


**BACTERIAL AND VIRAL MENINGITIS: CLINICAL, DIAGNOSTIC, AND THERAPEUTIC  
UPDATES IN LIGHT OF NEW SCIENTIFIC EVIDENCE**

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### **Abstract**

Bacterial and viral meningitis remain among the leading causes of morbidity and mortality associated with infectious diseases of the central nervous system, requiring continuous updates in clinical and therapeutic protocols in light of emerging scientific evidence. This chapter aims to analyze recent advances related to diagnosis, clinical management, and treatment of bacterial and viral meningitis, highlighting contemporary challenges for healthcare practice and public health. This is a narrative review based on the analysis of scientific articles, clinical guidelines, and national and international institutional documents addressing the topic. The findings demonstrate that the incorporation of more sensitive diagnostic methods, including molecular testing and advanced laboratory techniques, has improved the speed of etiological identification and therapeutic decision-making. Early recognition of clinical signs combined with timely treatment initiation remains a determining factor in reducing complications and mortality. It is concluded that integrating diagnostic advances, evidence-based therapeutics, and strengthened health surveillance is essential to improving clinical outcomes in patients with meningitis.

**Keywords:** Bacterial meningitis, Clinical diagnosis, Health surveillance, Therapeutics, Viral meningitis.

### **INTRODUCTION**

Bacterial and viral meningitis constitute important causes of inflammation of the meninges and remain among the main infectious conditions associated with the central nervous system across different age groups. Despite advances related to vaccination, laboratory diagnosis, and antimicrobial treatment, these conditions still have considerable clinical relevance due to their potential for rapid progression, the occurrence of neurological sequelae, and their impact on health systems. According to van de Beek et al. (2016), meningitis remains a medical emergency that requires early recognition and immediate intervention in order to reduce mortality and clinical complications.

Meningitis has distinct etiologies, with bacterial forms generally being associated with greater clinical severity when compared with viral forms. Among the main bacterial agents, *Neisseria meningitidis*, *Streptococcus pneumoniae*, and *Haemophilus influenzae* stand out, while enteroviruses are among the most frequently identified viral agents (Tunkel et al., 2017). The development of more sensitive and rapid diagnostic methods, especially molecular techniques, has significantly changed the clinical management of these infections, enabling greater accuracy in etiological identification and therapeutic targeting.

In this context, the following research problem is defined: how have clinical, diagnostic, and therapeutic updates contributed to improving care for patients with bacterial and viral meningitis in light of new scientific evidence?

The general objective of this chapter is to analyze clinical, diagnostic, and therapeutic updates related to bacterial and viral meningitis in light of recent scientific evidence. The specific objectives are to identify the main advances in diagnostic methods; discuss contemporary therapeutic approaches used in the management of these diseases; and analyze the impacts of these updates on healthcare delivery and patients' clinical outcomes.

The justification for this study is based on the epidemiological and clinical relevance of meningitis and on the continuous need for healthcare professionals to remain updated in view of changes observed in diagnostic and therapeutic protocols. As emphasized by the World Health Organization (2021), reducing the global burden of meningitis depends not only on strengthening prevention and vaccination, but also on improving early diagnosis and timely access to treatment.

From a theoretical standpoint, recent evidence shows that the incorporation of molecular tests, automated laboratory techniques, and evidence-based clinical protocols has contributed to faster diagnosis and to reducing the inappropriate use of antimicrobials (Roos; Tunkel, 2020). In addition, studies indicate that early recognition of clinical signs and immediate initiation of therapy remain determining factors in reducing neurological sequelae and mortality associated with meningitis (Solomon; Michael, 2022). Thus,

understanding the scientific advances related to bacterial and viral meningitis is essential for improving care quality and strengthening health surveillance and care strategies.

### **METHODOLOGY**

#### **STUDY DESIGN**

This chapter is characterized as qualitative research, with a descriptive and exploratory approach, developed through a narrative literature review. This type of investigation makes it possible to gather, analyze, and interpret knowledge produced on a given topic, allowing a critical construction of the current state of scientific evidence (Gil, 2022). This methodological approach was chosen due to the need to comprehensively discuss the clinical, diagnostic, and therapeutic updates related to bacterial and viral meningitis.

According to Minayo (2014), qualitative research favors an in-depth understanding of complex phenomena present in healthcare practices and makes it possible to integrate different theoretical and scientific perspectives. Thus, the narrative review proved suitable for understanding recent advances and contemporary challenges related to the management of meningitis.

