FREQUENTLY ASKED QUESTIONS ON

MENINGOCOCCAL DISEASE

PAHO
Pan American Health Organization
World Health Organization
REGIONAL OFFICE FOR THE Americas

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PAHO Pan American Health Organization World Health Organization Regional Office for the Americas

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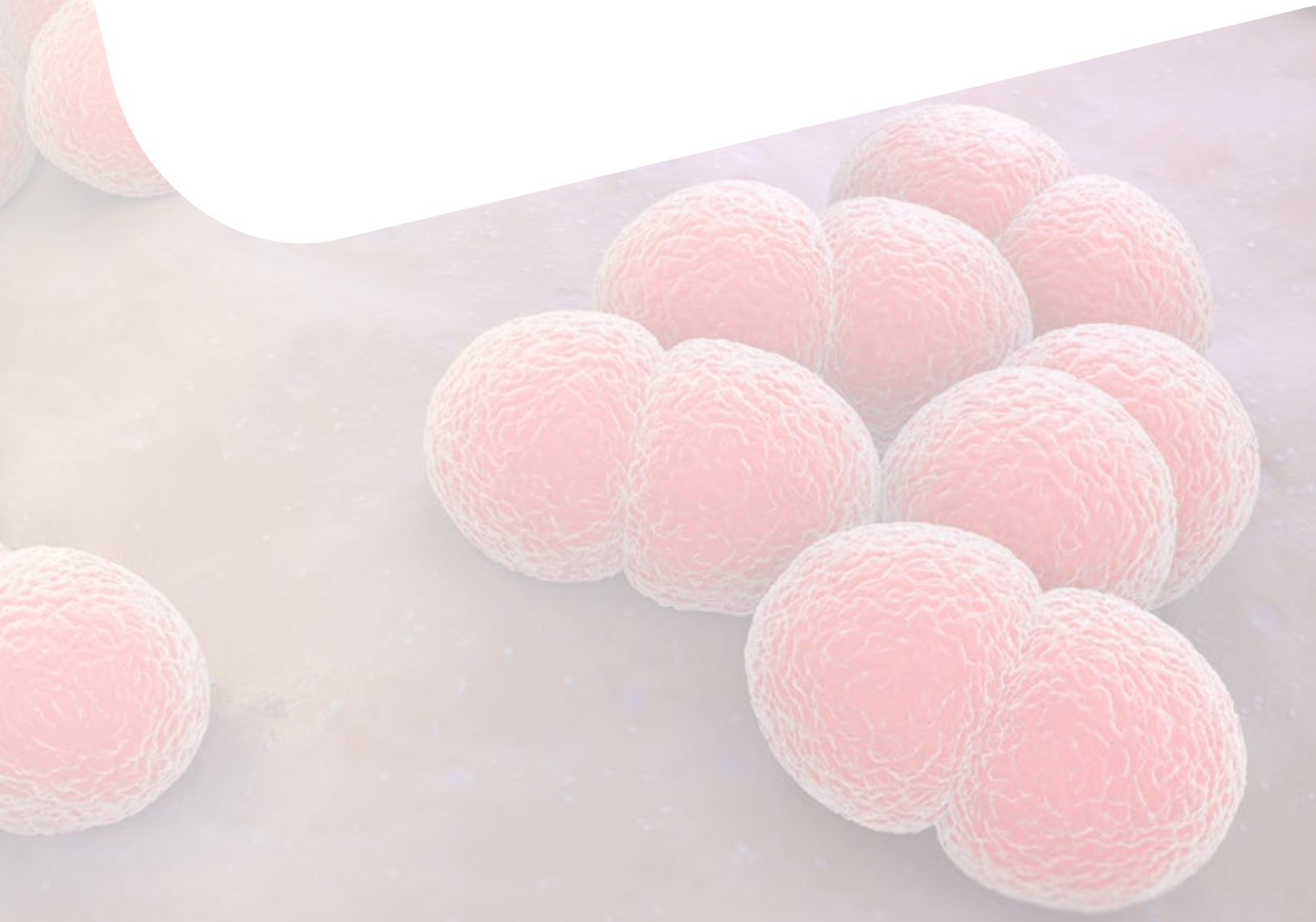


ABBREVIATIONS AND ACRONYMS

CSF	cerebrospinal fluid
ESAVIs	events supposedly attributable to vaccination or immunization
Hib	*Haemophilus influenzae* type b
HIV	human immunodeficiency virus
IMD	invasive meningococcal disease
NRL	national reference laboratory
OMV	outer membrane vesicle
PAHO	Pan American Health Organization
PCR	polymerase chain reaction
RDT	rapid diagnostic test
WHO	World Health Organization

INTRODUCTION

This publication of the Pan American Health Organization (PAHO) aims to answer common questions on meningococcal disease. Meningococcus, or *Neisseria meningitidis*, is one of the causes of bacterial meningitis and septicemia worldwide. Infants are the most susceptible to meningococcal disease, with the peak among those 3–5 months of age. The overall incidence of meningococcal meningitis is low, but the fatality rate is high. Furthermore, survivors of meningococcal disease may suffer from severe and life-long sequelae, affecting their quality of life.

The burden of this disease is still uncertain across much of the Americas, and to address this, PAHO conducts surveillance of bacterial meningitis among children under five years through a regional network. Meningococcal case fatality rates are high in many Latin American countries.

Meningococcal disease is treatable with timely administration of antibiotics and preventable by vaccination. Several types of vaccine are available, safe, and effective. As of May 2021, in the Region of the Americas, meningococcal vaccines are included in the routine national vaccination programs of Argentina, Brazil, Canada, Chile, Cuba, and the United States of America. The World Health Organization (WHO) and partners have developed a global road map toward defeating meningitis by 2030.

This publication uses a question and answer format to explain technical concepts using plain language to raise awareness and provide the reader with a general overview and clearer understanding of meningococcal disease, including its presentations, diagnosis, and prevention.

The questions and answers are organized into the following five main sections:

1. **Meningococcal disease**
2. **Meningococcal vaccination**
3. **Meningococcal vaccine safety**
4. **Meningococcal vaccine education and programmatic concerns**
5. **Meningococcal vaccine and disease myths and misconceptions.**

The list of questions presented is not exhaustive but provides an accessible introduction to the topic. The target audience of this publication is health professionals, but the information it contains is relevant to a broader audience.

1. MENINGOCOCCAL DISEASE

1. WHAT IS MENINGOCOCCUS?

Meningococcus, or *Neisseria meningitidis (Figure 1)*, is one of the bacteria that cause meningitis around the world (*1*). This Gram-negative bacterium can reside harmlessly in the human pharynx (*1*). This asymptomatic carriage can progress to invasive meningococcal disease (IMD), which can lead to meningitis, septicemia/meningococcemia (blood poisoning), or both (*1*). Meningococcal carrier status is rare in young children and in adults (1%) (*2*). According to carriage studies conducted around the world, adolescents and young adults have the highest rates of carriage, whereas infants have the highest rate of disease and one of the lowest rates of carriage (*3*).

2. HOW MANY TYPES OF MENINGOCOCCUS ARE THERE?

There are 13 strains (types), known as serogroups, of this bacterium. Some of the most prevalent ones are denoted by the letters A, B, C, W, X, and Y (*1*). Serogroup X is the least prevalent serogroup, but it is becoming more widespread in some regions of the world, like countries in the so-called African meningitis belt (*4*).

3. WHAT ARE THE BIOLOGICAL CHARACTERISTICS OF MENINGOCOCCUS?

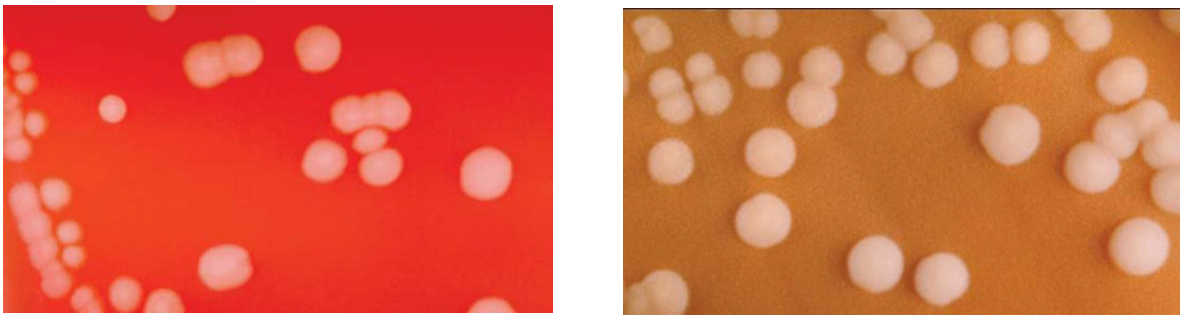
N. meningitidis is a Gram-negative bacterium (Table 1). It is often described as "coffee-bean shaped" diplococci, meaning that it occurs in the form of two joined cells (*5*). This bacterium can occur inside or outside of polymorphonuclear leukocytes (PMNs) (*5*), which is a type of a white blood cell (*6*). *N. meningitidis* grows best at 35–37 ˚C with around 5% CO_2 (*5*).

4. HOW CAN MENINGOCOCCUS BE CONTRACTED?

Humans are the only host of *N. meningitidis* (*7*). *N. meningitidis* is spread from person to person by respiratory secretions, such as saliva or spit (*7*). This exchange usually happens during close contact, such as coughing or kissing, or lengthy contact, like living in close proximity with others (*7*). Therefore, social determinants of health, like living situations, can exacerbate the issue and put people at a higher risk of contracting meningococcus.

According to a 2017 case-control study of risk factors for meningococcal disease in Chile by Olea et al, conditions of social vulnerability, like low income and

Figure 1. Left: *N. meningitidis* colonies on a blood agar plate; right: *N. meningitidis* colonies on a chocolate agar plate



Source: World Health Organization; United States Centers for Disease Control and Prevention. Laboratory Methods for the Diagnosis of Meningitis Caused by *Neisseria meningitidis*, *Streptococcus pneumoniae*, and *Haemophilus influenzae*. 2nd ed. Geneva: WHO; 2011.

overcrowding, increased the probability of illness in the surveyed individuals (*8*). The connection between social determinants of health and meningococcal disease needs further exploration in order to accurately determine the risk of developing IMD in vulnerable populations.

5. WHO IS AT HIGH RISK OF CONTRACTING MENINGOCOCCUS?

The risk of meningococcal disease varies from country to country. In endemic countries, WHO (WHO) characterizes endemicity in three levels: low, moderate, and high (*9*). Low endemicity is characterized by < 2 cases / 100,000 population per year, moderate endemicity by 2–10 cases / 100,000 per year, and high endemicity by > 10 cases / 100,000 per year (*9*). In the African meningitis belt, the definition used by WHO of a meningococcal epidemic is > 100 cases / 100,000 population per year. Outside the meningitis belt, an outbreak is defined as a substantial increase in IMD above the expectation by place and time (*9*).

Everyone is at risk of contracting meningococcus, but some people are at a higher risk of becoming infected. According to WHO, there are several risk factors that increase someone's likelihood of contracting meningococcal disease. These risk factors include age, group settings, certain medical conditions, and travel (*9, 10*).

