Recommendations for Invasive Meningococcal Vaccine from Emirates Family Medicine Society

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1. Executive Summary

Executive Summary: Medical Guidelines for Invasive Meningococcal Disease (IMD) due to Neisseria meningitidis.

1.1 Overview:

Invasive meningococcal disease (IMD) caused by Neisseria meningitidis poses a significant global public health challenge. With mortality rates reaching up to ~8–15%, even with timely intervention, the disease remains a serious concern.[1] Survivors often endure long-term disabilities and neurological complications.[2,3]

1.2 Epidemiology:

- Despite a well-developed Healthcare system, in the United States U.S. cases of meningococcal disease have increased sharply since 2021 and now exceed pre-pandemic levels.
- There are 12 identified serogroups of N. meningitidis, with serogroups A, B, C, W, X, and Y being most responsible for IMD cases globally.
- Serogroup B is the predominant cause of IMD worldwide, accounting for 51% of documented cases in 2021.
- In the Middle East, MenB has been the most prevalent serogroup (54.7%) among IMD cases.

1.3 Risk Factors:

- Adolescents and young adults, individuals with compromised immune systems, and microbiologists are at higher risk.
- Mass gatherings, such as university students living in dorms, military personnel, Hajj, and Umrah pilgrimages, significantly increase the risk of meningococcal transmission.

1.4 Scope:

This recommendation applies to healthcare professionals licensed in the UAE.

1.5 Purpose:

The Emirates Family Medicine Society (EFMS) contributes to improving the criteria and standards of practice within the profession and advancing levels of health awareness among the public in UAE, providing recommendations to have the highest level of safety and quality immunization services at all times, through the development, establishment, and enforcement of minimum required international best practices.

1.6 Applicability:

This guideline is intended to be used by all healthcare providers in public and private health settings.

1.7 Recommendations:

- *Meningococcal B Vaccine for Adolescents and Young Adults (16-23 years):*
  - Adolescents and young adults have the highest carriage rates of IMD Vaccination is crucial to reduce transmission and long-term impacts of the disease. CDC recommends routine MenACWY vaccination with booster doses for those at increased risk.

Serogroup B meningococcal vaccine is also recommended for this age group, especially those at increased risk due to medical conditions or outbreaks.

- Based on shared clinical decision-making, 2-dose series MenB-4C at least 1 month apart or 2-dose series MenB-FHbp at 0, 6 months (if dose 2 was administered less than 6 months after dose 1, administer dose 3 at least 4 months after dose 2); MenB-4C and MenB-FHbp are not interchangeable (use the same product across all doses in series).

- *Meningococcal B Vaccine Recommendations for Special Population:*
  - Anatomical or functional asplenia (including sickle cell disease), persistent complement component deficiency, complement inhibitor (e.g., eculizumab, ravulizumab) use, microbiologists routinely exposed to Neisseria meningitidis.
  - 2-dose primary series MenB-4C at least 1 month apart or 3-dose primary series MenB-FHbp at 0, 1–2, 6 months (if dose 2 was administered at least 6 months after dose 1, dose 3 not needed; if dose 3 is administered earlier than 4 months after dose 2, a fourth dose should be administered at least 4 months after dose 3); MenB-4C and MenB-FHbp are not interchangeable (use same product for all doses in series); 1 dose MenB booster 1 year after primary series and revaccinate every 2–3 years if risk remains.

- *Meningococcal B Vaccine Recommendations during Hajj and Umrah:*
  - Based on shared clinical decision-making, the use of the Meningococcal B (4CMenB) vaccine in two doses, one month apart for all adults before going to perform Hajj is recommended.

1.8 Conclusion:

Effective vaccination strategies are essential to control the spread of IMD, particularly among high-risk groups and during mass gatherings. The guidelines underscore the importance of comprehensive immunization practices to protect public health in Dubai.

2. Introduction

Invasive meningococcal disease (IMD), due to Neisseria meningitidis, remains an important global public health concern. Mortality is high, with reported case fatality rates (CFRs) of 50%.[4]. Even with timely and appropriate intervention, overall mortality is 10–20%.[4,5]. Up to 50% of survivors experience significant long-term physical disabilities, social limitations, and reduced quality of life due to serious sequelae, which include a wide range of neurological complications such as seizures, hearing loss, visual disturbances, and language impairments.[2,3]

A total of 12 serogroups of N. meningitidis have been identified; 6 of these serogroups (A, B, C, W, X, and Y) are responsible for most IMD cases worldwide.[5,6]

