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Review

Current global trends in meningococcal disease control, risk groups and vaccination: Consensus of the Global Meningococcal Initiative

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SUMMARY

This review outlines recent trends on invasive meningococcal disease (IMD) discussed at the latest meeting of the Global Meningococcal Initiative (GMI). There has been a re-emergence of the Hajj strain sublineage (serogroup W; ST-11 clonal complex), with travel to the Kingdom of Saudi Arabia being a critical factor in transmission. The epidemiology of IMD has also changed following the COVID-19 pandemic, with annual IMD cases increasing in many countries. For example, the highest number of IMD cases since 2014 was reported in the USA in 2023–2024. Atypical presentations of IMD have been prominent irrespective of the pandemic. For instance, an increase in cases of meningococcal epiglottitis has been reported in France in 2022–2023 (serogroups W and Y). When considering vaccination, the GMI has identified a need for broader meningococcal serogroup B (MenB) immunisation owing to the potential impact of the vaccines on reducing IMD incidence caused by other serogroups than MenB. There is also a case for using MenB vaccination to protect against *Neisseria gonorrhoeae* infection based on initial evidence, albeit further studies will need to be conducted.

Introduction

Invasive meningococcal disease (IMD) is communicable and a potentially fatal outcome from exposure to the Gram-negative bacterium, *Neisseria meningitidis*. The disease can manifest as meningitis and/or septicaemia,[1] and lead to several serious sequelae, be they neurological, physical or behavioural.[2] *N. meningitidis* can be classified into twelve serogroups, with six being responsible for the vast majority of IMD cases (MenA, MenB, MenC, MenW, MenX and MenY).[1]

Despite the robustness of surveillance networks and disease control strategies in many countries, IMD cases remain under- or mis-reported in some regions.[3] This may underscore a misunderstanding in the manifestations of IMD, with some national networks only reporting meningitis.[3] The Global Meningococcal Initiative (GMI) was established to address such shortcomings in disease prevention, helping to raise awareness through both education and research.[3–7]

GMI members and delegates convened virtually on March 18 and 19, 2025, as part of its 5th Summit Meeting. These sessions adopt a global perspective, exploring the latest trends in research and

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control strategies, which may impact various regions. The principal objectives of this year's meeting were as follows: (i) to review the latest epidemiological trends in IMD following the coronavirus disease-19 (COVID-19) pandemic; (ii) to assess the prevalence of IMD in at-risk populations; (iii) to highlight recent research in pentavalent meningococcal vaccines containing Men ACWY conjugates combined with wither a Men X conjugate or a Men B vaccine; (iv) to explore the importance of timing when considering booster vaccination schedules.

The surveillance of meningococcal carriage and IMD: latest serogroup trends and studies

Re-emergence of Hajj clone (cc11) in 2024

The ST-11 cc11 has been associated with a number of serogroups, including MenB, MenC and MenW 8]. This specific clonal complex is characterised by severe sequelae, a high case fatality rate (CFR) and atypical presentations (i.e., joint infection, gastrointestinal symptoms, and urethritis). As mentioned, cc11 continues to expand and diversify, affecting multiple populations, including men who have sex with men (MSM), heterosexual men and military personnel.[8]

In the 1960s, a major outbreak of MenB cc11 IMD among US military recruits gave way to a MenC cc11 outbreak.[9] A further wave of MenC cc11 disease, associated with the ET-15 clone (lineage 2) in particular, swept across North America and Europe during the mid to late 1990s leading to the introduction of the MenC conjugate vaccine in the UK in 1999. The UK MenC vaccine programme, and similar programmes in other countries led to significant reductions in MenC IMD cases.[10] MenC cc11 persists, however. The ET-15/lineage 2 strain has given outbreaks of invasive disease among MSM, and a novel strain has emerged causing a large multistate outbreak of urethritis among heterosexual males in the United States.[11]

A pilgrimage to Makkah in the Kingdom of Saudi Arabia (KSA), the Hajj is attended by millions of Muslims from over 185 countries over several days each year.[12] A separate pilgrimage, Umrah is attended by a greater number of people, albeit taking place at any time throughout the year.

Since 1987, various IMD outbreaks have been reported among those travelling to and from the Hajj and Umrah.[13,14] Cramped conditions and overcrowding have acted as central risk factors in facilitating the spread of communicable diseases.

