The Epidemiology Of Meningococcal Meningitis

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Objectives:

- 1.Understanding transmission patterns and risk factors.
- 2. Identifying global and regional differences (such as the "meningitis belt").
- 3. Evaluating the impact of control strategies : chemoprophylaxis and vaccination.

Meningococcal meningitis or cerebrospinal fever

- Is an acute communicable disease caused by Neisseria meningitidis.
- It usually begins with intense headache, vomiting and stiff neck and progresses to coma within a few hours.

- The meningitis is part of a septicemic process.
- The fatality of typical untreated cases is about 50 per cent.
- With early diagnosis and treatment, case fatality rates have declined to less than 8-15 per cent.

HISTORY

- Meningococcal meningitis was first described in 1805,
- Its bacterial cause, Neisseria meningitidis, was identified in 1887.
- Major epidemics occurred throughout the 19th and 20th centuries, especially in military settings and parts of Africa.
- World Wars: Major epidemics were noted during World War I and World War II, affecting military camps and civilian populations.

Problem statement

- Distribution worldwide, occurring sporadically and in small outbreaks in most parts of the world.
- In some regions this endemic situation may alternate with devastating, unpredictable epidemics.

- This is the case in the African meningitis belt, which is the region in sub-Saharan Africa stretching from Senegal in the west to Ethiopia in the east.
- This region is inhabited by around 400 million people.
- In the African meningitis belt, the WHO definition of a meningococcal epidemic is > 100 cases per 100,000 population per year.


Mauritania
Mali
Niger
Chad
Sudan
Eritrea
Djibouti
Senegal
Gambia
Guinea–
Bisseau
Guinea
Sierra Leone
Liberia
Côte
d'Ivoire
Burkina
Faso
Nigeria
Central African
Republic
Ethiopia
Somalia
Cameroon
Uganda
Kenya
Benin
Togo
Ghana
Meningitis belt

- In the endemic countries, the incidence of
- > 10 cases per 100000 high endemicity
- 2-10 cases per 100000 moderate endemicity
- <2Case per 100000 low endemicity.

Iraq situation

- **Incidence and trends**
- **Overall incidence:** The annual incidence rate for meningococcal meningitis is \(0.86\) per \(100,000\) people.
- **Seasonal trend:** The disease is more common during the winter.
- **Age and gender:** Meningococcal meningitis is often associated with young people.
- From 2007 to 2023, male cases were more frequent, with the exception of 2019 when female cases were more common.

An outbreak outside the meningitis belt

- may be defined as a substantial increase in invasive meningococcal disease in a defined population above that which is expected by place and time.

- During recent years, several serious outbreaks affecting numerous countries have occurred in tropical and temperate zones of other continents, i.e., Americas, Asia and Europe.
- In Europe, the incidence of disease ranges from 0.2 to 14 cases per 100,000 population and majority cases are caused by serogroup B strains.
- In Americas, the incidence of disease is in the range of 0.3 to 4 cases per 100,000 population.