Age

Infants are the most susceptible to meningococcal disease, and the peak is in children between 3 and 5 months of age (*2*). Multiple studies have shown that the rates of meningococcal disease increase starting at age 16, in the absence of vaccination (*11*). Peak rates of meningococcal disease are reached in late adolescence before declining to reach rates that are similar to adult age groups (*11*).

Group settings

In group settings where people live in close proximity to each other, infectious diseases like meningococcal disease are easily spread from person to person. In particular, university students living in dormitories tend to have a higher risk of contracting meningococcal disease compared with other teens and young adults who are not enrolled in university (*7*). Additionally, localized outbreaks occur in other enclosed crowded spaces, like military barracks (*12*). Other social conditions that involve crowding, like living in a small home with many individuals, may also increase the risk of contracting meningococcus.

Underlying medical conditions

Some existing medical conditions and medications may increase the risk of contracting meningococcal disease, due to a weakened immune system (*10*). Examples of these medical conditions include:

- Persistent complement component deficiencies: disorders of the complement system, which helps the body fight off infections. These disorders are rare and usually genetic.
- People taking medications that serve as complement inhibitors are also at increased risk of meningococcal disease. Examples of these medications include: eculizumab (Soliris®) and ravulizumab (Ultomiris®) (*13*).
- Functional or anatomic asplenia: anatomic asplenia refers to people who do not have a spleen and functional asplenia means that the spleen is present but does not work properly (like with sickle cell anemia) (*10*).
- HIV infection: children and adults with HIV are at an increased risk for meningococcal disease (*10*).
- Standard and intensive chemotherapy: patients with acute leukemia experience a decrease in vaccine-specific antibody and an increased susceptibility to certain vaccine-preventable diseases. Revaccination of patients after completion of standard chemotherapy for acute leukemia is recommended in order to provide a good level of protection against vaccine-preventable diseases, like meningococcal disease (*10*).
- Malaria and malaria chemoprophylaxis: malaria suppresses the immune response to meningococcal capsular polysaccharide antigens; therefore, post-vaccination antibody levels are better maintained in those who are receiving malaria chemoprophylaxis as opposed to those who are not (*10*).
- Pre-term infants: pre-term infants are at greater risk of infection in comparison with those born at full term, due to their immature immune systems. Provided they are well and there are no contraindications to immunization, pre-term infants are recommended to receive the routine immunization schedule in accordance with their chronological age (*10*).

Travel

Those living in or traveling to the meningitis belt in sub-Saharan Africa are at an increased risk for meningococcal disease due to the high rates of disease in those 14

countries. Countries in the meningitis belt include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Côte d'Ivoire, Democratic Republic of the Congo, Ethiopia, Ghana, Mali, Niger, Nigeria, Sudan, and Togo. Meningococcal disease is most common during the dry season in this area of Africa, from December through June (*9*). Additionally, traveling to Saudi Arabia for the annual Hajj and Umrah pilgrimages is another activity with increased risk of meningococcal disease. However, Saudi Arabia has made meningococcal vaccination (quadrivalent ACWY) prior to entering the country mandatory, therefore controlling the spread of the disease (*14*). Saudi Arabia has also introduced meningococcal polysaccharide vaccines in its routine vaccination programs, similar to China (*9*).

6. CAN MENINGOCOCCAL DISEASE BE PASSED FROM A MOTHER TO HER CHILD DURING PREGNANCY?

Like many other bacterial infections, meningococcal disease acquired by the mother during pregnancy can cross the placenta and infect the fetus, thereby affecting the brain and development of the fetus, putting the child at risk of cognitive disorders and other postnatal complications (*15*).

7. CAN VACCINATING PREGNANT WOMEN CONFER INFANT IMMUNITY AGAINST MENINGOCOCCAL DISEASE?

Immunity against meningococcus can be acquired passively through the placenta from a mother who has previously been infected or vaccinated (*2*). However, previous studies have shown that although there was passive transfer of meningococcal antibodies from mother to child, the passive transfer was irregular and did not guarantee immunity against meningococcal disease in children (*16*).

Table 1. Characteristics of *N. meningitidis*

Etiologic agent	***N. meningitidis***
Type of bacterium	Gram-negative diplococcus
Reservoir	Humans
Distribution	Global
Seasonality	Winter and spring
Transmission	By direct contact (person to person) and nasopharyngeal secretions (droplets)
Period of transmission	While in the respiratory tract and up to 24 hours after the start of treatment with the specific antibiotic
Carrier status	Yes
Incubation	2 to 10 days (generally between 3 and 4 days)
Susceptibility	Infants are the most susceptible, and the peak is in children between 3 and 5 months of age. Incidence increases again in adolescence and in the first years of adulthood.
Risk factors	Carriers of some chronic diseases have an increased risk. Overcrowded conditions, low socioeconomic status, active or passive exposure to tobacco smoke, and concurrent upper respiratory infections
Immunity	Immunity can be acquired passively transplacentally or actively by previous infection or immunization.

Source: Adapted from Heymann DL. The Control of Communicable Diseases. Washington, DC: Pan American Health Organization; 2017.

Therefore, only vaccinating pregnant women is not an effective strategy for preventing meningococcal disease in infants and children; both the mothers and the children need to be vaccinated separately.

8. WHAT ARE ALL THE HEALTH PROBLEMS CAUSED BY MENINGOCOCCUS?

Most commonly, meningococcal infection results in two health complications: meningococcal meningitis and meningococcemia/septicemia (blood poisoning), both of which have non-specific symptoms at early stages of disease (*17*). These conditions can happen separately or simultaneously (*18*). Other than meningococcal meningitis and meningococcemia/septicemia, the most common non-neurological organ disease caused by *N. meningitidis* is meningococcal pneumonia (*19*).

Meningitis
Meningitis is defined as the inflammation of the membranes around the brain and the spinal cord (*7*). Symptoms of meningococcal meningitis include fever, headache, and stiff neck (*7*). Sometimes there are other symptoms, such as nausea, vomiting, photophobia (eyes being more sensitive to light), and confusion (*7*). In newborns and babies, it may be difficult to notice these symptoms. Instead, babies may be slow or inactive, may be irritable, may vomit, may feed poorly, or may have a soft spot on their head (bulging fontanel) (*20*).

Meningococcemia/septicemia
Meningococcemia happens when the bacteria enter the bloodstream, causing damage to blood vessels, leading to bleeding into the skin and organs (*20*). Meningococcemia is characterized by sepsis and rash (*20*). Other symptoms are listed in Table 2.

Meningitis and meningococcemia/septicemia
It is important to note that meningitis and meningococcemia/septicemia can overlap to a certain extent and may occur simultaneously (*18*).

Meningococcal pneumonia
Meningococcal pneumonia occurs mainly with serogroups B, W, and Y (*19*). This occurs in 5%–10% of patients with meningococcal infection and its clinical symptoms are indistinguishable from pneumonia caused by other pathogens (*19*). The most common symptoms include fever, chills, and pleuritic chest pain in more than 50% of cases (*19*).

Sequelae
Up to 30% of bacterial meningitis cases may have permanent sequelae (*2*). These sequelae include loss of limb(s), deafness, nervous system problems, and brain damage (*9*). The most frequent is sensorineural hearing loss. Other important sequelae are language disorders, intellectual impairments, motor abnormalities, seizures, and visual disorders. The most common sequelae of meningococcal disease are listed in Table 3.

Table 2. Signs and symptoms of meningococcal disease by age

< 1 year of age	≥ 1 year of age
• Bulging of the fontanel • Seizures • Decreased appetite • Irritability without other justification or other clinical cause • Lethargy • Vomiting	• Alteration of the state of consciousness • Seizures • Headache • Photophobia • Lethargy • Stiff neck or other sign of meningeal inflammation, or both • Prominent signs of hyperactivity • Projectile vomiting (explosive)

Source: Pan American Health Organization. Surveillance of bacterial pneumonia and meningitis in children aged under 5 years. Field guide. Second edition. Washington, DC. PAHO. 2021.

Table 3. Sequelae due to *N. meningitidis*

Etiologic agent	Sequelae (%)				Lethality (%)
	Deafness	**Intellectual impairments**	**Spasticity/ paresis**	**Seizures**	
N. meningitidis	6	2	2	6	8–15

Source: Adapted from Baraff LJ, Lee SI, Schriger DL. Outcomes of bacterial meningitis in children. Pediatric Infectious Disease Journal 1993;12(5):389–394.

Meningitis can rapidly evolve into stupor (a state of unconsciousness), coma, and death.

Having both meningococcal meningitis and meningococcemia can result in additional sequelae, such as amputations (fingers, toes, limbs), skin scarring, and bone growth problems (*21*). In the absence of meningitis, meningococcemia can still result in serious sequelae, such as learning delays, poor concentration and memory, and psychological problems (*21*).

9. WHAT IS THE DIFFERENCE BETWEEN BACTERIAL MENINGITIS AND INVASIVE MENINGOCOCCAL DISEASE (IMD)?

Bacterial meningitis
It is important to note that meningitis can be caused by several different pathogens, such as *N. meningitidis*, *Haemophilus influenzae*, and *Streptococcus pneumoniae* (*22*). Therefore, the term bacterial meningitis can refer to infection by more than one pathogen, including *N. meningitidis*, which is responsible for meningococcal disease.

Invasive meningococcal disease (IMD)
IMD refers strictly to infection caused by *N. meningitidis*. As mentioned above, IMD can manifest as meningitis and/or meningococcemia/septicemia.

10. WHAT IS THE IMMUNE RESPONSE AFTER MENINGOCOCCAL INFECTION?

When *N. meningitidis* manages to circumvent the body's first line of defense, mucosal immunity, meningococcal disease develops. In response to meningococcal infection, the complement system of plasma proteins is strongly activated (*23*). The complement system is a part of the body's innate immune system, which bridges the innate (non-specific) and adaptive (specific) immune response (*24*). The complement system is composed of a series of more than 20 proteins that circulate in the blood and tissue fluids. The complement system is in charge of killing any bacterium that enters the body (*25*). There are three ways in which the complement system can be activated: through antibody mediation, direct binding of complement components to the pathogen surface, or by mannose-binding lectin (a pattern-recognition molecule of the innate immune system) recognizing and binding to mannose on the pathogen's surface (*23*).

Once the bacterium is recognized by the complement system, effector functions like opsonization and phagocytosis, lysis of meningococci, and other inflammatory responses get activated (*23*). All of these responses aim to kill the bacteria that are present in the body, preventing them from multiplying and colonizing the spine, brain, and/or blood.

Another important part of the immune response after meningococcal infection is cytokine activation. Cytokines are small proteins released by cells that affect the interactions and communications between cells (*26*). While activation of cytokines will result in an adequate immune response, overactivation can cause extreme harm (*23*).

Clinical consequences of immune activation, like purpuric skin rash and shock, start to appear when inflammatory mediators cause organ damage and capillary leakage (the leakage of fluid and proteins out of blood vessels into surrounding tissues) (*23, 27*).

11. WHAT IS THE INCIDENCE OF MENINGOCOCCAL DISEASE?

Global burden

Globally, before the introduction of the vaccine, *N. meningitidis* serogroup A had the highest incidence, causing invasive disease in infants under 1 year. The area most affected by serogroup A was sub-Saharan Africa. Serogroups B and C cause the majority of cases in Europe and the Americas, while serogroups A and W are the most frequent cause of IMD in Asia (Figure 2). Increases in cases of IMD caused by serogroup Y in the United States of America and Israel have been seen since the mid-1990s, and serogroup X has caused local epidemics in sub-Saharan Africa (*2*).

