Framework for implementing the Defeating Meningitis by 2030 global road map in the Eastern Mediterranean Region

World Health Organization
Eastern Mediterranean Region

Cover photo credit: © Freepik

Regional Committee version
October 2025

Framework for implementing the Defeating Meningitis by 2030 global road map in the Eastern Mediterranean Region

World Health Organization
Eastern Mediterranean Region

Contents

Landscape analysis of meningitis

Global situation

Meningitis is a potentially fatal disease caused by inflammation of the membranes surrounding the brain and spinal cord *(1)*. Despite a 21% reduction in the incidence rate of meningitis from 2000 to 2019, the Global Burden of Disease Study 2019 found that meningitis still caused an estimated 2.5 million incident cases and 236 000 deaths globally in 2019 *(2)*. Meningitis can affect people at any age, but children under 5 years of age account for about half of all cases and deaths *(3)*. The World Health Organization (WHO) estimated that more than 16 million healthy life years were lost worldwide due to meningitis in 2019 *(4)*.

Multiple pathogens can cause meningitis, but bacterial meningitis caused by *Neisseria meningitidis* (meningococcus), *Streptococcus pneumoniae* (pneumococcus), *Haemophilus influenzae* type b and *Streptococcus agalactiae* (group B streptococcus) accounted for the largest global burden of meningitis and about three quarters of deaths in 2019. Bacterial meningitis leaves one in five patients with lifelong disability, such as hearing loss, visual and physical impairment, cognitive disability, seizures, scarring and limb amputation *(5, 6)*. These after-effects have negative economic, emotional and social impacts on individuals, their families and communities. The high case-fatality rate of bacterial meningitis, the occurrence of epidemics and the associated burden of debilitating sequalae highlight the importance of defeating meningitis as a public health threat *(7, 8)*.

Regional context

The WHO Eastern Mediterranean Region comprises 22 countries and territories. There are wide disparities between the countries in terms of income level and health system performance, and eight countries in the Region were classified by the World Bank as fragile and conflict-affected in 2024 *(9)*. Protracted conflicts, insecurity, socioeconomic challenges and workforce shortages are overwhelming fragile health systems and their capacity to deliver basic services. In 2021, the Region hosted 66% of the world's refugees and 41% of internally displaced persons *(10)*. These populations are especially vulnerable to meningitis transmission due to poor living conditions and limited access to quality health care *(11)*.

Sudan is the only country of the Region that is located in the sub-Saharan meningitis belt, an area spanning the African continent that is prone to large, recurrent meningococcus outbreaks *(12)*. However, outbreaks of meningitis have also been reported in other countries of the Region. Huge numbers of people from the Region participate in the annual Hajj in Saudi Arabia, an event that has historically been associated with meningococcal outbreaks both locally and internationally *(13,14,15)*. Another major religious event is the annual Arba'een ceremony in Iraq, which attracted more than 22 million pilgrims in 2023 *(16)*. Member countries of the Gulf Cooperation Council (GCC) have also become a hub for social and commercial mass gathering events, such as the 2022 FIFA World Cup that attracted 3.4 million visitors to Qatar *(17)*.

Most types of meningitis are caused by infections that are vaccine preventable. However, not all vaccines are available in all countries, or their introduction may be dependent on donor support. Prevention measures have helped to curb meningitis outbreaks in the Region, but fragile contexts, dynamic populations and the evolving nature of the disease, including shifts in serotypes/serogroups and genotypes that can escape vaccines, continue to pose a threat *(18,19)*.

Defeating meningitis by 2030

Global road map

In November 2020, the Seventy-third World Health Assembly approved a global road map for defeating meningitis by 2030 (resolution WHA73.9) *(20)*. The road map sets out a vision "towards a world free of meningitis" and has three visionary goals: (i) to eliminate bacterial meningitis epidemics; (ii) to reduce cases of vaccine-preventable bacterial meningitis by 50% and deaths by 70%; and (iii) to reduce disability and improve quality of life after meningitis of any cause. To achieve these visionary goals, the global road map identifies 19 strategic goals across the following five pillars: (i) prevention and epidemic control; (ii) diagnosis and treatment; (iii) disease surveillance; (iv) care and support for people affected by meningitis; and (v) advocacy and engagement *(21)*.

Regional framework

To facilitate implementation of the global road map to defeat meningitis by 2030, the targets for the visionary and strategic goals need to be contextualized through regional plans. Therefore, the meningitis situation in the WHO Eastern Mediterranean Region has been reviewed to establish a baseline for developing plans to implement the road map in countries of the Region.

WHO organized a three-level retreat in Cairo, Egypt, in April 2023 to discuss the plans and priorities for the Region, with the participation of the WHO country offices in Saudi Arabia and Sudan. All relevant technical units at the Regional Office for the Eastern Mediterranean were consulted, as were the Brain Health unit, the Health Emergencies Programme and the Immunization, Vaccines and Biologicals department of WHO headquarters, as well as the Immunization and Vaccines Development unit of the WHO Regional Office for Africa. Using the technical inputs, an initial framework was drafted and shared with the Regional Immunization Technical Advisory Group, countries of the Region and the three levels of WHO for further consultation and feedback. The revised version of the framework is presented here.

The framework aims to prioritize the countries and issues where the expected impact of interventions will be greatest, while leveraging existing regional and interregional platforms to ensure maximum efficiency.

The objectives of this document are to assess the burden of meningitis in the Region, review the status of prevention and control interventions, prioritize countries based on their level of risk and the feasibility of implementation of the global roadmap, and provide recommendations to guide regional and country actions in implementing it. A data analysis was therefore carried out, as described in the methods section. The data analysis serves as the basis for country prioritization and for identifying indicators to ensure achievable and measurable impact. Existing platforms relevant to the strategic goals of the five pillars were also reviewed, and these can serve as guiding mechanisms for which country actions on meningitis can be incorporated.

The proposed regional framework for implementation of the global road map to defeat meningitis is provided in Table 1. Country-level data are summarized in Table 2. All departments of the WHO Regional Office for the Eastern Mediterranean engaged in an exercise to define each indicator and the data source/year from which it was derived (Table 3).

Methods

Data sources

Burden of meningitis

Estimates of all-cause meningitis incidence, mortality and burden for countries in the Region use data from the Institute for Health Metrics and Evaluation's Global Burden of Disease Study 2021 and WHO's Global Health Estimates 2023. Data on neonatal mortality due to meningitis were extracted from WHO's Global Health Observatory.

National meningitis services and capacities

Data on vaccine introduction and vaccine coverage were extracted from the WHO/United Nations Children's Fund (UNICEF) Joint Reporting Form on Immunization. Information on laboratory capacity was collected from the Invasive Bacterial Vaccine-Preventable Disease (IB-VPD) Laboratory Network, external quality assessment (EQA) reports and WHO's Global Antimicrobial Resistance and Use Surveillance System (GLASS). Country outbreak signals were reviewed, where available, to assess detection and response activities and case-fatality rates of meningitis.

Data analysis

Burden of meningitis

The regional trends in all-cause meningitis incidence and mortality rates were reviewed for 2000–2021 (Fig. 1). To assess pathogen-specific burden, the proportion of disability-adjusted life years (DALYs) attributed to *Haemophilus influenzae* type b, meningococcus and pneumococcus in the Region was analysed for 2021 (Fig. 2). To assess the meningitis burden in different age groups, the proportion of estimated deaths in children aged under 5 years, those aged 5–19 years, adults aged 20–54 years and those aged 55 years and older were compared for 2021 (Fig. 3). To assess country-specific burden, the estimated all-cause meningitis incidence rate per 100 000 population (Fig. 4) and the number of neonatal deaths due to meningitis/encephalitis (Table 2) were analysed for 2021.

National programmes and implementation

The status of vaccine introduction (Fig. 5a and Fig. 5b) and vaccine coverage (Fig. 6) was used to analyse the implementation of prevention measures in the Region compared with the recommended targets of the Immunization Agenda 2030 *(22)*. A baseline for prevention interventions was calculated for countries, using reported introduction of pneumococcal conjugate and meningococcal vaccines and reported vaccine coverage in 2023. In Fig. 6, countries are ranked by highest average coverage rates.

Laboratory capacity in countries was assessed using indicators extracted from a review of implementation of the regional strategic framework for strengthening health laboratory services (2016–2023), which includes laboratories affiliated with health ministries and involved in laboratory-based surveillance *(23)*. The availability of recommended first-choice and second-choice antibiotics in countries, antimicrobial resistance data reported to WHO's GLASS and surveillance data reported by a number of selected laboratories, case management and epidemic preparedness practices related to meningitis (Table 2) were also reviewed.

Results

Burden assessment

The estimated incidence rate of all-cause meningitis dropped by 52% in the Eastern Mediterranean Region between 2000 and 2021, from 74 cases per 100 000 population to 34 cases per 100 000 population. The meningitis mortality rate reduced by 61%, from 8 deaths per 100 000 population in 2000 to 3 deaths per 100 000 population in 2021 (Fig. 1).

In 2021, the countries with the highest estimated incidence rates of all-cause meningitis per 100 000 population were Somalia (180 per 100 000), Djibouti (79 per 100 000), Pakistan (58 per 100 000), Afghanistan (49 per 100 000) and Sudan (23 per 100 000) (Fig. 4). The countries with the highest number of neonatal deaths due to meningitis/encephalitis were Pakistan (3485), Afghanistan (653), Somalia (266), Sudan (99), Egypt (64), Morocco (46) and Yemen (44) (Table 2).

Of the estimated DALYs attributed to bacterial meningitis in the Region in 2021, about 47% were due to *Neisseria meningitidis*, *Streptococcus pneumoniae*, group B streptococcus and *Haemophilus influenzae* type b, while 42% were due to other bacterial pathogens. Of the four main pathogens, 36% of DALYs were due to *Neisseria meningitidis*, 35% due to *Streptococcus pneumoniae*, 19% due to group B streptococcus and 11% due to *Haemophilus influenzae* type b (Fig. 2).