USA OUTBREAKS

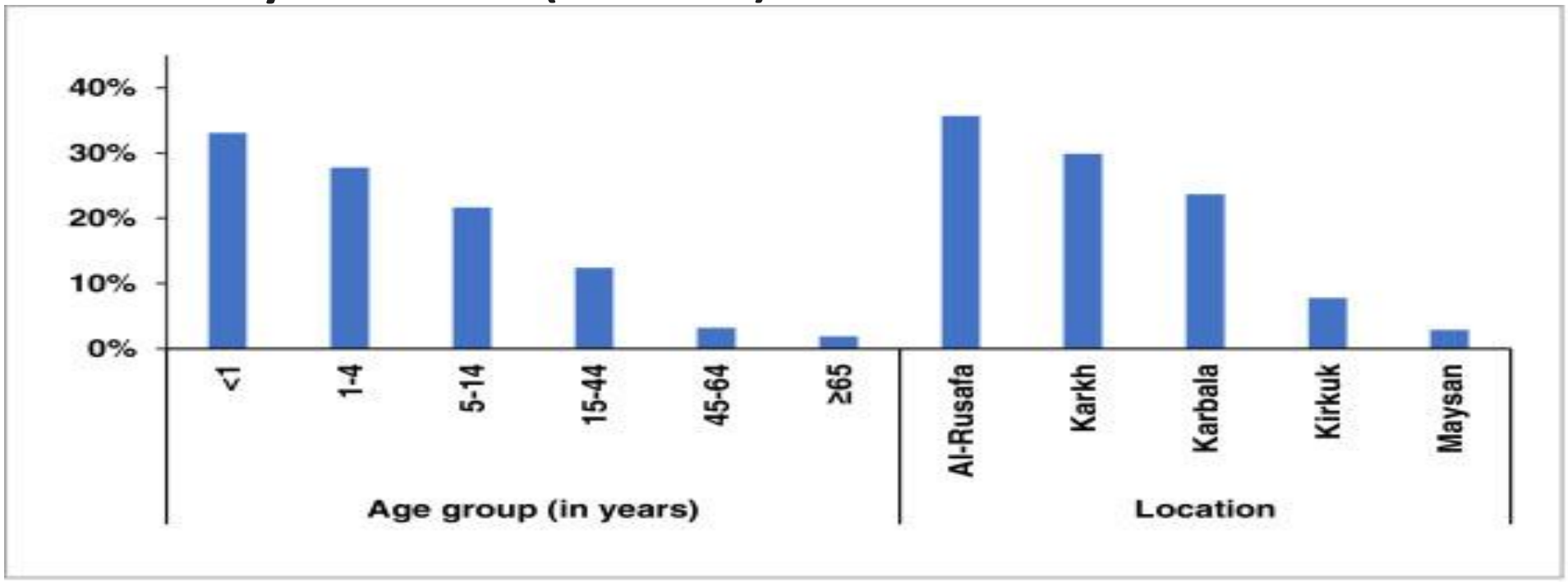
- In 2013, the most notable meningococcal meningitis outbreak in the US was at Princeton University, caused by serogroup B Neisseria meningitidis.
- This outbreak involved nine cases between March 2013 and March 2014 and led to the temporary authorization of an investigational serogroup B vaccine for use on campus.
- Another outbreak of serogroup B occurred at the University of California, Santa Barbara in late 2013.

USA OUTBREAKS

- The United States reported 503 confirmed and probable cases of meningococcal disease in 2024, the highest number since 2013.
- Much of the recent increase is attributed to Neisseria meningitidis serogroup Y.
- The highest rates of meningococcal disease are seen in young children, teenagers, older adults, and those with weakened immune“.
- "At least 22 states require meningococcal vaccine, with most requiring meningococcal vaccine for students living on campus."

- In United States, the majority cases are caused by serogroups B, C and Y.
- In Asia most meningococcal disease is caused by meningococci belonging to serogroup A or C

Distribution of patients with suspected meningitis in Iraq, according to age and location, June 2018 to May 2020. (N370)

