cultures should be taken from different venipunctures to optimise the detection of bacteria that can be present in low amounts.

Moreover, according to the consensus of experts on children's sepsis from two scientific societies (SECIP-SEUP) (24), if a septic patient carries a central catheter, a specimen should always be taken from it, and the other by percutaneous puncture (57). This is also recommended in different Guides, such as CLSI, CDC, NSH, etc.

**Evidence quality:** High**Recommendation:**

**Strong** It is recommended to take blood cultures by means of phlebotomies carried out at that time in two separate anatomical sites, rather than from a central catheter. But a previously inserted central catheter can be used (and, should it be a multiple-line catheter, using some of the lines not used until then), provided that another series of blood cultures is also taken by means of a phlebotomy from a peripheral vein in another anatomical site in the patient.

**11. Can blood cultures be taken from the peripheral venous lines which have been previously inserted in the patient?****Evidence Summary:**

No works support this idea, except that carried out on adults by Smart et al 1993(58), which is far from the search period specified by the Authoring Group. It states that blood culture contamination results in those taken through a new phlebotomy and those taken through a newly channelled peripheral vein (e.g. when the patient is in A&E) are similar.

More recent works such as those by Norberg et al (52) do not even contemplate this possibility, and only consider using a central catheter (as seen in the previous point). Even though it can be accepted that, due to therapeutic requirements, the patient should have a peripheral catheter, that moment can be used to insert the peripheral catheter, take the blood cultures through it, and leave it placed in the patient for further use.

**Evidence quality:** Low**Recommendation:**

**Weak** Using previously inserted peripheral catheters to take blood cultures is not recommended, unless they are taken upon insertion.

## 12. When taking blood cultures from the central venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?

### Evidence Summary:

Placement of a previous venous line involves manipulation of the area, and this line can be easily colonised by bacteria, with higher risk of contamination the longer it is placed. For this reason, in general it is specifically recommended not to take blood cultures from a previous line. For example, Hernández-Bou et al (2016)(59), in their guide to take blood cultures in paediatric emergencies, specify that “the specimen should not be taken from a catheter already placed in the patient (except if infection associated with the catheter is suspected). This practice has proven to increase the blood culture contamination rate by 2 and 3 times, so the specimen should be taken by needle puncture, never with an angiocatheter.” In a 2017 paired cohort study of more than 500 adult patients in A&E, Self, WH et al (60) it was shown that blood cultures taken from a previously placed catheter had a 1.83 relative risk of contamination with respect to those obtained by direct venipuncture.

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In another specific study on 186 paired specimens in a paediatric population by Winokur, E et al (61) in 2014, the blood that is usually discarded (5 ml) when taking specimens for blood cultures from a central catheter was cultured, and it was found that the pathogenic microorganism isolated was the same in the first 5 ml (usually discarded) as in the next 5 ml. Along the same lines, Diwivedi, S et al (60) showed in 2009, by means of specimens from 653 patients in which the first 10 ml taken from a catheter and the next 10 ml were cultured, that there was no difference in the degree of blood culture contamination.

A systematic review conducted by García, RA et al (40) from January 1990 to March 2015 reports that discarding the initial portion of blood obtained through an intravascular catheter does not reduce contamination rates. This review falls outside the inclusion period for the study, but its contributions are included due to the significance of its data.

However, multiple guides continue to recommend discarding the initial 5-10 ml of blood when taking specimens through a catheter.

**Evidence quality:** Moderate

**Recommendation:**

**Strong** It is recommended not to discard the blood taken from the central venous catheter prior to inoculation into the blood culture bottle.

**13. When taking blood cultures from the peripheral venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?**

It was already discussed in point 11 that blood cultures should not be taken from previously placed peripheral lines, but that this could be done if they were inserted when the blood cultures are taken. In this situation, some authors indicate the possibility of discarding a volume of blood taken before inoculation into the blood culture bottles. The reason for this is that their contamination is due to the fact that 20% of contaminating microorganisms are found in the deeper skin layers, and sterility/asepsis is not possible.

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**Evidence Summary:**

The IDSA (Infectious Diseases Society of America) (62) clinical guide indicates that new products are available that make it possible to divert and discard the first millilitres of blood that have the higher likelihood of containing skin contaminants. A retrospective study by Stohl et al (42) at Hadassah-Hebrew University Medical Centre between January 2005 and June 2010 concludes that the diversion of initial volumes of donated blood products reduced contamination by 40 to 90%; discarding the initial blood volume in phlebotomy for blood cultures decreased blood culture contamination.

The ENA (Emergency Nurses Association) clinical guide for the prevention of blood culture contamination (37) recommends diverting the initial 1-2 ml of blood into a sterile container when taking blood culture specimens through peripheral venipuncture with a Level B- Moderate degree of evidence.

A cohort study conducted by Bell et al (63) from May 2016 to November 2016 using the ISDD (Initial Specimen Diversion Device) Steripath®, following ENA's recommendations on a series of 6293 specimens shows that the implementation of the Steripath® device resulted in a significant reduction in the contamination rate. ENA's current guidelines

recommend diverting the initial 1 to 2 ml of blood into a sterile container, as this has been proven to decrease blood culture contamination in patients, from 3.52% contamination following the standard method to 0.6% with the Steripath® device – a statistically significant decrease.

**Evidence quality:** Low

**Recommendation:**

Weak ✓ It is suggested not to discard the blood drawn from a recently inserted peripheral venous line. If specific devices are available, 1-2 ml blood are automatically discarded before inoculation into the blood culture bottles.

**14. If blood cultures and blood specimens for analysis are to be taken at the same time, what would the order be?**

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In recent years, there has been a significant increase in laboratory tests. Samples can be taken for various procedures, which gives rise to a discussion on the proper order to fill tubes for analysis or other procedures. In this case, we want to establish the proper order between inoculation into blood culture bottles and the rest of tubes.

**Evidence Summary:**

The systematic review conducted by García, RA et al(40) concludes that, in order to minimise contamination when drawing blood for multiple laboratory tests during a single collection procedure, blood should be first taken for culture, avoiding potential cross-contamination, in the understanding that tubes other than blood culture tubes are not sterile.

The bibliographic review carried out by Sesma, A. et al (64) establishes that blood cultures should always be taken first.



The Great Ormond Street (an NHS Hospital for Children) clinical guide (23) also prioritises the inoculation of blood into the blood culture bottles before introducing the blood in other bottles, as many of these bottles are not sterile and accidental contamination can occur.

**Evidence quality:** Low

**Recommendation:**

Weak      It is suggested, when drawing blood for different laboratory specimens, always to draw the blood culture specimen first.

### 15. Which anatomical site is most suitable?

On the basis of the evidence available, there are few studies on the most suitable venipuncture site for blood cultures. Some of the scientific evidence described below pertains to catheter venipuncture, but this is similar to blood culture collection.

**Evidence Summary:**

The IDSA(64) (Infectious Diseases Society of America) guide for the prevention of catheter-related infections establishes that the upper limbs should be used to insert the catheter in adults. Category II.

Along the same lines, the CDC(66) (Centers for Disease Control and Prevention) guide recommends, with Category II, using the upper limbs to insert a catheter in adults. In children, the upper and lower limbs, as well as the scalp (in newborns and small babies), can be used to insert the catheter.

In the clinical guidelines published by Hernández-Bou, S et al(59) on recommendations with indications and techniques on blood culture taking, processing, and interpretation in children, it is recommended to take the blood culture preferably from the antecubital region, and, if allowed by the patient's clinical situation, delaying taking it at the start of a spiking fever. The specimen should not be taken from a catheter already placed in the patient

(except in cases of suspected infection associated with the catheter). This practice has proven to increase contamination rates by 2 and 3 times.

Miller, JM et al (62) recommend, in the clinical guide published by IDSA, peripheral venipuncture as the preferred technique to take blood for culture on the basis of the data that show that the blood obtained this way has a lower probability of being contaminated than blood obtained from an intravascular catheter or another device.

In the cohort study conducted by Self, WH (60), it is suggested that the collection of blood culture specimens through a peripheral intravenous catheter increases the risk of contamination by comparison to specific venipuncture.

In the systematic review by Weinstein, MP(67) published to identify blood culture contamination problems, it is reported that several studies have documented greater contamination when blood cultures are obtained from a central access, as well as, if the blood is taken by venipuncture rather than an intravascular catheter. Indications for blood culture in ICUs are multiple, but peripheral venipuncture can be particularly difficult due to the presence of peripheral oedema, thrombophlebitis, multiple permanent catheters, wounds, and burns. Permanent arterial catheters can serve as a viable alternative source of blood in these cases, as the procedure is painless and provides a reliable volume of blood. The observational study conducted by Berger, I et al (67) in general and cardiac ICUs in a tertiary paediatric medical centre concludes that blood cultures taken with an arterial catheter are reliable to detect bloodstream infections in children. Gary, V Doern et al(68) recommend, in their UpToDate review, avoiding taking blood cultures through existing intravenous lines among the measures to reduce contamination. Taking blood for cultures through a permanent intravascular catheter should be avoided whenever possible. If blood cultures are taken from an intravenous catheter, a second set must come from a peripheral venipuncture site.

The clinical guide for the prevention of blood culture contamination published by ENA (69) Emergency Nurses Association recommends not to take blood cultures from a peripheral venipuncture site, not from an intravenous catheter. Level B: moderate. It is also recommended that blood cultures be taken from a recently inserted catheter (less than one hour) intravenously, adequately preparing the skin. Level B: moderate.

The AHRQ (Agency for Healthcare Research and Quality) guide for the interpretation of positive blood cultures indicates that blood cultures taken from permanent intravenous catheters or other access devices are contaminated more frequently than those obtained by peripheral venipuncture.

The guide published by E.J. Baron et al (69) recommends that blood be taken by percutaneous venipuncture. As this is not always possible, blood can be taken for culture

through vascular access devices, but should always be combined with another specimen taken through venipuncture.

The systematic review conducted by Snyder, SR et al (53), published in 2012, recommends venipuncture as the best practice to reduce blood culture contamination rates. This is also recommended in the systematic review conducted by García, RA et al (40), which indicates that the blood obtained when taking blood cultures should be drawn by means of a peripheral venipuncture unless otherwise necessary. If contamination connected to the central venous catheter is suspected, paired blood specimens should be taken from the catheter and a peripheral vein.

**Evidence quality:** Moderate

**Recommendation:**

**Strong** In adult patients, it is recommended to draw blood from an upper limb, from an antecubital vein through direct venipuncture. In children, it is recommended to use the upper limbs, preferably using the antecubital region, but, if this is not possible, the lower limbs can be used, or the scalp (in newborns and infants).

## 16. What is the recommended number of blood specimens?

**Evidence Summary:**

Miller, JM et al (62) recommend, in the clinical guide published by IDSA, taking at least 2 blood culture bottles.

The systematic review by Weinstein, MP(67) recommends taking two blood culture specimens as a standard practice to detect blood culture contamination problems.

Gary V Doern et al (70) specify in their UpToDate review that two blood culture specimens should be taken from two different sites by direct venipuncture.

Another UP TO DATE review conducted by Mermel, LA et al (71), supported by the Infectious Diseases Society of America, states that if a contamination of the central venous catheter is suspected, a specimen should be taken from the central line and another one from a peripheral line. (A-II). Paired blood specimens, taken from the catheter and a peripheral vein,

should be drawn before the start of the antimicrobial therapy, and the bottles should be adequately marked to reflect the site from which the specimens were taken (A-II). If a blood specimen cannot be taken from a peripheral vein, it is recommended to draw 2 blood specimens through different catheter lumina (B-III).

Towns, ML et al(72), in the clinical guide published, establish that four 10 ml bottles (two sets) of blood should be drawn to detect approximately 90-95% of bacteraemias, and six 10 ml bottles (three sets) should be taken to detect approximately 95-99% of bacteraemias. The systematic review conducted by Garcia, RA et al (40) recommends taking two series (sets) of blood cultures (where one set comprises an aerobic bottle and an anaerobic bottle).

#### Evidence quality: High

##### Recommendation:

Strong	It is recommended to take at least two blood culture sets, where each set comprises an aerobic blood culture bottle and an anaerobic blood culture bottle. In the case of children, it is recommended to take only one paediatric bottle (volume suited to weight and age).
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## 17. What volume should be drawn to inoculate in blood culture bottles?

#### Evidence Summary:

Various studies have proven that one of the factors that have the strongest impact on the sensitivity of the blood culture is the volume of blood drawn. Even though there is not enough evidence to establish the exact volume, certain minimal amounts specified in the SECIP-SEUP document (24) are reasonable: for lactating infants: 1-2 ml, for children: 4 ml, and for young adults and adults: 10 ml.

In the case of paediatric patients, the follow-up study by Thomas, G et al (45), describes that, in routine clinical practice in a tertiary children's hospital, more than half of the blood cultures contained a volume of blood that was inadequate for a negative result to reliably exclude bacteraemia, which has significant implications. A negative result was interpreted almost invariably without considering the volume of blood sent, and thus without a real appreciation of the sensitivity of the test or the negative predictive value in a specific patient.