In terms of mortality due to bacterial meningitis, the most-affected age group was children aged under 5, accounting for 70% of all deaths caused by *Haemophilus influenzae* type b, 64% of deaths caused by group B streptococcus, 48% of deaths caused by *Neisseria meningitidis* and 46% of deaths caused by *Streptococcus pneumoniae*. Among adults aged 55 years and older, the highest proportion of meningitis deaths were caused by *Streptococcus pneumoniae*, accounting for 20% of all pneumococcus deaths (Fig. 3).

Service and capacity assessment

Vaccine introduction

As of 2023, of the vaccines that prevent bacterial meningitis, all 22 countries and territories in the Eastern Mediterranean Region have introduced *Haemophilus influenzae* type b vaccines. Eighteen countries in the Region (82%) have introduced pneumococcal conjugate vaccines and 11 countries (50%) have introduced meningococcal vaccines into routine immunization. Specifically, of the different meningococcal vaccines, nine countries introduced meningococcal group A, C, W-135 and Y (MenACWY) conjugate vaccine, the Syrian Arab Republic introduced MenACW polysaccharide vaccine and Sudan is administering MenA conjugate vaccine. Egypt, Iran (Islamic Republic of), Oman and Qatar have introduced meningococcal vaccines only to specific risk groups, such as travellers and pilgrims, and in particular people living in settings such as prisons and dormitories. Only six countries have introduced all three vaccines (*Haemophilus influenzae* type b, pneumococcal conjugate and meningococcal): Bahrain, Kuwait, Libya, Saudi Arabia, Sudan and United Arab Emirates. Two countries (Jordan and Somalia) have introduced only *Haemophilus influenzae* type b vaccines into routine immunization (Fig. 5, Table 2).

Vaccine coverage

Of the 22 countries and territories in the Eastern Mediterranean Region, nine (Afghanistan, Djibouti, Lebanon, Libya, Pakistan, Somalia, Sudan, Syrian Arab Republic and Yemen) have an estimated coverage of less than 90% for one or more antigens. Among the five countries administering

meningococcal vaccination in 2023, four countries have achieved at least 90% coverage (Bahrain, Libya, Saudi Arabia and United Arab Emirates) and Sudan has an estimated coverage of 51% (Kuwait is yet to report coverage data, following introduction of the vaccine). Of the 17 countries/territories administering pneumococcal conjugate vaccines in 2023, nine (Bahrain, Kuwait, Morocco, occupied Palestinian territory, Oman, Qatar, Saudi Arabia, Tunisia and United Arab Emirates) have achieved coverage of more than 90% (94–99%) and eight (Afghanistan, Djibouti, Iraq, Lebanon, Libya, Pakistan, Sudan and Yemen) have an estimated coverage of less than 90% (14–86%). Regarding *Haemophilus influenzae* type b vaccine administration, 13 countries/territories (Bahrain, Egypt, Morocco, Iran (Islamic Republic of), Iraq, Jordan, Kuwait, occupied Palestinian territory, Oman, Qatar, Saudi Arabia, Tunisia and United Arab Emirates) have achieved coverage of more than 90% (91–99%) and nine (Afghanistan, Djibouti, Lebanon, Libya, Pakistan, Somalia, Syrian Arab Republic, Sudan and Yemen) have an estimated coverage of less than 90% (42–86%) (Fig. 6).

Epidemic preparedness and response

From 2012 to 2023, seven countries/territories in the Region (Iraq, Lebanon, Libya, occupied Palestinian territory, Sudan, Syrian Arab Republic and Yemen) have reported meningitis outbreaks or signals, of which three countries reported viral meningitis. Five countries (Egypt, Iraq, Qatar, Saudi Arabia, United Arab Emirates) have conducted risk assessments using the WHO Strategic Toolkit for Assessing Risks (STAR) *(24)* ahead of mass gathering events (Table 2).

Diagnosis and laboratory quality assurance

Four countries in the Region (Afghanistan, Sudan, Pakistan and Yemen) participate in the global IB-VPD laboratory network. Previously, Egypt served as a regional reference laboratory providing standardized laboratory guidance. These four countries use standardized algorithms for diagnosis and have capacity at national level. Sixteen countries have national reference laboratories participating in international EQA programmes (Table 2).

Antimicrobial use and resistance monitoring

According to WHO's AWaRE (access, watch, reserve) classification and antibiotics book *(25)*, the first-choice antibiotics for empirical treatment of suspected or probable meningitis in children aged over one month and adults are intravenous cefotaxime and ceftriaxone, and second-choice antibiotics are amoxicillin, ampicillin, benzylpenicillin and chloramphenicol. Two countries have not included first-choice antibiotics in their essential medicines list – Somalia and Yemen. At the time of analysis, *Streptococcus pneumoniae* was included in WHO GLASS reporting but only for blood and urine specimens. A number of WHO-selected laboratories in the Region, both governmental and nongovernmental, are reporting through GLASS (Table 2).

Surveillance

Four countries carry out IB-VPD laboratory-based sentinel case-based surveillance (Afghanistan, Pakistan, Sudan and Yemen), including sentinel sites and national public health laboratories. Road maps for integrated disease surveillance have been developed in two countries (Pakistan and Somalia). Since 2012, 11 outbreaks of bacterial and/or viral meningitis have been reported, including in Sudan (2012 and 2022), occupied Palestinian territory (2014 and 2022), Yemen (2017), Libya (2022), Lebanon (2022 and 2023), Syrian Arab Republic (2022 and 2023) and Iraq (2023). Reported case-fatality rates ranged from 0.5% to 16%. Initial sources of reporting included national IHR focal points, communications to WHO from health ministries, data from other United Nations agencies and media sources (Table 2).

Discussion

The reduction in estimated meningitis incidence and mortality rates in the Eastern Mediterranean Region follows global trends and reflects the positive impact of preventive measures taken so far *(26)*. However, the trend has flattened in recent years and reduction may not be equal in all locations, indicating the need for sustained efforts. Seven countries in the Region (a mix of middle- and low-income countries) still have an estimated meningitis incidence of more than 20 cases per 100 000 population in 2023. Although Sudan is the only country of the Region within the sub-Saharan meningitis belt, the meningitis incidence rate is particularly high in Djibouti and Somalia – two countries that neighbour the meningitis belt and share similar climate patterns. Children aged under five are the most-affected age group for all bacterial pathogens, further evidence of the need to introduce new vaccines, improve vaccine coverage and enhance surveillance in countries of the Region.

Based on the assessment of meningitis burden and capacities in the Eastern Mediterranean Region, a framework for implementation of the global road map for defeating meningitis by 2030 is proposed in Table 1. The framework outlines the key recommendations for WHO and countries, structured under the five main pillars of the road map, to guide national-level plans and actions towards defeating meningitis in the Region.

Pillar 1. Prevention

Pillar 1 of the road map aims at achieving higher vaccine coverage, improving prevention strategies and ensuring a more effective response to meningitis epidemics.

In the Eastern Mediterranean Region, coverage of *Haemophilus influenzae* type b and pneumococcal conjugate vaccines is insufficient in low- and middle-income countries (Table 1). Financing is a major issue for vaccine introduction and roll-out. A 12-year review of national immunization technical advisory groups (NITAGs) in the Region described their increased functionality in countries with higher levels of income. Lower income countries manage to implement immunization policy decisions and cover financial gaps due to their eligibility for support from Gavi, the Vaccine Alliance *(27)*. As a result, middle-income countries are being left behind. What Gavi calls its MICS Approach, which is an approach to engagement with middle-income countries *(28)*, could serve as an opportunity for those countries that are lagging in terms of vaccine introduction and help to prevent backsliding of coverage rates.

Following the experience of the Gulf Joint Procurement programme, WHO organized a regional consultation in 2023 to review existing pooled procurement modalities and propose regional models *(29)*. This could serve as a mechanism to compensate for limited financial and technical capacity related to vaccine roll-out in countries.

Access issues could also be affecting immunization coverage in the Region, especially among vulnerable populations such as refugees and migrants. These populations face the same health risks as the host population and also have to contend with poor living and working conditions, the process of migration itself and potential social exclusion, which makes them more vulnerable – as evidenced by reported disparities in health status and access to care *(30, 31)*. The COVID-19 pandemic highlighted that tailored actions are required to ensure equitable access to vaccination for these populations and underscored the importance of whole-of-society approaches *(32)*. Following the endorsement of a strategy to promote the health and well-being of refugees, migrants and displaced populations in the

Region by the 69th session of the Regional Committee in 2022 *(33)*, WHO is rolling out country technical assistance plans to guide countries in the assessment and inclusion of required services targeting these populations within national health plans. The regional meningitis framework proposes utilizing this platform to include meningitis case management in high-burden countries with large migrant populations. In view of the multiple emergencies in the Region, novel distribution mechanisms will be crucial to reach mobile and displaced populations in settings where routine health services are unavailable. Countries have previously deployed mobile clinics, outbreak response campaigns and explored integration with delivery of other essential health services *(34)*.

Additional prevention strategies are needed in the Eastern Mediterranean Region to prevent meningitis outbreaks at mass gathering events, both recurring and ad hoc. WHO is supporting countries through the use of the STAR tool during mass gathering events to identify risks, assess levels of preparedness and estimate capacities to respond to potential negative health impacts. The regional meningitis framework proposes reinforcement of national capacities in risk assessment through the all-hazards approach. Risk communication strategies also need to be reinforced in high-burden countries, particularly those with reported previous outbreaks.

In terms of vaccine introduction, the meningitis framework proposes the submission of dossiers to the NITAGs in the four remaining countries yet to introduce pneumococcal conjugate vaccines (Egypt, Jordan, Somalia and Syrian Arab Republic). High-burden countries (Afghanistan, Djibouti, Pakistan and Somalia) should also introduce multivalent meningococcal conjugate vaccines, a move supported by the Gavi Board in 2023 *(35)*. Surveillance of circulating serogroups is required to provide evidence and tailor the needs assessment for meningococcal vaccine introduction. Per the recommendations of the Strategic Advisory Group of Experts on Immunization (SAGE) in 2023, Sudan would need to conduct a disease risk assessment to inform introduction and roll-out of Men5CV *(36)*. The framework also proposes assessment of group B streptococcus transmission patterns and risk factors to guide vaccine introduction, particularly in countries with high neonatal mortality due to meningitis.