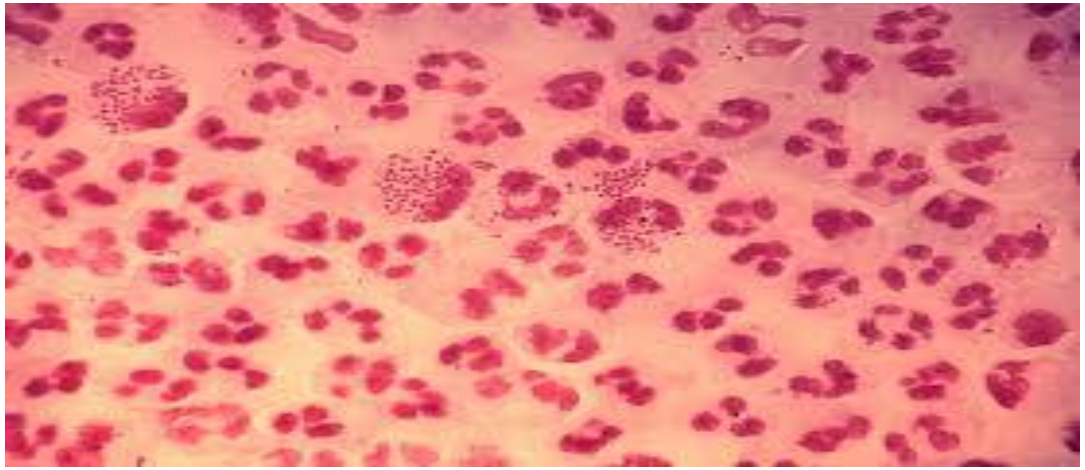


- n total, 370 patients were confirmed to have bacterial meningitis (215 had *N. meningitidis,* 154 had *Streptococcus pneumoniae,* and one case had *Haemophilus influenzae type b*).
- The most common *N. meningitidis* serogroup was B (77.7%), followed by W (18.1%) and X (4.2%).

- Since April **2024**, 12 cases of **meningococcal** disease linked to KSA travel for Umrah have been reported
- in the United States (5 cases), France (4 cases), and the United Kingdom (3 cases).
- People don't catch the bacteria through casual contact or by breathing air where someone with meningococcal disease has been.
- Generally, it takes close (e.g., coughing, kissing) or lengthy (e.g., roommates) contact to spread these bacteria.

Epidemiological features

- (a) AGENT : The causative agent, N. meningitidis is a gram-negative diplococci.
- 12 serotypes have been identified, viz. Groups A, B, C,29E, H, I, K, L, W135, X, Y, Z based on the structure of the polysaccharide capsule.
- The majority of invasive meningococcal infections are caused by organisms of serogroups A, B, C, X, W135 and Y



Agent(cont.)

- Meningococci of these serogroups have the potential to cause both endemic disease and outbreaks.
- In African meningitis belt, subgroup A has been the most important cause of disease.
- N. meningitidis is a delicate organism; it dies rapidly on exposure to heat and cold.

SOURCE OF INFECTION:

- The organism is found in the nasopharynx of cases and carriers.
- Clinical cases present only a negligible source of infection.
- More often the infection causes mild or even unnoticeable symptoms of nasopharyngitis.

SOURCE OF INFECTION(Cont.):

- 4 to 35 per cent of the normal population may harbor the organism in the nasopharynx during inter epidemic periods.
- Carriers are the most important source of infection.
- The mean duration of temporary carriers is about 10 months.
- During epidemics, the carrier rate may go up to 70-80 per cent.

PERIOD OF COMMUNICABILITY :

- Until meningococci are no longer present in discharges from nose and throat.
- Cases rapidly lose their infectiousness within 24 hours of specific treatment.

AGE AND SEX :

- This is predominantly a disease of children and young adults.
- Both sexes.
- With highest attack rate in infants aged 3-12 months.

IMMUNITY

- All ages are susceptible.
- Younger age groups are more susceptible than older groups as their antibodies are lower.
- Immunity is acquired by subclinical infection (mostly), clinical disease or vaccination.
- Infants derive passive immunity from the mother(20 days-45 days).

ENVIRONMENTAL FACTORS :

- The seasonal variation of the disease is well established; outbreaks occur more frequently in the dry and cold months of the year from December to June.
- Overcrowding, as occurs in schools, barracks, refugee and other camps, is an important predisposing factor.

The incidence is also greater in:

- Low socio-economic groups living under poor housing conditions,
- Exposure to tobacco smoke,
- Asplenia,
- HIV infection
- Travel to endemic areas.

- Mode of transmission :The disease spreads mainly by droplet infection.
- The portal of entry is the nasopharynx.
- Incubation period: Usually 3 to 4 days, but may vary from 2 to 10 days.

Clinical course

- Most infections do not cause clinical disease.
- Many infected people become asymptomatic carriers of the bacteria and serve as a reservoir and source of infection for others.
- In general, susceptibility to meningococcal disease decreases with age.
- Meningococcal meningitis has a sudden onset of intense headache, fever, nausea, vomiting, photophobia, stiff neck and various neurological signs.