Although the highest burden of meningococcal meningitis is seen in the African meningitis belt, with lower incidence across Europe and North America, the burden of this disease is uncertain across much of South America, Southeast Asia, and the Western Pacific due to inconsistent surveillance (*21*).

Region of the Americas

According to a 2017 special report in the Pan American Journal of Public Health, Latin America has a high prevalence of serogroups B, C, W, and Y (*28*). Since 2007, an increasing proportion of cases of infection by serogroup W have been identified in countries of the Region of the Americas (*2*). Table 4 details the spread of these serogroups across various regions and countries.

12. ARE THERE ANY SURVEILLANCE SYSTEMS IN PLACE TO MONITOR MENINGOCOCCAL DISEASE TRENDS AND OUTBREAKS IN THE REGION OF THE AMERICAS?

Yes, PAHO has set up a passive laboratory-based surveillance network called SIREVA II (Sistema de Redes de Vigilancia de los Agentes Bacterianos Responsables de Neumonía y Meningitis) (*28*). This Spanish acronym translates to: Surveillance Network System for Bacterial Agents Responsible for Pneumonia and Meningitis. This network is composed of 21 national reference laboratories (NRLs) and two regional reference laboratories: the Adolfo Lutz Institute in Brazil and the National Institute of Health in Colombia. Participating hospitals voluntarily report lab data and some clinical and epidemiological characteristics for cases of invasive *S. pneumoniae*, *H. influenzae*, and *N. meningitidis* infection. Furthermore, hospitals also send cerebrospinal fluid (CSF) and blood specimens to NRLs for strain confirmation and antibiotic susceptibility testing.

13. WHAT IS SENTINEL SURVEILLANCE?

Sentinel surveillance is a type of active surveillance, which involves a limited network of carefully selected reporting sites that meet the criteria defined by the surveillance. Laboratories involved in hospital sentinel surveillance fall into four levels of complexity: sentinel hospital laboratory (SHL), regional reference laboratory, and global reference laboratory (*2*).

PAHO conducts hospital-based sentinel surveillance of bacterial meningitis among children under 5 years (*2*). In Latin America, nine countries and 22 hospitals are involved in active sentinel surveillance. Since 2014, the Regional Network has been included in the WHO-coordinated global Rotavirus and Invasive Bacterial Vaccine-Preventable Diseases (IB-IVD) Sentinel Hospital Surveillance Networks (*28*).

The objectives of bacterial pneumonia and meningitis surveillance in children under 5 years in Region of the Americas are as follows (*2*):

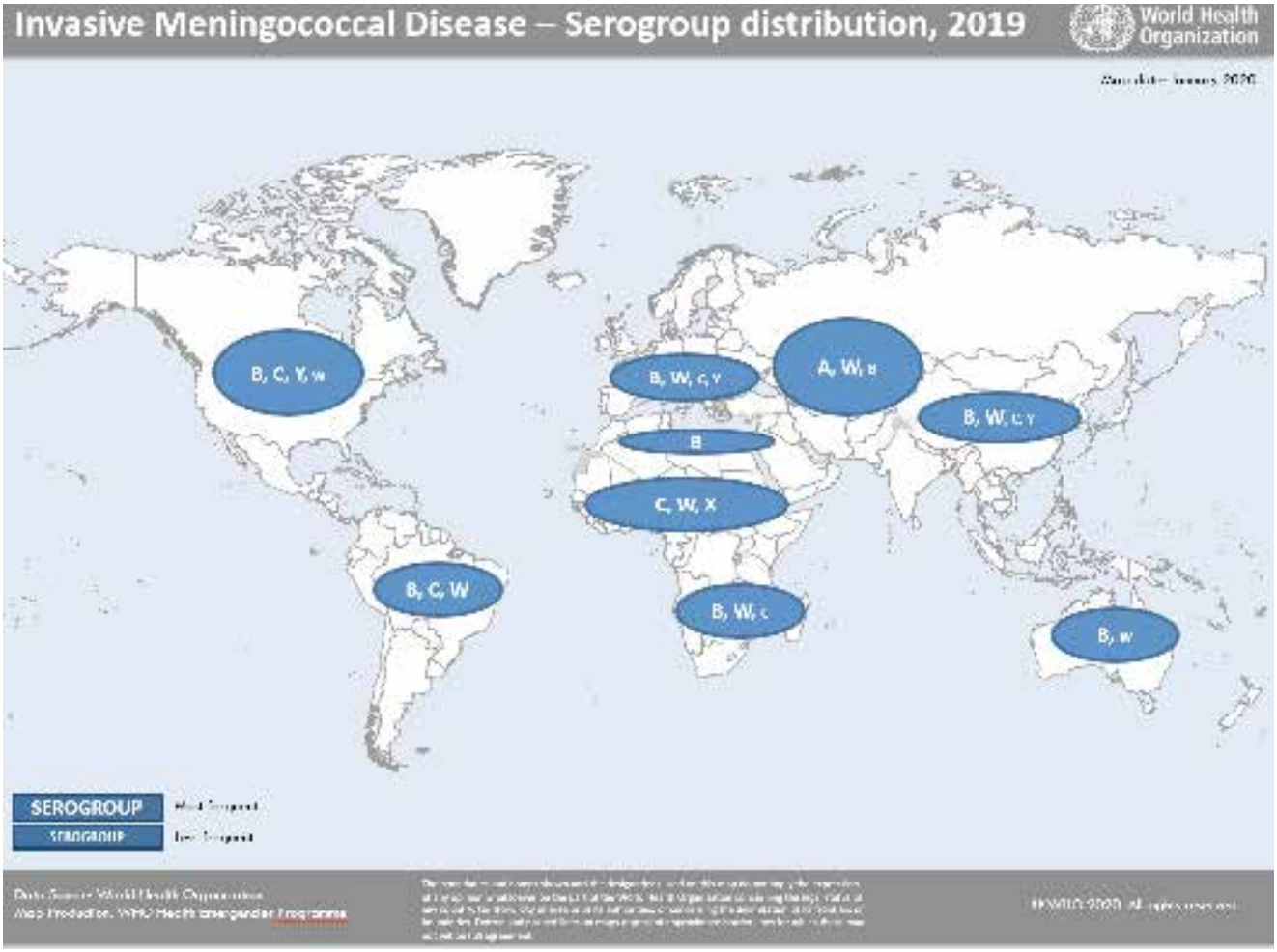
- To obtain standardized epidemiological data on bacterial pneumonia and meningitis;
- To identify *H. influenzae*, meningococcus, and pneumococcus, and to describe the strains of those agents in circulation, as well as changes of serotypes/serogroups as they emerge;
- To monitor antimicrobial susceptibility patterns and contribute to establishing technical standards for the use of antimicrobial drugs; and
- To generate information on the basis of which to introduce new vaccines and monitor their impact.

Case definitions

Three case definitions are used for surveillance purposes: suspected cases, probable cases, and confirmed cases (please refer to question 18 for more details). The following additional classifications may also be used (*2*):

- Bacterial meningitis discarded: every suspect case with CSF findings not compatible with bacterial etiology, and without bacterium identification

Figure 2. Prevalence of *N. meningitidis* serogroups, global overview



Source: World Health Organization [Internet]. Geneva: WHO; 2021 [cited 2021 Jun 2]. Meningitis. Available from: https://www.who.int/health-topics/meningitis#tab=tab_1

from the CSF or blood (through culture, rapid test, polymerase chain reaction [PCR], etc.).

- Inadequately investigated case of suspect meningitis: every suspect case without collection of a CSF specimen (*2*).

14. WHAT IS THE BURDEN OF MENINGOCOCCAL DISEASE?

The overall incidence of meningococcal meningitis is low, but the fatality rate is high (*29*). Furthermore, IMD survivors may suffer from severe and life-long sequelae, which affects their quality of life.

African meningitis belt

According to WHO, every year, meningococcal meningitis epidemics affected more than 400 million people living in 26 countries of the African meningitis belt (*30*).

Meningococcus was the leading cause of meningitis mortality in 1990 (192,833 deaths globally) (*31*).

From 1991 to 2010, close to 1 million suspected meningococcal meningitis cases were reported among countries of the African meningitis belt, of which 100,000 died. About 80,000 of these meningitis cases, including 4,000 deaths, happened in 2009 alone (*32*). During the 2006–2007 epidemic season in the African meningitis belt, 53,438 suspected cases and 3,816 deaths were reported to WHO from 15 African countries (*9*).

From 2010 to 2014, cases steadily decreased from 24,000 cases in 2010 to 11,500 cases in 2014 due to mass prevention campaigns in the region with the monovalent meningococcal A conjugate vaccine (30).

Table 4. Prevalence of *N. meningitidis* serogroups

Serogroup	Country/region
A	Has not been circulating in the Americas (North America and Latin America) and the Caribbean for a while (past 65 years), but it is present in sub-Saharan Africa and Asia
B	Asia, Latin America, Canada, United Kingdom, and United States of America
C	Latin America, Canada, United States of America
W	Asia, Argentina, Brazil, Canada, Chile, United Kingdom, and United States of America
X	Sub-Saharan Africa
Y	Argentina, Canada, Chile, Colombia, Costa Rica, United States of America, Uruguay, and Venezuela (Bolivarian Republic of)

Sources: Sáfadi MAP, Valenzuela MT, Carvalho AF, Oliveira LHD, Salisbury DM, Andrus JK. Knowing the scope of meningococcal disease in Latin America. Revista Panamericana de Salud Pública 2017;41:118.
Pan American Health Organization. Surveillance of bacterial pneumonia and meningitis in children aged under 5 years: Field guide. Second edition. Washington, DC: PAHO; 2021.
United States Centers for Disease Control and Prevention https://www.cdc.gov/. Atlanta: CDC; 2019 May 31. Clinical Information: Meningococcal Disease: Technical and Clinical Information.
Meningitis Foundation Canada https://www.meningitis.ca. Waterloo: Meningitis Foundation Canada; c. 2020. Meningococcus and Vaccines.

However, epidemics due to serogroups C, W, and X remain a persistent threat in the region. Almost 18,000 cases of serogroup C were reported in Niger and Nigeria in the 2017 epidemic season (*31*).

Region of the Americas

As for Latin America, in 2006, Brazil reported the highest case fatality rate in the region, with a 20% case fatality rate (*33*). In 2006, Uruguay had the second highest case fatality rate in Latin America, with a 15% case fatality rate (*33*). Argentina and the Bolivarian Republic of Venezuela both had case fatality rates of 10% in 2006. In 2007, Argentina had a case fatality rate between 8% and 10% and Chile had a case fatality rate of 11% (*33*).

In 2012, Chile reported the highest case fatality rates in Latin America (*34*). In 2013, the case fatality rates in Brazil remained high, reaching 18%–20% (*33*). Therefore, meningococcal case fatality rates are high in many Latin American countries.

15. HOW LONG AFTER A MENINGOCOCCAL INFECTION DOES IT TAKE FOR MENINGOCOCCAL DISEASE TO DEVELOP IN THE BODY?

Meningococcus has a relatively short incubation period, ranging from 2 to 10 days, with an average of about 3 to 4 days (*7, 17*). Therefore, IMD has a fast rate of clinical progression. To reduce the risk of infection and potential death, prevention and prompt treatment need to be available to vulnerable populations.