In many countries worldwide, serogroup B has emerged as the predominant source of IMD.[7] Serogroup B remains the major cause of IMD and accounted for 51% of serogroup-documented cases as per the annual epidemiological report for 2021.[8] In the Middle East, MenB has been the most prevalent serogroup (54.7%) among IMD cases.[9] In the United Arab Emirates (UAE), the majority of the population with estimations of approximately 88% is non-citizens placing an additional burden on the country due to the diverse origins of these individuals.[10]

Recognized risk factors for IMD span a range of individual and social elements.[11] The greatest risk (as evident from greatest incidence rates) is seen in adolescents and young adults, individuals with congenital or acquired immunosuppressive conditions (asplenia/splenic dysfunction, complement deficiency) or receiving specific immunosuppressive medications (e.g., complement component inhibitors), and microbiologists routinely exposed to Neisseria meningitidis.[11] Mass gatherings and religious events such as the Hajj and Umrah pilgrimages are well-recognized risk factors for meningococcal transmission and subsequent outbreaks.[11] In 2023, the UAE has been granted a quota of 6,228 pilgrims for Hajj, with half of that allotted for UAE Nationals departing from Dubai, which imposes an additional challenge on the UAE in managing the transmission of IMD.[12]

This guideline is developed/adopted with reference to the World Health Organization (WHO) immunization recommendation, Centers for Disease Control and Prevention (CDC) immunization resources, and UK immunization guideline and best practice 2023. This guideline presents a framework intended to guide and assist all healthcare providers in the UAE to facilitate successful immunization administration to all target groups in our community.

3. Epidemiology

The epidemiology of invasive meningococcal disease (IMD) is unpredictable, varies by region and age group and continuously evolves. The highest incidence was usually observed in infants, generally followed by young children and adolescents/young adults, as well as older adults in some countries. Globally, serogroup B was a predominant cause of IMD in most countries. Additionally, there was a notable increase in the number of IMD cases caused by serogroups W and Y from 2010 to 2019 in several regions, highlighting the unpredictable and dynamic nature of the disease. Overall, serogroups A, B, C, W, and Y were responsible for the vast majority of IMD cases, despite the availability of vaccines to prevent disease due to these serogroups.[13]

Invasive meningococcal disease (IMD) remains rare in EU/EEA countries but is a severe and life-threatening disease in all age groups. In 2020–2021, the total number of notified cases and the notification rates across all age groups sharply decreased compared to 2018–2019. In 2021, the IMD incidence was low. The

containment measures implemented in EU/EEA countries to tackle the circulation of SARS-Cov-2 from March 2020 onwards impacted the transmission of respiratory pathogens transmitted by droplets, including Neisseria meningitidis, and contributed to the explanation of the drop in the notification rates of IMD observed between 2020 and 2021. In 2022, compared to 2021, there was an overall upsurge in the number of cases reported and the notification rate of all serogroups of IMD except for serogroup C, for which both the proportion and the incidence of IMD cases remained low. Meanwhile, serogroup B remained the dominant serogroup increasing in all age groups. The notification rate of IMD-confirmed cases of serogroup B increased beyond the level observed in 2018–19 in 15– 24-year-olds. There was a sharp increase in serogroup Y IMD incidence and a moderate increase in IMD serogroup W incidence without reaching the level of incidence observed in 2018–19. Particularly, the notification rate of serogroup Y IMD incidence increased in all age groups.[14]

Cases of meningococcal disease are on the rise. As of 25th March 2023, 143 cases of meningococcal disease have been reported in the United States, compared with 81 for the same period last year. For all of 2023, 422 cases were reported, the highest annual figure since 2014.[15]