Clinical course(cont.)

- The disease is fatal within 24-48 hours in 5-10 per cent of cases even with prompt antimicrobial treatment in good health care facility.
- Among individuals who survive, up to 15-20 per cent have permanent neurological sequelae.
- Meningococcal septicemia, in which there is rapid dissemination of bacteria in the bloodstream, is a less common form of meningococcal disease, characterized by circulatory collapse, hemorrhagic skin rash and high fatality rate

Skin rash can coalesce for hemorrhagic area and gangrene





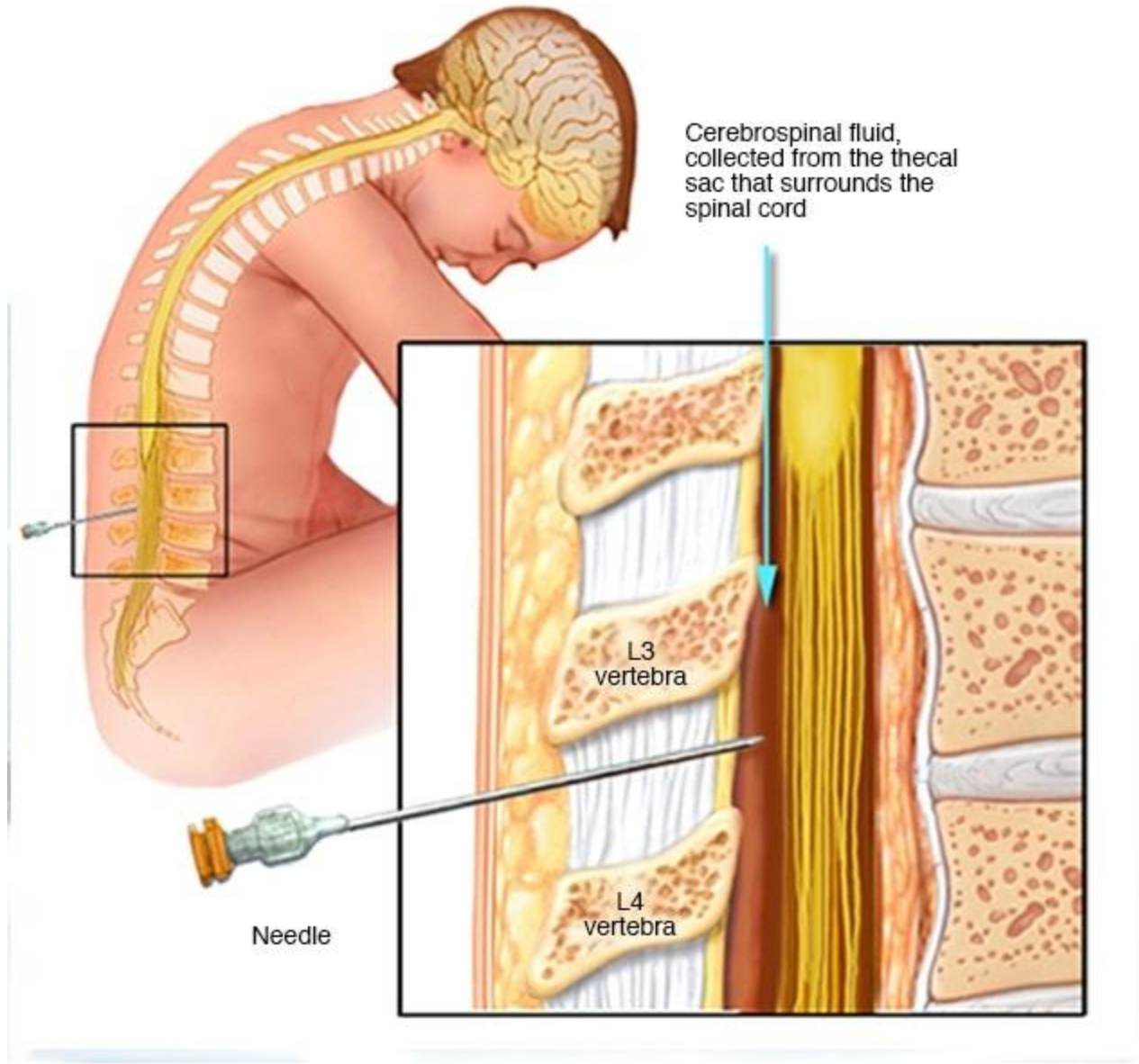




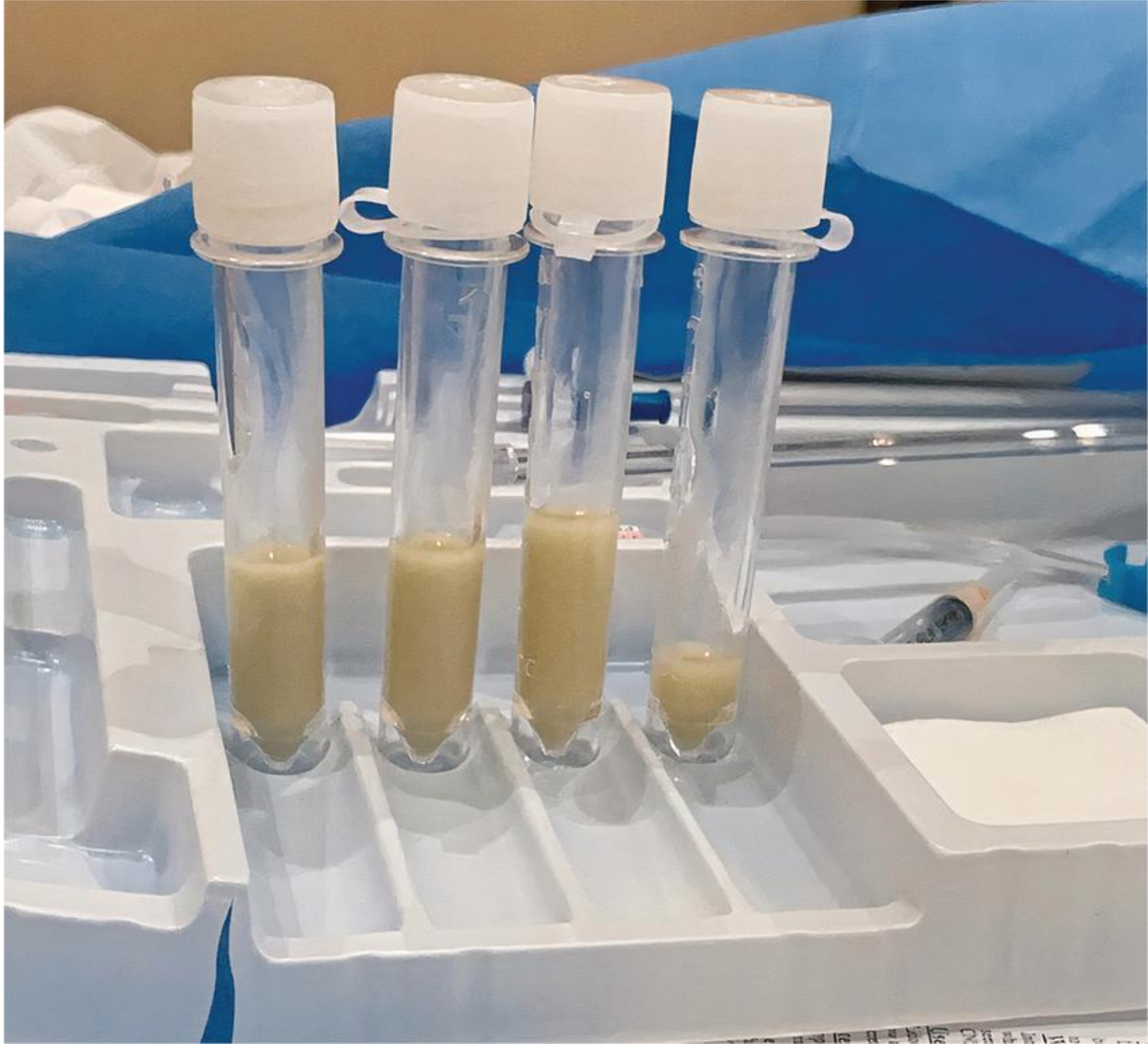


Diagnosis

- Initial diagnosis - Clinical Examination followed Lumbar Puncture (LP)
- LP- purulent spinal fluid (CSF)
- The bacteria can sometimes be seen in microscopic examinations of the spinal fluid.
- Confirmed by growing the bacteria from specimens of spinal fluid or blood - by agglutination tests or by Polymerase Chain Reaction (PCR).


Cerebrospinal fluid, collected from the thecal sac that surrounds the spinal cord
L3 vertebra
L4 vertebra
Needle


A
30
ml
25
20
15
10
5
2.5



Prevention and control

- (a) CASES : Treatment with antibiotics can save the lives of 95 per cent of patients provided that it is started during the first 2 days of illness.
- Penicillin is the drug of choice.
- In penicillin-allergic patients, ceftriaxone and other third generation cephalosporins should be substituted.