In many cases in this study, the blood culture submitted not only was a test with diminished sensitivity, but was the equivalent of not having conducted a significant test, as the volume of blood provided was too small to have reasonable possibility of detecting bacteraemia. Specifically, out of 1358 blood cultures, 169 (12.4%) were submitted with <0.5 ml of blood, and this ratio increased to 40 (33%) out of 133 blood cultures for patients younger than 1 month. This meant that up to one third of blood cultures taken from newborns could be misleading. This study also established that an adequate blood culture volume was  $\geq 0.5$  ml for patients younger than 1 month,  $\geq 1.0$  ml for patients between 1 month and 36 months of age, and  $\geq 4.0$  ml for patients 36 months of age or older.

The clinical guide of Great Ormond Street Hospital (an NHS Hospital for Children) (25) states that one or two millilitres of blood are recommended for newborns (57).

The clinical guide published by Hernández-Bou, S et al (59) on recommendations with indications and techniques on blood culture taking, processing, and interpretation in children, supported by AEP (Spanish Paediatrics Association), reports that the positivity rate increased by 0.6-4.7% per extra millilitre of blood. A baseline study by Kellogg, JA et al (57) reaches the same conclusion, stating that the sensitivity of blood cultures taken from newborns increases if more blood is cultured.

Various studies (73,74) highlight that the optimal value of blood taken from lactating infants and children is smaller; however, the data available indicate that the performance of pathogens increases in direct proportion to the volume of blood cultured. The recommended value of blood to be drawn should be based on the patient's weight (see Table 5), and an aerobic bottle should be used, unless an anaerobic infection is suspected (75). Special blood culture bottles for use with children under 2 are commercially available. These are specifically designed to maintain the usual ratio of blood to be cultured (1: 5 to 1:10) with smaller blood volumes, and have been proven to improve microbial detection.

**Table 5 Recommended blood volumes for the culture. Kellogg et al (68)**

Patient weight (kg)	Blood vol (ml) used for:						Maximum total blood loss vol (%)
	Blood culture set 1			Blood culture set 2			
	Insulator	Aerobic bottle	Anaerobic bottle	Insulator	Aerobic bottle	Anaerobic bottle	
≤1	1.5		0.5				4
1.1-2	1.5		1.5	1.5			4.5
2.1-12.7	1.5		3.0	1.5			3
12.8-36.3	1.5	5.0	5.0	1.5	5.0	5.0	2.9
> 36.3	10	10	10	10	10	10	2.8

In the case of adults, according to authors Miller JM et al in their clinical guide published by IDSA(62), the volume of blood to be drawn is 20–30 ml of blood per blood culture set, that is 10-15 ml per bottle, in adults, the volume of blood in the case of paediatric patients depending on the child's weight.

The study by Stohl, S et al (42) concludes that the volume of blood is positively and consistently correlated to the performance of blood cultures for blood cultures and for children, and performance increases by approximately 3% per additional millilitre of blood.

Other studies specify higher volumes, such as that by Gary, V Doern et al (68), who, in their UpToDate review, recommend that the optimal volume for each blood culture in adults is 20 ml (10 ml for an aerobic bottle and 10 ml for an anaerobic bottle). The guide published by E.J. Baron et al (76) recommends that the volume of blood for blood culture in adults be 20-30 ml divided into 2 bottles, an anaerobic bottle and an aerobic bottle.

The clinical guide for the prevention of blood culture contamination published by ENA (69) (Emergency Nurses Association) reports that there is inadequate evidence to make a recommendation on the volume of the blood specimen and the prevention of blood culture contamination. The manufacturers' recommendations regarding the volume of the blood specimens per culture bottle should be followed. Level I / E.

In the study on an educational programme, Lin, H-H et al (77) indicate that drawing an adequate volume of blood is important to detect bloodstream infections, where the volume of blood drawn should range between 8 ml and 10 ml per bottle.

The study by Bouza, E et al(74) indicates that the higher the volume of blood cultured, the higher blood culture performance. The systematic review conducted by García RA et al reaches the same conclusion: that the number of pathogens found increases in direct proportion to the volume of blood cultured.

**Evidence quality: Moderate**

**Recommendation:**

**Strong** It is recommended to draw 10-15 ml of blood for each blood culture bottle in adult patients, always following the manufacturer's recommendations. In children it is recommended to draw 1-2 ml. However, volume should be adjusted to weight and age.

**18. What is the most suitable time to take blood cultures?**

**Evidence Summary:**

Miller, JM et al (62) establish, in the clinical guide published by IDSA, that a specimen should be taken before the administration of antibiotics. Once antibiotics have been administered, the microbiota changes and etiological agents are affected, which results in potentially misleading culture results.

Gary, V Doern et al(70) recommend in their UpToDate review the time before initiation of antimicrobial therapy as the optimal time to take blood cultures. They also indicate that the presence of fever when drawing blood is not sensitive or specific for the presence of bacteraemia.

The clinical guide by Mermel LA et al (71) indicates that blood culture specimens should be taken before the start of antibiotic therapy (IA).

The systematic review conducted by Coburn, B et al(78) concludes that blood cultures should not be requested for adults with an isolated fever or leucocytosis without considering the probability of the previous test. The systemic inflammatory response syndrome and Shapiro's decision rule may be useful to identify patients who do not require blood cultures. Shapiro's decision rule (79) to take blood cultures from patients is defined by "major criteria" defined as: temperature > 39.5 °C, permanent vascular catheter, or clinical suspicion of

endocarditis. The “minor criteria” were: temperature 38.3-39.4 ° C, age > 65 years, chills, vomiting, hypotension (systolic blood pressure < 90 mm Hg), neutrophil % > 80, white blood cell count > 18 k, bands > 5%, platelets < 150 k, and creatinine > 2.0. A blood culture is indicated by the rule if at least one major criteria or two minor criteria are met. Otherwise, the patients are classified as low risk and cultures can be omitted.

The systematic review conducted by García, RA et al(40) concludes that they should be taken in any patient with a fever ( $\geq 38$  ° C), hypothermia ( $\leq 35$  ° C), leucocytosis, absolute granulocytopenia, or a combination of these markers. The specific conditions in which blood cultures should be taken include sepsis, meningitis, suspected bacteraemia connected to the catheter, infectious endocarditis, arthritis, osteomyelitis, and fever of unknown origin.

The systematic review by Dellinger, RP et al(51) shows that blood cultures should be taken before antibiotic therapy (1C) .

#### Evidence quality: Moderate

88

#### Recommendation:

Strong	It is recommended to take blood cultures before the start of antibiotic therapy if sepsis and other infections of unknown origin are suspected.
Weak	It is suggested that the patient need not present with a spiking fever coinciding with the taking of the blood culture.

#### 19. Should 20 or 30 minutes elapse after taking the first specimen to take the next one?

#### Evidence Summary:

Miller, JM et al (62) establish, in the clinical guide published by IDSA, that the time between the collection of each blood culture should be determined by the seriousness of the patient’s condition. In emergencies, 2 or more blood culture groups can be obtained sequentially in a short period of time (minutes), after which empirical therapy can start. In less urgent situations, the collection of blood culture series can be spaced out for several hours or more.



Gary V Doern et al(70) recommend in their UpToDate that, in patients who are seriously ill or have a high probability of continued bacteraemia, it is acceptable to take blood cultures from two different sites within minutes.

#### Evidence quality: Low

##### Recommendation:

- |      |  |
|------|--|
| Weak | It is suggested that, if the patient is in a serious situation, blood cultures can be taken from two different sites within a very short time interval or even simultaneously. |
| Weak | It is suggested that, if allowed by the patient's clinical situation, the interval between blood cultures can range from minutes to hours.                                     |

#### 20. Should the puncture site change in each pair of blood specimens for blood cultures?

89

#### Evidence Summary:

An IJB summary indicates that "the literature suggests that one method to reduce the risk of contamination is taking the specimen at two points." And "there is consensus in the literature in avoiding taking culture specimens in venous or arterial lines, due to the possibility of bacterial growth around the catheter": "Up to 6% of the blood specimens are contaminated when taken from peripheral venous systems, by comparison to 3% of specimens taken by venipuncture". A paediatric study (52) found lower rates of false positives in patients of whom specimens were taken in different points than those of catheter insertion. A&E nurses drew the specimens for this study; 2,108 blood cultures taken from recently inserted catheters were compared to 2,000 blood cultures taken, at a second stage, from different points. The rate of false positive (contaminated) blood cultures decreased significantly (from 9.1% to 2.8%  $p < 0.01$ ) in the second group.

Evidence quality: Low

**Recommendation:**

Weak      It is suggested to draw the blood for each pair of blood cultures from different anatomical sites.

**21. Should blood cultures be taken before or after administering antipyretic drugs and antibiotics?**

**Evidence Summary:**

No studies, protocols, or Clinical Practice Guides (CPGs) have been found that recommend taking the blood specimens before or after antipyretic drugs. 3 CPG, 1 UpdoDate Evidence Summary (ES) (68), 1 expert document, and 1 Clinical Guide (CG), which, despite making no recommendations, coincide in stating that the blood culture specimen should be taken before the administration of antibiotics and preferably during pyrexia periods.

One of the CPGs on care of women with bacterial sepsis after pregnancy (80) recommends taking the blood culture specimens before the administration of antibiotics states however that treatment with antibiotics should start without waiting for the microbiology results.

Likewise, another CPG with microbiology rules (3) on blood cultures indicates that the specimens should be taken as soon as possible, after the appearance of the clinical symptoms, and before the antimicrobial therapy whenever possible. Even though blood specimens can be taken at any time, blood should be drawn as soon as possible, optimally after spiking fever, except in endocarditis, where time is less important. The third CPG for the collection of microbiology and virology specimens (25) with respect to the blood culture specimens also states that they should preferably be taken during fever episodes, which is when bacteria may be present.

In general, regarding the collection of microbiological specimens, it is recommended that they be taken before any treatment, such as antibiotics or antipyretic drugs. However, treatment should not be delayed in serious sepsis.

A bedside information form should be filled in, as it helps to interpret the results and reduces the risk of errors. One of the data to be provided is whether the patient is taking antimicrobial drugs.

The UpToDate ES (68) on blood cultures for the detection of bacteraemia also recommends taking blood cultures before the start of antibiotic therapy, but provides no indications as to antipyretic drugs.

Finally, the Spanish Society of Infectious Diseases and Clinical Microbiology (43) indicates, regarding the collection of blood cultures, that some studies suggest that the optimal time to take blood cultures is exactly before the start of the chills. Because this is impossible to predict with accuracy, it is recommended that the blood for the culture be drawn as soon as possible after the start of the fever and the chills, or whenever a serious infection is suspected. However, when the blood specimen is taken is irrelevant if bacteraemia is continued as in endocarditis or other intravascular infections and in the first weeks of typhoid fever or brucellosis. This is not the case with intermittent bacteraemia, which appears in various infections, and in transient bacteraemia, generally self-limited and benign, which usually occurs after manipulation in non-sterile mucous surfaces (dental or urological procedures, endoscopies), in infected tissues (abscesses, boils, cellulitis), and in the surgery of contaminated areas. In both cases, which constitute most of bacteraemias, the blood specimen should be taken as near as possible to the spiking fever.

Moreover, if the patient is receiving antibiotic treatment, this information should be added in the referral note, which helps to assess the bacteraemia in the laboratory.

Moreover, the document on expert consensus on sepsis in paediatrics from two scientific societies (SECIP-SEUP) (24) states that if a dose of antibiotic has been administered, it is advisable to take a blood culture immediately before the following dose.

This consensus document (24) highlights that in recent years molecular techniques have been developed, such as PCR, which can contribute to earlier microbiological diagnosis and to greater sensitivity in the detection of the germ 126-133. Its usefulness may be superior to that of blood cultures in specimens taken after the start of the antibiotic treatment.

**Evidence quality: Low****Recommendation:**

Weak	It is suggested to take the blood cultures before the start of antibiotic therapy. In children, it is suggested that, if an antibiotic dose has been administered, it is advisable to take a blood culture immediately before the next dose.
√	There are no clear recommendations regarding the time to take the blood culture with respect to the administration of antipyretic drugs.

**22. Is the introduction of air in the bottle for anaerobic germ cultures indicated?****Evidence Summary:**

92

No rigorous studies have been found in the search period that evaluate the result of the manoeuvre of introducing air in the culture from a blood specimen.

After reviewing protocols for action when taking blood culture specimens (70), the only indication is to avoid introducing air when the specimen is taken to detect anaerobic germs, as it decreases its growth.

**Evidence quality: Low****Recommendation:**

Weak	Avoiding introducing air when taking the specimen to detect anaerobic germs is suggested.
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**23 Should the needle used to draw blood for blood cultures be replaced by a new one for inoculation into the bottle so as to decrease contamination levels?**

4 Evidence Summaries (ESs) have been found, as well as 1 narrative review, which includes 2 Systematic Reviews with meta-analysis and one Randomised Clinical Trial (RCT).