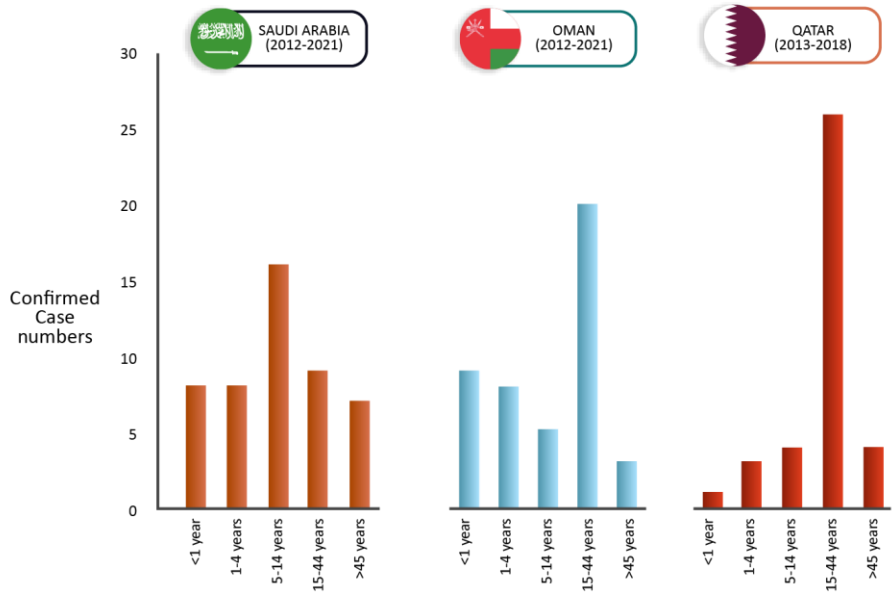
While global perspectives are important, understanding IMD epidemiology and attendant risk factors at a regional and local level is essential to better understand the benefits of existing preventive approaches (and to help identify policy gaps). This is of particular importance in the Gulf Cooperation Council (GCC) Countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia [SA], and United Arab Emirates [UAE]), where IMD outbreaks associated with Hajj pilgrimage gatherings within SA in the 1990s and then in 2000/2001 resulted in significant morbidity and mortality, both locally within SA and at the regional level in neighboring GCC Countries. Moreover, these latter outbreaks had far broader repercussions, with subsequent intercontinental spread via returning pilgrims acting as a prime driver in the global emergence of MenW disease.[16]

The data indicate that capsule switching in N. meningitidis can occur by gene conversion of the capsule polymerase and that this event occurs in vivo. Presumably, co-colonization of serogroup B and C strains in the human nasopharynx and genetic exchange of capsule biosynthesis genes by transformation and allelic exchange are the events responsible for capsule switching. The high frequency (5–10%) of meningococcal carriage in the human nasopharynx of adults, which appears to increase in epidemic settings, may facilitate the chances of capsule switching. These data are supported by molecular analysis of meningococcal strain collections that contain isolates with otherwise identical genetic markers (e.g., ET-type) that express different capsular polysaccharides.[17]

3.1. Role of adolescents and young adults in N meningitidis transmission

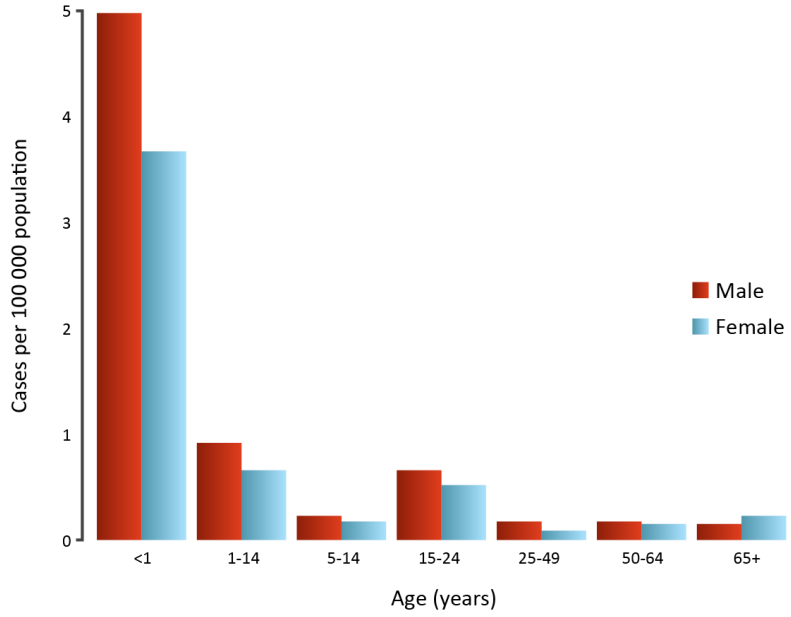
Transmitted through respiratory secretions, N meningitidis is often asymptomatically carried at the mucosal surface of the nasopharynx. This process, known as carriage, is a prerequisite for the development of IMD. One of the most consistently identified risk factors for meningococcal nasopharyngeal carriage is age, with the highest carriage rates often observed in adolescents and young adults. In a systematic review and meta-analysis of data from 89 studies from European countries or countries in which meningococcal serogroup B (MenB) and meningococcal serogroup C (MenC) predominate, adolescents and young adults were determined to have the highest carriage rates of any age-based population, peaking at a point estimate of 23.7% for those aged 19 years.[18]

Age distribution of IMD in GCC Countries (2012–2021). Data as reported in national health surveillance reports and related publications.[16]



Notes: for Qatar, data were available for 38/39 cases. Abbreviations: GCC, Gulf Cooperation Council, IMD, invasive meningococcal disease.