Pillar 2. Diagnosis and case management

The diagnosis and case management pillar focuses on rapid confirmation of acute bacterial meningitis and optimal care.

Capacities for meningitis case management vary across countries in the Eastern Mediterranean Region. Higher income GCC countries have excellent laboratory and case management capacities. Only four additional countries are included in the IB-VPD laboratory network, with Egypt previously serving as a reference laboratory. Despite inclusion in the Network, poor reporting and high turnover of staff indicate the need for additional training. No information on bacteriological capacity is available for some lower income countries, such as Somalia and Djibouti. Another available mechanism in the Region is the Regional External Quality Assurance Scheme (REQAS), distributed by the national laboratory in Oman, which includes bacterial meningitis pathogens. Access to recommended antibiotics may also be difficult in Somalia and Yemen, where first-choice antibiotics for meningitis were not included in the essential medicines lists.

As rapid confirmation and treatment is essential in bacterial meningitis, a comprehensive assessment of national bacteriological capacity in countries of the Region is needed. An assessment will guide further training requirements for bacteriological testing, including quality and biosafety standards for all the steps in diagnosis of pathogens. WHO has also developed a protocol to study the facilitators and barriers to lumbar puncture practice, and its roll-out in a select number of countries can provide

further qualitative evidence to a capacity assessment. The WHO Collaborating Centre for Reference and Research on Bacterial Pathogens at the American University of Beirut *(37)* can serve as a regional reference laboratory to meet training requirements. This reference laboratory can also support countries in standardizing operating procedures for serotyping/serogrouping of isolated strains and in validating and rolling out rapid diagnostics tests under development. The Centre can also be linked to the WHO International Pathogen Surveillance Network (IPSN) and the Global Meningitis Genome Library (GMGL) to foster data sharing of molecularly characterized strains. Regional centres are essential to counteract the migration of workforce and high staff turnover experienced by countries in the Region.

In terms of case management, further dissemination of the WHO AWaRE antibiotic book can help to provide guidance for empirical case management of suspected meningitis cases and appropriate antibiotic use *(25)*. WHO has also been providing training for meningitis focal persons at the country level, including on diagnosis of suspected meningitis in resource-limited settings. The training includes a comprehensive care pathway, according to the local context, from clinical suspicion of cases to discharge of suspected cases. In the Region, viral meningitis (caused by enteroviruses) has been more frequently reported in recent years. Making a quick clinical differentiation between viral and bacterial meningitis at first visit is critical to delivering appropriate treatment in a timely manner. An additional resource with specific recommendations for health care workers is the *WHO guidelines on meningitis diagnosis, treatment and care* published in 2025, which can also be disseminated *(38)*.

Pillar 3. Surveillance

Surveillance is required to guide meningitis prevention and control measures, monitor the impact of vaccines, rapidly detect outbreaks and estimate disease burden. The Region has additional needs for meningitis surveillance due to the number of emergencies and annual mass gathering events.

In 2021, the 68th session of the Regional Committee endorsed a regional strategy for integrated disease surveillance *(39)* as a cost-effective and efficient solution to address data fragmentation and inequal distribution of resources between disease programmes and strengthen the components of surveillance systems. By 2023, WHO had supported countries in implementing the strategy through: development and implementation of national road maps for integrated disease surveillance in Pakistan and Somalia; development of national guidelines and standard operating procedures for event-based surveillance in Afghanistan, Jordan, Libya, Morocco, Qatar and Sudan; capacity-building for media scanning and deployment of Epidemic Intelligence from Open Sources (EIOS) in 12 countries; and capacity-building for analysis and use of surveillance data for epidemiologists from 10 countries. Going forward, WHO is developing consolidated guidance and training materials on integrated disease surveillance, encompassing both indicator-based and event-based surveillance *(40)*. The guidance will encourage linkages between laboratory and epidemiological systems to address data quality issues and gaps in IB-VPD laboratory network surveillance.

These efforts could also be linked with subregional projects supporting epidemiological surveillance, such as MENINGSTOP in Morocco and Tunisia, and MenMap in Egypt, the Islamic Republic of Iran and Iraq *(41,42)*. Additionally, the 2023 WHO GLASS manual and subsequent reporting cycles have included the three meningitis bacterial pathogens and cerebrospinal fluid (CSF) samples *(43)*.

There is a wide range in the estimated prevalence of maternal colonization of group B streptococcus in countries of the Region (from 15% to 30%), which signals the need for additional surveillance *(44)*.

WHO is developing surveillance standards for group B streptococcus and these will be disseminated for country use.

The regional meningitis framework proposes leveraging these opportunities to support surveillance for meningitis, antimicrobial resistance and group B streptococcus. The inclusion of standardized packages, definitions and capacity-building for common end-users will ensure evidence-informed decision-making while avoiding additional fragmentation at the country level, especially in high-burden countries.

Pillar 4. Support and care for people affected by meningitis

The pillar on support and care for people affected by meningitis focuses on access to care for early diagnosis and treatment, improved management of after-effects and the provision of support, including rehabilitation.

Meningitis can lead to a number of disabling sequelae. A systematic review in 2010 estimated that hearing loss was the most common type sequalae from bacterial meningitis globally *(6)*. In the Eastern Mediterranean Region, the estimated prevalence of meningitis-related hearing loss was 2.99 cases per 100 000 population in 2021 *(45)*.

Underdeveloped capacity to recognize and provide rehabilitation for meningitis sequalae can impede access to rehabilitation and delay identification of people requiring services. WHO has developed standardized tools to measure disability, including the WHO Disability Assessment Schedule 2.0 (WHODAS2.0) *(46)*, as well as guidance to support countries to identify rehabilitation needs and develop comprehensive strategic plans for rehabilitation *(47)*. As services are required in both hospital and community settings, WHO has developed the *Package of interventions for rehabilitation*, which addresses 20 priority health conditions and outlines the required material resources and workforce; the module on sensory functions outlines the required interventions for providing hearing rehabilitation services to children and adults *(48)*. The *mhGAP intervention guide for mental, neurological and substance use disorders in non-specialized health settings* can serve as additional resource on methods to recognize and treat other sequalae, including epilepsy *(49)*. The 2025 *WHO guidelines on meningitis diagnosis, treatment and care* also address sequalae, particularly hearing deficits and rehabilitation *(6)*.

WHO is providing countries of the Region with technical support to design essential service packages that include preventive, promotive, curative, rehabilitative and palliative health services delivered through five levels of health care *(50)*. These packages can serve as an additional conduit to deliver the required services for meningitis-related care and support.

The regional meningitis framework aims to increase access and availability of services for people affected by meningitis by reinforcing national capacities in recognizing sequalae, assessing their needs and delivering appropriate services. Countries with the highest mortality are the proposed focus, as previous reviews estimated the risk of major sequalae to be three times greater in countries with the highest mortality stratum *(6)*.

Pillar 5. Advocacy and engagement

For advocacy and engagement, the aim is to ensure that the meningitis road map is prioritized and integrated into country plans, that there is high awareness of meningitis and its impact among the population and a commitment to equal access for meningitis prevention, treatment and support for

those affected by meningitis. (Suggested advocacy and engagement outlines several specific actions aimed at raising awareness, mobilizing resources and ensuring sustained commitment to defeating meningitis.) The key actions expected to be broadly implemented under this pillar include:

1. Raising awareness:
    - Ministries of Health in several countries in the Region have launched public awareness campaigns during World Meningitis Day and other health observances.
    - Educational materials are being disseminated in local languages to inform communities about symptoms, prevention and the importance of vaccination.

2. Community and civil society engagement:
    - Partnerships with nongovernmental organizations and community leaders are being used to reach underserved populations, especially in rural and conflict-affected areas.
    - Countries such as Pakistan and Sudan have engaged religious and community leaders to promote vaccine acceptance and health-seeking behaviour.

3. Political commitment:
    - Some countries in the Region have integrated meningitis control into national immunization plans, with support from WHO and Gavi.
    - High-level advocacy has led to increased political will in countries such as Egypt and Jordan, where meningitis is now part of broader infectious disease strategies.

4. Partnership building:
    - Regional collaboration is being fostered through WHO's Regional Office for the Eastern Mediterranean, which supports technical workshops and cross-country learning.
    - Countries are working with UNICEF, Gavi, and Médecins Sans Frontières to strengthen advocacy and resource mobilization.

5. Resource mobilization:
    - Efforts are under way to secure domestic funding and leverage international support for meningitis-related programmes.
    - Some countries have begun cost-effectiveness studies to advocate for sustained investment in meningitis prevention and care.

6. Monitoring and accountability:
    - WHO is helping countries track progress using regional indicators aligned with the global roadmap.
    - Annual reviews and stakeholder meetings are being held to assess advocacy outcomes and adjust strategies.

In 2023, WHO developed a Regional Partnership Engagement Resource Mobilization Strategy *(51)* to address gaps in resource mobilization, support donor intelligence capacity and strengthen effective communication. Tailored advocacy and engagement strategies are essential to address meningitis in low-income countries in the Eastern Mediterranean Region. Further leveraging of the expertise and resources of higher income countries will be required, as well as engagement with governments to

allocate necessary resources and collaboration with stakeholders – including health care organizations, government agencies, nongovernmental organizations and academic institutions – particularly in fragile countries and those suffering from protracted crisis.

With a focus on high-burden countries, the proposed actions build on the same guiding principles to address specific goals of Pillar 5, including partnership strengthening, resource mobilization and awareness-raising. Regular monitoring and evaluation will measure the effectiveness of implemented strategies and inform adjustments, as needed, for better outcomes.