An UpToDate review (70) of the procedures to prevent contamination states that “until definitive studies become available, in our view the risk of changing needles after venipuncture is usually not comparable to the benefit achieved. Moreover, there are more significant ways to decrease blood culture bottle contamination, such as the use of disinfectant on the skin, avoiding taking blood cultures through the existing intravenous lines, and remembering to disinfect the blood culture bottle membrane”.

In general they conclude that the practice of changing the needle between venipuncture and injection into the blood culture bottle slightly decreases contamination rates, although this practice is not recommended as it increases the risk of needle stick injury, so it is recommended to puncture the vein by means of vacuum blood drawing systems. The UpToDate review (68) on blood cultures for the detection of bacteraemia recommends, regarding the technique to take the specimens, that the blood be directly drawn into the culture bottles during the venipuncture procedure, rather than into tubes for later transfer, in the laboratory, into the culture bottles. However, it does not mention whether the needle should be replaced or not before inoculation into the culture bottle.

It is also emphasised that a correct technique should be used to draw the specimen, as it is crucial in order to avoid contamination of the blood cultures by the normal skin flora before it is taken.

**Evidence quality: Moderate**

**Recommendation:**

**Strong** It is recommended not to change the needle between venipuncture and inoculation into the blood culture bottle, as the risk of injury through needle puncture increases, even though contamination rates slightly decrease. It is recommended to puncture the vein by means of vacuum blood drawing systems.

**24. Should the rubber cap of the bottle be disinfected with antiseptics?****Evidence Summary:**

If a vacuum blood drawing system is not available, the clinical guide of the NHS Great Ormond Street Hospital (25) specifies, for the collection of blood cultures, using both blood culture bottles (aerobic and anaerobic), removing the plastic cap and rubbing the cap with a 2% chlorhexidine / 70% alcohol wipe for 15 seconds, allowing it to dry before inoculating the blood.

A blood culture quality evaluation study, conducted to study factors that have an impact on blood culture contamination, was published in 1998 (81). This is an extensive prospective study in which 640 institutions took part, including an assessment of almost 500,000 blood cultures. The variables significantly associated with a lower contamination rate were: "phlebotomy effort ( $p=0.039$ ); skin disinfection ( $p=0.036$ )".

An UpToDate review (68) of the procedures to prevent contamination states that "until definitive studies become available, in our view the risk of changing needles after venipuncture is usually not comparable to the benefit achieved. Moreover, there are more significant techniques to decrease blood culture bottle contamination, such as the use of the right aseptic preparation on the skin, avoiding taking blood cultures through the existing intravenous lines, and remembering to disinfect the blood culture bottle membrane."

**Evidence quality: Low****Recommendation:**

Weak	It is suggested to use both blood culture bottles (aerobic and anaerobic), removing the plastic cap and disinfecting the cap with a 2% alcoholic chlorhexidine wipe for 15 seconds, allowing it to dry before the blood is inoculated.
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## 25. Should the blood culture bottles be shaken after the blood specimen has been inoculated?

### Evidence Summary:

The theoretical basis for shaking blood cultures after inoculating the specimen is its better distribution in the culture medium to optimise the growth of the bacteria potentially present.

No recent studies have been found, but there are previous studies that can be regarded as methodologically adequate to draw conclusions.

There are baseline paired prospective studies, such as that by Arpi et al (61), in which, after analysing 7,033 specimens in paired bottles (with and without shaking after inoculation and pre-incubation), no differences were found in the total result of cultured bacteria. However, in the shaken bottles, the result was obtained significantly faster for some common bacteria (between 0.5 and 1 day before) than in non-shaken bottles.

Regarding the detection of microbacteria (*Mycobacterium avium* complex), another paired prospective study of 265 cultured specimens in BACTECT by Jackson et al(61), also confirmed faster growth in shaken bottles, concluding that shaking after inoculation can promote bacterial growth and thus shorten detection times.

Several current guides from scientific societies (SEMI, SEIMC) and hospitals (Andalusian Government, Alberta Health Services, etc.) recommend gentle shaking or gentle mixing through reversal of the bottles after inoculation in their protocols for the collection of blood cultures.

### Evidence quality: High

#### Recommendation:

Strong      Gentle shaking or mixing by upturning the bottles after inoculation is recommended.

26. Using a vacuum system, which blood culture bottle (aerobic/anaerobic) should be filled first?

27. Using a needle syringe system, which blood culture bottle (aerobic/anaerobic) should be filled first?

### Evidence Summary:

In the case of a vacuum system:

The clinical guide of Great Ormond Street Hospital (an NHS Hospital for Children) (25) states that, whenever available, a closed system to inoculate blood culture bottles should be used.

In the case of adapted flanges and butterfly systems (which contain air inside, and where blood is transferred into the first vial connected to the blood drawing system), it should be inoculated into the aerobic bottle first, avoiding air intake, followed by the second, anaerobic bottle, reversing them several times to mix the blood and the culture medium.

If a vacuum blood drawing kit is used, the blood should be inoculated into the aerobic bottle first to avoid transferring air from the device into the anaerobic bottle (82).

In the case of a syringe and needle system:

The Great Ormond Street guide (25) specifies that, when inoculating blood into the blood culture bottles, it should be inoculated into the anaerobic culture bottle first and then into the aerobic culture bottle, so that the oxygen trapped in the syringe is not transferred into the anaerobic bottle. It recommends ensuring that, when using both bottles, the blood is inoculated into the anaerobic bottle first.

If a needle and syringe are used, the blood should be inoculated into the anaerobic bottle first, to prevent air intake (82).

The retrospective cohort study by Garey, KW et al (83) describes that, if the amount of blood drawn is lower than the recommended volume, then approximately 10 ml (in adult patients) should be inoculated into the aerobic bottle first, as most cases of bacteraemia are caused by aerobic bacteria. Moreover, pathogenic yeasts and strict aerobes (e.g. *Pseudomonas*) are detected almost exclusively in aerobic bottles. Any remaining blood should be inoculated into the anaerobic bottle.

**Evidence quality:** Low



**Recommendation:**

- Weak It is suggested that, if a vacuum blood drawing kit is used, blood should be first inoculated into the aerobic bottle, to prevent the transfer of air from the device into the anaerobic bottle. If a needle and syringe are used, the blood should be inoculated into the anaerobic bottle first, to prevent air intake.
- Weak If the amount of blood drawn is lower than the recommended level, the blood should be inoculated into the aerobic bottle first.

**28. Could covering the puncture site with a gauze while removing the needle used to draw the specimen for blood cultures increase the risk of contamination?****Evidence Summary:**

The protocol for the collection of blood cultures in paediatric emergencies by Hernández-Bou, S et al (59) recommends occluding the puncture site after removing the needle, without making contact with it.

The SEIMC guide (38) specifically mentions that no cotton or other non-sterile material should be placed on the needle when removing it from the vein.

**Evidence quality: Low****Recommendation:**

- Weak It is suggested not to place cotton or other non-sterile material on the needle when removing it from the vein.

**29. Can the first blood cultures be taken while channelling a peripheral line?**

Given that the collection of blood cultures should follow a strict protocol, ensuring adequate disinfection of the venipuncture site, and avoiding unnecessary manipulation, the question

arises of whether placing a new peripheral line and later taking the blood cultures could pose an increased risk of contamination.

#### Evidence Summary:

The clinical guide of Great Ormond Street Hospital (an NHS Hospital for Children) (25) describes that blood specimens taken for culture from a peripheral cannula should only be taken from recently inserted peripheral cannulae, if there is no alternative to obtain a blood specimen for culture through a separate venipuncture. Strict asepsis should be maintained. The specimen should be clearly labelled, indicating that the blood specimen was taken from a peripheral cannula, as the risk of contamination is high.

Isaacman, DJ et al(84) conducted a prospective study on 99 patients who required the collection of blood cultures, taking one specimen from a recently placed catheter and another one from another site through direct venipuncture. No significant differences in contamination were found. They insisted, however, on the adequate blood drawing technique and a strict skin disinfection protocol.

#### Evidence quality: Low

##### Recommendation:

Weak	It is suggested that blood specimens for culture drawn from a peripheral cannula should only be taken from recently inserted peripheral catheters, if there is no alternative to draw a blood specimen for culture through a separate venipuncture.
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## 4.2. Specimen transportation and storage

**30. How should recently collected blood cultures be stored before sending them to the laboratory?**

#### Evidence Summary:

The review by García et al (40) indicates that the literature identified various complex problems connected to blood culture practices, including the impact of false positive results, the definition of laboratory contamination, the effect on information of bloodstream infection associated with the central catheter, indications for the collection

of blood cultures, drawing blood from venipuncture sites versus intravascular catheters, antiseptic selection, use of connectors with no needles, inoculation into blood culture bottles, programme management optimisation in A&E departments, and education in and implementation of combined practice initiatives. It concludes by stating that hospitals should optimise best practices in the collection and handling of blood culture specimens, a factor that is often overlooked but is essential to provide optimal care to patients in all environments and populations and reducing the financial burden. Even though there are universal concepts in blood culture practices, some problems require more research to establish the benefits.

The Protocol for the collection of blood cultures at Valme Hospital of the Andalusian Government (85) establishes that duly identified bottles should be immediately transported to the laboratory. They should only be kept at room temperature for short periods of time so as not to affect the later detection of microorganisms.

If they cannot be immediately sent to the lab they should be kept at “room temperature”. The maximum time they can remain at room temperature before entering the system has not been precisely specified, but should never exceed 18 hours. Blood cultures should never be refrigerated.

The consensus document from the Spanish Society for Infection Diseases and Clinical Microbiology by Sánchez-Romero, M et al (86) states that the interpretation and accuracy of microbiological results still depend, to a large extent, on the quality of the specimens and their processing in the microbiology laboratory. The type of specimen, the right time to take the specimen, the procedure to take the specimen, storage and transport are critical factors in the diagnosis process.

**Evidence quality:** Low

**Recommendation:**

**Weak** It is suggested that blood culture specimens should only be kept at room temperature for short periods of time. If they cannot be immediately sent to the laboratory, they should be kept at “room temperature”. The maximum time they can remain at room temperature before entering the system has not been precisely specified, although it is recommended that it be less than 2 hours and not exceed 18 hours.

### 31. What is the best way to store blood cultures in the laboratory?

#### Evidence Summary:

The protocol for the collection of blood cultures at Valme Hospital (85) states that, in cases in which the introduction of a blood culture in an automatic system is delayed by more than 18 h, particularly if it has been incubated at 35-37 ° C, a blind subculture should be performed to avoid a potential false negative result. This is due to the fact that microorganisms may have grown to reach the plateau stage and not be detected by the system.

The review by García et al (40) specifies that the microbiology laboratory should establish, after the specimen is received in the laboratory, whether it meets the requirements to be processed. These requirements include, among others, proper identification, adequate type of specimen for the request, and adequate transport and conservation conditions. It is necessary for each laboratory to establish and make known to the requesting services its own requirements to accept a specimen for a microbiological study. The microbiology laboratory should also have a system to register these incidents, which specifies that specimen in question, the individual who received it, the type of incident, the contact at the requesting service, and the resolution of the incident (the specimen is not processed, it is decided to process it, in what conditions, etc.)

The most frequent incidents upon the arrival of a specimen at the microbiology laboratory and the actions to be performed (decision-making) in each case are the following:

- Deficiently identified specimen: no specimen that is unidentified, improperly identified, or in which the identification in the request form and on the specimen are not the same. In any case, the requesting service should be contacted to notify it of the need for proper identification of the specimen. If another specimen can be taken, it will be requested again.
- Depending on the importance of the specimen, it may be processed before proper identification to prevent its deterioration.
- Spilled specimens: no specimens that have been clearly spilled will be accepted. As in the previous case, a new specimen should be requested. If taking a new specimen is not possible, the bottle should be externally disinfected or the specimen should be transferred into a sterile container. In this case, it should be stated in the report that the specimen was spilled, and the results should be interpreted with due caution.

In a randomised controlled clinical trial, Kerreman, J.J. et al(87) assessed the impact of immediate incubation of blood cultures delivered to the laboratory outside operating times

on response times, antibiotic prescription practices, and patient outcomes. The existence of satellite blood cultures reading systems that can be installed in high-volume units, such as critical care and A&E departments, minimises the time blood cultures are stored before incubation. Growth detection was decreased by 10.1 h in Bactec-ON. Immediate incubation of blood cultures that arrive after the medical microbiology laboratory has closed significantly shortens response times. This reduction results, in turn, in a significantly earlier change in the antibiotic regime. However, this earlier change in the antibiotic regime did not result in a reduction of mortality rates or of the hospital stay in the study patients.

**Evidence quality:** Low

**Recommendation:**

Weak      It is suggested that the best method would be the automated equipment for satellite blood cultures.

**32. Would leaving them in an incubator connected to the laboratory in those services in which delivery of blood cultures is delayed lower the contamination rate?**

**Evidence Summary:**

According to the study by García Cañete, P(88), published by professionals at the General Bacteriology Department of Pontificia Universidad Católica de Chile, once the specimen has been taken, it should be kept at room temperature and quickly sent to the laboratory, never refrigerated. Samples are transported at room temperature. Incubation at 35 °C should be implemented as soon as possible, at the latest 2 hours after the specimen was taken.