Distribution of confirmed invasive meningococcal disease cases per 100 000 population by age and gender, EU/EEA, 2022[14]

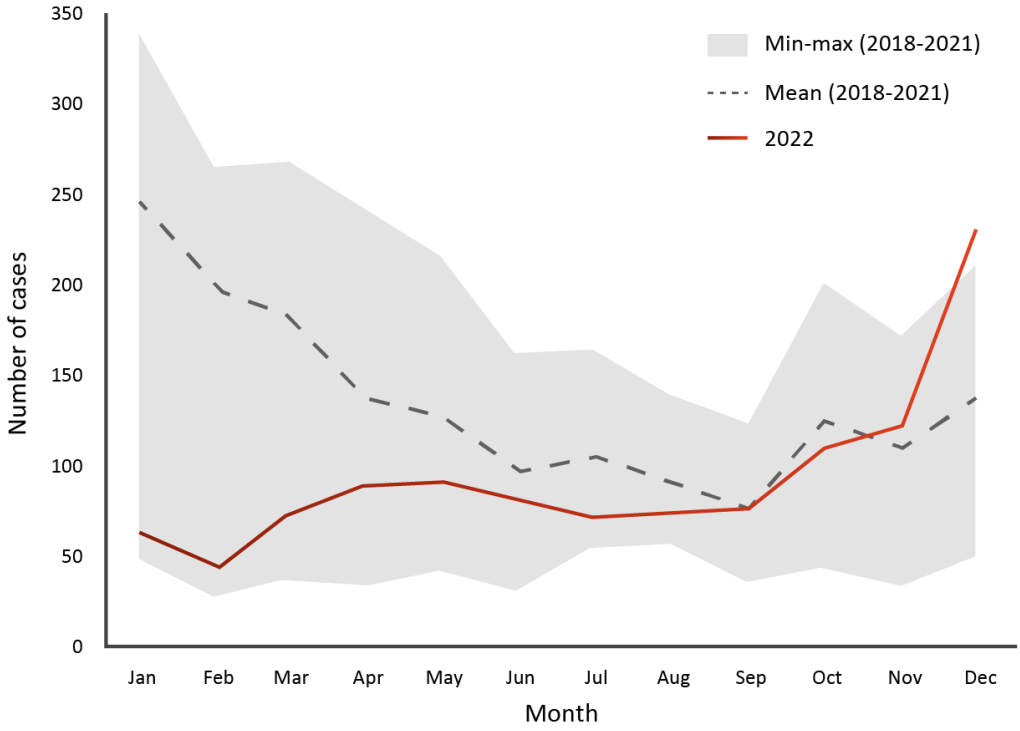


Source: country reports from Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

3.2. Seasonality and trend

Between 2018 and early 2020, the seasonality of IMD followed a pattern similar to previous years. IMD occurred primarily in the winter months, while the number of cases was lowest in summer. The number of reported confirmed cases sharply decreased in 2020–22 with an attenuated seasonality pattern. The strong rise in the number of cases observed in December 2022 might mark the restart of a more common seasonality pattern similar to the pre-COVID-19 pandemic.[14]

Distribution of confirmed invasive meningococcal disease cases by month, EU/EEA, 2022 and 2018–2021[14]



Source: country reports from Austria, Belgium, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

4. Recommendation

Meningococcal Vaccine Recommendations for Adolescents and Young Adults aged 16–23 years

The carriage rates of IMD are highest in adolescents/young adults.[18] A comprehensive systematic review and meta-analysis of 89 studies conducted across European countries and regions where meningococcal serogroup B (MenB) and serogroup C (MenC) are prevalent revealed that adolescents and young adults have the highest carriage rates compared to other age groups. The data indicated a peak point estimate of 23.7% for individuals aged 19 years.[18]

Meningococcal disease progresses rapidly, often leading to a high mortality rate and posing a significant risk for serious, lasting complications in survivors.[18-20] The primary manifestations include meningitis and septicemia, which can occur simultaneously.[18] In children and adolescents, septicemia typically presents with symptoms such as lower limb pain, cold extremities, and pale skin. The rash is a classic sign of

meningococcal septicemia, occurring in 40% to 80% of cases.[18] Within 9 to 12 hours of onset, adolescents may experience drowsiness, breathing difficulties, diarrhea, neck stiffness, rash, and sensitivity to light, alongside clinical signs of sepsis-like leg pain, cold extremities, and skin discoloration. Confusion, unconsciousness, and seizures usually develop around 24 hours after onset. The CFRs for meningococcemia in this population are notably elevated, reaching levels as high as 40%.[18]

