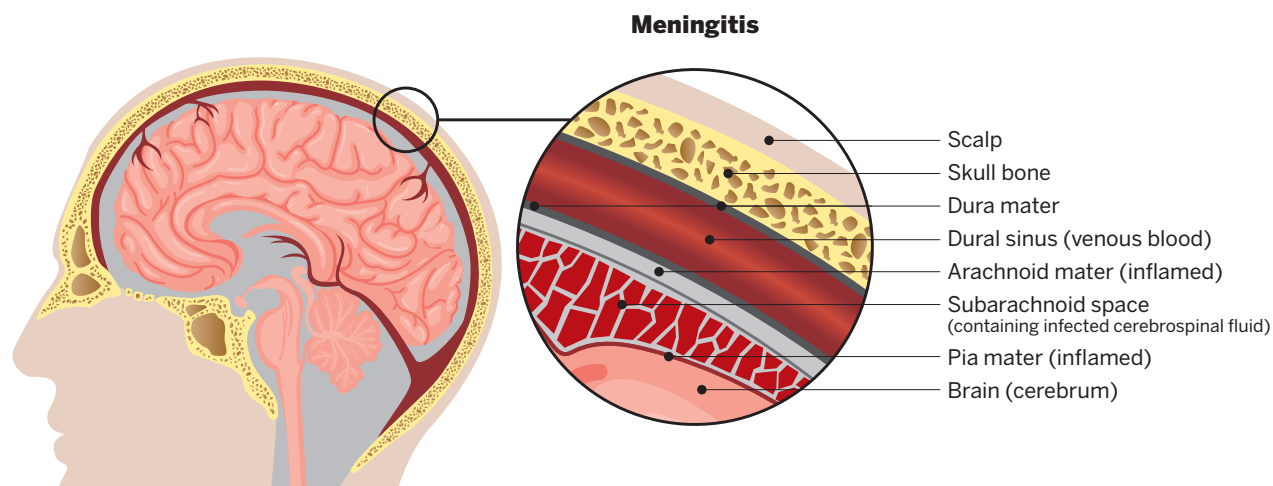




MENINGITIS

KEY FACTS ABOUT MENINGITIS¹⁻⁴

- Meningitis is a **severe infection of the central nervous system**. It occurs when bacteria, viruses, or fungi infect the meninges, or tissue membranes that cover the brain and spinal cord. This causes inflammation of the membranes and accumulation of purulence within the cerebrospinal fluid (see illustration below).
- Meningitis most commonly affects **young children, the elderly, and immunocompromised people**.
- **Viral meningitis** is the most common form and is usually a self-limited illness, although some viruses do respond to specific antiviral treatment.
- **Bacterial or fungal meningitis is a medical emergency** which, if not treated rapidly, can lead to irreversible brain damage and death.
- **Meningococcal meningitis**, a rapidly progressing form of community-acquired meningitis caused by *Neisseria meningitidis*, also has an elevated risk in adolescents and young adults in group settings, such as college dormitories, military barracks, or refugee camps and also in certain geographic regions such as sub-Saharan Africa.



THE BURDEN OF MENINGITIS⁵⁻¹⁰

- Meningitis represents a **heavy health burden** for both patients and society.
- It is especially prevalent in an area of sub-Saharan Africa known as the "**meningitis belt**" that stretches across 26 countries from Senegal to Ethiopia.

GLOBAL BURDEN

- 2.5 million cases per year
 - 0.7-0.9 per 100,000 in US/Europe
- 250,000 deaths per year
- ~50% of cases and deaths in children <5 years old
- 1 in 5 survivors have permanent disability such as cognitive impairment, hearing loss, motor weakness or paralysis, incoordination, and epilepsy

BURDEN IN AFRICA

- 30,000 cases per year
 - 10 – 40 per 100,000
 - Epidemics of meningococcal meningitis up to 250,000 cases per year
- 2,000 deaths per year (up to 25,000 during epidemics)
- Many cases go undiagnosed



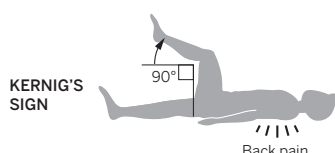
CAUSES AND CLINICAL PRESENTATION OF MENINGITIS ^{1,2,3,10}

- Meningitis may be due to many different viruses, bacteria, mycobacteria, fungi and, less commonly, parasites.
- The most likely pathogen depends on several factors including a patient's age, immune and vaccination status, and geographic location.
- However, four bacteria are responsible for more than half of the deaths from meningitis globally.
- They are:
 - *Neisseria meningitidis* (meningococcus)
 - *Streptococcus pneumoniae* (pneumococcus)
 - *Haemophilus influenzae* type B (Hib)
 - *Streptococcus agalactiae* (group B streptococcus).