According to the Recommendations of the Spanish Society of Infectious Diseases and Clinical Microbiology, by Cercenado E. y Cantón R et al (38), duly identified bottles should be immediately transported to the laboratory. They should only be kept at room temperature for short periods of time so as not to affect the later detection of the microorganisms. If they cannot be immediately sent to the laboratory, they should be incubated in a stove at 35-37 °C until then.

The maximum time they can remain at room temperature before entering the system has not been precisely specified, but should never exceed 18 h. If they have been incubated at

35-37 °C, they should be introduced in the automatic devices before 12 h elapse. In cases in which the introduction of a blood culture in an automatic system is delayed by more than 18 h, particularly if it has been incubated at 35-37 °C, a blind subculture should be performed to avoid a potential false negative result. This is due to the fact that microorganisms may be grown to reach the plateau stage and not be detected by the system. Blood cultures should never be refrigerated.

**Evidence quality:** Low

**Recommendation:**

**Weak** It is suggested that they be immediately transported to the laboratory. If they cannot be immediately sent to the laboratory, they should be incubated in automated equipment for satellite blood cultures.

### 4.3. Nursing registration when taking blood cultures

#### 33. What information is crucial to make a good nursing record when taking blood cultures?

**Evidence Summary:**

The review conducted for the descriptive cross-sectional study by Sánchez Bermejo, R (89) (2012) indicates that the bottles should be identified taking care not to mark or place the patient's identification label over the barcode or covering the bottom of the bottles. The identification data area: the patient's full name, date, medical history number, time when the blood culture was taken, and sequence number. The bottles should be marked in the patient's room/box.

Rodríguez Díaz, JC et al(38), in the recommendations given in the document "Microbiological diagnosis of bacteraemia and fungemia: blood cultures and molecular methods", recommends that, upon arrival at the laboratory, it should be checked whether the bottles are properly identified as regards the patient and the blood collection from which they come. Once intake has been registered, it is recommended that they be immediately placed

in specific incubators. The devices have computer programs that register the intake of the bottle, the growth curve, the positivity time, the time of unloading, and even the amount of blood they contain, among other parameters.

**Evidence quality:** Low

**Recommendation:**

**Weak** It is suggested to record identification data such as the patient's full name, date, medical history number, time when the blood culture was taken, and sequence number. Upon arrival at the laboratory, check that the bottles are correctly identified regarding the patient and blood-taking they come from.

**34. What benefits does explaining the technique and purpose of the test to the patient provide?**

**Evidence Summary:**

Marmesat Alcántara, E. et al (90) in their communication, establish that, before the blood culture is taken, the professional should actively identify the patient, including their name and surname. The technique to be performed, what it is and its purpose should be explained to the patient, in terms that they can understand. The way in which they should cooperate and the importance of this cooperation should also be explained to the patient. They should be given the necessary information on the tests to be conducted. Finally, and no less important, they should be given maximum privacy when implementing the technique, and should be helped to take the best position to do so, thus increasing their trust. Manuel Gómez, J. et al(91), in their guide for the collection of blood cultures, also encourage clearly explaining the purpose of the test and the procedure to be followed to the patient before the procedure is performed.

**Evidence quality:** Low

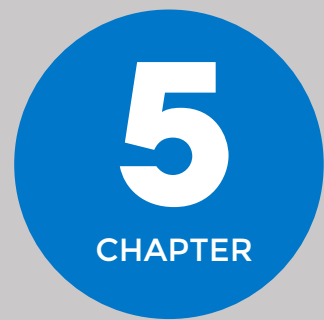
**Recommendation:**

**Weak** It is suggested that the purpose of the test and the procedure to be followed be explained to the patient, as well as how they should cooperate and the importance of this.





EVIDENCE LEVELS  
AND DEGREES





## 5. EVIDENCE LEVELS AND RECOMMENDATION DEGREES

### 5.1 Classification of evidence quality in the GRADE system

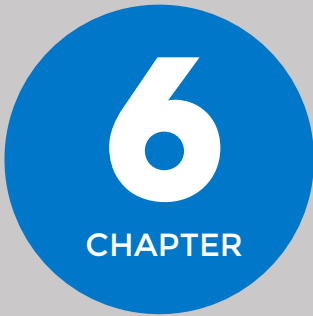
Table 1 Classification of evidence quality in the GRADE system (2)

Classification of evidence quality in the GRADE system			
Evidence quality	Study design	Decrease quality if:	Increase quality if:
High	RCT	Significant design limitation (-1)	<b>Association</b> • Scientific evidence of strong association (RR>2 or <0.5 based on observational studies with no confounding factors (+1)) • Scientific evidence of a very strong association (RR>5 or <0.2 based on studies with no possible biases (+) Dose-response gradient (+1) All potential confounding factors could have reduced the effect observed (+1)
Moderate		Very significant (-2) Inconsistency (-1) Direct evidence	
Low	Observational studies	Some uncertainty (-1) High uncertainty (-2) Imprecise data (-1)	
Very Low	Other types of design	Publication bias High likelihood (-1)	

**Table 2 Implications of the strength of recommendation in the GRADE system (2)**

<b>Implications of the recommendation in the GRADE system.</b>		
<b>Implications of a strong recommendation</b>		
<b>Patients</b>	<b>Clinicians</b>	<b>Managers/Planners</b>
The vast majority of people would agree with the the recommended action and only a small number would not.	Most patients should receive recommended intervention. in most situations.	The recommendation can be implemented as healthcare policy in most situations.
<b>Implications of a weak recommendation</b>		
<b>Patients</b>	<b>Clinicians</b>	<b>Managers/Planners</b>
Most people would agree with the recommended action but a significant number of them would not.	Recognises that different options will be suitable for different And the doctor should help each patient to make the decision that is most consistent with their values and preferences	There is a need for significant debate and stakeholder patients in most situations.

RECOMMENDATIONS  
CPG





## 6. CPG RECOMMENDATIONS

### 6.1. Blood collection procedure

Blood should always be drawn with proper hand hygiene and use of gloves. The procedure is as follows:

#### 1. Information for the patient

##### Evidence Summary:

- Informing the patient on the procedure to be performed and the reasons to draw blood.
- Encouraging the patient to notify the healthcare staff of any change they notice in the area where the catheter has been inserted or the venipuncture site or any other discomfort.

#### 2. Hand hygiene before the procedure.

##### Evidence Summary:

1st Perform hand hygiene before contact with the patient (moment 1) with a hydroalcoholic solution, before disinfecting the lids of the blood culture bottles, applying the tourniquet, and performing asepsis in the venipuncture area.

2nd hand hygiene action: (moment 2) before a clean/aseptic procedure. Don the gloves before exposure to fluids.

3rd Hand hygiene action, bringing two indications together: moment 3, after risk of exposure to bodily fluids and moment 4, after contact with the patient, once the procedure has been completed.

- Performing proper hand hygiene, using hydroalcoholic solutions. Guaranteeing hand hygiene before and after palpating the insertion areas. The insertion site should not be palpated after applying the antiseptic, unless the aseptic technique is maintained.
- Use of gloves does not exclude [hand hygiene](#).

#### 3. Preparing the puncture area, if blood is drawn through endovenous puncture.

**Evidence Summary:**

- If the insertion area is very hairy, the body hair should be shaved with scissors or an electric razor.
- Skin cuts and abrasion should be avoided, as they increase the risk of infection.

4. Disinfect the lids of blood culture bottles with an antiseptic solution.

5. A tourniquet should be applied and the vein should be palpated before venipuncture site antiseptics. If further palpation of the vein is required after the skin has been prepared, a sterile glove should be used.

**6. Antisepsis of the venipuncture area should be performed with 2% alcoholic chlorhexidine (at least within a 5-cm diameter).**

**Evidence Summary:**

- Apply an adequate antiseptic on the clean skin before puncture. A 2% chlorhexidine preparation, preferably with alcohol, is preferable.
- Leave the antiseptic on the insertion area and respect the relevant drying time. In the case of 2% alcoholic chlorhexidine, leave it on the skin for at least 1 minute, until its action time has ended.
- Do not palpate the insertion point after skin has been disinfected with an antiseptic.

7. Draw a minimum of 10-15 ml of blood in adults (5 ml per bottle; the ideal amount is 8 to 10 ml per bottle) and the highest amount possible in children, if possible a minimum of 1-2 ml per bottle. There are specific paediatric bottles.

8. Blood should be introduced into each of the two bottles for this collection, using a vacuum system.

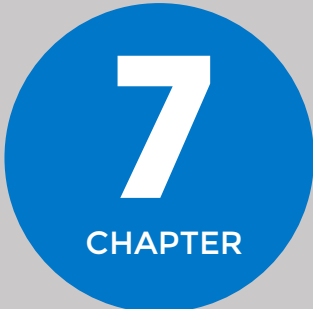
9. The sealed rubber lid should never be taken off.

10. Care should be taken to hold the plunger so that the vacuum pressure in the bottle does not aspirate quickly, or more than the adequate amount of blood, or any air that might remain at the bottom of the syringe.

11. The vacuum system can be used to take blood cultures, taking care to draw blood for the blood cultures first, before any other tube for other purposes, as the system needle and thus the blood cultures taken later can become contaminated.



DISSEMINATION  
AND IMPLEMENTATION





## 7. DISSEMINATION AND IMPLEMENTATION

### 7.1. Dissemination and implementation strategy

CPGs are useful to improve the quality of care and patient outcomes. Designing a plan for dissemination and implementation in healthcare services, integrated with hospital quality and safety programmes, is recommended. The ultimate goal is to achieve professionals' adherence to the recommendations in this guide. To facilitate its use, professionals must have easy access to the quick guidelines and to the algorithms that illustrate the practical aspects.

The implementation strategy to overcome barriers in the environment where they are to be implemented are given below. The plan to implement the CPG on blood cultures includes the following interventions:

1. Presentation of the guide by the Spanish General Council of Nursing to the media available.
2. Presentation of the guide to the Professional Associations in each Region.
3. Presentation of the guide to the directorates and subdirectorates for Primary Care and Specialist Care of the various Health Services in Spain.
4. Institutional presentation of the guide to the various scientific and professional societies involved.
5. In all presentations, the educational materials designed for patients will be highlighted, in order to encourage distribution among all healthcare professionals as well as among patients with this health problem.
6. Targeted effective distribution to other professional groups involved (physicians, auxiliary nursing care technicians) to facilitate dissemination.
7. Publication of the guide in electronic format on the Spanish General Council of Nursing website, the BD website, and the websites of the societies involved in the project.
8. Publication of the guide in scientific journals.
9. Establishment of criteria for good care in programme contracts and clinical management contracts, in accordance with the guide.
10. Evaluation of the effectiveness of implementation, establishing support systems for clinical decision-making, integrating the guide and the selected indicators in the computer program used in Specialist Care.

Strategies and tools to facilitate the use of the guide, which should include an analysis of the resources required for compliance, are given below. The dissemination plan should consider those factors that might facilitate implementation, such as:

Presentation of the guide in scientific activities (conferences, congresses, meetings).

Design of graphic documents with the main information, including algorithms for action and the distribution of training materials that can be handed out in the workplace. Implementation will be more successful if the main recommendations on technical aspects are given in a pocket-size form for inclusion in computer programs, distributed to nursing staff, and available in the workplace. The basis for this synopsis is the quick guide reference tool. The APPENDICES that supplement the information in the Guide with technical aspects should be widely available. Protocols for action to face potential complications can be easily established on the basis of the guide recommendations. These should be available in the care units for reference if needed. Professionals who are interested in implementing a CPG should apply their own judgement to decide which strategy will work better, considering context factors, barriers to adequate clinical practice and feasibility, costs, and the potential benefits of the strategy.

There are different ways of approaching the implementation of the CPG, considering various factors, such as the type of change to be achieved, the place where it is to be implemented, and the barriers and facilitating factors identified. In this respect, a number of interventions aimed at healthcare professionals can serve to mitigate potential barriers: appointment of a professional to lead the implementation of the guide, who will be in charge of conducting it together with middle and senior management. Accredited training activities and informative activities in healthcare centres: clinical sessions, workshops, presentations in conferences and congresses, etc.

**Local consensus process:** involving the clinical and healthcare professionals directly connected to the guide in order to ensure that “local implementation” has the widest support, bringing usual practice closer to that defined by the guide. Requesting cooperation from professionals with specific training in the subject to provide advice to those units that will implement the guide. Involving “informal and opinion leaders” in units and services, due to their influence on the other professionals, thus facilitating implementation. Nursing managers can establish the measures to implement the recommendations regarding the evaluation of outcomes and nurse training and accreditation. The Guide also provides useful materials for pregraduate nursing training. Any publication on “good practice standards” will fail to complete its usefulness cycle if it is not integrated in quality systems. These require that recommendations which have a high impact on health, are relevant for the organisation, and are based on high-quality evidence be selected as quality indicators. In this regard, we propose a set of 4 audit indicators with their respective recommendations, which are given in Appendix 6, which can make it possible to monitor the implementation of the guide recommendations in healthcare units.

## 7.2. Implications for clinical practice

### Hand hygiene

Performing hand hygiene at the right time before contact with the patient, before the aseptic technique is performed (collection of blood cultures), and after contact with bodily fluids is a goal.