Among survivors of meningococcal infection, up to 20% suffer serious and long-term physical and psychological sequelae.[18] These may include skin scarring, vertigo, mobility problems, speech impairments, hearing loss, cognitive impairment, amputations, seizures, and symptoms consistent with Raynaud's disease.[18] IMD exerts wide-ranging impacts on survivors, influencing leisure activities, physical capabilities, academic success, family life, friendships, and career choices. [18] Adolescents who overcome IMD often report increased fatigue, decreased social support, lower quality of life, and academic challenges compared to peers matched for age and sex. They also contend with memory issues, attention deficits, and slower cognitive processing speeds. Notably, younger adolescents exhibit more pronounced cognitive deficits than older counterparts. A questionnaire-based study published in 1998, featuring a quarter of respondents aged 10 to 19 years, highlighted widespread declines in quality of life and heightened anxiety among IMD survivors. [18]

As a result, it is recommended to administer the meningococcal vaccine to individuals in this specific group to reduce both the transmission and the long-term impacts of IMD. [18] The CDC recommends routine MenACWY vaccination for adolescents. In addition, adolescents at the highest risk of meningococcal disease should receive a booster dose.[21] For adolescents who receive the first dose at age 13 through 15 years, administer a booster dose at age 16 through 18 years, before the period of increased risk.[22]
Adolescents who are at increased risk due to medical conditions need a 2-dose primary series of MenACWY vaccine administered 8 weeks apart, as well as regular booster doses every 5 years. [22]

CDC also recommends a booster dose for those at increased risk due to an outbreak if 5 or more years have passed since receiving MenACWY.[22]

Adolescents and young adults (16 through 23 years old) may also receive a serogroup B meningococcal vaccine.[21] The preferred age for receipt is 16 through 18 years so adolescents have protection during the ages of increased risk.[22]

In September 2015, the UK became the first country to implement 4CMenB into its publicly funded national infant immunization programme. To compare clinical disease and outcomes, laboratory-confirmed MenW cases in children younger than 5 years during the 4 prevaccine and 4 postvaccine years were compared according to their 4CMenB vaccination status. There were 69% fewer MenW cases in children due to the direct impact of the infant 4CMenB programme, incremental to the herd effect of the adolescent MenACWY programme.[23]

4CMenB may provide additional benefit through cross-reactivity and cross-protection against non-B meningococcal serogroups, which is important considering the evolving epidemiology of IMD. [24]

Meningococcal Vaccine Recommendations for High-risk population

Risk factors for meningococcal disease include antecedent viral infection, household crowding, and smoking. In addition, certain groups are at increased risk for meningococcal disease, including the following:[25]

- **Persons with persistent complement component deficiencies:** Persons who have persistent (e.g., genetic) deficiencies in the complement pathway (e.g., C3, C5–C9, properdin, factor D, or factor H) have up to a 10,000-fold increased risk for meningococcal disease Persons with complement deficiencies might experience recurrent disease and inherited disorders might affect additional family members; therefore, testing for complement deficiency should be considered for patients with meningococcal disease.[25]

- **Persons who use complement inhibitors:** Use of complement inhibitors (e.g., the currently licensed eculizumab [Soliris] and its long-acting derivative ravulizumab [Ultomiris] monoclonal antibody therapies that block C5) is associated with a substantially increased risk for meningococcal disease Eculizumab use is associated with an approximately 2,000-fold increased incidence of meningococcal disease Complement inhibitor recipients remain at risk for meningococcal disease even after meningococcal vaccination; therefore, CDC guidance indicates that providers could consider treating patients with antimicrobial prophylaxis for the duration of complement inhibitor treatment.[25]

- **Persons with anatomic or functional asplenia:** Persons with anatomic or functional asplenia (including sickle cell disease) appear to be at increased risk for meningococcal disease and, compared with healthy persons, have a higher mortality rate (40%–70%) from the disease.[25]

In general, Individuals with anatomic asplenia face an elevated risk of infection, with approximately 36% experiencing a post-splenectomy infection, as observed in a study conducted in the United States. Furthermore, these individuals have a roughly 5% chance of developing overwhelming post-splenectomy infection (OPSI), which proves fatal in approximately 50% of cases.[26]

To decrease the risk of transmission, the CDC advises receiving MenACWY vaccines.[22] Additionally, the CDC recommends the administration of a MenB vaccine due to the potentially devasting consequences of MenB infection.[22]

The CDC recommends that certain adolescents and young adults should receive a serogroup B meningococcal vaccine.[22] They include those at increased risk because of a serogroup B meningococcal disease outbreak and people with certain medical conditions or taking certain medications.[22]
These include:[22]