16. HOW DOES *N. meningitidis*, A BACTERIUM THAT RESIDES IN THE PHARYNX OF MANY HUMANS, PROGRESS TO INVASIVE MENINGOCOCCAL DISEASE (IMD)?

It is common for *N. meningitidis* to be present in the human pharynx. In fact, between 5% and 24% of adolescents and young adults can carry meningococcus in the nasopharynx (*2*). However, meningococcal disease occurs when the bacterium progresses from invading the nose and throat

Table 5. Case definitions for meningococcal disease (meningitis and meningococcemia)

Case definitions		
Suspected	**Probable**	**Confirmed**

All patients hospitalized with a clinical diagnosis of meningitis or meningococcemia	Clinical diagnosis of meningitis or septicemia and at least one of the following:
	
	Purpuric rash (skin rash in which small spots of blood appear on the skin) where IMD is considered the most likely cause
	
	Gram-negative diplococci identified from any sterile site (blood, CSF) or from a purpuric skin lesion
	
	Any suspected case in which the CSF examination is compatible with bacterial meningitis; that is, it has at least one of the following characteristics:
	
	• Cloudy appearance
	• Increased leukocytes (> 100 / mm^3)
	• Leukocytes 10–100 / mm^3 and
	  • Protein elevation (> 100 mg/dL) or
	  • Decrease in glucose (< 40 mg/dL)
	
	N. meningitidis antigen detection (e.g., by latex agglutination testing) from any normally sterile site or from a purpuric skin lesion
	
	Rapid tests are also used in outbreak settings to test for infection. Examples of rapid tests include latex agglutination testing and immunochromatography dipsticks.
		N. meningitidis is identified via culture or polymerase chain reaction (PCR) from a purpuric skin lesion or any normally sterile site (blood, cerebrospinal fluid [CSF] or other fluids, such as synovial fluid from joints).

Sources: World Health Organization. Meningococcus: Vaccine preventable diseases surveillance standards. Geneva: WHO; 2018.

Pan American Health Organization. Surveillance of bacterial pneumonia and meningitis in children aged under 5 years: Field guide. Second edition. Washington, DC: PAHO; 2021.

World Health Organization. Specifications for a rapid diagnostic test for meningitis: African meningitis belt. Geneva: WHO: 2016.

to invading deeper mucosal layers (*35*, *36*). The bacterium is then able to rapidly multiply and cause harm to the nervous system. In 10%–20% of cases, *N. meningitidis* may also enter the bloodstream, causing meningococcemia (*36*). Additionally, it is possible to have both meningococcal meningitis and meningococcemia at once, in which case the bacteria invade the blood 24–48 hours in advance of invading the spine and the brain (*35*).

17. HOW IS MENINGOCOCCAL DISEASE INVESTIGATED?

Lumbar puncture/cerebrospinal fluid (CSF)

According to WHO, once a patient exhibits clinical symptoms, physicians do a lumbar puncture to collect CSF (*1*). A lumbar puncture is a medical procedure that involves inserting a needle in between two vertebrae in the lower back to obtain a sample of CSF (*37*). An infected individual's CSF typically contains pus, and bacteria may be seen on microscopic examination of the CSF (*1*). For confirmation of results, there are rapid tests available, PCR, and culture (*1*). If infection is confirmed, it is important the meningococcal serogroup be determined (*1*).

Blood tests

Blood samples may also be collected to test for the presence of meningococcus in the blood (*1*). Then, any detected bacterium is grown and sent for further laboratory testing.

Rapid diagnostic tests for African meningitis belt and decentralized settings

Rapid diagnostic tests (RDTs) are used in the investigation of meningitis outbreaks and are useful in decentralized health care facilities with no laboratory infrastructure available (*38*). These RDTs include latex agglutination and immunochromatography dipsticks (*38*). RDTs are a useful field tool in the surveillance of outbreaks (especially in the African meningitis belt countries), but they have limited performance, which necessitates other testing methods for a definite confirmation of the disease (*38*).

18. HOW ARE MENINGOCOCCAL DISEASE CASES DEFINED?

WHO proposes a system with specific case definitions in order to properly investigate meningococcal disease (*1*). Table 5 provides an explanation of these case definitions.

19. HOW IS MENINGOCOCCAL DISEASE TREATED?

Preferably after performing a lumbar puncture to obtain CSF, antibiotics should be administered in a timely fashion (Table 6). According to the 2020 PAHO Field Guide *Surveillance of Bacterial Pneumonia and Meningitis in Children Aged Under 5 Years*, every child with meningitis should be referred to the nearest hospital for treatment (*2*). Various antibiotics are able to fight the infection (*7*), and the choice of drug depends on country or local protocol. Some patients may need additional treatments, depending on the seriousness of the infection (*7*). These include breathing support, medications for low blood pressure, surgery to remove dead tissue, and wound care for parts of the body that may have damaged skin (*39*).

20. HOW CAN MENINGOCOCCAL DISEASE BE PREVENTED?

Vaccination

There are many licensed vaccines against meningococcal disease. Several vaccines target different strains of meningococcus, but to date there is no universal vaccine that covers all strains (*7*). More details about the meningococcal vaccines currently available are presented in Section 2, Meningococcal Vaccination.

Chemoprophylaxis (the usage of drugs to prevent disease)

Antibiotics are prescribed for close contacts of patients with meningococcal disease and to extended close contacts in some cases, especially children (*7*). Close contacts include those living in the same household/ those who have an equivalent level of contact, those who attend the same childcare or preschool, travel contacts (such as people sitting next to an IMD case on a long flight), and anyone directly exposed to respiratory or oral secretions of a case in the seven days before disease onset (*1*). This preventive measure reduces the risk of transmission and infection.

Table 6. Medications used for prophylaxis

Drug of choice	Age group	Dosage and duration
Rifampin	< 1 month	5 mg/kg; maximum 300 mg; orally every 12 hours for 2 days
	≥ 1 month	10 mg/kg; maximum 600 mg; orally every 12 hours for 2 days
Ciprofloxacin	Full-term neonates to 4 years	30 mg/kg orally single dose; up to a maximum of 125 mg
	5–11 years	250 mg orally single dose
	≥ 12 years	500 mg orally single dose (contraindicated during pregnancy)

Sources: Sáfadi MAP, Cintra OAL. Epidemiology of meningococcal disease in Latin America: current situation and opportunities for prevention. Neurological Research 2010;32(3):263–271.

World Health Organization [Internet]. Geneva: WHO; 2001. WHO Model Prescribing Information: Drugs Used in Bacterial Meningitis. Available from: https://apps.who.int/iris/bitstream/handle/10665/42372/9241401079.pdf?sequence=1&isAllowed=y

United Kingdom, National Health Service [Internet]. [Dundee]: NHS Tayside; 2019 Feb. Meningococcal Infection Chemoprophylaxis. Available from: https://www.nhstaysideadtc.scot.nhs.uk/Antibiotic%20site/pdf%20docs/Chemoprophylaxis%20for%20meningococcal%20disease%20Apr%2012.pdf

2. MENINGOCOCCAL VACCINATION

21. WHAT ARE THE CONSIDERATIONS THAT AFFECT A COUNTRY OR TERRITORY'S CHOICE OF WHICH VACCINE TO USE IN THEIR NATIONAL IMMUNIZATION PROGRAM?

Vaccine introduction should be evaluated according to the WHO categorization of risk. In endemic countries, WHO characterizes endemicity in three levels: low, moderate, and high (*9*). Low endemicity is characterized by < 2 cases / 100,000 population per year, moderate endemicity by 2–10 cases / 100,000 per year, and high endemicity by >10 cases / 100,000 per year (*9*). In the African meningitis belt, the WHO definition of a meningococcal epidemic is > 100 cases / 100,000 population per year. Outside the meningitis belt, an outbreak is defined as a substantial increase in IMD above the expectation by place and time (*9*). For each country, the choice of vaccine depends on the locally prevalent serogroup(s) of *N. meningitidis* (or serosubtype in case of serogroup B).

For all countries, knowledge of the meningococcal disease burden is essential for making appropriate use of available vaccines. Countries considering the use of meningococcal vaccines should develop surveillance systems to characterize meningococcal disease epidemiology, including a standard clinical case definition, field investigation of cases and outbreaks, and laboratory capacity for the confirmation and characterization of *N. meningitidis*. Surveillance is also needed to determine the meningococcal serogroup that is present in the country. Continued surveillance of IMD should dictate the need for and timing of repeat mass vaccination campaigns (*2*).

The following countries in the Region of the Americas have made meningococcal vaccines a routine part of their national vaccination programs: Argentina, Brazil, Canada, Chile, Cuba, and the United States of America (*28, 40, 41*). Outside of the Americas, the following countries have introduced meningococcal vaccines into their national vaccination programs: Australia, Austria, Belgium, China, Czech Republic, Egypt, France, Germany, Greece, Iceland, Italy, Netherlands, New Zealand, Portugal, Saudi Arabia, Spain, Switzerland,

Table 7. WHO characterization of meningococcal risk

Endemicity	High/intermediate endemic rates	Low endemic rates
Rates	> 10 cases / 100,000 population / year 2–10 cases / 100,000 population / year	< 2 cases / 100,000 population / year
Method of vaccination	Routine immunization programs and supplementary immunization activities (SIAs)	Given to at-risk populations
Target group	The whole population (depending on national epidemiology and socioeconomic resources)	Children and young adults in closed communities Laboratory workers at risk of exposure to meningococci Travelers to high-endemic areas Individuals suffering from immunodeficiency: asplenia, terminal complement deficiencies, or advanced HIV infection

Source: World Health Organization. Meningococcal vaccines: WHO position paper. Weekly Epidemiological Record 2011;86:521–540.

Syria, and the United Kingdom (*9, 28, 40, 41*). Please refer to Table 8 for more details regarding vaccine introduction.

22. WHO SHOULD RECEIVE THE MENINGOCOCCAL VACCINE?

Depending on the epidemiological situation, a country may decide to introduce meningococcal vaccines into routine immunization programs and supplementary immunization activities. As described in the previous question, countries need to conduct surveillance in order to determine the burden of disease and the circulating serogroup of meningococcus before deciding on whether to introduce a meningococcal vaccine or not. In countries with low risk of a meningococcal disease outbreak, meningococcal vaccination may be recommended for at-risk populations. These at-risk populations include children and young adults in closed communities, laboratory workers at risk of exposure to meningococci, travelers to high-endemic areas, and individuals suffering from immunodeficiency (asplenia, terminal complement

Table 8. List of vaccines used in some countries for routine immunization

Vaccine type	Region
Polysaccharide vaccine against MenA	China, Egypt
Polysaccharide vaccine against MenC	China, Cuba, Egypt
Conjugate vaccine against MenA infection	Meningitis belt of sub-Saharan Africa: Burkina Faso, Cameroon, Central African Republic, Chad, Ethiopia, Eritrea, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Mali, Niger, Nigeria, Senegal, South Sudan, Sudan, Uganda
Recombinant vaccine against MenB infection	Czech Republic, Italy, New Zealand, United Kingdom
Outer membrane vesicles (OMV) or proteoliposome of MENGOC-BC vaccine	Cuba
Conjugate vaccine against MenC infection	Australia, Belgium, Brazil, Canada, France, Germany, Iceland, Netherlands, New Zealand, Portugal, Spain, Switzerland, United Kingdom
Quadrivalent conjugate vaccines against MenACWY infection	Argentina, Australia, Austria, Brazil, Canada, Chile, Czech Republic, Greece, United Kingdom, United States of America

Sources: Sáfadi MAP, Valenzuela MT, Carvalho AF, Oliveira LHD, Salisbury DM, Andrus JK. Knowing the scope of meningococcal disease in Latin America. Revista Panamericana de Salud Pública 2017;41:118. doi: 10.26633/rpsp.2017.118

Ali A, Jafri RZ, Messonnier N, Tevi-Benissan C, Durrheim D, Eskola J, et al. Global practices of meningococcal vaccine use and impact on invasive disease. Pathogens and Global Health 2014;108(1):11–20. doi: 10.1179/2047773214y.0000000126

Vetter V, Baxter R, Denizer G, Sáfadi MAP, Silfverdal S-A, Vyse A, Borrow R. Routinely vaccinating adolescents against meningococcus: targeting transmission & disease. Expert Review of Vaccines 2016;15(5):641–658. doi: 10.1586/14760584.2016.1130628

Sierra-González VG. Cuban meningococcal vaccine VA-MENGOC-BC: 30 years of use and future potential. MEDICC Review 2019;21(4):19–27. Available from: https://scielosp.org/pdf/medicc/2019.v21n4/19-27/en

deficiencies, or advanced HIV infection) (*9*). Countries with high risk of meningococcal disease outbreak may decide to introduce meningococcal vaccines into the routine immunization program.