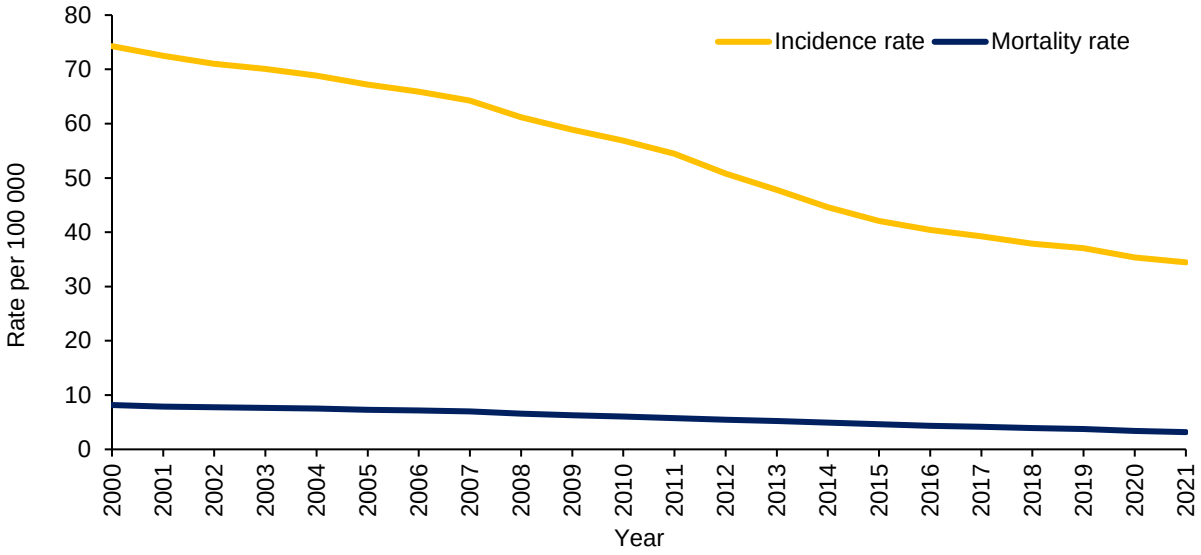
Conclusion

The framework for defeating meningitis in the Eastern Mediterranean Region by 2030 has a number of limitations. To assess the burden of meningitis, estimates of incidence and mortality are used rather than reported data. Information reported by countries in the Region is used to assess services and capacity; the lack of standardized case definitions and the variable levels of laboratory and monitoring capacities may have led to some under- and misreporting *(52)*.

Countries are therefore invited to conduct their own assessment and validate their baseline status, based on the indicators in the proposed framework. This document outlines opportunities to include meningitis activities within existing mechanisms but is not intended to be prescriptive, as differentiated approaches are needed in different settings. Countries are requested to adapt the proposed actions according to their existing systems and contexts.

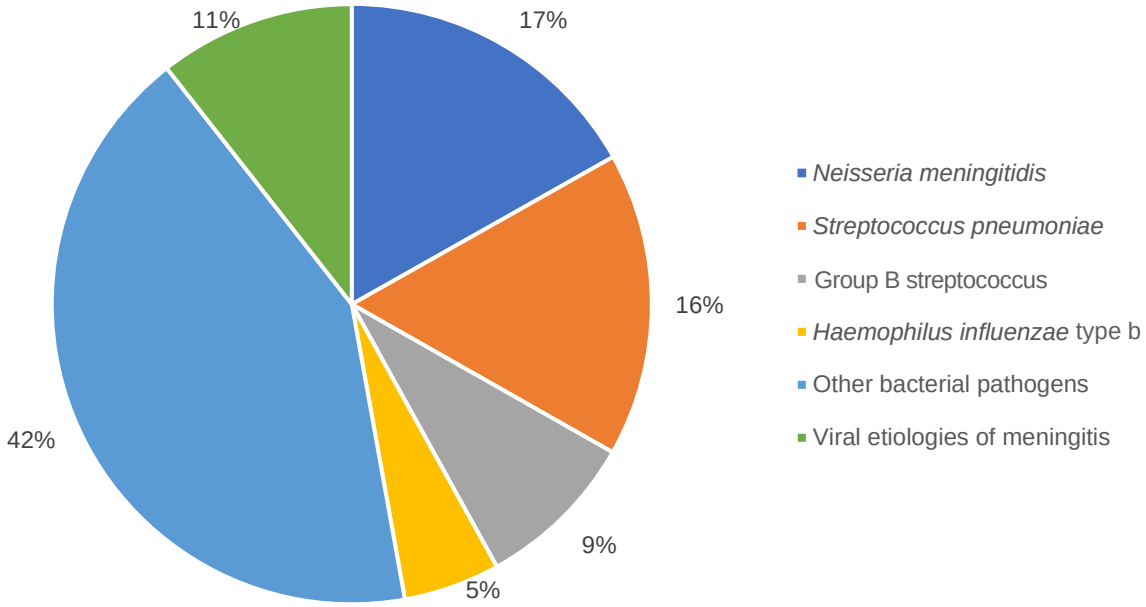
The proposed regional framework aims to guide countries in implementation of the global road map for defeating meningitis by 2030 and to support countries in the adoption and application of standardized guidance and tools. To avoid fragmentation, the framework promotes the use of existing platforms and pathways of care where services for meningitis can be integrated, ensuring access to all. To facilitate monitoring of progress towards the road map goals, the proposed framework defines WHO regional outputs, country outcomes and indicators across the five pillars. Implementation of the meningitis framework will also help to address data gaps and foster evidence generation to better inform actions. This collaborative, integrated framework is a regional adaptation of the global road map on defeating meningitis by 2030.

Figures and tables



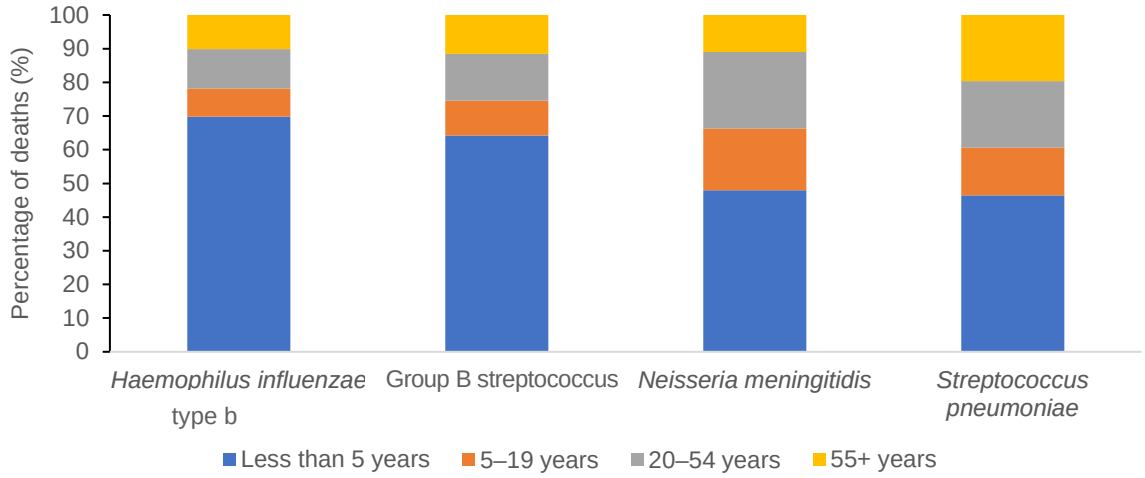
Source: Global Burden of Disease Study 2021 *(53)*.

Fig. 1. Estimated all-cause meningitis incidence and mortality, Eastern Mediterranean Region, 2000–2021



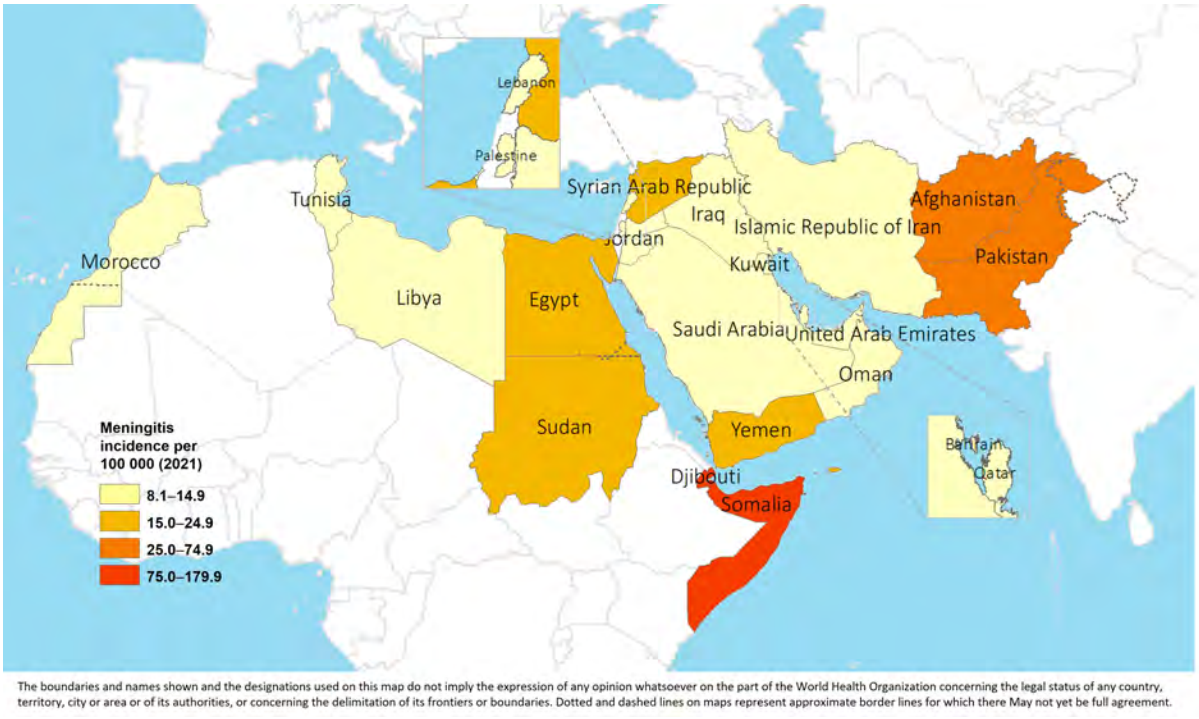
Source: Global Burden of Disease Study 2021 (53).

Fig. 2. Percentage of disability-adjusted life years (DALYs) attributed to meningitis by causative pathogen, Eastern Mediterranean Region, 2021



Source: Global Burden of Disease Study 2021 *(53)*.