Significant IMD outbreaks occurred in 2000 and 2001 during the Hajj. Of the total IMD cases reported between 1995 and 2011, 60% were recorded in these two consecutive years, involving two MenW outbreaks in Mecca and Medina.[15] In 2000–2001, 654 IMD cases were reported in KSA, with 259 cases confirmed in external pilgrims.[15] MenW (sequence type (ST)-11; clonal complex (cc) 11) was the strain largely responsible for the outbreak in 2000/2001.[16] Subsequent MenW IMD epidemics due to the corresponding 'Hajj strain' sublineage occurred in sub-Saharan Africa.[17] At the same time a distinct W:cc11 sublineage, the 'South American strain sublineage', emerged in South America[18] before spreading to Europe[19] and beyond in the late 2000s and throughout the 2010s.

The emergence of MenW cc11 is posited as stemming from a MenC to MenW capsular switch in the 1970s. Of the two modern MenW strains, (the Hajj strain sublineage and the South American-strain sublineage),[17,18] the MenW cc11 Hajj strain sub-lineage is rare in Western countries, with cases often being imported from African countries.

Three MenW (cc11) Hajj-strain sublineage strains (A, B, and C), in particular, are contemporary, with the strains A and B being direct descendents of the Hajj (2000/2001) strain. Strain C is directly descended from strain B and endemic to Africa, but has appeared in small country-specific clusters in Europe and North America.

Travel to KSA during Umrah remains a key factor in the transmission of MenW cc11 IMD. In early 2024 an international cluster of three ciprofloxacin-resistant Umrah-associated Hajj strain sublineage 'strain C' cases occurred, two associated with travel to KSA. At the same time, Hajj strain sublineage 'strain A', caused 27 largely Umrah/Middle Eastern and Asian travel-related cases. These fell into four distinct phylogenetic clusters: cluster A1 (n=9 cases across Canada, England, and France; one with Middle Eastern travel), cluster A2 (n=8 cases across France, US, England, and Netherlands; 6 associated with travel to Saudi Arabia), cluster A3 (n=8 across England, France, Saudi Arabia, and US; 5 associated with travel to Saudi Arabia) and cluster A4 (n=2 across England and Sweden; both associated with travel to United Arab Emirates). Among the 12 KSA travel-associated cases,[20] ten were adult patients who travelled to KSA, and two were child patients of household contacts of adult travellers to KSA. This recent outbreak may be due to various impacts of the COVID-19 pandemic including a population immune deficit owing to reduced meningococcal exposure during social-distancing, or reduced numbers of pilgrims and therefore vaccinees, coupled with increased travel following the pandemic.

Changes in meningococcal epidemiology following the COVID-19 pandemic and lockdown restrictions

Previous reports have described the impact of COVID-19 lockdown measures on the decreased incidence of IMD in various countries during this period.[5] However, most national surveillance networks have reported that annual IMD cases have subsequently increased following the easing of lockdown measures. Of significance, 422 MenY cases were reported (2023–2024) in the United States – the highest number of annual cases since 2014.[21]

Over a similar period (July 2023–February 2024), there was an unusual MenY outbreak in Australia, leading to 41 urogenital/anorectal cases.[22] Of these MenY cases, 30 were ST-1466, and 11 were not sequence typed. The urogenital isolates were closely related to the invasive MenY ST-1466 strain in the US. CFRs were high in the invasive ST-1466 cases at ~25–30%. Such rates may be associated with economic resource barriers, as well as delayed presentation and diagnosis. A high number of deaths occurred in patients who also had risk factors, such as smoking.

Atypical presentations of IMD have been increasing in certain regions irrespective of the COVID-19 pandemic. In France, over 2015–2022, MenB has predominantly been associated with bacteraemia/sepsis and meningitis across all age groups[23]; MenW has been associated with abdominal symptoms in younger populations as well as pneumonia and septic arthritis; and MenY has been associated with pneumonia mainly in older individuals. An increase in cases of meningococcal epiglottitis has also been reported following the COVID-19 pandemic in France (n=8 in October 2022–June 2023 vs n=5 over 2015–March 2020).[24] These post-pandemic cases were related to MenW and MenY.