### Protection equipment

Use all the applicable measures, such as sterile gloves when taking blood cultures and a mask when required as a standard precaution.

### Antisepsis when taking blood cultures

The standard antiseptic is 2% alcoholic chlorhexidine. The antiseptic should be applied in circular movements, respecting the time for each antiseptic. Alcohol solutions are contraindicated in children younger than 2 months. In these cases, it is recommended to use 2% aqueous chlorhexidine.

### Technique

Blood cultures should be preferably taken following skin antisepsis with 2% alcoholic chlorhexidine by venipuncture, except in exceptional cases due to the patient and the inability to take the specimen by venipuncture (in this case, it is recommended to take the blood cultures from the various lumina in the central catheter).

If blood is taken for both blood analysis and blood culture, the blood should be first inoculated into the anaerobic blood culture bottle.

Disinfect with antiseptic the rubber lids of the blood culture bottles, and allow to dry before inoculating the blood.

Make the puncture, avoiding as far as possible touching the patient's disinfected skin area, and, if it is necessary to do so, use sterile gloves. Prevent the needle from coming into contact with cotton or gauze to avoid contamination.

Draw enough blood to have 10 ml of blood per bottle for adults and 1 to 2 ml per paediatric bottle.

### Specimen transportation and storage

It is suggested that incubation at 35 ° C should be implemented as soon as possible, at the latest 2 hours after the specimen was taken. The best method would be automated equipment for satellite blood cultures.

## Nursing registration when taking blood cultures

Do not cover barcodes or the bottom of the bottle, label the bottles with the blood collection order number, indicate the inoculated blood volume, indicate on the bottles and order forms whether the blood is peripheral or from a line if the blood comes from a puncture, and if so whether it comes from a peripheral or central line.

The inoculated blood from each blood culture or collection should be duly identified with the patient's data, as well as with the name of the requesting doctor, the identification card number of the nurse who drew the blood, the patient's diagnosis, and the antimicrobial treatment administered.

## 7.3. Proposed evaluation indicators

### 7.3.1. Structure indicator

#### Methodological information sheet

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**Indicator name:**

The clinical practice guide on blood cultures is available at the unit/service.

**Definition:**

Total number of clinical practice guidelines on blood cultures in the National Health Service care units/services, stated as a percentage out of the unit sample universe.

**Calculation formula:**

No. of units with the CPG/Total no. of existing units x 100

Measurement units or form in which the indicator is specified:

Percentage

**Interpretation of the indicator:**

For every 100 services, there is a x% of services where the nursing clinical practice guide on blood cultures is available.

**Standard:**

The clinical practice guidelines on blood cultures are available in 100% of units.

**Clarifications:**

Through accreditation

**Breakdown:**

By region, hospital, and service

**Source of information:**

Own information and registration system

**Frequency of the indicator:**

Yearly

**Data availability:**

November 2020

**Calendar for publication of the indicator:**

January of the previous year.

**Remarks:**

Previous consent from the various units is required to obtain this indicator. Date of creation of the methodological information sheet:

January 2019

### 7.3.2. Process indicator

#### Methodological information sheet

**Indicator name:**

Percentage of professionals who correctly perform hand hygiene at moment 2: before performing a clean/antiseptic task

**Definition:**

Total number of professionals who correctly perform hand hygiene at moment 2 in the National Health Service care units/services, stated as a percentage out of the unit sample universe.

**Calculation formula:**

No. of blood cultures taken in which the professional performs hand hygiene at moment 2 / Total no. of blood cultures taken x 100

**Measurement units or form in which the indicator is specified:**

Percentage

**Interpretation of the indicator:**

x% of professionals who correctly perform hand hygiene at moment 2 for every 100 services.

**Standard:**

100% professionals correctly perform hand hygiene at moment 2: before performing a clean/antiseptic task

**Clarifications:**

Through direct observation following WHO methodology. Completion of appendix 9 is required.

**Breakdown:**

By region, hospital, and service

**Source of information:**

Information and registration system provided in appendix 9.

**Frequency of the indicator:**

Monthly

**Data availability:**

November 2020

**Calendar for publication of the indicator:**

Until day 15 of every month of the ongoing year

**Remarks:**

\*Moment 2: Before performing a clean/aseptic task. Previous consent from the various care units is required to obtain this indicator. Date of creation of the methodological information sheet:

January 2019

### 7.3.3. Outcome indicator

#### Methodological information sheet

**Indicator name:**

Percentage of patients with false positives in the blood culture results

**Definition:**

Total number of patients with false positives in the blood culture results in the National Health Service care units/services, stated as a percentage out of the unit sample universe.

**Calculation formula:**

No. of blood culture units with false positive results / Total no. of samples taken x 100

**Measurement units or form in which the indicator is specified:**

Percentage

**Interpretation of the indicator:**

x% of patients with false positives for every 100 services

**Standard:**

< 3% of patients with false positives in the blood culture results

**Clarifications:**

From laboratory results

**Breakdown:**

Microbiology service

**Source of information:** Laboratory data

**Frequency of the indicator:**

Monthly

**Data availability:**

November 2020

**Calendar for publication of the indicator:**

Until day 15 of every month of the ongoing year



**Remarks:**

Blood culture contamination rate (91): there is no standardised definition of contaminated blood culture. According to the update to the SEMICYUC 2017 quality indicators, "a blood culture is regarded as contaminated when coagulase-negative Staphylococcus, Bacillus sp., Propionebacterium acne or Corynebacterium sp. Are isolated in a single set". Nonetheless, this definition may be confusing, as some of these microorganisms are also associated with bacteraemia of unknown origin and associated with a catheter (30.83% of isolated Staphylococcus epidermidis and 6.99% of negative-coagulate Staphylococcus, according to the latest ENVIN report). The current recommendation is to keep the blood culture contamination rate  $\leq 3\%$ <sup>1</sup>.

**Date of creation of the methodological information sheet:**

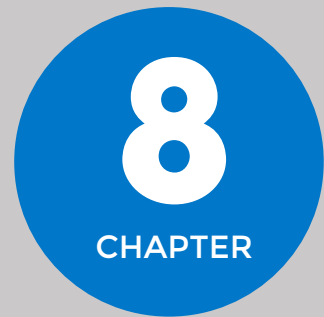
January 2019

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<sup>1</sup> Note: Factors that affect the results of bacterial cultures, factors connected to the technique; result of the culture, amount, dilution of collected secretions; sensitivity, size of the sampled area, specificity, contamination by the patient's flora.



ALGORITHM FOR  
ACTION





## 8. ALGORITHM FOR ACTION

Illustration 1 Sepsis Flowchart

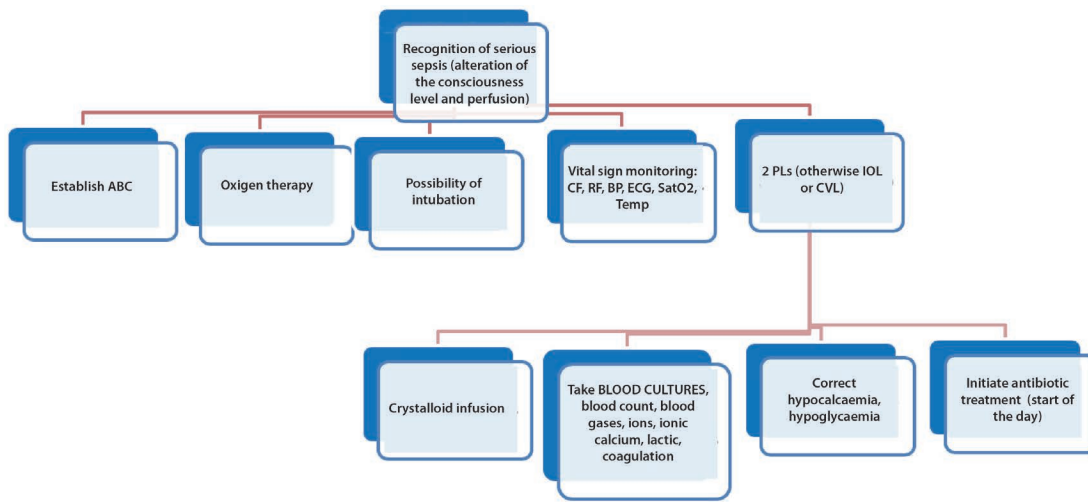
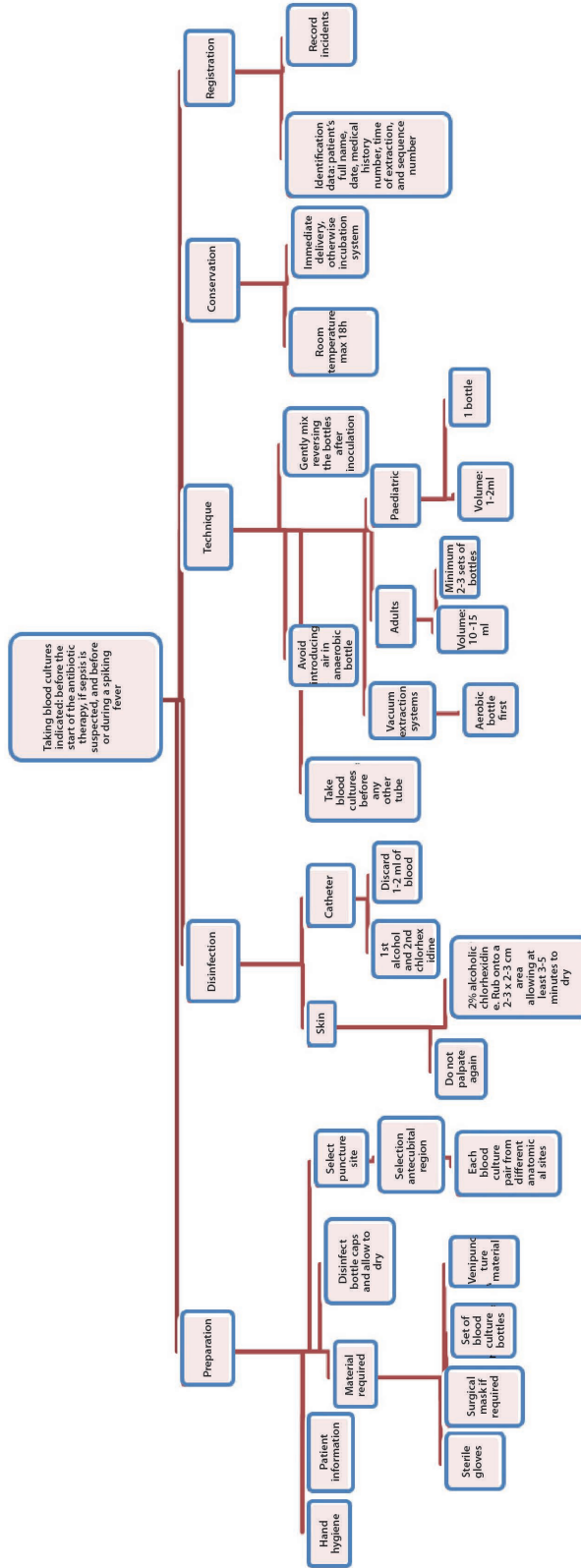
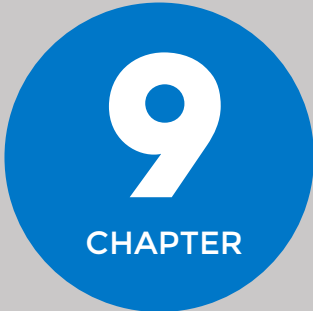


Illustration 2 Blood Culture Flowchart



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APPENDICES





## 10. APPENDICES

### Appendix 1. Evidence quality and strength of recommendation

Table 1 Classification of evidence quality in the GRADE system (2)

Classification of evidence quality in the GRADE system			
Evidence quality	Study design	Decrease quality if:	Increase quality if:
High	RCT	Significant design limitation (-1) Very significant (-2)	<b>Association</b> • Scientific evidence of strong association (RR>2 or <0.5 based on observational studies with no confounding factors (+1)) • Scientific evidence of a very strong association (RR>5 or <0.2 based on studies with no possible biases (+) Dose-response gradient (+1) All potential confounding factors could have reduced the effect observed (+1)
Moderate		Inconsistency (-1) Direct evidence	
Low	Observational studies	Some uncertainty (-1) High uncertainty (-2) Imprecise data (-1)	
Very Low	Other types of design	Publication bias High likelihood (-1)	

Table 2 Implications of the recommendation in the GRADE system (2)

<b>Implications of the recommendation on the GRADE system.</b>		
<b>Implications of a strong recommendation</b>		
<b>Patients</b>	<b>Clinicians</b>	<b>Managers/Planners</b>
The vast majority of people agree with the recommended action and only a small number would not.	Most patients should receive the recommended intervention.	The recommendation can be implemented as healthcare policy in most situations.
<b>Implications of a weak recommendation</b>		
<b>Patients</b>	<b>Clinicians</b>	<b>Managers/Planners</b>
Most people would agree with the action recommended but a significant number of them would not.	Recognises that different options will be suitable for different patients and the doctor should help each patient to make the decision that is most consistent with their values and preferences.	There is significant need for debate and stakeholder involvement.