23. WHAT VACCINES ARE AVAILABLE TO PREVENT MENINGOCOCCAL DISEASE?

Currently, there are four different types of meningococcal vaccines:

- Conjugate vaccine against meningococcus A, against meningococcus C, and tetravalent conjugate vaccines against meningococci (ACWY);
- Outer membrane vesicles against meningococci B and C;
- Polysaccharide vaccines against meningococci (can be 2-to-4-valent A, C, W, Y);
- Recombinant vaccines against meningococcus B.

As of April 2020, there is no available vaccine on the market for serogroup X (*9*).

As of 2019, the PAHO Revolving Fund for the Region of the Americas, which helps countries procure high-quality life-saving vaccines at the lowest price, includes the tetravalent conjugate vaccine (ACWY), which is sold to Member States (*42*).

24. WHAT ARE THE MENINGOCOCCAL VACCINES COMPOSED OF?

Polysaccharide vaccines
Meningococcal vaccines are bivalent (A and C), trivalent (A, C, and W), or tetravalent (ACWY). These vaccines are composed of purified, heat-stable, lyophilized (freeze-dried) capsular polysaccharides from meningococci of the respective serogroups (*44*).

Conjugate vaccines
Conjugate meningococcal vaccines are available as monovalent serogroup A and serogroup C vaccines; bivalent serogroups A, C vaccine; and tetravalent serogroups A, C, W, and Y vaccine (*43*). Conjugate vaccines are inactive and have a carrier protein that is bound or conjugated to the polysaccharide of the bacterial capsule. The transporter proteins used can be the diphtheria toxoid, tetanus toxoid, outer membrane of the meningococcus, or protein mutant of *Corynebacterium diphtheriae* (the pathogen that causes diphtheria). This conjugation allows the immune system of children under 2 years to identify the protein and produce an adequate and long-lasting antibody response. In addition, studies have shown that conjugate vaccines lead to herd immunity by decreasing the bacterial colonization of the respiratory tract of those who are vaccinated, thus reducing transmission to others (*2*).

Recombinant vaccines
There are two recombinant vaccines on the market that protect against serogroup B meningococcal disease: Trumenba and Bexsero. Trumenba is composed of two recombinant lipidated factor H binding protein (fHbp) variants from N. meningitidis serogroup B (A05 and B01). As for Bexsero, that vaccine is composed of four serogroup B antigens: factor H binding protein (fHbp), Neisserial adhesin A (NadA), Neisserial heparin-binding antigen (NHBA), and PorA P1.4 immunodominant antigen of OMV NZ (strain NZ98/254) (2, 44).

Outer membrane vesicles vaccine
MENGOC-BC vaccine is a bivalent vaccine of serogroups B and C meningococcal antigens, which forms a stable mixture adsorbed to aluminum hydroxide gel. Each dose contains 50 µg of membrane proteins, with 2 µg of serogroup B lipopolysaccharide, integrated in the OMVs, and 50 µg of serogroup C polysaccharide, as well as 2 mg of aluminum hydroxide gel, a formulation buffered with phosphates and sodium chloride at physiological pH. Currently this vaccine is used only in Cuba (*45*, *46*).

25. WHAT IS THE IMMUNE RESPONSE TO THE MENINGOCOCCAL VACCINE?

Polysaccharide vaccines
After receiving a polysaccharide meningococcal vaccine, a protective antibody response occurs within 10 days of vaccination. For children of school age and adults, one dose of the polysaccharide vaccine provides protection for at least three years. Polysaccharide vaccines have important limitations: they do not induce an immune response in children under 2 years of age. They also have little effect on the carrier status, result in a decrease in the level of protection in a few years, and do not generate a memory response (*2*).

Conjugate vaccines
The conjugate vaccines induce a T-cell-dependent immune response. This response is characterized by increased immunogenicity among infants and a prolonged duration of protection. Additionally, recipients of the conjugate meningococcal vaccines show reduced nasopharyngeal carriage of meningococci (*43*). Reduced carriage occurs as a result of decreasing the bacterial colonization of the respiratory tract of those who are vaccinated, thus reducing transmission to others (*2*).

Recombinant vaccines
Recombinant vaccines work by the production of protective antibodies. According to some studies, the antibodies usually persist for about five years after vaccination and may start to wane afterwards, which is why a booster may be needed, depending on the person's age at vaccination and the vaccine schedule followed (*47*). In terms of the recombinant vaccines' effect on meningococcal carriage, a study conducted on adolescents in Australia showed that the 4CmenB vaccine had no discernible effect on the carriage of meningococci (*48*). Therefore, it is not clear whether or not recombinant vaccines reduce the carriage of meningococci in the pharynx of those vaccinated.

Outer membrane vesicles vaccine
This vaccine's serological and overall efficacy is related to OMV presence, stability, and consistency. The vesicular structure gives adjuvant and immunostimulant properties. OMVs provide the polysaccharide and other low immunogenic antigens with some degree of thymus dependence and enhance immune response to them (*45*, *49*).

26. WHY IS IT IMPORTANT FOR INFANTS AND ADOLESCENTS TO BE VACCINATED AGAINST MENINGOCOCCUS IN COUNTRIES WHERE A VACCINE IS INDICATED?

In countries where a vaccine is indicated according to the epidemiological situation (not all countries), it is important for infants to be vaccinated against meningococcus. After they are born, infants (0–1 year of age) have a weak and immature immune system, which is more susceptible to infections and diseases, including meningococcal disease, and the peak is in children between 3 and 5 months of life (*2*). Therefore, to protect infants, which are a vulnerable population, it is important to follow country and physician recommendations on vaccinations and immunizations. Infants who are 2 months of age or older are able to receive conjugate or recombinant vaccines, given there are no contraindications (Table 9) (*2*).

According to carriage studies conducted around the world, adolescents and young adults have the highest rates of carriage of *N. meningitidis* (*3*). Therefore, when a country introduces a meningococcal vaccine, WHO recommends a catch-up campaign for all adolescents under 18 years (*9*). Catch-up campaigns promote herd immunity and decrease meningococcal carriage in the pharynx (depending on the vaccine introduced).

27. WHAT IS THE RECOMMENDED SCHEDULE FOR MENINGOCOCCAL VACCINES?

Polysaccharide vaccines
Polysaccharide vaccines are only recommended to control epidemic outbreaks produced by the specific serogroups, and for use in hyperendemic areas (*2*). Polysaccharide vaccines are given in a single dose, starting at 2 years of age. They can also be given to adults (including older adults 56 years and above) (*2*).

Conjugate vaccines
Conjugate meningococcal vaccines are given in two doses, starting at 2 months of age. These doses are given two months apart. A booster is needed after 1 year of age. Teenagers and adults receive one dose of a conjugate meningococcal vaccine (*2*).

For the meningococcal vaccine that is combined with Haemophilus B vaccine, three doses are recommended at 2, 4, and 6 months. A booster is also recommended between 12 and 15 months of age (*2*).

Recombinant vaccines
Starting at 2 months of age, three doses are given at 2-month intervals, and a booster is given after 1 year of age. Those who start the vaccinations at 6 months of age only need two doses plus a booster after 1 year of age (*2*).

For those older than 1 year of age, adolescents, and adults, two doses are needed with 2-month intervals; or, depending on the product, three doses with a 2-month interval between the first and second dose and a 4-month interval between the second and third doses (*2*).

Outer membrane vesicles vaccine
This vaccine has been given in Cuba in a two-dose schedule, the first at age 3 months and the second at age 5 months. There are indications that duration of post-immunization protection has decreased with the two-dose schedule used in Cuba, particularly in children up to age 1 year. According to an author, the vaccine could offer higher protection in infants and against the clinical meningeal form if an initial immunization schedule with three or more doses along with a booster (which improves maturation of the immune response) were instituted (*45*).

28. WHY IS IT RECOMMENDED TO WAIT TWO MONTHS BETWEEN THE DOSES OF CONJUGATE AND RECOMBINANT VACCINES?

In order to ensure long-term protection, multiple doses of conjugate and recombinant vaccines are recommended. This means that the same vaccine is given more than once in order to enhance immunity. It has been found that longer intervals between vaccines are associated with generally greater immune responses (*49*). Moreover, having a 3-week minimum interval between primary doses prevents competition between successive waves of primary response (*50*). Therefore, doses of conjugate and recombinant vaccines are administered two months apart in order to optimize the long-term protection conferred by vaccines.

29. ARE THE MENINGOCOCCAL VACCINES EFFICACIOUS AND EFFECTIVE IN PREVENTING MENINGOCOCCAL DISEASE AND COMPLICATIONS?

Efficacy (efficaciousness) refers to how successful the vaccine is at providing protective immunity against meningococcal disease in controlled settings (in labs, for example), whereas effectiveness refers to the vaccine's success in "real-world" situations (in practice).

POLYSACCHARIDE VACCINES

Efficacy
Following one dose, serogroup A and serogroup C vaccines have shown short-term efficacy levels of 85%–100% in older children (≥ 2 years of age) and adults (*43*). Although serogroup A polysaccharide vaccine may induce an antibody response in infants as young as 3 months, an adequate response is not achieved until age 4–5 years (*9*). As for serogroup C polysaccharide vaccine, the immune response of children aged < 18–24 months is very poor. Hyporesponsiveness to multiple doses of serogroup C polysaccharide vaccine has been demonstrated in infants and adults, especially if doses are repeated more than once (*9*). Serogroup B polysaccharide vaccine also induces a low immune response (*2*). As for serogroup W and serogroup Y polysaccharide vaccines, those are immunogenic among adults and children over 2 years of age (*2*).