Another important factor for understanding changing epidemiological trends is meningococcal carriage studies. Such studies have been conducted peri- and post-pandemic and help to understand how lockdown measures and COVID-19 infection may have impacted carriage rates, leading to disease reduction. In a recent study assessing carriage in South Australian adolescents during the pandemic, pharyngeal carriage of meningococci increased peri- vs pre-pandemic (6.83 vs 3.66%, adjusted odds ratio (aOR): 2.03 [95% CI: 1.22, 3.39]).[25]

Separate analyses have identified increased meningococcal carriage rates among those with a previous COVID-19 infection. The Meningo-Carr-TR study was designed to assess meningococcal carriage in children, adolescents, and young adults during the COVID-19 pandemic in Turkey (N=1585). The overall carriage rate was 8.5%

(n=134) and was higher among those who had a previous COVID-19 infection (OR: 1.95; 95% CI: 1.11, 3.44; p=0.05).[26]

Importance of carriage studies for implementation and understanding vaccination

Carriage studies are performed for various reasons, including to: understand the threat of hypervirulent strains; support the introduction of meningococcal vaccines; monitor the acquisition of antibiotic resistance; and measure the indirect impact of vaccines in national programmes.

Understanding carriage dynamics in the African meningitis belt is critical in the implementation and ongoing assessment of meningococcal conjugate vaccines. Carriage is associated with age and season in this region, being observed at higher prevalences at younger ages compared with Europe or the USA. With the introduction of MenAfriVac (MenA conjugate vaccine) as part of a vaccination programme in Burkina Faso MenA carriage was found to be eliminated.[27]

Nasopharyngeal carriage studies have also provided evidence for herd (indirect) protection from multivalent meningococcal vaccination programmes.[28] Polysaccharide–conjugate vaccines have been found to stop ongoing meningococcal transmission through preventing carriage acquisition, thereby offering herd protection.[29] While several studies looking at carriage reduction following MenACWY vaccination were unable to show an effect, usually because of too small sample size or inappropriate design,[25] the impact of MenACWY conjugate vaccination on pharyngeal carriage was assessed in a large analysis in adolescents during the UK's MenACWY programme.[28] The observational study used two cross-sectional studies (2014 to 2015 and 2018), with a total of 10,625 participants pre-implementation and 13,438 post-implementation. The combined carriage of MenC, MenW and MenY decreased from 2.03 to 0.71% (OR: 0.34; 95% CI: 0.27, 0.44; $p < 0.001$). The impact on carriage was specific to the serogroup targets of MenW and MenY (albeit with carriage remaining low for MenA and MenY), while MenB carriage rates remained unaffected.

The principal purpose of this emergency vaccination programme, which was introduced at a similar time to the four-component serogroup B vaccine (4CMenB), Bexsero, was to directly protect children from specific capsular groups of IMD.[30] Poisson regression model estimates indicated that the MenACWY programme for adolescents may have indirectly prevented between 114 to 899 cases in those eligible for the 4CMenB vaccine during the dual programme's first four years.[30] In a separate analysis, a trend of decreasing IMD (MenW) cases was identified among unvaccinated cohorts (≥65 years) between 2017/18 and 2019/20 (50% reduction).[29]

Surveillance of *Neisseria meningitidis* carriage four years after MenACWY vaccine implementation in the Netherlands found a 3.8-fold reduction ($p < 0.001$) in vaccine-type carriage rates and 9.0-fold increase ($p < 0.0001$) in non-vaccine type MenE prevalence, suggesting that implementation of MenACWY vaccine affected carriage.[31]

Carriage studies are important when evaluating the direct and indirect protection potentially offered by meningococcal vaccines in practice, and such studies are strongly recommended to be implemented in relation to the introduction of the pentavalent polysaccharide conjugate vaccine (MenACWYX) in the African meningitis belt (see below).

Vaccine developments

Assessing strain coverage with MenB vaccines

The aforementioned 4CMenB vaccine, along with Trumenba (lipidated factor H binding protein [fHbp]), is often used to address MenB outbreaks and routinely in programmes. Strain characterisation is, therefore, important to inform vaccine choice. Such selection is determined using phenotypic cross-reactivity and/or expression data (MATS [4CMenB]/MEASURE[Trumenba]) which requires a culture isolate and/or genotypic antigenic data on the strain, either using culture isolate (e.g., WGS to reveal all antigen sequences) or non-culture genotyping (PorA and fHbp typing directly from clinical specimens—although this depends on the availability of residual specimen/DNA extract and DNA load).[32]

For 4CMenB, the MATS assay combines conventional genotyping for PorA with a specialised sandwich ELISA approach. Only one antigen needs to be covered (i.e., > 82% chance of killing) for the strain to be considered susceptible to Bexsero.[32]

When considering Trumenba strain coverage, the MEASURE assay objectively quantifies surface expression of fHbp on fixed meningococcal cells using a monoclonal antibody.[33] Surface quantity is expressed as a mean fluorescence intensity (MFI) value, which is positively correlated with the serum bactericidal activity (SBA). Strains with MFI > 1000 have a 91.2% chance of being killed.