## Appendix 2. Information for patients

### Appendix 2.1 Patient education: sepsis in adults (Basic Concepts)

#### What is sepsis?

Sepsis is a serious disease that occurs when an infection spreads across the organism.

Anyone can have sepsis, but it is most common in people who:

- Are elderly or bed-bound
- Are in hospital or have recently undergone surgery
- Thin tubes such as catheters or intravenous lines have been inserted in their bodies
- Their system is weakened to fight infection (e.g. because they are receiving treatment against cancer)

Sepsis can appear due to an infection anywhere in the body, but it is most frequently associated with infections in:

- The lungs (pneumonia)
- The kidneys (urinary duct infection)
- The skin (cellulitis)
- The bowel (colitis) Sepsis caused by colitis is particularly likely after taking antibiotics.

Sepsis requires fast treatment, as it can turn very serious untreated. When this happens, it is known as “septic shock”, and life is at danger.

#### What are the symptoms of sepsis?

The symptoms of sepsis can include:

- Fever - Some people experience a drop in their body temperature rather than fever
- Chills
- Rapid breathing
- Very rapid heartbeats

The symptoms of serious sepsis can include:

- Confused behaviour or dizziness
- Difficulty breathing

- Sweaty and clammy or flushed skin
- Loss of appetite
- Urinating much less frequently than usual
- Different types of skin rashes. One type is a lace-like purple rash, which usually appears on the legs but can also appear on the arms. Another rash is red or purple spots on the skin which do not disappear when touched. These spots are usually on the chest and legs, but can also appear in other areas.
- Other heart, kidney, or brain problems

People in septic shock have many of the symptoms described above. Their blood pressure also drops and sometimes they faint.

### Should I see a nurse?

Yes. Sepsis can develop both at home and in hospital. In either case, you (or the person who is with you) should call a doctor or nurse if:

- You are experiencing fever and/or chills and any of the symptoms above or you feel very ill
- Surgery was performed or you were recently hospitalised and are now ill or have an infection

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If your doctor or nurse is unable to examine you immediately, or if you are unable to contact them, you should go to the closest A&E unit.

### Will I have to be tested?

Most likely. Your doctor will ask you questions about your symptoms and examine you. They will probably run tests to establish whether there is an infection, if the infection has spread to your blood, and its seriousness. These tests include:

- Blood tests, including tests called “blood cultures”
- Urine tests
- Laboratory tests E.g. if you cough and mucus comes out, the doctor may examine the mucus to find bacteria
- X-rays or other imaging studies. These studies generated images of the inside of the body. These could include a test to observe the heart, called echocardiogram



### How is sepsis treated?

Sepsis and septic shock are usually treated in hospital with:

- Antibiotics administered into a vein through a thin tube (called “intravenous line”)
- Liquids administered into a vein through an intravenous line
- Other medicines. E.g. if your blood pressure is too low, your doctor may give you some medicines to raise it

If the cause of sepsis is an intravenous line or a catheter, the doctor may remove the intravenous line or the catheter.

Some people also receive surgical treatment. If you have a serious skin infection or an infection of the tissue beneath the skin, your doctor may perform surgery to remove the infected areas.

Some patients with serious cases of septic shock might require a blood transfusion. A blood transfusion is what happens when a person receives blood donated by another person. However, this is not frequent.

### Can sepsis be prevented?

You can help to prevent sepsis by:

- Receiving immediate treatment if you have an infection
- Preventing infection. One way to prevent infection is to receive all the vaccines recommended by your doctor or nurse. Vaccines can help to prevent serious and deadly infections. If you have a child, ensure that they also receive the vaccines recommended in your region’s calendar.

## Appendix 2.2 Patient education: fever in children (Basic Concepts) (94)

### What is fever?

Fever is a rise in body temperature, which may be accompanied by general malaise in the child or not.

In general, having a fever means having a temperature higher than 38°C. When you take your child's temperature, it may vary slightly depending on how you take it: orally (from the mouth), from the armpit, ear, forehead, or rectally.

Armpit, ear, and forehead temperatures are easier to take than rectum and mouth temperatures, but measurements are not so accurate. In any case, temperature is an indicator that does not exclude your child's malaise. If you believe that your child has a fever and is ill, your child's doctor or nurse may ask you to verify the temperature by taking another measurement.

### What is the best way to take my child's temperature?

The most accurate way is to take temperature rectally (figure 1), but mouth and armpit temperatures are more usually taken. This is the right way to take temperature from the mouth:

- Wait for at least 30 minutes if your child has eaten or drunk something cold or hot.
- Wash the thermometer with cold water and soap. Then rinse it.
- Place the tip of the thermometer under your child's tongue, near the back. Ask your child to hold the thermometer with their lips, not their teeth.
- Make them keep their lips pressed against the thermometer. Most digital thermometers take less than one minute.

### What is the cause of fever?

In children, the most common cause of fever is an infection. E.g. children can have a fever if they have:

- A cold or flu
- An airway infection, such as croup or bronchiolitis
- Stomach bacteria

In some cases, children have a fever after being vaccinated

### Should I take my child to see a doctor or a nurse?

You should take your child to see a doctor or a nurse in these cases:

- If they are younger than 3 months and are running a temperature of 38 ° C or higher. The doctor or nurse must examine the baby even if they look normal or seem not to feel ill. Do not give fever medication to a baby younger than 3 months, unless a doctor has indicated it
- If the baby is 3 to 36 months old and they are running a temperature of 38 ° C or higher for more than 3 days. Check with the doctor or nurse immediately if your child looks ill or uncomfortable, is too clingy, or refuses to drink liquids
- If the baby is 3 to 36 months old and are running a temperature of 38.9 ° C or higher.

You should also go to the doctor or nurse if a child of any age has:

- A mouth, rectum, ear, or forehead temperature of 40 ° C or higher
- An armpit temperature of 39.4 ° C or higher
- A neurological crisis caused by the fever
- A fever that does not go away (even if it only lasts a few hours)
- Fever and a chronic medical problem, i.e. heart condition, cancer, lupus, or sickle-cell anaemia
- Fever and a new skin rash

### What can I do to help my child to feel better?

You can do the following:

- Offer your child plenty of liquid to drink. Call the doctor or nurse if your child will not or cannot take liquid for several hours.
- Encourage your child to rest whenever they like, but do not force them to sleep or rest. Your child may go back to school or their usual activities after they have had a normal temperature for 24 hours.

Some parents use baths to lower their children's temperature, but in general this is not necessary. Some people believe that they can lower a child's temperature by rubbing their skin with alcohol or by pouring alcohol into the bath water, but these practices are dangerous. Do not use any type of alcohol to treat fever.

### How is fever treated?

That depends on the cause of the fever. Many children do not require treatment, but those who do may require:

- Antibiotics to fight the infection causing the fever. However, antibiotics are only effective in the case of infections caused by bacteria, not by virus. E.g. antibiotics are not effective in a cold.
- Some medicines, like paracetamol and oral ibuprofen, can help to lower the fever. However, these medicines are not always necessary.

If you do not know what the best way to treat your child's fever is, call your child's doctor or nurse.

## Appendix 2.3 Good nursing practice guide Informational leaflet on healthcare education about blood cultures (95)

### **What is a blood culture?**

A blood culture is a blood test to find whether there are microorganisms that are causing an infection. This must be known to administer you the right antibiotic.

### **How is a blood culture taken?**

It is taken by means of a puncture in a vein (usually in your arm), as in a conventional blood test. In some cases, specific devices (catheters) must be used.

### **How is the blood drawn?**

The blood is drawn by puncturing a vein in your arm, and, if an intravenous line is required, the puncture will be used to place it. Your nurse will inform you about the procedure and, depending on the device used, will ensure that it is as comfortable as possible for you.

If blood is drawn using a needle connected to a butterfly and a flange, the nurse will do it in the way that is most comfortable for you.

### **What do I need to know before blood is taken for a blood culture?**

The applicable protocols will be followed to correctly take the specimen and prevent infection and contamination: perform hand hygiene, assess the risk of infection, apply a suitable antiseptic to your skin before the needle is inserted to draw blood. Ask your nurse if you have any questions.

## Appendix 3. Abbreviations

- **AGREE:** Appraisal of Guidelines for Research and Evaluation
- **CENTRAL:** The Cochrane Central Register of Controlled Trials
- **SD:** Standard deviation
- **DOR:** Diagnostic Odds Ratio
- **RCT:** Randomised Clinical Trial
- **AG:** CPG Authoring Group
- **WG:** CPG Working Group
- **CPG:** Clinical Practice Guide
- **GRADE:** Grading of Recommendations Assessment, Development and Evaluation
- **95% CI:** 95% confidence interval
- **MA:** Meta-analysis
- **NICE:** The National Institute for Health and Care Excellence
- **OR:** Odds ratio
- **PICO:** Population, Intervention, Comparator, Outcome
- **RR:** Relative Risk
- **SR:** Systematic Review

## Appendix 4. Glossary

**Ethyl alcohol with gel glycerine:** chemical name of the antiseptic for hand hygiene.

**Asepsis:** a term that defines the microorganism-free state. In medicine, it refers to the set of procedures that prevent the arrival of microorganisms in a germ-free (aseptic) medium; i.e. procedures that prevent contamination and thus preserve sterility. This includes: adequate surgical techniques, isolation, ventilation, and air extraction techniques, adequate use of clothing, pest and rodent control, adequate staff training.

**Antisepsis:** the term that defines the procedures aimed at removing the existing pathogenic microorganisms. This includes: cleaning and disinfecting the surgical field, hygienic or surgical hand washing.

**Antiseptic:** a low-toxicity germicide that can be applied onto skin and live tissues; e.g. iodinated compounds, alcohol (ethyl and isopropyl alcohol), chlorhexidine, and hexachlorophene.

**Catheter-associated bacteraemia:** isolation of the same microorganism at the tip of the catheter and in a peripheral blood specimen in a patient who has signs or clinical symptoms of blood infection, with no other apparent infection focus.

Case of bacteraemia(95), two options:

- **B (1):**
  - A positive blood culture for a recognised pathogen, or
  - The patient presents with at least one of the following signs or symptoms: fever ( $>38^{\circ}\text{C}$ ), chills, or hypotension and two positive blood cultures for a usual skin contaminating microorganism (from two different blood specimens taken within a 48-hour interval) plus clinical symptoms.
  - Skin contaminants: Coagulase-negative staphylococcus, Micrococcus sp., Propionibacterium acnes., Bacillus sp., Corynebacterium sp.
  
- **B (2):** The patient presents with at least one of the following signs or symptoms: fever ( $>38^{\circ}\text{C}$ ), chills, or hypotension and
  - A positive blood culture for a skin contaminant in a patient with clinical symptoms who has an intravascular catheter and for whom suitable antibiotic treatment has been established.
  - Antigen-positive blood test (e.g. *H. influenzae*, *S. pneumoniae*, *N. meningitidis*, or Group B *Streptococcus*).

**CDC:** US Center for Disease Control and Prevention A set of interconnected research centres that study infectious diseases and issue standards for control of infection.

**2% alcoholic chlorhexidine:** 2% alcoholic solution diglucuronate chlorhexidine.

**CLSI:** The Clinical and Laboratory Standards Institute, an international non-profit organisation for the promotion of excellence in laboratory medicine.

**Disinfectant:** a germicide that is capable of destroying most pathogenic microorganisms (except for spores), but which can be toxic for the skin and mucus, and thus is only applied to inanimate objects, surfaces, and the environment, e.g. chlorine compounds, acid-alkalis, aldehydes (glutaraldehyde and formaldehyde), phenols, etc.

**Sterilisation:** the process of destruction and removal of all forms of microbial life.

**FDA (Food and Drug Administration):** A United States Government office that regulates the production of food (except for beef, poultry, and some eggs), ensures the effectiveness of all medicines and biological products (blood, vaccinations, and transplant tissues), medical devices, animal medicines and foods, and ensures that cosmetic and radiation-emitting medical products do not harm consumers.

**Blood culture:** a blood specimen sent to culture microorganisms. It makes it possible to identify potential pathogens in patients suspected of having bacteraemia or fungemia.

- **Blood culture series:** a group of time-connected blood cultures that are taken to establish whether a patient has bacteraemia or fungemia.
- **Blood culture set:** the combination of two blood culture bottles (an aerobic and an anaerobic one) into which a single blood collection is inoculated.

**IDSA:** the Infection Diseases Society of America is a United States community of more than 11,000 doctors, scientists, and public health experts specialised in infectious diseases.

**Cleaning:** the physical removal of organic matter and contamination from objects. The basic agent is detergent.

**NHS:** the United Kingdom National Health Service.



## Appendix 5. Declaration of interest

The following individuals have declared an absence of conflict of interest:

Tamara Domingo Pérez, M<sup>a</sup> Luisa Rodríguez Navas, Raúl Sánchez Bermejo, Inés Rubio Pérez, Marta Zugasti, Sonsoles Hernández, Mercedes Gómez, José Luis Cobos.