- Complement component deficiency (e.g., C5-C9, properdin, factor H, factor D)
- Functional or anatomic asplenia (including sickle cell disease)
- Complement inhibitor (e.g., Soliris® or Ultomiris®)

Those at increased risk need regular booster doses. A booster dose of the MenB vaccine 1 year after series completion is recommended and then every 2 to 3 years thereafter.[22] For those at increased risk due to an outbreak who previously received the MenB vaccine series, the CDC recommends a booster dose if a year or more has passed since primary series completion.[22]

Based on shared clinical decision-making, 2-dose series MenB-4C at least 1 month apart or 2-dose series MenB-FHbp at 0, 6 months (if dose 2 was administered less than 6 months after dose 1, administer dose 3 at least 4 months after dose 2); MenB-4C and MenB-FHbp are not interchangeable (use the same product for all doses in series).

- **Persons living with HIV infection:** In studies from the United States, United Kingdom, and South Africa, persons living with HIV infection or acquired immunodeficiency syndrome have an elevenfold to twenty-four-fold increased risk for meningococcal disease. Among persons living with HIV infection, low CD4 count

or high viral load are associated with greater risk. Most meningococcal cases reported among persons living with HIV infection in the United States are caused by serogroups C, W, or Y.[25]

A first-of-kind study assessed the immunogenicity and safety of a meningococcal serogroup B vaccine or the co-administration of a MenB and MenACWY vaccine in people living with HIV. All participants (100%; 95% confidence interval [CI] 93-100) achieved putative protective titers for two of the three MenB strains and for MenA, W, and Y. A total of 98% (95% CI 89-100) achieved a protective titer for the third MenB strain and 94% (95% CI 83-99) for MenC. No serious adverse events were reported.[27]

- **Microbiologists routinely exposed to N. meningitidis isolates:** The annual attack rate of laboratory-acquired meningococcal infection among microbiologists who routinely work with N. meningitidis isolates has historically been estimated to be 13 per 100,000 persons, which is manyfold higher than the rate for adults among the general population. This increased risk is likely related to mechanical manipulation of isolates that generates droplets or aerosols; increased risk was not observed among laboratory workers who handle clinical specimens but not isolates.[25]

Laboratory-acquired meningococcal disease presents a notable occupational hazard for clinical microbiologists.[28] Research indicates that the calculated attack rate is elevated among microbiologists compared to the general population, emphasizing the occupational hazard inherent in their field.[28,29]
The reported mortality rate for laboratory-acquired N. meningitidis sepsis or meningitis is approximately 50%, exceeding the mortality rate observed in cases of endemic infections.[29]

Between 1985 and 2001, a review of worldwide occurrences revealed sixteen probable cases of laboratory-acquired meningococcal disease.[28] Of these cases, six were documented in the United States. Serogroup B accounted for nine cases (56%), while serogroup C accounted for seven (44%). Disturbingly, half of the cases resulted in fatalities, totaling eight individuals.[28] Notably, all affected individuals were clinical microbiologists, indicating likely exposure to aerosols containing N. meningitidis.[28]

- **Persons at increased risk during an outbreak of meningococcal disease:** During outbreaks, the median attack rate is up to 1,400-fold higher than in the non-outbreak setting.[25]

People who were previously vaccinated may need additional protection if they're part of a population at increased risk during an outbreak. CDC recommends a booster dose for these individuals if 5 or more years have passed since the most recent MenACWY vaccine.[30]
CDC recommends the Men B vaccine (Trumenba: 3-dose series at 0, 1–2, and 6 months or Bexsero: 2-dose series at least 1 month apart), For individuals who remain at increased risk of serogroup B disease, a single dose of MenB vaccine is recommended 1 year after completion of the primary vaccination series and every 2-3 years thereafter.[30]

- **Travelers to countries where meningococcal disease is hyperendemic or epidemic:** Travelers to countries where meningococcal disease is hyperendemic or epidemic, such as the meningitis belt of sub-Saharan Africa, are at increased risk for exposure, and thus, disease. Historically, serogroup A was the predominant meningococcal pathogen in the meningitis belt. However, after the implementation of a meningococcal serogroup A conjugate vaccine (MenAfriVac), serogroup A disease has been nearly eliminated in the meningitis belt. Endemic meningococcal disease and outbreaks are now most commonly caused by serogroups C, W, and X.[25]