Using outer membrane vesicle (OMV) vaccines

Recent observational data indicate that the MenB OMV vaccine (4CMenB) may also provide some protection against infections from another *Neisseria* species – *Neisseria gonorrhoeae*, given their genetic relatedness. A MenB OMV vaccine (MeNZB) composed of a MenB outbreak strain in New Zealand, was estimated to be 30% effective against gonorrhoea in a retrospective case-control study of young adults aged 15–30 years.[34]

In South Australia, where adolescents are routinely immunised with 4CMenB, the estimated two-dose vaccine effectiveness (VE) against gonorrhoea was 32.7% among adolescents and young adults.[35] No reduction was observed in the age-matched case-control analysis of chlamydia infections. Ongoing surveillance has shown the vaccine to be 34.9% effective against gonorrhoea for at least 3 years after vaccination, with some evidence of waning of protection with time.[36] VE was higher after excluding patients with repeat gonorrhoea infections (37.3%) and for gonorrhoea cases co-infected with chlamydia (44.7%).

Several other observational studies have reported VE for 4CMenB against gonorrhoea, ranging from 33% to 46%.[37,38] Although some VE estimates were not statistically significant, likely because of small sample sizes, the trend in VE was invariably in the direction of protection against gonorrhoea. A systematic review and meta-analysis of published data estimated a significant 34% reduction in gonorrhoea with meningococcal vaccines in case-control studies, and a significant 33% reduction with 4CMenB in observational cohort studies.[38]

In addition to VE, the cost-effectiveness of 4CMenB against gonorrhoea has also been assessed in modelling studies.[39] Vaccinating adolescents had limited impact on total gonorrhoea diagnoses in the population, encompassing only 1.7% of gay, bisexual and other men-who-have-sex-with men (GBMSM) vaccinated per year, even though they accounted for nearly half of all gonorrhoea diagnoses in the UK. Vaccinating on attendance to sexual health clinics for sexually-transmitted infection (STI) testing had the largest impact but required more vaccine doses than other vaccination strategies. On the other hand, vaccinating according to risk had almost the same impact as vaccinating on attendance for testing but with fewer doses, and represented the most cost-effective strategy for vaccines of moderate efficacy or duration of protection (or both). Even with a VE of 30% and duration of protection of 18 months, this approach could avert 110,200 cases and save the UK National Health Service £7.9 million over 10 years.[39]

Progress with the MenABCWY vaccine

Two pentavalent vaccines are now approved for use in the US, as well as in other countries, for immunisation against MenA, B, C, W, and Y. PENBRAYA™ (Pfizer) (MenB-FHbp + MenACWY-TT) is recommended for use in those between 10 and 25 years of age and administered as two doses at a 6-month interval. PENMENVY™ (GSK) (4CMenB and MenACWY-CRM$_{197}$) has been recently approved under the same schedule for the same age group.

Another pentavalent MenABCWY vaccine candidate is currently undergoing clinical trials in the United States, involving both adults (18–25 years) and adolescents (10–17 years).[40]

There have been various discussions on how immunisation schedules should be revised in the US to accommodate these new vaccines. Of note, the Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunisation Practices (ACIP) met in October 2024 to discuss vaccine developments against different communicable diseases, including PENMENVY™.[41] The predominant focus on a revised meningococcal vaccine schedule should address reducing disease burden, schedule simplicity, and cost. It was recognised that there are number of advantages to using combination vaccines including: improved vaccine coverage rates, timely catch-up immunisations, and reduced logistical and financial burden. Confusion and uncertainty may develop, however, in relation to selecting vaccine combinations and follow-up dose schedules.