- A single dose of long-acting chloramphenicol or cetriaxone is used for treatment of epidemic meningococcal meningitis in sub Saharan Africa.

Control of Cases(cont.)

- Septicemic shock and raised intracranial pressure in meningitis are particular problem in the management of meningococcal disease.
- Treatment of cases has practically no effect on the epidemiological pattern of the disease because it only reduces the fatality rate of the disease according to the treatment efficiency.
- Isolation of cases is of limited usefulness in controlling epidemics because the carriers outnumber cases.

Control of CARRIERS :

- Treatment with penicillin does not eradicate the carrier state; more powerful antibiotics such as rifampicin are needed to eradicate the carrier state

Control of CONTACTS :

- Close contacts of persons with confirmed meningococcal disease are at an increased risk of developing meningococcal illness.
- Antibiotics are effective in preventing additional cases through eradicating carriage of the invasive strain.
- Most secondary case occur within the first 72 hours after presentation of the index case; risk of secondary disease decreases to near baseline by 10-14 days.
- Close contacts include household, child care, and preschool contacts.

Control of CONTACTS(Cont.)

- In outbreaks involving limited populations, those with direct, prolonged contact with a case of meningococcal disease may also be offered clearance treatment.
- Ideally, where indicated, treatment should be started within 24 hours of identification of the index case.