Fig. 3. Percentage of estimated bacterial meningitis mortality by age group and causative pathogen, Eastern Mediterranean Region, 2021



Source: Global Burden of Disease Study 2021 *(53)*.

Fig. 4. Estimated all-cause meningitis incidence rate per 100 000 by country, Eastern Mediterranean Region, 2021

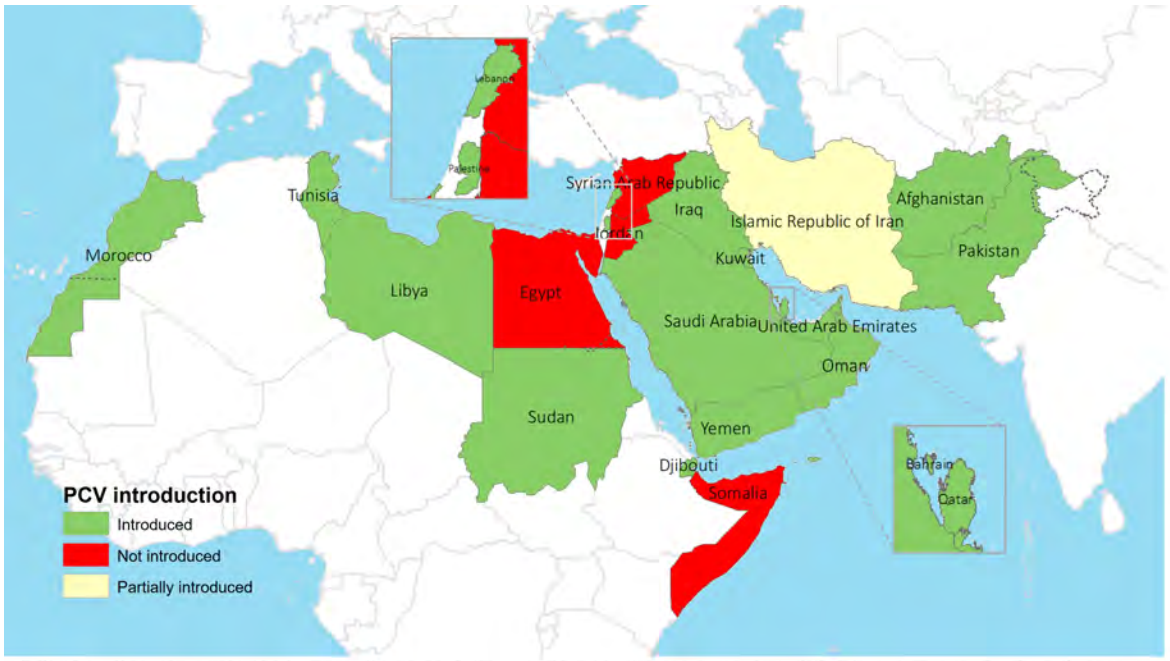
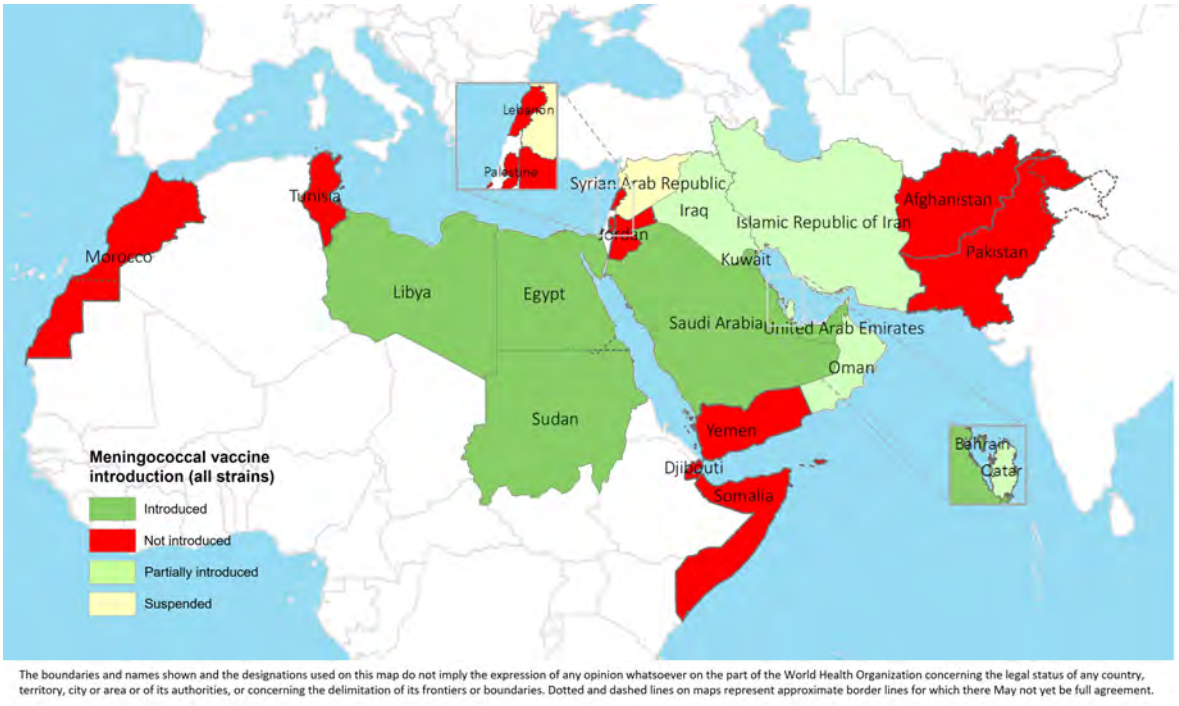
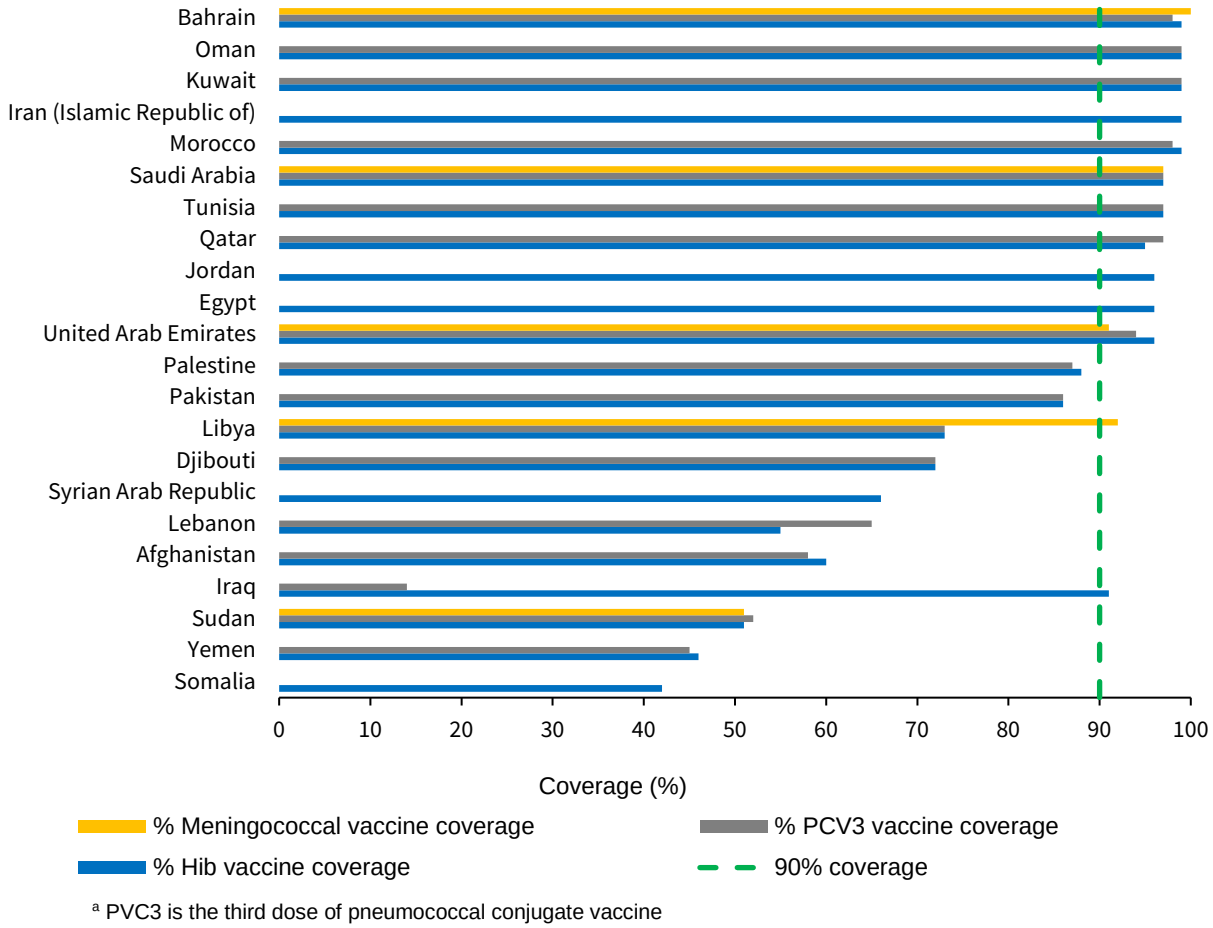


Fig. 5. Meningitis vaccine introduction status, Eastern Mediterranean Region, 2023
a. Pneumococcal conjugate vaccine introduction



Source: Introduction of meningococcal meningitis vaccines (all strains) [online database] *(54)*.

Fig. 5. Meningitis vaccine introduction status, Eastern Mediterranean Region, 2023
b. Meningococcal vaccine introduction (all strains)



Source: WHO/UNICEF estimates 2024 *(54)*.