The ACIP reviewed several schedule options for PENMENVY™[41]: using the pentavalent vaccine as an option for MenACWY/MenB vaccination in those currently recommended to receive both vaccines at the same visit (a quadrivalent vaccine at 11 years; a MenABCWY vaccine at 16 years and a MenB booster six months later); for people recommended to receive MenACWY only (a pentavalent vaccine to replace the two quadrivalent doses); and those recommended to receive MenB only (a quadrivalent vaccine at 11 years, and two doses of MenABCWY vaccine at 16 years). The committee advised that any recommendations should be harmonised to accommodate both PENBRAYA™ and PENMENVY™, unless there is a vaccine-specific reason not to do so.[41]

Another policy change that was discussed was the possibility of eliminating the quadrivalent meningococcal ACWY conjugate vaccine dose in 11-year-olds and instead vaccinating at 15 years old. This option is based on data for IMD incidence, which begins to increase at 15–16 years old.[42]

In April 2025, the ACIP noted that including PENMENVY™ in the immunisation schedule as an alternative when both the MenACWY and MenB vaccines are administered at the same visit (Table 2) should form part of shared clinical decision making. PENMENVY™ has been submitted for European Medicines Agency approval. In January 2025, the European Commission withdrew the marketing authorisation for PENBRAYA™ at the request of the manufacturer.

Successful vaccination programmes have reduced IMD incidence to such low levels that the cost-effectiveness of vaccines and vaccination programmes is scrutinised. However, the severity of IMD and the age groups affected (adolescents) suggest that vaccination is needed. Ultimately, experience from the US may provide a rationale for which schedules involving MenABCWY vaccines are commercially viable in the national immunisation programmes of other countries. Vaccines available against serogroup B are shown in Table 3.

Progress with the MenACWYX vaccine

Pentavalent vaccines have also previously been developed to address urgent need in other regions, particularly in sub-Saharan Africa. Both the NmCV-5 vaccine (developed by Serum Institute of India) and EuNmCV-5 vaccine candidate (developed by EuBiologics and currently undergoing phase II/III study)immunise against serogroups MenA, C, W, Y and X. The former vaccine is a mixture of CRM (C, Y, and W antigens) and tetanus (A and X antigens) conjugates, each of which contain 5 μg of polysaccharide. The EuNmCV-5 vaccine is CRM-conjugated, each of which contain 5 μg of polysaccharide for serogroups MenC, W, Y, and X and 10 μg for serogroup MenA.

Several studies have been performed in West Africa to assess the immunogenicity and effectiveness of NmCV-5. One such trial assessed outcomes with a single dose of NmCV-5 compared with a licensed MenACWY-TT (conjugate) vaccine given alongside other childhood vaccines).[43] The trial recruited 1325 Malian participants between March and August 2022 who were randomised to receive a single dose of vaccine at either 9 or 15 months of age. The study met its primary endpoint, with non-inferior seroprotection demonstrated for the NmCV-5 vaccine compared with the MenACWY-TT immunisation at either age. Seroresponses were non-inferior irrespective of serogroup. In addition, no immune interference was observed with concomitantly administered measles-rubella or yellow fever vaccines.[43]

The WHO currently recommends the NmCV-5 vaccine in a single-dose schedule for infants or young children aged between 9 and 18 months. However, the need for a booster dose has not been established in clinical trials. Initial results from Mali and the Gambia indicate the vaccine elicits strong seropersistence in individuals vaccinated in the 2–29 year old age range compared with MenACWY-D when measured 336 days later (≥98.6% of individuals with titre ≥8 for each serogroup).[44] A 5-year persistence study is in preparation. A companion study is currently ongoing in Mali to assess the seropersistence of NmCV-5 vs MenACWY-T in children who initially received the vaccine at 9 or 15 months of age, with initial results indicating > 90% seroconversion rates (titre ≥8) for all serogroups after 6 months, except for serogroup C which was around 80%; data on longer-term persistence 2 years after vaccination are expected later this year.

NmCV-5 is currently licensed in a number of African countries, and was already deployed in the large outbreak response in Nigeria in 2024 (> 1 million doses administered). Routine use and preventive campaigns using NmCV-5 are anticipated to start later in 2025 in Niger and elsewhere.