Rafael Herruzo Cabrera has received funding from BD to take part in research that poses no conflict of interest to take part in this guide.

The external reviewers Francesc Xavier Nuvials Casals, Juan González del Castillo, Pilar Elola Vicente, M.<sup>a</sup> Esther Gorjón Peramato, Inmaculada Fernández Moreno, Javier de la Fuente Aguado, Juan Francisco Navarro Gracia, Pablo Vidal Cortes, Roser Ferrer have declared an absence of conflict of interest. Collaborators Ascensión Hernández Encinas, Julián Antonio González Hernández and Miguel Ángel Cuevas Budhart have also declared the absence of conflict of interest.

## Appendix 6. Map of clinical questions

### Appendix 6.1 Map of clinical questions for the Nursing Clinical Practice Guide on blood culture collection

#### Section 1. Epidemiology and aetiology of bacteraemia (Reason by blood cultures are taken)

In this section, we will review the incidence, aetiology, origin, and mortality rate of bacteraemia, following a clinical approach based on key questions that should be answered when faced with a patient with suspected bacteraemia:

#### Questions to be answered

1. Does the patient meet the diagnostic criteria for serious sepsis or septic shock?
2. What is the place of acquisition of the bacteraemia?<sup>2</sup>
3. Does the patient have any underlying condition?
4. What is the focus of origin of the bacteraemia?
5. Is having a fever necessary to take a blood culture?
6. At what time should blood cultures be taken, before or after the spiking fever? Or is this irrelevant?

The correct answer to these questions, together with knowledge of local epidemiology, will make it possible to establish the clinical judgements, including the most likely aetiology of the bacteraemia, and recommend the most suitable treatment.

#### Section 2. Clinical assessment: from suspected to confirmed bacteraemia (Clinical suspicion of bacteraemia)

In this section we will review the clinical suspicion of bacteraemia, classifying the initial seriousness, the specifics of blood culture indication in different populations and the final

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<sup>2</sup> Classification of bacteraemia according to the place of acquisition: in the community, associated with healthcare, nosocomial, in the ICU, from a vascular catheter, in a qx patient, with neutropenia after chemotherapy treatment, in major burns patients, in patients with underlying conditions, in haemodialysis, in post-transplant, with HIV, etc.

diagnosis of bacteraemia classified by its clinical impact<sup>3</sup>, following a clinical approach based on key questions to be answered when faced with a patient with suspected bacteraemia:

#### Questions to be answered

1. What is the initial classification of bacteraemia seriousness?
2. In which cases<sup>4</sup> is taking blood cultures indicated?
3. What signs and symptoms should be considered when bacteraemia is suspected?
4. When is bacteraemia confirmed?

The correct answer to these questions, together with knowledge of the initial diagnosis, will make it possible to establish the clinical judgment and recommend the most suitable indication.

### Section 3. Treatment of patients with bacteraemia

In this section we will review the empirical antimicrobial treatment of bacteraemia of unknown origin based on the place of acquisition and the patient's underlying condition up to the empirical treatment based on the patient's clinical situation, following a clinical approach based on key questions to be answered when faced with a patient with suspected bacteraemia:

#### Questions to be answered

1. What is the empirical treatment in cases of bacteraemia?
2. What is the empirical treatment in cases of bacteraemia according to the type of patient?

The correct answer to these questions will make it possible to establish the most suitable treatment.

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<sup>3</sup> When faced with bacterial growth in blood cultures, the following possibilities should be considered: false bacteraemia or true bacteraemia; the latter may be transient, persistent, or breach bacteraemia.

<sup>4</sup> Patient particularity.

## Section 4. Procedure to take blood cultures

Several factors in the drawing process can result in better test performance and a lower rate of contaminated blood cultures. In this section, we will review key questions that should be answered when faced with a patient from whom a blood culture must be taken.

### Questions to be answered

#### **Section 4. 1 Antisepsis when taking blood cultures**

1. Which antiseptic is adequate for skin disinfection?
2. Should sterile gloves be used?
3. Which is the best method to apply the skin disinfection antiseptic before taking blood cultures?

#### **Section 4.2 Technique**

4. Which anatomical site is most suitable?
5. What is the recommended number of blood specimens?
6. Should 20 or 30 minutes elapse after taking the first specimen to take the next one?
7. Should the puncture site change in each blood specimen?
8. Can blood cultures be taken from the venous lines which have been inserted in the patient before the specimens were taken?
9. What volume should be drawn to inoculate in blood culture bottles?
10. Should blood cultures be taken before or after administering antipyretic drugs (paracetamol, metamizole, etc.)
11. Is the introduction of air in the bottle for anaerobic germ cultures indicated?
12. Should the needle used to draw blood for blood cultures be replaced by a new one for inoculation into the bottle so as to decrease contamination levels?
13. Should the rubber cap of the bottle be disinfected with antiseptics?

The correct answer to these questions will make it possible to establish the most suitable procedure to take blood cultures.

### Section 5. Monitoring of patients with bacteraemia

After finding the result of the blood culture and the antibiogram, the initial antimicrobial treatment should be adjusted in accordance with the criteria discussed in the previous section, and the patient should continue to be monitored through clinical and microbiological assessment. Correct interpretation of the evolution of the clinical and microbiological data will make it possible to establish the therapeutic failure or success and the final duration of the treatment. In this section, we will review key questions that should be answered when faced with a patient being monitored due to bacteraemia:

#### Questions to be answered

1. Should a “control” blood culture be taken after empirical treatment?
2. What are the reasons of microbiological failure?
3. What is the adequate duration of the antimicrobial treatment?
4. Is taking blood cultures in A&E from patients who are being assisted due to fever with no focus cost effective?

The correct answer to these questions will make it possible to establish the most suitable treatment.

### Section 6. Specimen transportation and storage

Once the specimen has been taken and inoculated into the blood culture bottles, the bottles should be properly labelled with the patient’s data and the pairs of bottles for each blood culture should be identified. In this section, we review key questions that must be answered:

#### Questions to be answered

1. How should recently collected blood cultures be stored before sending them to the laboratory?

The correct answer to these questions will make it possible to establish the most suitable method for transportation and preservation of the blood cultures until they are processed.

### Section 7. Nursing registration when taking blood cultures

In this section, we review key questions that must be answered to ensure adequate registration.

#### Questions to be answered

1. What information should be recorded when taking blood cultures?

Answering these questions correctly will make it possible to establish the minimum information to be recorded by a nurse after taking blood cultures.

### Section 8. Cost-quality when taking blood cultures

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In this section, we review key questions that must be answered: to ensure cost-effective indication of the procedure.

#### Questions to be answered

1. Is taking blood cultures in A&E from patients who are being assisted due to fever with no focus cost effective?

The correct answer to these questions will make it possible to establish the most efficient treatment.

## Appendix 6.2 Final map of clinical questions for the Nursing Clinical Practice Guide on blood culture collection

After the meeting of 22 March 2018, the Working Group decided to remove sections 1, 2, 3, 5, and 8 and leave sections 4, 6, and 7 below for analysis, due to their usefulness and clinical relevance for nursing professionals.

In the meeting of 27 September 2018, questions 10, 11, 12, 13, and 14 were moved to the technique section.

### Section 4. Procedure to take blood cultures

Several factors in the drawing process can result in better test performance and a lower rate of contaminated blood cultures. In this section, we will review key questions that should be answered when faced with a patient from whom a blood culture must be taken.

#### Questions to be answered

##### Section 4. 1 Hand hygiene

1. At what point does hand hygiene occur when taking blood cultures?
2. Which products should be used for hand hygiene?
3. Which hand hygiene method should be applied before the procedure?
4. Is hand hygiene necessary between each pair of blood cultures drawn from the same patient?

##### Section 4. 2 Protection equipment

5. Should sterile gloves be used?
6. Is a surgical mask necessary to take blood cultures?

##### Section 4. 3 Antisepsis when taking blood cultures

7. Which antiseptic is adequate for skin disinfection?
8. Which is the best method to apply the skin disinfection antiseptic before taking blood cultures?
9. Can the puncture site be palpated with a sterile glove or disinfecting the finger before taking the blood culture?

**Section 4. 4 Technique**

10. Can blood cultures be taken from the central venous lines which have been previously inserted in the patient?
11. Can blood cultures be taken from the peripheral venous lines which have been previously inserted in the patient?  
If so,
  12. When taking blood cultures from the central venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?
  13. When taking blood cultures from the peripheral venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?
  14. If blood cultures and blood specimens for analysis are to be taken at the same time, what would the order be?
  15. Which anatomical site is most suitable?
  16. What is the recommended number of blood specimens?
  17. What volume should be drawn to inoculate in blood culture bottles?
  18. What is the most suitable time to take blood cultures?
  19. Should 20 or 30 minutes elapse after taking the first specimen to take the next one?
  20. Should the puncture site change in each pair of blood specimens for blood cultures?
  21. Should blood cultures be taken before or after administering antipyretic drugs and antibiotics?
  22. Is the introduction of air in the bottle for anaerobic germ cultures indicated?
  23. Should the needle used to draw blood for blood cultures be replaced by a new one for inoculation into the bottle so as to decrease contamination levels?
  24. Should the rubber cap of the bottle be disinfected with antiseptics?
  25. Should the blood culture bottles be shaken after the blood specimen has been inoculated?
  26. Using a vacuum system, which blood culture bottle (aerobic/anaerobic) should be filled first?
  27. Using a needle syringe system, which blood culture bottle (aerobic/anaerobic) should be filled first?
  28. Could covering the puncture site with a gauze while removing the needle used to draw the specimen for blood cultures increase the risk of contamination?
  29. Can the first blood cultures be taken while channelling a peripheral line?

The correct answer to these questions will make it possible to establish the most suitable procedure to take blood cultures.



### Section 6. Specimen transportation and storage

Once the specimen has been taken and inoculated into the blood culture bottles, the bottles should be properly labelled with the patient's data and the pairs of bottles for each blood culture should be identified. In this section we will review the key questions to be answered:

#### Questions to be answered

30. How should recently collected blood cultures be stored before sending them to the laboratory?
31. What is the best way to store blood cultures in the laboratory?
32. Would leaving them in an incubator connected to the laboratory in those services in which delivery of blood cultures is delayed lower the contamination rate?

The correct answer to these questions will make it possible to establish the most suitable method for transportation and preservation for the blood cultures until they are processed.

### Section 7. Nursing registration when taking blood cultures

In this section, we review key questions that must be answered to ensure adequate registration.

#### Questions to be answered

33. What information is crucial to make a good nursing record when taking blood cultures?
34. What benefits does explaining the technique and purpose of the test to the patient provide?

Answering these questions correctly will make it possible to establish the minimum information to be recorded by a nurse after taking blood cultures.

## Appendix 6.3 Variables of interest in the clinical questions proposed for the Nursing Clinical Practice Guide on blood culture collection

Section 4. Procedure for the taking of blood cultures	Outcomes of interest
<b>Section 4. 1 Hand hygiene</b>	
<p><b>1. At what point does hand hygiene occur when taking blood cultures?</b></p>	<p>DI1: adherence to the hand hygiene<sup>5</sup> guide (WHO manual (26)), with hand hygiene defined as washing the hands at every opportunity<sup>6</sup> in which the guide. indicates hand hygiene. The measurement units used is "opportunity for hand hygiene", defined in the moments prior (first opportunity) to and after contact (second opportunity) with the patient or with objects in the room (environment) in accordance with the five critical moments defined by the WHO. Moments 1 and 2? 3-5 ? Wasn't this done?</p>
<p><b>2. What product should be used to perform hand hygiene?</b></p>	<p>OI2: alcohol-based preparation<sup>7</sup>, with soap and water, with antiseptic, with nothing?</p>
<p><b>3. What hand hygiene method should be applied before the procedure?</b></p>	<p>OI3: The hand hygiene outcome variable: hygienic hand washing, antiseptic hand washing, hand hygiene by rubbing, surgical hand washing?</p>

<sup>5</sup> Any hygienic measure aimed at achieving hand antisepsis to reduce transient microbial flora (generally consisting in rubbing hands with an alcohol-based antiseptic or in washing hands with water and normal or antimicrobial soap).

<sup>6</sup> Indication for hand hygiene: the reason why hand hygiene should be performed in a specific situation.

<sup>7</sup> Liquid preparation, gel or foam that contains alcohol, intended for hand hygiene and antisepsis.

**4. Is hand hygiene necessary between each pair of blood cultures taken from the same patient?**

O14: yes, no? adherence to the hand hygiene guide (WHO manual), with hand hygiene defined as washing the hands at every opportunity in which the guide indicates hand hygiene. The measurement units used is “opportunity for hand hygiene”, defined in the moments prior to (first opportunity) performing a clean/antiseptic task (second opportunity), after the risk of exposure to bodily fluids (third opportunity), after touching the patient (fourth opportunity), after contact with the patient or with objects in the room (environment) (fifth opportunity), in accordance with the five critical moments defined by the WHO.