- Antibiotics effective for this purpose include rifampicin, ciprofloxacin, ceftriaxone or azithromycin.

MASS CHEMOPROPHYLAXIS

- :This is in fact mass medication of the total population some of which are not infected.
- It is recommended that mass chemoprophylaxis be restricted to closed and medically supervised communities.
- Mass treatment causes an immediate drop in the incidence rate of meningitis and in the proportion of carriers.
- The efficacy of this preventive measure depends to a large extent on the population coverage.
- The drugs of choice are ciprofloxacin, minocycline, spiramycin and ceftriaxone.

VACCINE

- Currently available meningococcal vaccines include polysaccharide vaccines and polysaccharide-protein conjugate vaccines.
- The conjugate vaccines are more immunogenic and also induce immunogenic memory.
- Both vaccines are available against meningococci of serogroup A, C, W135 and Y.

Polysaccharide vaccine



Polysaccharide vaccines

- Internationally marketed meningococcal polysaccharide vaccines are available in bivalent (A, C), trivalent (A,C, W 135), and quadrivalent (A, C, W135, Y) formulations.
- The vaccines contain 50 μg of each of the individual polysaccharides.
- Meningococcal polysaccharide vaccines are administered as a single dose to persons ≥2 years old;
- Polysaccharide vaccines are not given to children under 2 years old because their B-cells are too immature to respond to pure bacterial sugars without help from T-cells.

Polysaccharide vaccines(cont.)