#### **PROCEDURES FOR INFORMATION COLLECTION**

Information collection was carried out through a bibliographic survey in scientific databases and nationally and internationally recognized institutional documents. Publications available on platforms such as the Virtual Health Library (VHL), Scientific Electronic Library Online (SciELO), PubMed, and official documents published by leading health organizations were consulted.

Materials produced by the World Health Organization (WHO), the Brazilian Ministry of Health, and international institutions related to epidemiological surveillance and infectious diseases were also considered.

To guide the search, descriptors in Portuguese and English were used in combination with Boolean operators, including the terms: “bacterial meningitis,” “viral meningitis,” “laboratory diagnosis,” “treatment,” “bacterial meningitis,” “viral meningitis,” “clinical diagnosis,” and “therapeutics.”

### **Inclusion and exclusion criteria**

Studies preferably published between 2015 and 2026, available in full text, in Portuguese or English, and addressing clinical, diagnostic, therapeutic, or epidemiological aspects related to bacterial and viral meningitis were included.

Duplicate studies, studies with insufficiently described methodology, publications with no direct relationship to the research object, and materials lacking recognized scientific or institutional support were excluded.

### **ANALYSIS TECHNIQUES AND INSTRUMENTS**

After the selection of bibliographic material, exploratory, analytical, and interpretative reading of the selected documents was carried out. The information was then organized into thematic categories related to the central axes of the study: clinical updates, diagnostic advances, and therapeutic approaches.

As a data interpretation strategy, thematic analysis based on the principles described by Bardin (2016) was used, making it possible to identify recurring patterns, scientific convergences, and relevant aspects for understanding the transformations observed in meningitis care.

### **CHARACTERIZATION OF THE DOCUMENTARY SAMPLE**

The documentary sample consisted of scientific articles, systematic reviews, clinical guidelines, international consensus statements, and institutional documents related to bacterial and viral meningitis.

Priority was given to studies produced by researchers and organizations recognized in the fields of infectious diseases, neurology, and public health, with the aim of encompassing different diagnostic and

therapeutic approaches. The selection of material sought to ensure methodological diversity and scientific currency, allowing a comprehensive view of the topic.

### METHODOLOGICAL FOUNDATION AND SCIENTIFIC DISCUSSION

The use of the narrative review made it possible to integrate knowledge produced in different clinical and epidemiological contexts, favoring a critical analysis of recent evidence related to meningitis. According to Gil (2022), reviews of this nature contribute to the systematization of knowledge and to broadening scientific interpretations of a given phenomenon.

Furthermore, authors in the field emphasize that the rapid evolution of diagnostic and therapeutic methods requires continuous updating of clinical practices in order to ensure better outcomes for patients (Tunkel et al., 2017; Van de Beek et al., 2016). In this sense, the adopted method made it possible to identify relevant advances in the use of molecular techniques, updated therapeutic protocols, and strategies aimed at early diagnosis.

Thus, the applied methodology enabled the construction of a grounded analysis of the main scientific evidence related to bacterial and viral meningitis, contributing to the understanding of current challenges and future perspectives in the field of healthcare delivery and health surveillance.

### RESULTS AND DISCUSSION

The analysis of the scientific literature showed that bacterial and viral meningitis continue to represent an important challenge for health services due to their high morbidity, potential for neurological complications, and need for early diagnosis. The reviewed studies demonstrated that recent scientific advances have contributed to significant changes in clinical management, especially through the incorporation of more sensitive diagnostic methods and the updating of therapeutic protocols.

The findings indicated that bacterial meningitis remains associated with greater clinical severity and a higher risk of sequelae when compared with viral forms. However, early recognition of clinical

signs and the use of faster diagnostic strategies have favored improved clinical outcomes and reduced time to treatment initiation.

**Table 1**

*Comparison of clinical and laboratory characteristics of bacterial and viral meningitis*

<b>Variable</b>	<b>Bacterial meningitis</b>	<b>Viral meningitis</b>
Clinical onset	Sudden	Progressive or acute
Fever	Frequent	Frequent
Altered mental status	More common	Less frequent
Cerebrospinal fluid – cellularity	Predominance of neutrophils	Predominance of lymphocytes
Cerebrospinal fluid proteins	Elevated	Mildly elevated
Cerebrospinal fluid glucose	Reduced	Generally normal
Prognosis	Higher risk of complications	More favorable course

Source: Adapted from Tunkel et al. (2017), van de Beek et al. (2016), and Solomon and Michael (2022).