Table 1
Number of IMD cases and deaths in France (2023) by serogroup.[52]

Age group	Total IMD		IMD B		IMD W		IMD Y	
	No. cases	No. deaths (%)	No. cases	No. deaths	No. cases	No. deaths	No. cases	No. deaths
< 1 y	56	2 (4%)	32	1	16	0	7	1
1–4 y	51	4 (8%)	29	2	16	1	4	1
5–14 y	39	–	28	0	2	0	7	0
15–24 y	101	3 (3%)	49	1	19	1	23	1
25–59 y	147	18 (12%)	61	4	41	10	35	3
60–79 y	104	14 (13%)	34	6	40	7	27	1
≥80 y	62	18 (29%)	7	2	26	**12 (46%)**	27	3
Total	560	59 (11%)	240	16 (7%)	160	31 (19%)	130	10 (8%)

Table 2
ACIP recommendations for use of pentavalent vaccination in US immunisation schedule.

Age group	Separate MenACWY and MenB recommendation	Pentavalent vaccine recommendation
> 10 years	MenACWY (dose 1)	
16 years	MenACWY (dose 2) and Men B (dose 1)	MenABCWY (dose 1)[a]
16–23 years	MenB (dose 2)	MenB (dose 2)[b]

[a] Recommended as an alternative to separate administration of MenACWY and MenB when they would have been given during the same clinical visit.
[b] When pentavalent vaccination is administered, the subsequent MenB booster must be from the same manufacturer.

The EuNmCV-5 vaccine candidate is currently under development with a Phase I trial in South Korea (N=60) completed. In that study 60 Korean adults were randomised to receive EuNmCV-5 (N=30) or MenACWY-CRM (N=30) to evaluate the safety and immunogenicity of EuNmCV-5.[45] The safety profiles were similar between the vaccines. For MenX, 26 participants in the EuNmCV-5 group demonstrated seroconversion (86.7%) compared with 2 in the MenACWY-CRM group (6.7%). Higher seroprotection rates (% > 1:8 in the rSBA assay) were identified for EuNmCV-5 vs MenACWY-CRM for serogroups C and X after 28 days, in each case with > 95% of EuNmCV-5 recipients attaining seroprotection. Of note, there was a significantly greater increase in geometric mean titres for each serogroup in the EmCV-5 group after 28 days compared with the MenACWY-CRM group.

A Phase II/III trial comparing the safety and immunogenicity of EuNmCV-5 with MenACWY-CRM and MenACWY-TT (comparator depends on the age group) in The Gambia and Mali is currently underway in 9 month–29 year olds (~4300 participants in total; ~3000 will receive EuNmCV-5). This pivotal trial is also examining lot-to-lot consistency and assessing immune interference with concomitant MR and YF vaccines. Safety and immunogenicity results in an initial cohort of Malian 18–29 year olds yielded similar results as those described above for the phase I Korean study.[46]

The additional data being gathered on the immune persistence of MenACWYX conjugate vaccines in Africa will be crucial to inform ongoing discussions regarding the ideal number and timing of doses. In July 2025, Uruguay incorporated into its National Immunization Program both 4CMenB for infants and the MenACWXY (MenFive®, Serum Institute of India) conjugate vaccine—administered as a single dose at 12 months of age with another dose at 11 years for adolescents.[47]

Assessing the timing of meningococcal booster vaccinations for at-risk groups

The topic of vaccination timing is critically important in developing immunisation programmes, particularly for those who are considered at higher risk of meningococcal infection. Many subpopulations fall into this category, including people with complement deficiencies; those who use complement inhibitors; those living with HIV; laboratory workers who may be exposed to *N. meningitidis*; the elderly; infants; travellers to countries with high rate of IMD; college students; military recruits/personnel and MSM.

Current national and international guidelines for booster vaccinations are variable for these at-risk groups. The ACIP recommends high-risk persons should get a booster every five years if IMD risk continues, following a complete primary MenACWY series.[48] If the primary series was given in early childhood, the ACIP recommends an earlier first booster at 3 years, then every five years. The WHO adopts a similar recommendation with periodic boosters (3–5 year interval) advised for high-risk individuals to top-up waning antibody levels.

The European guidelines, however, adopt a more cautious approach towards routine booster vaccinations. The European Centre for Disease Prevention and Control (ECDC) links this cautious approach to the reduction in IMD incidence rates following the introduction of MenACWY programmes in many countries. The ECDC and European authorities endorse risk-tailored booster strategies—typically a 5-year cycle for conjugate MenACWY vaccines in chronic risk conditions, and as-needed boosting for MenB and outbreak control.[49]

In the UK, MenACWY conjugate vaccine booster doses are not recommended in at-risk individuals, aside from those working in laboratories with *N. meningitidis*, owing to a lack of understanding on the need for, and timing of, such doses.[50] This rationale also extends to the 4CMenB vaccine, with a lack of data on the time period between booster doses (i.e. every 3 to 5 years). For travellers, a time-based booster schedule is not explicitly advised, but the requirement for a meningococcal certificate for Hajj means that travellers need a booster every five years.