MOST COMMON SIGNS AND SYMPTOMS

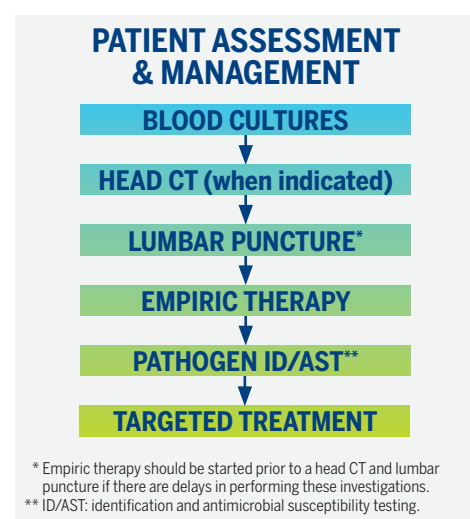
NEWBORNS AND INFANTS	PATIENTS OLDER THAN 2 YEARS
• High fever • Constant crying • Excessive irritability • Lethargy • A bulging fontanel • Hyper/hypotonia • Poor appetite (refusing food or drink) • Mottled skin	• Sudden high fever • Severe headache • Stiff neck • Nausea and/or vomiting • Confusion or difficulty concentrating • Decreased level of consciousness • Seizures • Photophobia • Petechial rash for older patients

A physical exam may produce a positive Kernig's and/or Brudzinski's signs



DIAGNOSTIC APPROACH ¹¹⁻¹⁵

- Many guidelines for the diagnosis and management of meningitis are available. They may have some differences based on regional specifics.
- **Blood tests** provide information about the infection and the patient. A **blood culture** may be positive in up to 50% of meningitis cases.
- **Computed tomography (CT) of the head**, when available, is reserved for select patients, such as those showing signs and symptoms of increased intracranial pressure (ICP). Magnetic resonance imaging (MRI) or CT may also be used to assess damage to the brain or spinal cord.
- Whenever safely possible, **cerebrospinal fluid (CSF)** should be obtained via a **lumbar puncture (LP)** for microscopic and biochemical analysis as well as **pathogen identification** and **potential antimicrobial sensitivity testing**.
- **Molecular diagnostics, such as multiplex polymerase chain reaction (PCR)**, are powerful diagnostic tools recommended to augment traditional diagnostics. These tests provide **fast and accurate identification of multiple pathogens**, which allows for targeted antimicrobial decisions to be made sooner, even when the patient has been pre-treated with antibiotics.



TREATMENT STRATEGIES¹¹⁻¹⁵

- **Parenteral antibiotics** should be given within one hour when bacterial meningitis is suspected.
- **Appropriate antimicrobial therapy** should not be postponed for diagnostic delays, such as when a head CT or LP is needed but cannot be obtained quickly.
- **Antimycobacterial regimens** for tuberculosis, **antifungal medication** for cryptococcus or **antivirals** such as acyclovir for herpes simplex virus and varicella zoster virus infection are given when there is an increased suspicion for these pathogens.
- **Ancillary treatments** such as steroids, antiseizure medications, and medications/procedures to manage ICP may be recommended based upon factors like age, pathogen (bacterial vs. viral), immune status, and patient condition (seizures, signs and symptoms of increased ICP).

PREVENTION^{14,16,17}

- **Vaccines** have led to substantial declines in many of the most common causes of bacterial meningitis including *Streptococcus pneumoniae*, *Haemophilus influenzae* type b, and *Neisseria meningitidis*.
- Historically, these vaccines have only been largely available in more developed countries and regions.
- However, recently a mass immunization program using a **conjugate vaccine against group A meningococcus**, which has caused >80% of epidemics in the African meningitis belt, is having a significant and dramatic impact in breaking the cycle of these epidemics.
- Where feasible, **close contacts of cases of meningococcus meningitis** may be given **chemoprophylaxis** with an appropriate antibiotic in order to prevent epidemic spread.

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