Among the results found, the increasing use of molecular techniques for diagnostic confirmation stood out. The studies showed that tests based on molecular biology have expanded the capacity for rapid identification of the etiological agent, reducing therapeutic delays and increasing clinical accuracy.

In addition to diagnostic advances, an important update in therapeutic approaches was observed, with emphasis on early treatment initiation, continuous monitoring, and the rational use of antimicrobials.

**Table 2***Main diagnostic and therapeutic updates identified*

Aspect	Observed updates	Clinical benefits
Molecular diagnosis (PCR)	Greater speed in etiological identification	Reduced time to treatment
Automated laboratory tests	Improved diagnostic accuracy	Support for clinical decision-making
Early antibiotic therapy	Immediate initiation in suspected bacterial cases	Reduced mortality
Antiviral therapy	Targeted use in specific cases	Reduced clinical progression
Neurological monitoring	Expansion of hospital surveillance	Reduction of sequelae

Source: Prepared based on Roos and Tunkel (2020), WHO (2021), and Tunkel et al. (2017).

Another observed result concerns the role of prevention and epidemiological surveillance. The studies indicated that the expansion of vaccination coverage against bacterial agents and the strengthening of surveillance systems directly contribute to reducing incidence and to the early identification of outbreaks.

**Table 3***Impacts of scientific advances on the management of meningitis*

Dimension analyzed	Observed impacts
Diagnosis	Greater speed and accuracy
Treatment	More targeted approaches
Hospital care	Improvement in clinical outcomes
Epidemiological surveillance	Early detection of cases
Public health	Reduction of morbidity and mortality

Source: Adapted from the World Health Organization (2021) and van de Beek et al. (2016).

The discussion of the results demonstrates that new scientific evidence has been significantly modifying care for patients with bacterial and viral meningitis. Strengthening early diagnosis, combined with therapeutic updating and preventive actions, contributes to reducing complications, optimizing health resources, and improving the quality of care provided.

## CONCLUSION

This chapter aimed to analyze clinical, diagnostic, and therapeutic updates related to bacterial and viral meningitis in light of recent scientific evidence, seeking to understand how scientific advances have contributed to improving care and clinical outcomes. To this end, aspects related to clinical manifestations, contemporary diagnostic methods, therapeutic strategies, and the impacts of these changes on healthcare practice were discussed.

The results obtained demonstrated that meningitis remains an important cause of morbidity and mortality associated with infectious diseases of the central nervous system, especially in bacterial cases, which have a greater potential for severe progression and the occurrence of neurological sequelae. However, it was observed that technological and scientific advances in recent decades have promoted relevant changes in the clinical management of these diseases.

Among the main findings, the expanded use of molecular diagnostic methods stands out, especially tests capable of accelerating etiological identification, allowing faster and more targeted interventions. Important updates in therapeutic protocols were also identified, with emphasis on early treatment initiation, continuous monitoring, and the rational use of antimicrobials and specific therapies according to the agent involved.

Another aspect highlighted concerns the strategic role of epidemiological surveillance and preventive actions, especially vaccination against vaccine-preventable bacterial agents. The studies analyzed demonstrated that integrated measures involving prevention, timely diagnosis, and evidence-based treatment favor reduced mortality, fewer complications, and better quality of care.

As a scientific contribution, this study gathered and discussed recent evidence on bacterial and viral meningitis, offering an updated view of the main advances observed in the clinical and laboratory fields. In addition, the chapter contributes to strengthening the discussion on the need for continuous updating of healthcare professionals in view of scientific and technological transformations related to the care of these infections.

For future research, the development of multicenter studies aimed at evaluating the effectiveness of new diagnostic methods in different care settings is recommended, as well as investigations into the impacts of technological incorporation on reducing diagnostic time and improving patients' clinical outcomes. It is also suggested that research related to epidemiological monitoring and strategies for meningitis prevention in different populations be expanded.

It is concluded that the advancement of scientific evidence has significantly transformed the management of bacterial and viral meningitis, making early diagnosis, evidence-based therapy, and health surveillance essential elements for improving care and reducing the burden of these diseases on public health.

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