Such variability in guidelines reinforces the need for standardised, evidence-based booster schedules to improve clarity, compliance and protection in these at-risk groups.

Meningococcal disease in at-risk populations

Older adults

Although IMD cases are reported across all age groups, sequelae associated with infection in the elderly are more diverse and frequent, with age being a specific risk factor for IMD.[51] As an illustrative example, data from France, between 2015 and 2022, show that meningococcal pneumonia and abdominal forms account for a higher proportion of IMD cases in elderly patients (> 65 years) compared with younger age groups.[23] In a separate case-control study, 34% of patients aged ≥60 years had at least one sequela, compared with 17% in those aged < 25 years and 29% in those aged 25 to 59 years.[52]

A rare form of IMD, meningococcal ventriculitis, has been identified among older adults,[53] which requires a longer duration of treatment and the need for brain magnetic resonance imaging scans. There have also been case reports of *N. meningitidis* causing acute adult epiglottitis,[54] with increasing rates reported in France from 2015 to 2023.[24]

IMD clusters have also been reported in care homes. In 2015, two IMD cases were identified among residents of a care home in England over seven months (both MenW) in 2015.[55] In this cluster, three carriers (two staff members and one resident) were also identified. More recently, a MenB cluster (two cases) was reported in a care home in England with residents subsequently vaccinated with 4CMenB.[56]

CFRs for IMD are also the highest among elderly patients (≥60 years).[57] Based on 2023 data from France, CFR was highest in those aged ≥80 years (29%), compared with 11% for the overall cohort (aged < 1 year to ≥80 years). Fatalities were particularly high in patients with serogroup W (46% in ≥80-year subgroup versus 19% overall) (Table 1).[58]

When considering vaccination status, many elderly people remain unvaccinated. In a study conducted in Europe between 2014 and 2018, the vaccination status in cases of IMD in elderly people (> 65 years of age) was unknown in most. In those with known status, the vast majority were unvaccinated.[59]

Table 3
Vaccines against group B *Neisseria meningitidis*.

Vaccine	Licensure (regions, year)	Composition	Age indications	Impact against non-B *Nm*	Impact against *Ng*
OMV only	Licensed for specific outbreaks (e.g., Cuba, New Zealand, Norway, Brazil, Chile, 1980s–2000s)	OMV containing immunodominant PorA; strain-specific[a][60–62]	Mostly outbreak use, adolescents & young adults	Minimal, unless shares the homologous PorA	Cross-protection reported against *Ng*[34,63]
4CMenB (Bexsero®, GSK)	EMA (2013, EU), FDA (2015, USA)	4 components: 3 recombinant proteins (fHbp, NadA, NHBA) + OMV from NZ outbreak strain	≥2 months through adulthood	Cross-protection with regards to fHbp, NadA, NHBA, PorA	Evidence of effectiveness against *Ng* infections (observational)[64,65]
Bivalent rLP2086 (Trumenba®, Pfizer)	FDA (2014, USA), EMA (2017, EU)	Two lipidated fHbp variants (subfamilies A & B)	≥10 years through adulthood	Cross-protection with regards to fHbp	None[66]
Pentavalent ABCWY (Penbraya, Pfizer)	FDA (2023, USA) EMA (2024, EU)	Combines rLP2086 (bivalent fHbp) with MenACWY-TT conjugate	Targeted for adolescents & young adults (10–25 years)	Contains ACWY conjugate. Expected broad coverage against non-ABCWY via shared antigens	Not investigated. Likely, none
Pentavalent ABCWY (Penmenvy, GSK)	FDA (2025, USA)	Combines MenB (4CMenB) with MenACWY-CRM conjugate	Targeted for adolescents & young adults (10–25 years)	Contains ACWY conjugate. Expected broad coverage against non-ABCWY via shared antigens	Not investigated. Likely as per 4CMenB.