Fig. 6. Meningitis vaccine coverage by country and antigen, Eastern Mediterranean Region, 2023

Table 1. Framework for implementation of the road map to defeat meningitis in the Eastern Mediterranean Region, 2025–2030

Pillar 1. Prevention						
Strategic goals	**Specific goals**	**WHO regional outputs**	**Country outcomes**	**Indicators**		
				Indicator	**Baseline 2023**	**Target 2030**
Increase coverage of licensed vaccines	Introduction of pneumococcal conjugate vaccine in all countries	Preparation of dossiers for NITAG review in countries where pneumococcal conjugate vaccine has not yet been introduced	Introduction of pneumococcal conjugate vaccine	Number of countries with pneumococcal conjugate vaccine in routine immunization	18	22 (addition of Egypt, Jordan, Somalia, Syrian Arab Republic)
	Introduction of Nm multivalent conjugate vaccine in targeted countries	• Epidemiological assessment including data on circulating serogroups • Survey on national meningococcal vaccine use • Preparation of dossiers for NITAG review in countries where Nm not introduced	Introduction of Nm multivalent conjugate vaccine	Number of target countries with Nm multivalent conjugate vaccine in routine immunization	11	15 (addition of Afghanistan, Djibouti, Pakistan, Somalia)
			Risk assessment in Sudan before introduction of Men5CV	Introduction of Men5CV in Sudan	0	Sudan
	Introduction of new vaccines including GBS	• Preparation of dossiers on GBS burden for NITAG review • Regional policy paper on introduction of new WHO prequalified Nm, Spn and GBS vaccines and prevention of GBS infection	Assessment of the feasibility of introducing new vaccines	Number of target countries introduced new Nm and Spn vaccines	0	Targeted [a]
				Number of target countries introduced GBS vaccine	0	(Targeted) Afghanistan, Egypt, Morocco, Pakistan, Somalia, Sudan, Yemen
Context-specific strategy for GBS	Prevention of GBS transmission	Inclusion of GBS activities into maternal package of care	Targeted countries delivering GBS activities through maternal package of care	Number of countries delivering maternal package of care services including GBS activities	0	(Targeted) Afghanistan, Egypt, Morocco, Pakistan, Somalia, Sudan, Yemen

Pillar 1. Prevention						
Strategic goals	**Specific goals**	**WHO regional outputs**	**Country outcomes**	**Indicators**		
				Indicator	**Baseline 2023**	**Target 2030**
Epidemic prevention	Prevention of meningitis at mass gathering events	Capacity-building for risk assessment and planning for mass gathering events	Risk assessment conducted for all mass gathering events	Proportion of all mass gathering events that assessed meningitis risk through STAR	Not reported	100%
	Evaluation of antibiotic prophylaxis during outbreaks					
	Prevention of meningitis among refugee and migrant populations	Roll-out of country technical assistance plans	Countries providing meningitis prevention and treatment services to refugee and migrant populations	Number of countries implementing technical assistance plans (including meningitis vaccination and care)	0	(Targeted) Djibouti, Iraq, Pakistan, Somalia, Syrian Arab Republic
	Communication strategies for disease outbreak prevention and control	Risk communication strategies for disease outbreak prevention and control	Countries having mapped social and communication channels	Number of countries with available risk communication strategies for meningitis outbreaks	1 (Oman)	(Targeted) Afghanistan, Djibouti, Iraq, Lebanon, occupied Palestinian territory, Pakistan, Somalia, Sudan, Syrian Arab Republic, Yemen

GBS: group B streptococcus*;* Nm: *Neisseria meningitidis;* NITAG: national immunization technical advisory group; STAR: Strategic Toolkit for Assessing Risks; Spn: *Streptococcus pneumoniae*.

[a] To be determined.

Pillar 2. Diagnosis and case management						
Strategic goals	**Specific goals**	**WHO regional outputs**	**Country outcomes**	**Indicators**		
				Indicator	**Baseline 2023**	**Target 2030**
Improve diagnosis	Increased testing of suspected cases of meningitis	• Gap assessment of diagnostic capacity • Study on barriers and facilitators to lumbar puncture practice • Regional testing requirements and capacity-building (including GBS infection in mothers and infants)	Countries with standard policies for testing suspected cases of meningitis at each level of the health system	Number of countries with standard algorithms for testing suspected cases of meningitis	5 (in addition to high-income countries)	22
	Improved testing capacity, including quality and biosafety		Capacity to diagnose meningitis at (as a minimum) national/central public health laboratory level	Number of countries with capacity to diagnose and confirm meningitis at (as a minimum) national/central public health laboratory level	5 (in addition to high-income countries)	22
	CSF collection		> 50% CSF collected and tested in target countries reporting epidemics	Number of target countries with > 50% CSF tested	5	(Targeted) Iraq, Somalia, Syrian Arab Republic
	Quality management of laboratories	Coordination of regional reference laboratory for bacteriology and epidemic-prone diseases	Countries with national reference laboratories participating in international EQA	Number of countries with national reference laboratory participating in international EQA	16	(Targeted) Afghanistan, Djibouti, Sudan, Syrian Arab Republic
	Introduction of new rapid diagnostic tests	• Feasibility assessment for rapid diagnostic test deployment • Capacity-building on validation of novel rapid diagnostic tests	Countries adopting new rapid diagnostic tests	Number of countries with new rapid diagnostic tests validated	0	(Targeted) Afghanistan, Pakistan, Somalia, Sudan, Yemen
Improve case management	Improved acute case management	• Standardized case management algorithms for bacterial and viral meningitis (including GBS) • Capacity-building of front-line health care professionals and local authorities	Countries deploying standardized algorithms for meningitis case management	Number of countries with standard algorithms for meningitis case management	4 (Iraq, Morocco, Syrian Arab Republic, Sudan)	22
	Access to quality-assured antimicrobials		Countries with first-choice and second-choice antibiotics in essential medicines list	Number of countries with required antibiotics in essential medicines list	14	22 (addition of Somalia and Yemen)

CSF: cerebrospinal fluid; EQA: external quality assessment.

Pillar 3. Surveillance						
Strategic goals	**Specific goals**	**WHO regional outputs**	**Country outcomes**	**Indicators**		
				Indicator	**Baseline 2023**	**Target 2030**
Improve surveillance, case detection and reporting	Improved epidemiological information	Standardized case reporting form	Countries utilizing minimum recommended standards for meningitis surveillance	Number of countries utilizing standard case reporting forms	0	22
	Integration of meningitis in national disease surveillance systems	Standardized surveillance package for meningitis developed		Number of countries including meningitis in their national disease surveillance systems	2 (Bahrain, Morocco)	(Targeted) Afghanistan, Djibouti, Pakistan, Somalia, Sudan and high-income countries
	Detection of pathogens and identification of strains (including serotyping/ serogrouping of isolated strains)	Capacity-building for pathogen characterization and molecular surveillance	Countries with capacity to characterize bacterial meningitis pathogens and strains	Number of countries reporting Nm, Spn, Hib and GBS pathogens and strains	2 (Egypt, Saudi Arabia)	(Targeted) Afghanistan, Djibouti, Iran (Islamic Republic of), Jordan, Pakistan Somalia, Syrian Arab Republic
	Surveillance of emerging antimicrobial resistance patterns	Monitoring emerging antimicrobial resistance patterns of main pathogens	Countries reporting antimicrobial resistance of meningitis pathogens in GLASS	Number of countries monitoring antimicrobial resistance of meningitis pathogens (Spn, Nm and Hib)	1 (Morocco)	All middle-income and high-income countries
	Epidemic detection and reporting through IHR focal points and/or other channels of existing surveillance system	Improved and standardized case definitions for meningitis and epidemics, including viral meningitis, to guide investigations and control measures	Countries reporting suspected meningitis outbreaks through IHR focal points and/ or other channels of existing surveillance system	Proportion of meningitis outbreaks reported through IHR focal points and/or other channels of existing surveillance system	Not reported	22

Pillar 3. Surveillance						
Strategic goals	**Specific goals**	**WHO regional outputs**	**Country outcomes**	**Indicators**		
				Indicator	**Baseline 2023**	**Target 2030**
Limitations in functioning related to meningitis sequelae	Estimation of limitations in functioning related to meningitis sequalae	Regional estimate on limitations in functioning related to meningitis sequalae and capacity-building on WHODAS 2.0	Countries estimates on limitations in functioning related to meningitis sequalae	Number of countries with limitations in functioning related to meningitis sequalae estimated	Not reported	22
GBS surveillance	Establishment of surveillance for GBS infection	Develop regional guidance on surveillance of GBS and capacity-building for GBS surveillance	Targeted countries reporting GBS infection	Number of targeted countries reporting GBS infection	0	(Targeted) Iraq, Jordan, occupied Palestinian territory, Pakistan, Somalia

GLASS: Global Antimicrobial Resistance and Use Surveillance System; Hib: *Haemophilus influenzae* type b; IHR: International Health Regulations (2005).

Pillar 4. Support and care for people affected by meningitis						
Strategic goals	**Specific goals**	**WHO regional outputs**	**Country outcomes**	**Indicators**		
				Indicator	**Baseline 2023**	**Target 2030**
Access to health services, including rehabilitation services	Availability of health services	Capacity-building for detection, monitoring and management of limitations in functioning related to meningitis sequalae	Countries have support services for limitations in functioning related to meningitis sequalae integrated at all levels of health system	Number of countries with rehabilitation services at all levels of the health system (tertiary, secondary and primary)	Not reported	Targeted[a]
	Access to health services	Gap analysis of access to health services for persons with disabilities related to meningitis	Assessment of disability inclusion in the health sector, which leads to actions integrated in health strategic planning	Number of countries with health strategic plans that integrate actions on disability inclusion	Not reported	Afghanistan, Djibouti, Pakistan, Somalia, Sudan, Yemen, middle- and high-income countries
			Countries disseminating information on access to health services through media, schools and community-based mechanisms	Number of countries disseminating information on access to health services	Not reported	Targeted[a] (Afghanistan, Djibouti, Pakistan, Somalia, Sudan, Yemen)

[a] To be defined further based on the results of the gap analysis.