**Authoring Group comments:**

**O11: O12: O13: O14:**

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**Section 4. 2 Personal protection equipment<sup>8</sup>**

**5 Should sterile gloves be used?**

DI5: the variables of interest would be: use of sterile gloves? use of exploration gloves? use of gloves not indicated

**6. Is a surgical mask necessary to take blood cultures?**

DI5: the variables of interest would be use of airway protections such as: use of mask? or airtight protective glasses?, none of these measures is necessary.

**Authoring Group comments:**

**O15:**

**O16:**

<sup>8</sup> Personal Protection Equipment (PPE): any items intended to be worn or carried by the worker for protection against one or several risks that might threaten their safety or health, as well as any complement or accessory item intended for this purpose.

**Section 4. 3 Antisepsis in blood culture collection**

**7. Which antiseptic is adequate for skin disinfection?**

OI7: ethyl alcohol, 0.5% or 2% alcoholic chlorhexidine solution, 0.1-0.5% aqueous chlorhexidine solution, 2% aqueous-base chlorhexidine, 2%-4% soap solution, 1% gluconate chlorhexidine - 61% ethyl alcohol?, none of the above.

**8. Which is the best method to apply the skin disinfection antiseptic before taking blood cultures?**

OI8: in circles, downward motion, inside out from the collection site, inwardly toward the collection site?

**9. Can the puncture site be palpated with a sterile glove or disinfecting the finger before taking the blood culture?**

OI9: palpate with sterile glove or finger disinfection? The variables of interest would be blood culture contamination rate<sup>9</sup>, rate of false positives in blood cultures, inadequate blood taking technique?

**Authoring Group comments:**

OI7: OI8: OI9:

**Section 4. 4 Technique**

**10. Can blood cultures be taken from the central venous lines which have been previously inserted in the patient?**

OI10 and OI11: Blood culture contamination rate when these were taken with respect to when they were taken through peripheral venipuncture

<sup>9</sup> By contamination we understand the growth of microorganisms in blood cultures that are not in the blood at that time and thus are not responsible for the sepsis.

**11. Can blood cultures be taken from the peripheral venous lines which have been previously inserted in the patient?**

If so,

**12. would it be necessary to discard a volume of blood, in blood is taken through a central venous line, before taking the specimen that will be inoculated into the blood culture bottles?**

**13. When taking blood cultures from the peripheral venous lines, should the blood taken before the specimen to be inoculated in the blood culture bottles be discarded?**

**14. If blood cultures and blood tests are to be taken at the same time, what would the order of collection be?**

**15. What anatomical site is most suitable for collection?**

**16. What is the recommended number of blood specimens?**

**17. What volume should be to drawn to inoculate into the blood culture bottles?**

**18. What is the most suitable after fever, time for blood culture collection?**

DI 12-13: establish the minimum volume required for a positive blood culture. The variables of interest would be the extent of bacterial growth, growth time

DI14: The variables of interest would be those critical points when taking specimens such as the order of collection: first blood cultures and then blood tests, or first blood tests and then blood cultures?

DI15: Upper limb veins? veins on the back of the hand? lower limb veins? head?

DI16: number of sets of positive cultures, number of positive bottles, growth time

DI17: amount of bacterial growth, growth time, 5ml? 10ml? >10ml? in each bottle

DI18: before fever, no fever, immediately after fever, any time in the fever process?

19. Should 20 or 30 minutes elapse from the time when the 1st specimen was taken to take the next one?

DI19: bacterial growth time in blood culture

20. Should the puncture site change in each pair of blood specimens for blood cultures?

DI20: blood culture contamination rate

21. Should blood cultures be taken before or after administering antipyretic drugs

DI21: blood culture collection time, positivity rates with respect to the time of collection

22. Is the introduction of air in the bottle for anaerobic germ cultures indicated?

DI22 to 29: contamination rate

23. Should the needle used to draw blood for blood cultures be replaced by a new one for inoculation into the bottle so as to decrease contamination levels?

24. Should the rubber cap of the bottle be disinfected with antiseptics?

25. Should the blood culture bottles be shaken after the blood specimen has been inoculated?

26. Using a vacuum system, which blood culture bottle (aerobic/anaerobic) should be filled first?

27. Using a needle and syringe system, which blood culture bottle (aerobic/anaerobic) should be filled first?

28. Could covering the puncture site with a gauze while removing the needle used to draw the specimen for blood cultures increase the risk of contamination?

29. Can the first blood cultures be taken while channelling a peripheral line?

**Authoring Group comments:**

OI10:

to OI29:

**Section 6. Specimen transportation and storage**

**Outcomes of interest**

30. How should recently collected blood cultures be stored before sending them to the laboratory

DI30: at room temperature, in refrigerator, on stove

31. What is the best storage method for blood cultures in the laboratory?

DI31: the outcomes of interest would be: immediate delivery, delayed delivery, storage in the unit

32. Would leaving them in an incubator connected to the laboratory in those services in which delivery of blood cultures is delayed lower the contamination rate?

DI32: positivity rate

**Authoring Group comments:**

OI30:

OI31:

OI32:

Section 7. Nursing registration in blood culture collection	Outcomes of interest (OIs).
<b>33. What information is crucial for good nursing registration in blood culture collection?</b>	DI33: registration number, patient's name, service and bed, collection date, type of specimen, number of blood cultures positives/number of blood cultures taken and outcome of the Gram staining
<b>34. What are the benefits for the procedure of explaining the technique and purpose of the test to the patient?</b>	DI34: having enough information, adequately understanding the information, being free to decide in accordance with one's own values, being able to make the decision in question.

**Authoring Group comments:** OI33:  
OI34:



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## Annex 8. The Authoring Group's position on the classification of skin antiseptics

Blood cultures play a significant role in the diagnosis of serious infections. The contamination of blood specimen cultures (i.e. false positives for blood cultures) is also a common problem in hospitals. Contaminated cultures also make it necessary to run tests again, and often mean that patients are treated with unnecessary antibiotics, which may extend the length of the hospital stay, which in turn increases costs and the risk of ARIs. The American Society of Microbiology and the Clinical and Laboratory Standards Institute recommend that the blood culture contamination rate not exceed 3%.

The most widely used antiseptics are chlorhexidine gluconate (CHG) and iodophors (such as povidone-iodine) in alcohol - solutions that are effective against a wide range of bacteria, fungi, and viruses. Aqueous solutions, particularly those that contain iodophors, are also widely used, particularly in developing countries.

The Spanish Drug Agency states, regarding disinfectant products (96): "products used for disinfecting purposes are subject to different regulations in accordance with the purpose specified in the product label and instructions of use. A detailed description of the different types of disinfectant and the applicable regulations in each case is provided."

Disinfectants are subject to different regulations in accordance with the purpose specified in the product label and instructions of use. There are three legal disinfectant categories:

- 1) Biocidal products: Antiseptics for health skin and disinfectants for clinical and surgical environments.
- 2) Medical devices: Products to disinfect tools, devices, equipment, etc. intended by the manufacturer for use on people for medical purposes.
- 3) Medicaments: Disinfectants for damaged skin.

Depending on the legislation, antiseptic products can fall within different legal frameworks on the basis of their classification as biocidal products or medicaments. In the European Union, classification of disinfectants is not uniform and it was acknowledged that it is necessary to establish a clear border between the Directive on biocidal products 98/8/EC67 (now replaced by the Biocidal Products Regulation (BPR, Regulation EU 528/2012 68) and medicaments for human use.

The European Chemical Agency (ECHA) has recognised that “all products for disinfection of damaged or undamaged skin before a medical procedure on a patient (e.g. disinfection before surgery and disinfection before an injection) will always be regarded as medical products (pharmaceutical specialities).”

In Spain, the Spanish Drug and Medical Devices Agency established in its informative note of 29 March 2011 the category of antiseptics for healthy skin intended for the preoperative surgical field and those intended for injection site disinfection: “Biocidal products: This category comprises antiseptics for healthy skin, including those intended for the preoperative surgical field and those intended for injection site disinfection, as well as disinfectants for environments and surfaces used in clinical and surgical areas that do not come into direct contact with patients, such as corridors, hospitalisation areas, care and treatment areas, furniture, etc.” Spain is thus one of the few European countries with a written positioning in favour of biocidal products rather than pharmaceutical specialities for skin antiseptics, even though it is “open” in an immediate medical procedure (surgery, injection).

This situation has led various scientific societies, patient organisations, and member of the European Parliament to send a joint request to the European Commission so that it “guarantees a uniform interpretation and a consistent implementation of legislation on biocidal products and medicinal products, thus protecting European patients from avoidable harm”, and “making use of this opportunity to improve the safety of patients and professionals, decrease antimicrobial resistance, and protect the environment” through the classification of skin antiseptics before a medical procedure as medical specialities.

Despite this, the legal definitions of biocidal products and pharmaceutical specialities are not uniformly interpreted in Member States. The healthcare authorities in most EU Member States (e.g. Germany, Belgium, United Kingdom) regard these disinfectants as pharmaceutical specialities, in line with the position of the European Chemicals Agency

(ECHA), which in February 2017 established that: “Products for disinfection of damaged skin (e.g. wound disinfection) or disinfection of undamaged skin before a medical treatment of a patient (e.g. pre-operative skin disinfection before surgery and disinfection before injection) and products with a claim of medicinal use, are always medicinal products (covered by the Directive 2001/83/EC on medicinal products for human use).”

### *The expert group's position*

The expert group highlights in its first comment that Europe (under European Legislation) allows both forms, and each country regulates at its own criterion. In Spain, antiseptics for healthy skin, including those intended for the preoperative surgical field and those intended for injection site disinfection, regulated by Royal Decree 1054/2002, 11 October (98), are classified as "Biocidal products": Their label should specify "nº-DES". Authorisation.

Moreover, medical devices are defined as products that are used for the disinfection of human beings. Regulated by Royal Decree 1591/2009 of 16 October (99) and by Directive 93/42/EEC on medical devices (1000). They should be marked by "CE" + identification number of the evaluating body for marketing.

This authorisation and information must be kept, provided, or registered in the relevant files and databases. The medical device surveillance service is a key factor. In Spain they are considered biocidal products, but ideally they should be regarded as medicines. Thus, we would be able to prevent products contaminated at the source by bacteria such as *Serratia* (medicines require more controls and monitoring after manufacturing than biocidal products). However, risk is low and we continue to have the current classification as biocidal products like Europe.

## Appendix 9. Instrument for the observation of hand hygiene at moment 2: before performing a clean/antiseptic task

<b>Institution</b>						
<b>Service</b>			<b>Observer</b>			
<b>Date</b>			<b>Start/ end time</b>			
<b>Duration</b>			<b>Session number</b>			
<b>Opportunity</b>	<b>Professional</b>	<b>Indication</b>	<b>Duration</b>		<b>Action</b>	
		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	>40-60 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>	<input type="checkbox"/>
					Water-soap <input type="checkbox"/>	<input type="checkbox"/>
					Lost <input type="checkbox"/>	<input type="checkbox"/>
					Disposable gloves <input type="checkbox"/>	<input type="checkbox"/>
					Sterile gloves <input type="checkbox"/>	<input type="checkbox"/>
		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	>40-60 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>	<input type="checkbox"/>
					Water-soap <input type="checkbox"/>	<input type="checkbox"/>
					Lost <input type="checkbox"/>	<input type="checkbox"/>
					Disposable gloves <input type="checkbox"/>	<input type="checkbox"/>
					Sterile gloves <input type="checkbox"/>	<input type="checkbox"/>
		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	>40-60 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>	<input type="checkbox"/>
					Water-soap <input type="checkbox"/>	<input type="checkbox"/>
					Lost <input type="checkbox"/>	<input type="checkbox"/>
					Disposable gloves <input type="checkbox"/>	<input type="checkbox"/>
					Sterile gloves <input type="checkbox"/>	<input type="checkbox"/>
		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	>40-60 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>	<input type="checkbox"/>
					Water-soap <input type="checkbox"/>	<input type="checkbox"/>
					Lost <input type="checkbox"/>	<input type="checkbox"/>
					Disposable gloves <input type="checkbox"/>	<input type="checkbox"/>
					Sterile gloves <input type="checkbox"/>	<input type="checkbox"/>

		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>
			>40-60 sec <input type="checkbox"/>	Water-soap <input type="checkbox"/>
				Lost <input type="checkbox"/>
				Disposable gloves <input type="checkbox"/>
				Sterile gloves <input type="checkbox"/>
		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>
			>40-60 sec <input type="checkbox"/>	Water-soap <input type="checkbox"/>
				Lost <input type="checkbox"/>
				Disposable gloves <input type="checkbox"/>
				Sterile gloves <input type="checkbox"/>
		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>
			>40-60 sec <input type="checkbox"/>	Water-soap <input type="checkbox"/>
				Lost <input type="checkbox"/>
				Disposable gloves <input type="checkbox"/>
				Sterile gloves <input type="checkbox"/>
		M2: Before-aseptic <input type="checkbox"/>	>20-30 sec <input type="checkbox"/>	Alcohol <input type="checkbox"/>
			>40-60 sec <input type="checkbox"/>	Water-soap <input type="checkbox"/>
				Lost <input type="checkbox"/>
				Disposable gloves <input type="checkbox"/>
				Sterile gloves <input type="checkbox"/>





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