EMA, European Medicines Agency; EU, European Union; FDA, USA Food and Drug Administration; fHbp, Factor H binding protein; GSK, GlaxoSmithKline; NadA, Neisserial adhesin A; NHBA, Neisserial heparin-binding antigen; *Ng*, *Neisseria gonorrhoeae*; *Nm*, *Neisseria meningitidis*; NZ, New Zealand; OMV, Outer membrane vesicle; TT, tetanus toxoid; USA, United States of America

[a] Cuban OMV is mixed with group C polysaccharide.

Advocacy and role of meningitis charities

Patient advocacy and disease awareness campaigns continue to play a central role in establishing meningitis as a key health priority. Based in the UK, the Meningitis Research Foundation (MRF) raises funds for research, policy development and advocacy for meningitis awareness. The international health charity collaborated with the WHO to help develop the 'Global Road Map to Defeat Meningitis by 2030'. The road map was ratified by the World Health Assembly in 2020 and formally launched in 2021. Since then WHO has published an investment case in 2024 calling for $440million to support prevention, diagnosis and treatment, surveillance, and support for families affected by meningitis with $130million of this investment needed now. Within this, MRF has highlighted a need for $37.5 million in investment for advocacy and engagement.

As part of these efforts, the MRF through its Confederation of Meningitis Organisations (CoMO) network leads on raising awareness globally through World Meningitis Day on 5 October each year. In 2024, over 135 countries participated (representing over two thirds of WHO member states). In addition 76 CoMO members in 37 countries engaged in World Meningitis Day (a 52% increase from 2023).[60] Examples of advocacy from CoMO members in 2024 included a meningitis documentary in Spain by the Spanish Association Against Meningitis and awareness-raising at Kenya's largest children's hospital.

To support 2024 activities, MRF invested £20,000 in global advocacy projects via the World Meningitis Day advocacy fund. This supported 6 innovative CoMO member projects across Ghana, Côte d'Ivoire, Japan, Nigeria, Tanzania, and the USA, to broaden their reach and amplify their impact.

The World Meningitis Day toolkit is another opportunity for members to access free resources in four different languages. The toolkit was downloaded 21,000 times across 100 countries in 2024. This represents an almost 30% increase in the number of countries using the toolkit and more than double the downloads vs 2023.

Conclusions

MenB continues to remain a prevalent serogroup, with clusters regularly occurring in recent years, leading to the introduction of 4CMenB in various countries. In the UK, the vaccine was introduced in the same year as the quadrivalent MenACWY vaccine, the latter as part of an emergency programme. However, MenB immunisation may have a potentially broader impact on populations aside from reducing MenB IMD incidence, as outlined in this paper. Its potential effectiveness in protecting against *N. gonorrhoeae* infection could help to avert cases and save financial resources in healthcare systems.

The burden on healthcare systems is also high when considering the impact of IMD in at-risk populations, particularly the elderly. As discussed, IMD sequelae are often more frequent, diverse and severe in these at-risk populations, with clusters often occurring in care homes. Coupled with a lack of vaccination, IMD incidence remains a key concern in this age group.

Improving vaccination uptake, including accelerating adoption of MenACWYX conjugate vaccines in the African meningitis belt, as well as optimising the structure and timing of immunisation schedules in many countries, is a critical focus for public health agencies and governmental institutions.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: RB, SAC and JL report contract research on behalf of UKHSA

for GSK, Pfizer and Sanofi. ECD performs contract work for the Eskisehir Osmangazi University funded by GSK, Pfizer, MSD and Sanofi. LHH reports serving as a consultant to CSL Seqirus, GSK, Merck, Pfizer, and Sanofi. IH reports contract research in past 2 years on behalf of University of Manchester for UKHSA Health Equity Division and is currently a co-investigator a Wellcome Trust and UKRI grants. JAV performs contract work for the Institute of Health Carlos III funded by Pfizer and he has received personal fees from GSK and Sanofi. MKT reports contract research on behalf of the Institut Pasteur for GSK, Pfizer and Sanofi and a patent NZ630133A with GSK "Vaccines for serogroup X meningococcus" issued. WPH reports research grants from EuBiologics and Serum Institute of India. DAC has received personal fee for scientific presentations for Sanofi. VS reports the Meningitis Research Foundation receives financial support from GSK, Pfizer, Sanofi, MSD and Serum Institute of India. MAPS reports research grants and consultancy fees from GSK, Pfizer and Sanofi.

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