Pillar 5. Advocacy and engagement						
Strategic goals	**Specific goals**	**WHO regional outputs**	**Country outcomes**	**Indicators**		
				Indicator	**Baseline 2023**	**Target 2030**
Coordination and resource mobilization	Partnership strengthening	Regional working group to synergize/coordinate technical support and mobilize resources for countries	Cross-sectoral mechanisms developed in target countries to coordinate meningitis activities (including immunization and disability sectors, and civil society)	Number of target countries with working groups established to coordinate meningitis activities	0	Afghanistan, Djibouti, Pakistan, Somalia, Sudan
	Resource mobilization	Regional costed action plan to support country implementation of the road map to defeat meningitis	Achievement of country outcomes outlined in the regional framework	Progress on indicators in regional framework		
Advocacy and communication	Awareness assessment on meningitis	Research in targeted countries on the knowledge, attitudes and practices of the population about meningitis and its sequalae, barriers to health-seeking behaviours and vaccine uptake	Target countries have analysed knowledge, attitudes and practices of the general population about meningitis, barriers to health-seeking behaviours and factors affecting vaccine uptake	Number of target countries with knowledge, attitudes and practice studies conducted	0	Afghanistan, Djibouti, Jordan, Lebanon, Libya, Somalia, Syrian Arab Republic
	Awareness-raising on meningitis and related disability	Regional information, education and communication package developed on prevention measures, recognition of meningitis and sepsis, and use of health services	Countries have meningitis and sepsis awareness messaging integrated into health awareness activities, campaigns and global health days	Number of countries with integrated meningitis and sepsis messaging in health awareness activities	Not reported	22
	Maintaining high vaccine confidence	Risk communication strategies to address access and acceptance issues and generation of demand for vaccines	Countries have meningitis risk communication strategies integrated in national plans	Number of countries with integrated meningitis risk communication strategies	Not reported	22

Table 2. Indicators: data source and year

Indicators	Data source	Year
Incidence rate per 100 000	Institute for Health Metrics and Evaluation	2021
Mortality rate per 100 000	Institute for Health Metrics and Evaluation	
Number of deaths	Institute for Health Metrics and Evaluation	
DALYs	Institute for Health Metrics and Evaluation	2021
Haemophilus influenzae type b, pneumococcal conjugate and meningococcal vaccine introduction	WHO/UNICEF estimates of national immunization coverage	2023
Haemophilus influenzae type b, pneumococcal conjugate and meningococcal vaccine coverage	WHO/UNICEF estimates of national immunization coverage	2023
Number of neonatal deaths due to meningitis/encephalitis	WHO Maternal and Child Epidemiology Estimation Group	2021
National reference laboratory participation in international EQA programmes	WHO analysis of implementation of the regional strategic framework for strengthening health laboratory services	2023
Antibiotics included in essential medicines list	WHO National Essential Medicines List repository	2022
Previously reported outbreaks	WHO Event Management System and Online Signal Management Tool	2012–2023

Table 3. Summary of country data

Country/ territory	Incidence rate (all-cause)	Mortality rate (all-cause)	Deaths (Nm, Hib, Spn, GBS)	DALYs (Nm, Hib, Spn, GBS)	Hib vaccine coverage, third dose (%)	Pneumococcal conjugate vaccine coverage, third dose (%)	Meningococcal vaccine coverage (%)	Neonatal deaths due to meningitis/ encephalitis	NRL participates in international EQA programmes	First-choice antibiotics included in EML	Second-choice antibiotics included in EML	Previous outbreaks		
												Year	Pathogen	CFR
Afghanistan	49	6.3	950	80 058	60	58	Not introduced	653	NR	Yes	Yes	NR	NR	NR
Bahrain	13	0.2	1	91	99	98	100[a]	0	Yes	Yes	Yes	NR	NR	NR
Djibouti	79	8.3	46	2716	72	72	Not introduced	3	NR	Yes	Yes	NR	NR	NR
Egypt	19	1	245	18 434	96	Not introduced	0[a]	64	Yes	Yes	Yes	NR	NR	NR
Iran (Islamic Republic of)	8	0.5	165	7872	99	Partial	Partial[a]	30	Yes	Yes	Yes	NR	NR	NR
Iraq	15	1.0	162	11 029	91	14	Partial[a]	32	Yes	Yes	Yes	2023	Viral	0%
Jordan	13	0.4	23	1721	96	Not introduced	Not introduced	3	Yes	Yes	Yes	NR	NR	NR
Kuwait	9	0.2	3	239	99	99	0[a]	0	Yes	NR	NR	NR	NR	NR
Lebanon	13	0.4	9	470	55	65	Not introduced	0	Yes	Yes	Yes	2022	Nm, Hib, Spn	5.7%
												2023	Nm, Hib, Spn	9.5%
Libya	9	0.7	19	1043	73	73	92[a]	1	Yes	Yes	Yes	2022	ND	ND
Morocco	14	0.7	108	5948	99	98	Not introduced	46	Yes	Yes	Yes	NR	NR	NR
Occupied Palestinian territory	11	0.4	8	645	88	87	Not introduced	ND	NR	NR	NR	2014	Viral	ND
Oman	14	0.3	4	322	99	99	Partial[a]	1	Yes	Yes	Yes	NR	NR	NR
Pakistan	58	5.9	6253	496 167	86	86	Not introduced	3485	Yes	Yes	Yes	NR	NR	NR
Qatar	8	0.2	2	123	95	97	Partial[a]	0	Yes	Yes	Yes	NR	NR	NR

Country/ territory	Incidence rate (all-cause)	Mortality rate (all-cause)	Deaths (Nm, Hib, Spn, GBS)	DALYs (Nm, Hib, Spn, GBS)	Hib vaccine coverage, third dose (%)	Pneumococcal conjugate vaccine coverage, third dose (%)	Meningococcal vaccine coverage (%)	Neonatal deaths due to meningitis/ encephalitis	NRL participates in international EQA programmes	First-choice antibiotics included in EML	Second-choice antibiotics included in EML	Previous outbreaks		
												Year	Pathogen	CFR
Saudi Arabia	8	0.5	63	3503	97	97	97[a]	0	Yes	Yes	Yes	NR	NR	NR
Somalia	180	21.7	2400	175 666	42	Not introduced	Not introduced	266	Yes	No	Yes	NR	NR	NR
Sudan	23	1.1	185	14 785	51	52	51[b]	99	NR	Yes	Yes	2012	Bacterial	16%
												2022	ND	5.3%
Syrian Arab Republic	20	1.6	96	5632	66	Not introduced	Suspended[c]	9	NR	Yes	Yes	2022	Viral	0.5%
												2023		ND
Tunisia	13	0.5	24	1285	97	97	Not introduced	3	Yes	Yes	Yes	NR	NR	NR
United Arab Emirates	8	0.5	16	895	96	94	91[a]	0	Yes	Yes	Yes	NR	NR	NR
Yemen	20	1.1	165	13 040	46	45	Not introduced	44	NR	No	Yes	2017	Nm	ND

CFR: case-fatality rate; DALYs: disability-adjusted life years; EML: essential medicines list; EQA: external quality assessment; Hib: *Haemophilus influenzae* type b; NA: not applicable; ND: no data; NR: not reported; NRL: national reference laboratory; Nm: *Neisseria meningitidis*; Spn: *Streptococcus pneumoniae*.

[a] MenACWY conjugate vaccine.

[b] MenA conjugate vaccine.

[c] MenACW polysaccharide vaccine.

References[1]

1. Van de Beek D, Brouwer M, Hasbun R, Koedel U, Whitney CG, Wijdicks E. Community-acquired bacterial meningitis. Nat Rev Dis Primers. 2016;2:16074 (https://doi.org/10.1038/nrdp.2016.74).

2. GBD 2019 Meningitis Antimicrobial Resistance Collaborators. Global, regional, and national burden of meningitis and its aetiologies, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Neurol. 2023;22(8):685–711 (https://doi.org/10.1016/S1474-4422(23)00195-3).

3. Wunrow HY, Bender RG, Vongpradith A, Sirota SB, Swetschinski LR, Novotney A et al. Global, regional, and national burden of meningitis and its aetiologies, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. Lancet Neurol. 2023;22:685–711 (https://doi.org/10.1016/S1474-4422(23)00195-3).

4. WHO Global Health Estimates 2020: Disease burden by cause, age, sex, by country and by region, 2000–2019. Geneva: World Health Organization; 2020. (https://cdn.who.int/media/docs/default-source/gho-documents/global-health-estimates/ghe2021_daly_bycountry_2020.xlsx?sfvrsn=592af661_5).

5. GBD 2016 Meningitis Collaborators. Global, regional, and national burden of meningitis, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Neurol. 2018;17(12):1061–82 (https://doi.org/10.1016/S1474-4422(18)30387-9).

6. Edmond K, Clark A, Korczak VS, Sanderson C, Griffiths UK, Rudan I. Global and regional risk of disabling sequelae from bacterial meningitis: a systematic review and meta-analysis. Lancet Infect Dis. 2010;10(5):317–28 (https://doi.org/10.1016/S1473-3099(10)70048-7).

7. Mount HR, Boyle SD. Aseptic and bacterial meningitis: evaluation, treatment, and prevention. Am Fam Physician. 2017;96(5):314–22.

8. Wall EC, Chan JM, Gil E, Heyderman RS. Acute bacterial meningitis. Curr Opin Neurol. 2021;34(3):386–95 (https://doi.org/10.1097/wco.0000000000000934).

9. FY24 list of fragile and conflict-affected situations. Washington (DC): World Bank; 2024 (https://thedocs.worldbank.org/en/doc/608a53dd83f21ef6712b5dfef050b00b-0090082023/original/FCSListFY24-final.pdf).

10. Refugee data finder [online database]. Geneva: United Nations High Commissioner for Refugees; 2024 (https://www.unhcr.org/refugee-statistics/download/?url=aF56GA).

11. Mipatrini D, Stefanelli P, Severoni S, Rezza G. Vaccinations in migrants and refugees: a challenge for European health systems. A systematic review of current scientific evidence. Pathog Glob Health. 2017;111(2):59–68 (https://doi.org/10.1080/20477724.2017.1281374).

12. Hart CA, Cuevas LE. Meningococcal disease in Africa. Ann Trop Med Parasitol. 1997;91(7):777–85. (https://doi.org/10.1080/00034989760536).

[1] All references were accessed on 28 September 2024.

13. al-Gahtani YM, el Bushra HE, al-Qarawi SM, al-Zubaidi AA, Fontaine RE. Epidemiological investigation of an outbreak of meningococcal meningitis in Makkah (Mecca), Saudi Arabia, 1992. Epidemiol Infect. 1995;115(3):399–409 (https://doi.org/10.1017/s0950268800058556).