Effectiveness
The meningococcal polysaccharide vaccines have high protective effectiveness, which is demonstrated in studies on immunization of closed populations of adults at high risk for the disease, such as household contacts of affected individuals and military recruits (*9*). These vaccines are also used successfully in outbreak control, although they do not significantly decrease meningococcal carriage in the pharynx (*9*). Studies have shown that after a single dose of the vaccine in children age 4 years and younger, the levels of specific antibodies and clinical protection decline rapidly over the first 2–3 years (*9*). This is different in schoolchildren and adults, where a single dose of subgroups A and C polysaccharide vaccine provides protection for at least three years (*9*). After 3–5 years have elapsed, one booster dose may be given to persons considered to be at continued risk of exposure, like health workers (*9*).

CONJUGATE VACCINES

Efficacy
Conjugate meningococcal vaccines are highly immunogenic (< 90%), although protective antibody titers are not long-lasting in young children (*43*). These vaccines also decrease meningococcal carriage in the pharynx, therefore generating herd immunity (*2*).

Effectiveness
Studies on the conjugate vaccine against meningococcus subgroup C in the United Kingdom found 88%–98% effectiveness among different age groups in the year following vaccination. When three doses are administered in the first year of life, effectiveness declined 81% within a year. However, a booster at 12 months of age was found to generate immunological memory and reduce the carriage of meningococcus C in the pharynx (*2*).

The conjugate vaccine against meningococcus A in the African meningitis belt has been proved to be very effective. In a study published in *The Lancet*, the conjugate MenA vaccine reduced meningitis incidence by 94% (*51*). Additionally, carriage of serogroup A decreased post vaccination, therefore greatly limiting the transmission of the bacterium (*51*).

RECOMBINANT VACCINES

Efficacy
Due to the low incidence of meningococcal disease, the efficacy of these vaccines has not been determined in pre-licensure clinical studies; their licensure was based on serological data (*52*).

Effectiveness
According to the package inserts of the Bexsero and Trumenba vaccines, the effectiveness of these vaccines against *N. meningitidis* serogroup B strains has not been confirmed (*53, 54*). However, epidemiological data from the introduction of Bexsero to the infant immunization program in the United Kingdom has provided preliminary evidence that the vaccine is effective (*52*).

OUTER MEMBRANE VESICLES VACCINE

Efficacy
From 1987 to 1989, a prospective, randomized, double-blind, placebo-controlled efficacy study was carried out in seven provinces in Cuba, involving 106,251 children aged 10–16 years. The field study lasted 16 months, during which 25 cases of meningococcal disease occurred. Once concluded, it was found there were 4 cases among the 52,966 who received the vaccine, and 21 among the 53,285 who received the placebo. Estimated efficacy was 83% ($p = 0.0019$) (*45*).

Effectiveness
Annual incidence of meningococcal disease in Cuba before vaccination averaged 14.4 per 100,000 population. Following vaccination, the rate decreased to 1 per 100,000 population in 1993 and has remained below 0.1 per 100,000 population since 2008. In children aged 6 years, average annual incidence before vaccination was 38–120 per 100,000, and this dropped to 0.01–1.8 per 100,000 population in the following two decades. The reduction was an estimated 95% (93%–98%) (*45*).

In Brazil, Colombia, and Uruguay, VA-MENGOC-BC has shown different effectiveness, in the range of 55%–98% in children aged ≤ 4 years and 73%–100% in children aged > 4 years (*48*).

30. CAN THE MENINGOCOCCAL VACCINE BE COADMINISTERED WITH OTHER VACCINES?

According to the 2015 WHO position paper on meningococcal vaccines, coadministration is acceptable for diphtheria toxoid, tetanus toxoid, whole cell pertussis, hepatitis B, *Haemophilus influenzae* type b, oral poliovirus, yellow fever, measles, and rubella vaccines. However, there is no evidence for coadministration with rotavirus vaccine, pneumococcal conjugate vaccine, or inactivated polio vaccine. This lack of evidence should not discourage coadministration, WHO advises (*55*). When meningococcal vaccines are coadministered with other vaccines, they need to be injected with a different, sterile syringe in a different injection site on the body (*2*).

31. CAN THE MENINGOCOCCAL VACCINES BE USED INTERCHANGEABLY WITH ONE ANOTHER?

There is limited information on the interchangeability of vaccines. However, from the information that is available, it has been found that no significant change in safety or reactogenicity has been observed when the group-specific monovalent polysaccharide vaccines are combined with bivalent or tetravalent polysaccharide vaccines (*43*). As for recombinant vaccines, the recombinant MenB vaccines are not interchangeable; the same product must be used for all doses in the series (*44*). This is due to the fact that each vaccine is composed of different protein or lipoprotein antigens, so they cannot be interchanged/combined (*56*). As for quadrivalent conjugate vaccines (MenACWY-D and ACWY-CRM), they are interchangeable, but only for persons age 9 months and older (*57*).

32. HOW SHOULD THE MENINGOCOCCAL VACCINES BE STORED?

The vaccines should be stored between 2 and 8 ˚C and must not be frozen (*2*).

Table 9. Information on the three types of meningococcal vaccines

Type of vaccine	Polysaccharide	Conjugate	Recombinant	Outer membrane vesicles
Composition	Serogroups A, C, W, and Y	Polysaccharides of serogroups A, C, W, and Y Protein conjugates (tetanus, diphtheria toxoid, or CRM197: mutant strain of *C. diphtheriae*)	Four serogroup B antigens (recombinant proteins of NadA[a] adhesion, FHbp[a] and NHBA[a] fusion and external membrane PorA[a]) Two serogroup B antigens (recombinant FHbp[a] fusion proteins of subfamilies A05 and B01)	Purified vesicles of the outer membrane of the serogroup B meningococcus and purified capsular polysaccharide of serogroup C meningococcus, adsorbed in aluminum hydroxide gel. The vaccine contains 0.01% thimerosal as a preservative, phosphates, and sodium chloride.
Dosage and route of administration	0.5 mL subcutaneously	0.5 mL intramuscularly	0.5 mL intramuscularly	0.5 mL intramuscularly
Indications	It is used to control outbreaks of meningococcal disease	For disease control, according to the epidemiological situation of the country	For disease control, according to the epidemiological situation of the country	For disease control, according to the epidemiological situation of the country
Minimum age	≥ 2 years of age	≥ 2 months of age	≥ 2 months of age	≥ 3 months of age
Maximum age	Any age; can be given to adults 56 years and older	55 years of age (but may be given to people age 56 years or older, depending on the individual situation)	25 years of age (but may be given to people age 26 years or older, depending on the individual situation)	≥ 3 months of age and older

Type of vaccine	Polysaccharide	Conjugate	Recombinant	Outer membrane vesicles
Presentation	Monovalent serogroup B (little available) Bivalent serogroups A and C; vials of 1, 10, and 50 doses Trivalent serogroups A, C, and W; vials of 1, 10 and 50 doses Tetravalent serogroups A, C, W, and Y; 10-dose vial	Monovalent serogroup A; 10-dose vial Monovalent serogroup C; pre-filled syringe 1 dose; 1-dose vial Combined Hib + serogroup C; vial of 1 and 10 doses Tetravalent serogroups A, C, W and Y; 1-dose vial	Monovalent serogroup B; pre-filled syringe 1 dose	Bivalent serogroups B and C
Plan	Single dose	Two doses from 2 months of age (2 months apart, minimum 1); booster ≥ 1 year old Teenagers and adults receive a dose Vaccine combined with Hib: three doses at 2, 4, 6 months and booster between 12 and 15 months of age	Three doses at 2-month interval (minimum 1) from 2 months of age; booster ≥ 1 year old; those who start at 6 months of age need two doses plus a booster at ≥ 1 year old. ≥ 1 year of age, adolescents and adults receive two doses with 2-month interval; or, depending on the product, three doses with 2-month interval between the first and second and 4-month interval between the second and third.	Two doses from 3 months of age (6–8 weeks apart)
Conservation	Between 2 and 8 ˚C (do not freeze)			

Type of vaccine	Polysaccharide	Conjugate	Recombinant	Outer membrane vesicles
Efficacy	Serogroup A: 85%–100% in children > 2 years and adults, but it is short term Serogroup B: low immune response Serogroup C: greater than 85% in adults and older children; 70% (95% CI: 5%, 91%) < 5 years; 55% (95% CI: 14%, 76%) in children aged 2–3 years Serogroup W and Y are immunogenic in > 2 years. The immune response occurs 10–14 days after vaccination. It does not induce immune memory. The duration of protective antibody levels decreases over time.	Conjugate vaccines, in addition to long-term individual protection, induce immunological memory; decrease the carriage, generating herd immunity.	Recombinant vaccines produce long-lasting individual protection.	Its efficacy was demonstrated to be 83% in a prospective, randomized, double-blind, placebo-controlled field study.
Adverse effects	Pain and redness at the injection site in 4%–56% of those vaccinated. Fever reported in < 5% of those vaccinated (most common in young children).	Pain, redness, and swelling at the injection site. Fever and irritation are rare.	Pain and redness at the injection site; fatigue, headache, and muscular pain Fever and irritation (more frequent in < 2 years)	Pain, erythema, and induration at the injection site Fever has been reported; very rarely this can be maintained for more than two days.

Type of vaccine	Polysaccharide	Conjugate	Recombinant	Outer membrane vesicles
	Severe reactions are extremely rare.			
Coadministration with other vaccines	It can be administered with other Expanded Program on Immunization (EPI) vaccines at the same visit, but with a different syringe and at a different injection site.			No data were found.
Duration of protection	Two to three years for children < 4 years who have received one dose Three years or more for school-age children and adults who have received one dose for serogroups A and C	Long-term protection for vaccinated people and other people	Long-term protection for vaccinated people	There are indications that duration of post-immunization protection has decreased with the two-dose VA-MENGOC-BC schedule used in Cuba, particularly in children up to age 1 year.
Contraindications	Severe allergic reaction after a previous dose or severe allergy to any component of the vaccine			

Sources: Pan American Health Organization. Surveillance of bacterial pneumonia and meningitis in children aged under 5 years: Field guide. Second edition. Washington, DC: PAHO; 2021. Available from: https://iris.paho.org/handle/10665.2/54637
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3. MENINGOCOCCAL VACCINE SAFETY

33. ARE THE MENINGOCOCCAL VACCINES SAFE?

All meningococcal vaccines have an excellent safety record. No serious adverse effects have been found, either during clinical trials or in post-marketing surveillance (*9*). Redness, swelling, and pain at the site of injection may occur and are adverse effects usually associated with other vaccines as well.

34. WHO MONITORS THE SAFETY OF THE MENINGOCOCCAL VACCINES?

WHO is active in the field of biological standardization, which guarantees the safety and quality of vaccines (*58*). This is done by establishing and publishing norms and standards that can then be used by Member States to ensure the quality and safety of biological materials (*58*). Additionally, WHO is active in the prequalification of vaccines. WHO prequalification makes sure that vaccines used in immunization programs are safe and effective and provides Member States and procurement agencies with guidance required to purchase safe and effective vaccines (Table 10) (*59*). WHO provides data on the efficacy, potency, thermostability, presentation, labeling, and shipping of vaccines (*59*). Additionally, it is important to note that there are no WHO prequalified polysaccharide meningococcal vaccines available on the market (*21*).

Once a vaccine is prequalified and is introduced to the market, WHO ensures its continuous safety and quality through reassessments and testing, in addition to tracking adverse events following immunization (AEFI) or events supposedly attributable to vaccination or immunization (ESAVIs) (*59*).