- Most of these vaccines are given subcutaneously.
- Adverse reactions to polysaccharide meningococcal vaccines are usually mild; the most frequent reaction is 1-2 days of pain and redness at the site of injection, which occur in 4%-56% of vaccine recipients.
- Transient fever is reported in<5% of recipients.

Conjugate vaccine



Conjugate vaccines :

- Licensed meningococcal conjugate vaccines are monovalent (A or C) or quadrivalent (A, C, W135, Y),
- and also include a combination vaccine based on Haemophilus influenzae type b and Neisseria meningitidis serogroup C vaccines (Hib/MenC).
- Conjugate vaccine should be given as intramuscular injection, preferably in the deltoid muscle (or in the anterolateral aspect of the upper thigh in children .

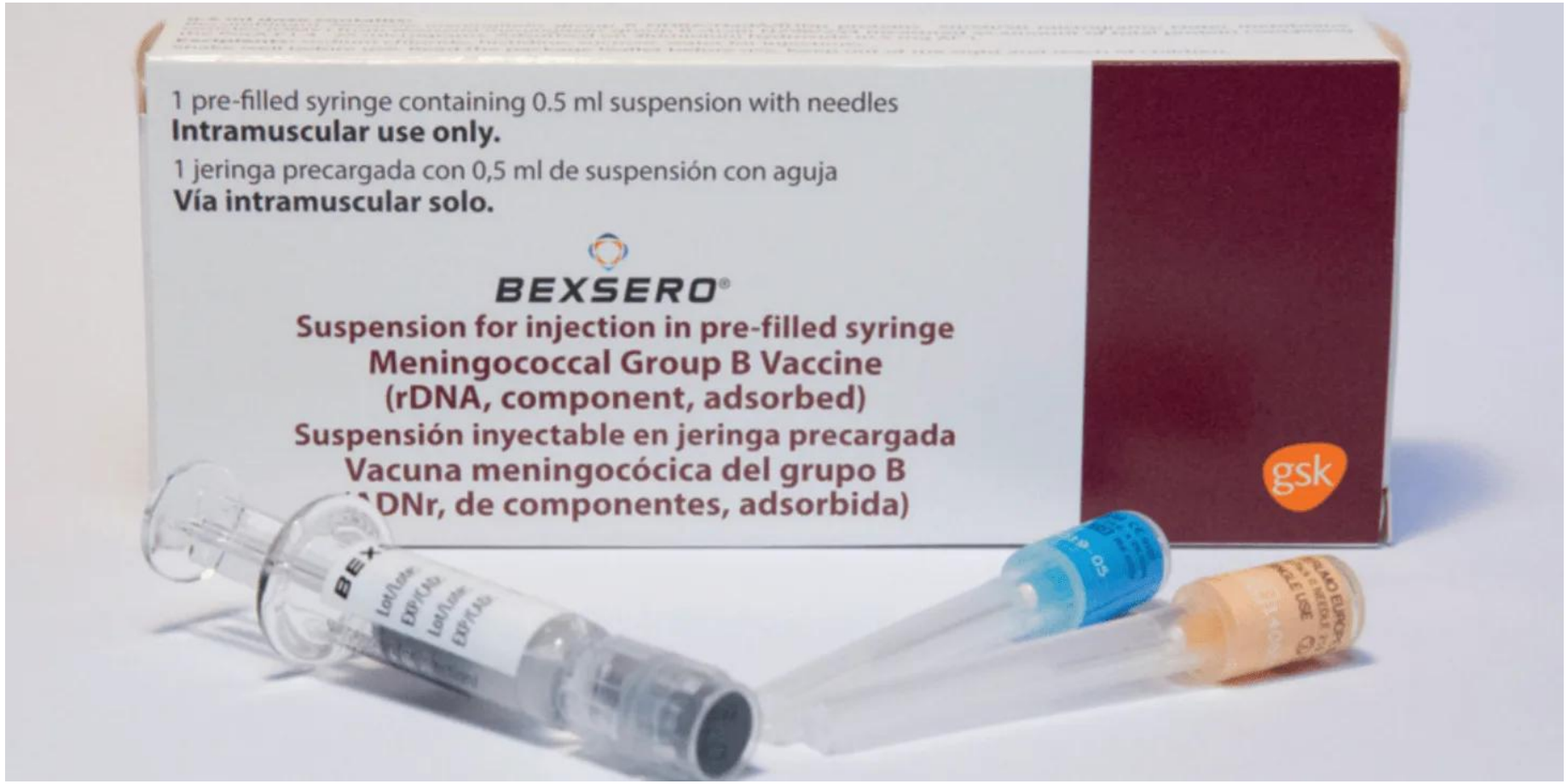
- Monovalent Men A conjugate vaccine should be given as a single dose to individuals 1-29 years of age.
- For monovalent Men C conjugate vaccine, one single intramuscular dose is recommended for children aged 2 12 months, teenagers and adults.
- Children 2-11 months of age require 2 dose administration at an interval of at least 2 months and a booster about 1 year thereafter.
- Quadrivalent vaccines are administered as a single dose to individuals aged ≥2 years.