- **College students:** Historically, college freshmen living in residence halls were identified as being at

increased risk for meningococcal disease. With improved control of serogroups C, W, and Y disease after widespread use of MenACWY vaccine among adolescents, the risk for meningococcal disease among college students is greatest for serogroup B, with a relative risk of 3.5 compared with persons not attending college, although serogroup B disease incidence among this population is low (0.17 cases per 100,000 population). Risk factors for serogroup B meningococcal disease among undergraduate college students include age 18–20 years, attendance at a 4-year college, freshman class year, and on-campus residence. Although not assessed outside of outbreak settings, participation in a fraternity or sorority is an additional risk factor during serogroup B meningococcal disease outbreaks.[25]

- **Military recruits:** Historically, new military recruits were identified as being at increased risk for meningococcal disease and outbreaks, most likely related to the crowded living conditions among persons originating from different geographic areas carrying diverse N. meningitidis strains.[25]

- **Oncology patients:** Patients with cancer often experience a compromised immune system because of a variety of factors, including chronic inflammation, impaired and/or decreased function of elements of the hematopoietic lineage, and treatments that compromise immune function. Consequently, patients with cancer are at a heightened risk for infection, which can extend beyond cancer treatment, highlighting the need for oncologists to partner with primary care providers to obtain an up-to-date vaccine history as part of the standard oncologic evaluation and to address intervention for vaccine-preventable diseases.[31]

Recommendations for Other Vaccines That May be Indicated for Adults With Cancer and Coexisting Health Conditions:[31]

Vaccine	Type	Other Risk Factor	Recommendations
Meningococcal vaccination[a]	Men ACWY (nonlive)	Anatomic or functional asplenia, complement component deficiency, complement inhibitor (eg, eculizumab, ravulizumab), Travel, Occupational, Military recruits, Residential living for college students	Two-dose series MenACWY-D Frequency: 8 weeks apart Revaccinate every 5 years if risk remains
	Men B (nonlive)	Anatomic or functional asplenia (including sickle cell disease), persistent complement component deficiency, complement inhibitor (eg, eculizumab, ravulizumab) use, occupational (microbiologists), pregnancy, MSM outbreak setting	Two-dose primary series MenB-4C at least 1month apart Or three-dose primary series MenB-FHbp at 0, 1-2, 6 months Revaccinate every 2-3 years if risk remains

Meningococcal B Vaccine Recommendations during Hajj and Umrah

IMD outbreaks associated with Hajj and Umrah pilgrimage events in the Kingdom of Saudi Arabia (KSA) are well recognized.

Hajj, the annual pilgrimage to Mecca in the Kingdom of Saudi Arabia, stands as one of the world's largest and most diverse mass gatherings, encompassing people from various geographical and ethnic backgrounds.[32,33] Hajj and Umrah pilgrimage events bring about 1.8 to 7.2 million people every year from more than 184 countries.[32] In Saudi Arabia, the disease incidence is influenced by the considerable influx of Muslim pilgrims from the African meningitis belt who participate in Hajj and Umrah.[33]

The US Centers for Disease Control and Prevention (CDC) issued a Health Alert Network advisory in May 2024, after 12 cases of invasive Neisseria meningitidis disease were reported in the UK (three), France (four), and the USA (five), raising alarm for public health authorities worldwide. Among these cases, ten were attributed to travelers who had returned from Saudi Arabia after performing Umrah, a pilgrimage to Mecca that happens throughout the year and is shorter than the Hajj, during Ramadan (March and April 2024). The two remaining cases involved individuals who had close contact with these returning

travelers.[34]

Recent data demonstrating the changes in dominant meningococcal serogroup based on nasopharyngeal carriage, Of the 1055 arriving unpaired pilgrim, 36 (3.4%) tested positive for nasopharyngeal carriage of *N. meningitidis*, and 24 (66.7%) **of these were serogroup B**, the remainder were non-groupable.[35]

Haemophilus influenza was detected among 45 (4.3%), and 11 (1%) carriers were positive for both *N. meningitidis and H. influenzae*. Out of 373 in the unpaired departing cohort, 6 (1.61%) tested positive for *N. meningitidis*, and 34 (9.1%) were positive for *H. influenzae*. Of the 628 paired cohort pilgrims, 36 (5.7%) pilgrims were positive for *N. meningitidis* at arrival and 16 (2.5%) pilgrims were positive after the hajj.[35]

Currently, all pilgrims, domestic and international, as well as residents of the holy cities and workers in contact with pilgrims are required to be vaccinated with the quadrivalent meningococcal (ACYW) vaccine.[33] The CDC recommends travelers>2 years of age making the Umrah or Hajj pilgrimage to provide documentation of quadrivalent vaccine ≥10 days and ≤3 years before arrival for polysaccharide vaccine and ≤5 years before arrival for conjugate vaccine. Travelers should confirm visa requirements with the KSA embassy.[36]