In the Latin America region, ESAVIs are monitored and investigated. Adverse events that merit investigation include severe events, events that happen in clusters, events related to the program that might indicate programmatic errors, and rumors that may undermine public confidence (*60*). Well-designed studies are conducted to test causality and make a final determination as to whether an adverse event happened due to a vaccine. Final determinations from the investigation fall under one of the following four determinations: not related to the vaccine/vaccination (coincidental event), related to the vaccine/vaccination, immunization process anxiety-related reaction or inconclusive evidence that the adverse event is related to the vaccine/vaccination.

35. ARE THERE ANY EVENTS SUPPOSEDLY ATTRIBUTABLE TO VACCINATION OR IMMUNIZATION (ESAVIS)/ ADVERSE EVENTS FOLLOWING IMMUNIZATION (AEFI) THOUGHT TO BE ASSOCIATED WITH THE MENINGOCOCCAL VACCINES?

Polysaccharide vaccines

The polysaccharide vaccines are safe and significant reactions are very rare. Some of the most common adverse reactions include erythema (reddening of the skin) and slight pain at the site of injection for 1–2 days. Additionally, fever exceeding 38.5 °C may occur in up to 2% of vaccinees.

Conjugate vaccines

All meningococcal conjugate vaccines are safe and significant adverse effects during clinical trials or in post-marketing surveillance have not been detected. Common adverse reactions include redness, swelling, and pain at the site of injection. These reactions usually occur within the first day after immunization and last 13 days. Children may develop a fever or be irritable for a short period of time, but that is a less common adverse effect (*43*).

Recombinant vaccines

The two recombinant vaccines (Trumenba and Bexsero) are safe, but like other vaccines, vaccinees may experience mild adverse effects. These adverse effects include injection site pain, fatigue, headache, muscle pain (myalgia), joint pain, chills, diarrhea, erythema (reddening of the skin), nausea, vomiting, fever, and induration (localized hardening of soft tissue) (*44*).

Outer membrane vesicles vaccine

In a considerable number of clinical trials and post-license studies conducted in Cuba and other countries, no serious adverse reactions have been observed in most VA-MENGOC-BC vaccinated. The expected local symptoms and signs reported have been pain, erythema, and induration, which have been mild and had a variable frequency, appearing within the first 24 hours and with a tendency to disappear 72 hours after vaccination. In isolated cases, higher-intensity local symptoms may occur. These local signs and symptoms are similar to those caused by other adsorbed vaccines. Among the general symptoms, temperatures of 38 ˚C or above have been reported; very rarely these can last for more than two days. Less frequently, cases of temperatures of 39 ˚C or higher have been reported; in general these fevers resolve rapidly and favorably.

36. IS THE VACCINE SAFE FOR PEOPLE WHO ARE IMMUNOCOMPROMISED AND/OR LIVING WITH HIV?

Yes, WHO recommends meningococcal vaccination for all individuals suffering from immunodeficiency, including asplenia, terminal complement deficiencies, or advanced HIV infection (*9*).

37. IS THE VACCINE SAFE FOR WOMEN WHO ARE CURRENTLY PREGNANT?

According to the 2015 WHO position paper on meningococcal vaccines, the vaccination of pregnant women is safe, supported by evidence from an observational study (*55*). If the epidemiological situation justifies and necessitates mass vaccination, pregnant women should be included if they fall within the age range targeted by mass vaccination campaigns (*55*).

38. SHOULD A PERSON WHO IS INFECTED WITH MENINGOCOCCUS STILL GET THE MENINGOCOCCAL VACCINE?

Due to several reasons, such as a weakened immune system, a person who is infected with meningococcus should wait he/she has completely recovered before taking any vaccines. Meningococcal vaccines are not recommended while there is an active infection.

Unlike viral infections, the body does not create long-term memory immunity against bacterial infections, meaning that bacterial infections, like meningococcal disease, may recur in the future after initial infection. There is an immune response of unknown duration

Table 10. List of WHO prequalified meningococcal vaccines

Vaccine type	Commercial name	Prequalified	Manufacturer
Meningococcal A conjugate 10 µg	Meningococcal A Conjugate MenAfriVac	23 June 2010	Serum Institute of India Pvt. Ltd. (India)
Meningococcal ACWY (conjugate vaccine)	Menveo	31 July 2013	GlaxoSmithKline Vaccines S.r.l. (Italy)
Meningococcal ACWY (conjugate vaccine)	Menactra	21 March 2014	Sanofi Pasteur-USA (United States of America)
Meningococcal A conjugate 5 µg	Meningococcal A Conjugate 5 micrograms MenAfriVac 5µg	12 December 2014	Serum Institute of India Pvt. Ltd. (India)
Meningococcal ACWY (conjugate vaccine)	Nimenrix	31 August 2016	Pfizer (Belgium)

Source: World Health Organization [Internet]. Geneva: WHO; c2021. List of Prequalified Vaccines. Available from: https://extranet.who.int/gavi/PQ_Web/.

that follows clinical and subclinical infections and which increases with age (*2*). Therefore, it is recommended for meningococcal disease survivors to receive the appropriate meningococcal vaccine, depending on which serogroup(s) presents the greatest risk of infection at that specific time and place/country. This includes the serogroup that they were infected with, in addition to any other serogroup that may be circulating in the community/country.

39. IS THERE ANYONE WHO SHOULD NOT RECEIVE THE MENINGOCOCCAL VACCINES?

People who have had any allergic reactions after a previous dose or have an allergy to any component of the vaccine are discouraged from receiving meningococcal vaccines (*2*). Additionally, people who are moderately or severely ill should wait until they are healthy again before taking any vaccines (*61*).

4. MENINGOCOCCAL VACCINE EDUCATION AND PROGRAMMATIC CONCERNS

40. WHAT IS WHO DOING TO ADDRESS MENINGOCOCCAL DISEASE?

In 2017, stakeholders from different fields (like governments, global health organizations, public health bodies, academia, private sector, and civil society) called for a global vision to defeat meningitis. As a result, WHO, along with global partners and experts, developed a road map to defeat meningitis by 2030 (*62*). This is the first global road map to tackle the main causes of bacterial meningitis, which include meningococcus. The WHO road map to defeat meningitis has three main goals:

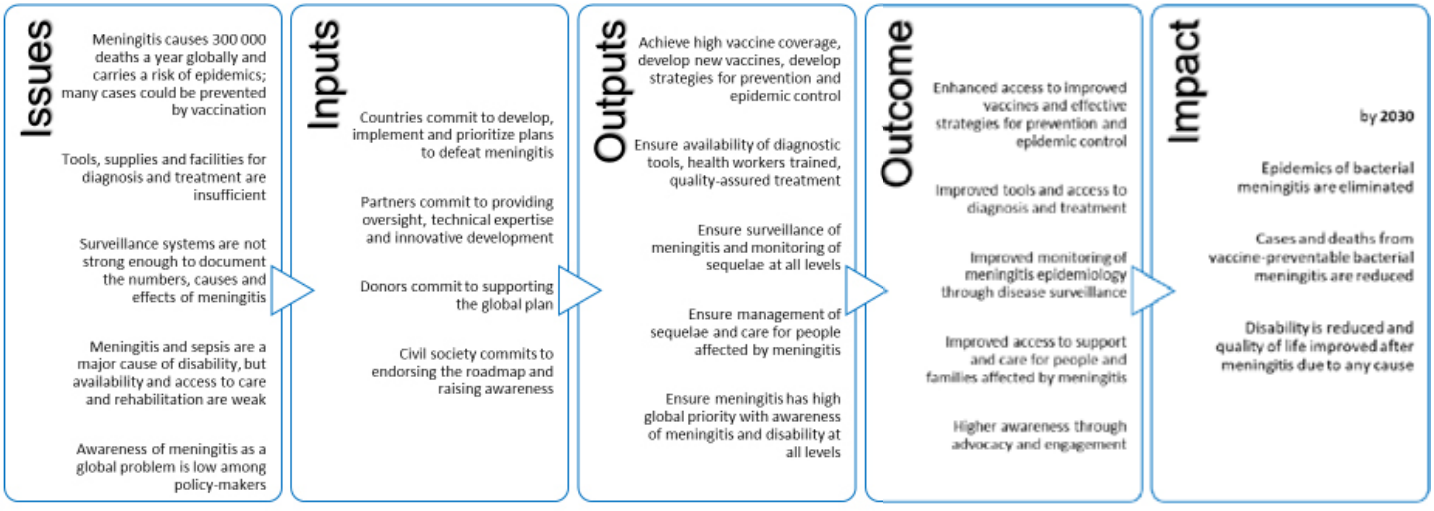
- Eliminate bacterial meningitis epidemics;
- Reduce cases and deaths from vaccine-preventable bacterial meningitis; and
- Reduce disability and improve quality of life after meningitis due to any cause.

In order to achieve these goals, the WHO road map has five pillars:

- Prevention and epidemic control;
- Diagnosis and treatment;
- Disease surveillance;
- Support and care for people affected by meningitis; and
- Advocacy and engagement.

Figure 3 presents a summary of the WHO road map framework to defeat meningitis by 2030.

Figure 3. Overall framework of the global road map to defeat meningitis by 2030



Source: World Health Organization. Defeating meningitis by 2030: a global road map [Draft]. Geneva: WHO; 2020 Apr 8. Available from: https://www.who.int/initiatives/defeating-meningitis-by-2030

41. WHAT ARE THE WHO RECOMMENDATIONS FOR MASS VACCINATION CAMPAIGNS?

First, each country needs to establish the need for mass vaccination campaigns based on surveillance data that detail the disease burden and meningococcal disease epidemiology, including information regarding the serogroup of meningococcus that is present in the country. Then, the country needs to determine whether to use polysaccharide meningococcal vaccines or conjugate meningococcal vaccines. Table 11 details the different vaccination strategies. It should be noted that, when possible, conjugate vaccines are preferred over polysaccharide vaccines due to their proven potential for herd protection and their increased immunogenicity, especially in children under 2 years of age (9).

Table 11. Different strategies for mass vaccination campaigns

	Polysaccharide vaccine	Conjugate vaccine
Vaccination strategy	To be used to **control outbreaks** in countries with **limited economic resources or insufficient supply** of conjugate vaccines.	**One recommended approach**: initial mass vaccination of all children and adolescents aged from 9 months to 18 years, followed by inclusion of the vaccine in the routine childhood immunization program. Depending on surveillance data, other age groups can be incorporated into the mass vaccination campaign. **An alternative strategy**: use conjugate vaccines for mass vaccination followed every 3–5 years by supplementary immunization activities (SIAs) for age groups at particular risk, as dictated by continued surveillance.
Vaccine option 1	**In the case of serogroup A or C outbreaks, bivalent AC polysaccharide vaccine is recommended for mass campaigns.** **However**, due to the limited efficacy of polysaccharide vaccines in children < 2 years of age, in confirmed group C outbreaks MenC conjugate vaccines should be used for protection of those aged 2–24 months. Similarly, during group A outbreaks, MenA conjugate vaccine is the preferred option for protection of children 12–24 months of age.	**Monovalent MenA conjugate vaccine** should be given as one single intramuscular dose to individuals 1–29 years of age. The possible need for booster doses is not yet established for this vaccine. **Monovalent MenC conjugate vaccine** should be administered as one single intramuscular dose for children aged ≥ 12 months, teenagers, and adults. Children 2–11 months of age require two doses administered at an interval of at least two months and a booster about one year thereafter. If the primary series is interrupted, vaccination should be resumed without repeating the previous dose.