- Meningococcal vaccines should be stored at 2-8°C.
- Conjugate vaccines are preferred over polysaccharide vaccines due to their potential for herd protection and their increased immunogenicity, particularly in children < 2 years of age.
- meningococcal conjugate vaccines are capable of reducing nasopharyngeal carriage of N“
- Both vaccines are safe when used during pregnancy.
- WHO recommends that countries with high or medium endemic rates of invasive meningococcal disease and countries with frequent epidemics should introduce appropriate large-scale programmes.

How Conjugate Vaccines Block Transmission

- * **High mucosal antibodies (IgG and IgA)**: By linking the bacterial sugar capsule to a carrier protein, conjugate vaccines engage T-helper cells. This triggers a much stronger immune response that produces high levels of IgG and secretory IgA antibodies that leak onto the moist lining of the nose and throat—the exact spot where Neisseria meningitidis lives harmlessly in healthy carriers.
- *** Clearing the carrier state**: When those antibodies coat the bacteria in the throat, they block the bacteria from attaching to mucosal cells and help immune cells clear them out. Because adolescents and young adults are the main asymptomatic carriers who spread the bacteria through coughing, sneezing, or close contact, vaccinating them cuts off the chain of transmission across the whole community—including unvaccinated infants and older adults.
- *** Long-lasting immune memory**: Conjugate vaccines generate durable memory B-cells, keeping antibody levels high enough over years to continue suppressing throat colonization.

- all Hajj and Umrah pilgrims aged one year and older are required by KSA to receive quadrivalent meningococcal vaccine.


1 pre-filled syringe containing 0.5 ml suspension with needles
Intramuscular use only.
1 jeringa precargada con 0,5 ml de suspensión con aguja
Vía intramuscular solo.
BEXSERO®
Suspension for injection in pre-filled syringe
Meningococcal Group B Vaccine
(rDNA, component, adsorbed)
Suspensión inyectable en jeringa precargada
Vacuna meningocócica del grupo B
DNr, de componentes, adsorbida)
gsk

BEXSERO(LICENSED SINCE 2015)

- is a vaccine approved for 10- through 25-year-olds to prevent meningococcal group B disease (also known as meningitis B) caused by Neisseria meningitidis bacteria.
- Vaccination with BEXSERO can be completed with 2 or 3 doses.
- Help protect teen against meningitis B.

Recent vaccines

- Sanofi's recent meningitis vaccine news includes the FDA's May 2025, Europe August 2026 approval of its MenQuadfi conjugate vaccine for infants as young as six weeks old, making it the first of its kind for this age group.
- The vaccine protects against serogroups A, C, W, and Y, and is administered as a four-dose series in infancy.
- Sanofi has also been conducting clinical trials for other meningococcal vaccines, including a novel multicomponent Group B vaccine.
- From two months through 25 years of age.

REFERENCE :park's textbook of preventive and social medicine 27th edition