With the introduction of mandatory MenACWY immunization for Hajj and Umrah pilgrims entering the KSA, there were substantial benefits in reducing IMD outbreaks and subsequent spread in returning travelers.[32] However, meningococcal disease remains a critical public health concern during the Hajj and Umrah pilgrimages primarily because the existing mandatory vaccines do not provide coverage for all serogroups capable of causing invasive disease.[37]

There are still outbreaks caused by serogroup B driven by its increasing predominance in several countries, including those with significant Muslim populations.24 Between 2002 and 2011, MenB was accountable for 16.5% of IMD cases.[32]

Current Hajj and Umrah meningococcal disease preventative measures do not protect against MenB or MenX disease and do not necessarily prevent carriage and transmission of N. meningitidis.[37]

A concern is that the current Hajj and Umrah compulsory quadrivalent vaccine policy could lead to an increase in meningococcal disease incidence or outbreaks due to strains not included in the vaccine or those with reduced vaccine antigen expression. This could hypothetically occur through capsular switching or through serogroup replacement, whereby nonvaccine-type organisms fill the niche vacated by the removal of vaccine-type strains.[37]

Due to the possibility of a rapid change in the epidemiology of meningococcal disease during Hajj and Umrah, contingency plans should be in place to contain outbreaks, which may include the availability of MenB vaccines for mass vaccinations to control potential outbreaks.[37]

Therefore, the CDC recommends those who remain at increased risk to receive regular booster doses.[22] A booster dose of the MenB vaccine 1 year after series completion and then every 2 to 3 years thereafter is recommended and for those at increased risk due to an outbreak who previously received the MenB vaccine series, CDC recommends a booster dose if a year or more has passed since primary series completion.[22]

Based on shared clinical decision-making, the use of the Meningococcal B (4CMenB) vaccine in two doses, one month apart for all adults before going to perform Hajj is recommended. Emirates Family Medicine Society endorses Saudi Arabia Health Authorities to add Meningococcal B vaccination for Hajj Pilgrim requirements.

5. Cost-effectiveness of Meningococcal disease vaccines

Cost-Effectiveness of MenACWY Vaccines

The cost-effectiveness of MenACWY vaccines in the United States was last assessed in 2010 using a Monte Carlo simulation. In this evaluation, cost per quality-adjusted life year (QALY) of vaccinating at ages 11 and 16 years was similar to vaccinating at either age 11 or 15 years ($212,000–$256,000), although the estimated number of cases and deaths averted among the vaccinated cohort was substantially higher with a 2-dose strategy (184 and 22, respectively) compared with a single-dose strategy (94–115 and 11–14, respectively).[38]

Cost-Effectiveness of MenB Vaccines

The cost-effectiveness of MenB vaccines among U.S. adolescents was first assessed in 2015 and most recently evaluated in 2018 (10,239). Vaccination strategies included a MenB primary series at age 11 years with a booster at age 16 years, a series at age 16 years, a series at age 18 years, and a series among college students. Cost per QALY saved for these four strategies ranged from $9.6 million to $12.7 million, with the number needed to vaccinate to prevent a case ranging from 152,000 to 305,000 and the number needed to vaccinate to prevent a death ranging from 1.6 million to 2.8 million.[38]

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7. Glossary:

- 4CMenB: 4-component serogroup B meningococcal vaccine
- CD4: Clusters of differentiation 4
- CDC: Centers for Disease Control and Prevention
- CFRs: Case fatality rates
- COVID-19: Coronavirus Disease 2019
- EEA: European Economic Area
- EFMS: Emirates Family Medicine Society
- EU: European Union
- GCC: Gulf Cooperation Council
- H. influenzae: Haemophilus influenza
- HIV: Human immunodeficiency viruses
- IMD: Invasive Meningococcal Disease
- KSA: Kingdom of Saudi Arabia
- MenA: Meningococcal serogroup A
- MenACWY: Meningococcal ACWY Vaccines
- MenAfriVac: Meningococcal serogroup A conjugate vaccine
- MenB: Meningococcal serogroup B
- MenB-4C: Multi-component meningococcal serogroup B (MenB)-4C
- MenB-FHbp: Meningococcal serogroup B-factor H binding protein vaccine
- MenC: Meningococcal serogroup C
- MenW: Meningococcal Group W
- MenX: Meningococcal serogroup X
- N. meningitidis: Neisseria meningitidis
- OPSI: Overwhelming post-splenectomy infection
- QALY: Quality-adjusted life year
- SA: Saudi Arabia
- SARS-Cov-2: Severe acute respiratory syndrome coronavirus 2
- UAE: United Arab Emirates
- UK: United Kingdom
- US: United States
- WHO: World Health Organization