	Polysaccharide vaccine	Conjugate vaccine
Vaccine option 2	**Outbreaks caused by W serogroup require trivalent (ACW) polysaccharide vaccines.** Meningococcal polysaccharide vaccines should be administered to individuals aged ≥ 2 years as one single dose; most polysaccharide vaccines are administered subcutaneously. One booster 3–5 years after the primary dose may be given to persons considered to be at continued high risk of exposure, including some health workers.	N/A
Vaccine option 3	**Outbreaks caused by W or Y serogroups require quadrivalent (ACWY) polysaccharide vaccines.** Meningococcal polysaccharide vaccines should be administered to individuals aged ≥ 2 years as one single dose; most polysaccharide vaccines are administered subcutaneously. One booster 3–5 years after the primary dose may be given to persons considered to be at continued high risk of exposure, including some health workers.	**Quadrivalent conjugate vaccines (ACWY-D and ACWY-CRM)** should be administered as one single intramuscular dose to individuals aged ≥ 2 years. ACWY-D is also licensed for children 9–23 months of age, and given as a 2-dose series, three months apart, beginning at age 9 months. If the primary series is interrupted, vaccination should be resumed without repeating the previous dose.

Source: World Health Organization. Meningococcal vaccines: WHO position paper. Weekly Epidemiological Record 2011;86:521–540. Available from: https://www.who.int/publications/i/item/WER8647

42. AS A HEALTH CARE PROVIDER, WHAT IS MY ROLE AND RESPONSIBILITY IN THE PREVENTION OF MENINGOCOCCAL DISEASE?

It is important for health care providers to know the clinical symptoms of meningococcal disease in order to be able to treat the patient and provide prophylaxis to close contacts in a timely manner. Furthermore, it is important for health care providers to be able to accurately conduct diagnostic tests (like obtaining CSF and blood tests) in order to avoid additional harm to the patient and to ensure proper detection of the disease. Moreover, having proper knowledge of the prevention and treatment methods is essential in treating existing patients and controlling the spread of the disease. Last but not least, it is important for health care providers to follow country guidelines regarding reporting and surveillance of meningococcal disease and cases.

5. MENINGOCOCCAL VACCINE AND DISEASE MYTHS AND MISCONCEPTIONS

43. IS MENINGOCOCCAL DISEASE ONLY DANGEROUS IN YOUNG CHILDREN AND ADOLESCENTS?

No, meningococcal disease is dangerous in all age groups. Meningococcal disease mainly affects people between ages 1 and 30 but can be fatal for all age groups. Even with early diagnosis, 5%–10% of patients die typically within 24 to 48 hours after the onset of symptoms. If left untreated, up to 50% of cases may die. Meningococcal disease can also lead to sequelae in 10%–20% of survivors. These complications include brain damage, hearing loss, or intellectual impairment (*32*).

44. DO MENINGOCOCCAL VACCINES CAUSE MENINGOCOCCAL DISEASE?

No, meningococcal vaccines do not cause meningococcal disease. On the contrary, meningococcal vaccines protect vaccinated individuals from contracting meningococcal disease (manifested as meningitis, meningococcemia, or both). Meningococcal disease can only be caused by the bacterium *N. meningitidis*. Meningococcal vaccines do not contain any bacteria; they are only made of the capsule polysaccharide or capsule protein of the bacterium (*61*).

45. IS MENINGOCOCCAL DISEASE SPREAD FROM AN INFECTED PERSON BY CASUAL CONTACT, SUCH AS SHAKING HANDS?

Since meningococcal disease is transmitted by direct contact (person to person) and nasopharyngeal secretions (droplets), it is possible for meningococcal disease to spread from an infected person by casual contact (such as shaking hands), since the hands can come in contact with nasopharyngeal secretions (droplets). To avoid infection, it is best to keep your distance from meningococcal patients until they complete treatment. If you have been in close contact with a meningococcal patient, please consult your primary care physician regarding taking prophylactic medications as a preventative measure.

46. IS ONE IMMUNIZATION AT CHILDHOOD ENOUGH TO KEEP ADULTS PROTECTED FROM MENINGOCOCCAL DISEASE? OR IS A BOOSTER NEEDED?

According to WHO, it is recommended that all previously vaccinated adolescents receive a booster dose of quadrivalent conjugate vaccine at 16 years of age, especially for certain high-risk groups (like people with asplenia or complement deficiencies and HIV patients), depending on the epidemiological situation of the country (*9*).

47. IS MENINGOCOCCAL DISEASE ALWAYS FATAL?

When left untreated, the fatality rate due to meningococcal meningitis is high (up to 50%) (*7*). However, patients who receive timely diagnosis and treatment have lower case fatality rates, ranging from 8% to 15% (*2*).

48. ARE THERE ANY RISKS ASSOCIATED WITH UNDERGOING A LUMBAR PUNCTURE TO OBTAIN A SAMPLE OF CEREBROSPINAL FLUID (CSF)?

Obtaining CSF is a procedure with certain high risk, similar to a surgery. Since obtaining CSF is an invasive procedure and the puncture site must be properly prepared, it should only be performed by an experienced physician in a health care facility that has the appropriate conditions for the procedure (*2*).

6. FINAL KEY TAKEAWAYS

49. WHAT ARE THE ESSENTIAL MESSAGES THAT I SHOULD KNOW AND CONVEY TO PATIENTS AND THE GENERAL COMMUNITY ABOUT MENINGOCOCCAL DISEASE AND VACCINES?

It is important to acknowledge that meningococcal vaccinations are only to be used in certain circumstances, according to the specific epidemiological situation of each country, which examines the disease burden and the serogroup that is circulating in that country. In the case that a specific country introduces meningococcal vaccinations, health care providers should convey the message that these vaccinations are safe and provide protective immunity against meningococcal disease. However, the health care provider must be familiar with the contraindications (when to not administer these vaccinations, on a case-by-case basis). Additionally, once a meningococcal patient is identified, it is essential to control the transmission of meningococcus by administering prophylactic medications to close contacts of the patient. These prophylactic medications are indicated according to the risk of transmissibility of the disease from the patient to others.

ADDITIONAL RESOURCES

If you would like to learn more about meningococcal disease, please consult the following sources and documents: World Health Organization. Defeating meningitis by 2030: a global road map [Draft]. Geneva: WHO; 2020 Apr 8.

Pan American Health Organization. *Vigilancia de las neumonías y meningitis bacterianas en menores de 5 años.* Guía práctica. Segunda edición. Washington, DC: OPS; 2020. Disponible en: https://iris.paho.org/handle/10665.2/51883,

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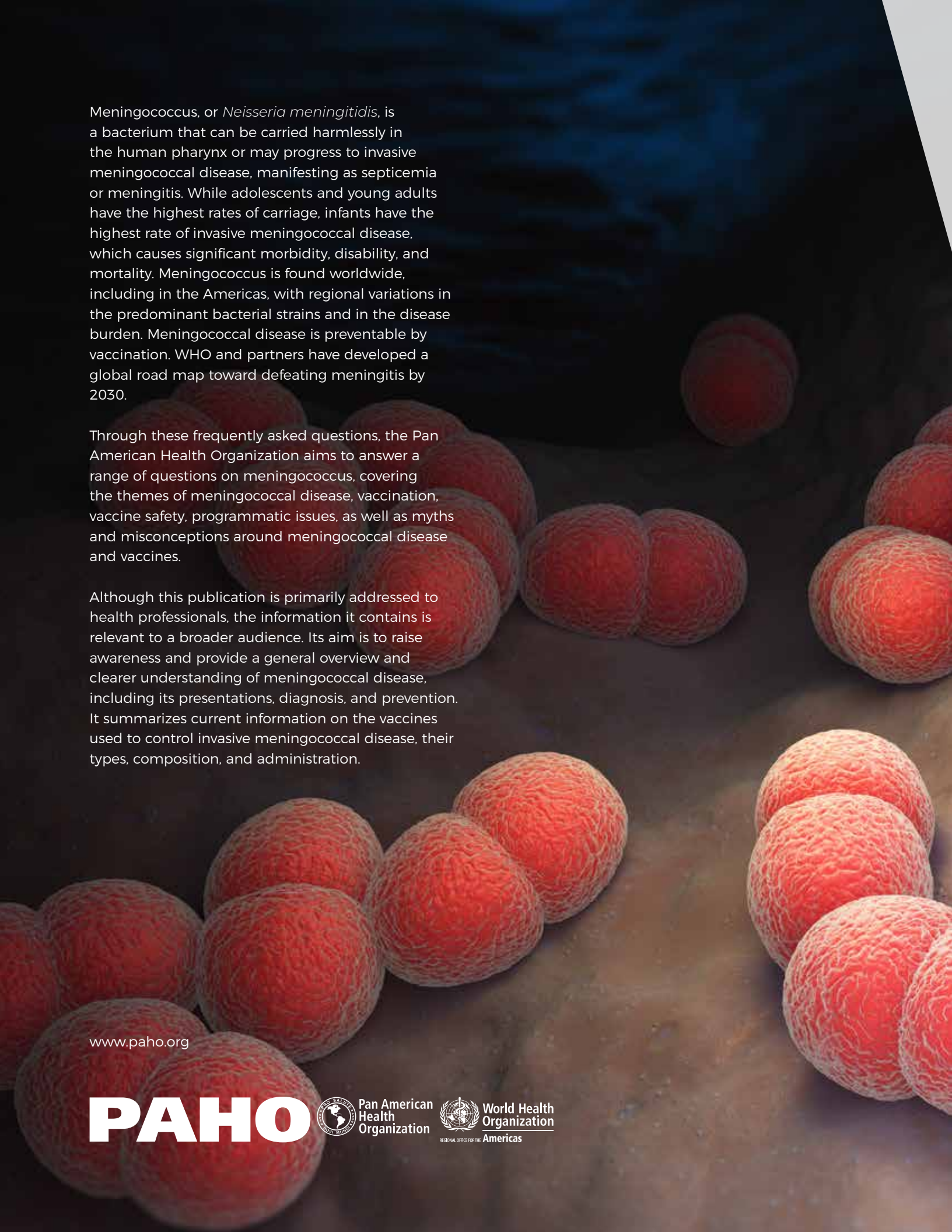

Meningococcus, or *Neisseria meningitidis*, is a bacterium that can be carried harmlessly in the human pharynx or may progress to invasive meningococcal disease, manifesting as septicemia or meningitis. While adolescents and young adults have the highest rates of carriage, infants have the highest rate of invasive meningococcal disease, which causes significant morbidity, disability, and mortality. Meningococcus is found worldwide, including in the Americas, with regional variations in the predominant bacterial strains and in the disease burden. Meningococcal disease is preventable by vaccination. WHO and partners have developed a global road map toward defeating meningitis by 2030.

Through these frequently asked questions, the Pan American Health Organization aims to answer a range of questions on meningococcus, covering the themes of meningococcal disease, vaccination, vaccine safety, programmatic issues, as well as myths and misconceptions around meningococcal disease and vaccines.

Although this publication is primarily addressed to health professionals, the information it contains is relevant to a broader audience. Its aim is to raise awareness and provide a general overview and clearer understanding of meningococcal disease, including its presentations, diagnosis, and prevention. It summarizes current information on the vaccines used to control invasive meningococcal disease, their types, composition, and administration.

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