14. Bushra HE, Mawlawi MY, Fontaine RE, Afif H. Meningococcal meningitis group A: a successful control of an outbreak by mass vaccination. East Afr Med J. 1995;72(11):715–8.

15. Aguilera JF, Perrocheau A, Meffre C, Hahné S, W135 Working Group. Outbreak of serogroup W135 meningococcal disease after the Hajj pilgrimage, Europe, 2000. Emerg Infect Dis. 2002;8(8):761–7 (https://doi.org/10.3201/eid0808.010422).

16. Al-Arba'een pilgrimage final statistics [website]. Alkafeel Global Network; 2023 (https://alkafeel.net/news/index?id=20977&lang=en).

17. FIFA World Cup Qatar 2022 in numbers [website]. FIFA; 2023 (https://publications.fifa.com/en/annual-report-2022/tournaments-and-events/fifa-world-cup-quatar-2022/fifa-world-cup-qatar-2022-in-numbers/).

18. Yezli S, Saeed AaB, Assiri AM, Alhakeem RF, Yunus MA, Turkistani AM, Booy R, Alotaibi BM. Prevention of meningococcal disease during the Hajj and Umrah mass gatherings: past and current measures and future prospects. Int J Infecti Dis. 2016;47:71–8 (https://doi.org/10.1016/j.ijid.2015.12.010).

19. Parikh SR, Campbell H, Bettinger JA, Harrison LH, Marshall H, Martinón-Torres F et al. The everchanging epidemiology of meningococcal disease worldwide and the potential for prevention through vaccination. J Infect. 2020;81(4):483–98 (https://doi.org/10.1016/j.jinf.2020.05.079).

20. Seventy-third World Health Assembly, Geneva, 18–19 May (*de minimis*) and 9–14 November (resumed) 2020, resolutions and decisions, annexes. Geneva: World Health Organization; 2020 (WHA73/2020/REC/1, https://iris.who.int/handle/10665/345951).

21. Defeating meningitis by 2030: a global road map. Geneva: World Health Organization; 2021 (https://iris.who.int/bitstream/handle/10665/342010/9789240026407-eng.pdf). Licence: CC BY-NC-SA 3.0 IGO.

22. Implementing the Immunization Agenda 2030: a framework for action through coordinated planning, monitoring & evaluation, ownership & accountability, and communications & advocacy. Geneva: World Health Organization; 2021 (https://www.who.int/publications/m/item/implementing-the-immunization-agenda-2030). Licence: CC BY-NC-SA 3.0 IGO.

23. Strategic framework for strengthening health laboratory services in the WHO Eastern Mediterranean Region, 2024–2029. Cairo: WHO Regional Office for the Eastern Mediterranean; 2024 (https://applications.emro.who.int/docs/Health-laboratory-services-framework-eng.pdf).

24. Strategic toolkit for assessing risks: a comprehensive toolkit for all-hazards health emergency risk assessment. Geneva: World Health Organization; 2021. (https://www.who.int/publications/i/item/9789240036086). Licence: CC BY-NC-SA 3.0 IGO.

25. The WHO AWaRe (access, watch, reserve) antibiotic book. Geneva: World Health Organization; 2022 (https://www.who.int/publications/i/item/9789240062382). Licence: CC BY-NC-SA 3.0 IGO.

26. Wahl B, O'Brien KL, Greenbaum A, Majumder A, Liu L, Chu Y et al. Burden of *Streptococcus pneumoniae* and *Haemophilus influenzae* type b disease in children in the era of conjugate vaccines: global, regional, and national estimates for 2000–15. Lancet Glob Health. 2018;6:e744–57 (https://doi.org/10.1016/S2214-109X(18)30247-X).

27. Etapelong Sume G, Quamrul H, Md S, Kissa J, Hutin Y. National immunization technical advisory groups (NITAGs) in the WHO Eastern Mediterranean Region (EMR): a decade of shaping immunization policies, 2010–2021. Vaccine. 2023;42(3):629–35. (https://doi.org/10.1016/j.vaccine.2023.12.049).

28. Gavi approach to engagement with middle-income countries. Geneva: Gavi, the Vaccine Alliance; 2022 (https://www.gavi.org/sites/default/files/programmes-impact/support/Gavi-MICs-Approach-Overview.pdf).

29. DeRoeck D, Bawazir SA, Carrasco P, Kaddar M, Brooks A, Fitzsimmons J et al. Regional group purchasing of vaccines: review of the Pan American Health Organization EPI revolving fund and the Gulf Cooperation Council group purchasing program. Int J Health Plann Manage. 2006;21(1):23–43 (https://doi.org/10.1002/hpm.822).

30. Al-Mandhari A, Brennan R, Abubakar A, Hajjeh R. Tackling COVID-19 in the Eastern Mediterranean Region. Lancet 2020;396(10265):1786–8 (https://doi.org/10.1016/S0140-6736(20)32349-7).

31. Al-Mandhari A, Ardalan A, Mataria A, Rifaey T, Hajjeh R. Refugee and migrant health strategy for the Eastern Mediterranean Region. East Mediterr Health J. 2021;27(12):1129–31 (https://doi.org/10.26719/2021.27.12.1129).

32. OHCHR, IOM, UNHCR and WHO joint press release: the rights and health of refugees, migrants and stateless must be protected in COVID-19 response [news release]. World Health Organization, 31 March 2020 (https://www.who.int/news/item/31-03-2020-ohchr-iom-unhcr-and-who-joint-press-release-the-rights-and-health-of-refugees-migrants-and-stateless-must-be-protected-in-covid-19-response).

33. Strategy to promote the health and well-being of refugees, migrants, internally displaced persons and other displaced groups in the Eastern Mediterranean Region. Cairo: WHO Regional Office for the Eastern Mediterranean; 2023 (https://iris.who.int/handle/10665/366486). License: CC BY-NC-SA 3.0 IGO.

34. Sudan to respond to new emergence of variant poliovirus in Red Sea State [website]. Cairo: WHO Regional Office for the Eastern Mediterranean; 2024 (https://www.emro.who.int/media/news/sudan-to-respond-to-new-emergence-of-variant-poliovirus-in-red-sea-state.html).

35. Review of decisions: Board meeting, 6–7 December 2023, Accra, Ghana. Geneva: Gavi, the Vaccine Alliance; 2023 (https://www.gavi.org/news/document-library/gavi-alliance-board-review-decisions-6-7-december-2023).

36. Meeting of the Strategic Advisory Group of Experts on Immunization, September 2023: conclusions and recommendations. WHO Weekly Epidemiological Record: No 47, 2023, 98, 599–620 (https://www.who.int/publications/i/item/WER-9847-599-620).

37. WHO Collaborating Centre for Reference and Research on Bacterial Pathogens. In: WHO collaborating centres: global database [online database). Geneva: World Health Organization (https://apps.who.int/whocc/Detail.aspx?BC2Rb14ysgs0ctSqxvLgsg==).

38. WHO guidelines on meningitis diagnosis, treatment and care. Geneva: World Health Organization; 2025 (https://www.who.int/publications/i/item/9789240108042). Licence: CC BY-NC-SA 3.0 IGO.

39. A regional strategy for integrated disease surveillance: overcoming data fragmentation in the Eastern Mediterranean Region. Cairo: WHO Regional Office for the Eastern Mediterranean; 2021 (https://iris.who.int/handle/10665/352421).

40. Regional Committee for the Eastern Mediterranean: progress report on implementing the regional strategy for integrated disease surveillance: overcoming data fragmentation in the Eastern Mediterranean Region. Cairo: WHO Regional Office for the Eastern Mediterranean; 2023 (EM/RC70/INF.DOC.12-Rev.1; https://applications.emro.who.int/docs/Progress-report-IDS-eng.pdf).

41. Smaoui H, Tali-Maamar H, Zouhair S, Bouheraoua S, Mefteh K, Bouskraoui M et al. Implementation of a prospective study for enhancing surveillance of invasive bacterial infections in North Africa. Int J Infect Dis. 2022;115:101–5 (https://doi.org/10.1016/j.ijid.2021.11.036).

42. Invasive bacterial disease surveillance network in Africa, Middle East, and Eurasia: Meningitis and Septicemia Mapping Network (MenMap). Amman: Eastern Mediterranean Public Health Network (EMPHNET), Global Health Development (GHD); 2021 (https://emphnet.net/media/f05abvfg/sanofi_y21_menmap_project-breif_final.pdf).

43. GLASS manual for antimicrobial resistance surveillance in common bacteria causing human infection. Geneva: World Health Organization; 2023 (https://iris.who.int/bitstream/handle/10665/372741/9789240076600-eng.pdf?sequence=1). Licence: CC BY-NC-SA 3.0 IGO.

44. Hall J, Adams NH, Bartlett L, Seale AC, Lamagni T, Bianchi-Jassir F et al. Maternal colonization with group B streptococcus and serotype distribution worldwide: systematic review and meta-analyses. Clin Infect Dis. 2017;65(suppl_2):S100–11 (https://doi.org/10.1093/cid/cix658).

45. WHO rehabilitation need estimator [website]. Washington: Institute for Health Metrics and Evaluation; 2021 (https://vizhub.healthdata.org/rehabilitation/).

46. Measuring health and disability: manual for WHO Disability Assessment Schedule (WHODAS 2.0). Geneva: World Health Organization; 2012 (https://www.who.int/publications/i/item/measuring-health-and-disability-manual-for-who-disability-assessment-schedule-(-whodas-2.0). Licence: CC BY-NC-SA 3.0 IGO.

47. Rehabilitation in health systems: guide for action. Geneva: World Health Organization; 2019 (https://www.who.int/publications/i/item/rehabilitation-in-health-systems-guide-for-action). Licence: CC BY-NC-SA 3.0 IGO.

48. Package of interventions for rehabilitation. Module 6: sensory conditions. Geneva: World Health Organization; 2023 (https://iris.who.int/bitstream/handle/10665/370508/9789240071223-eng.pdf?sequence=1). Licence: CC BY-NC-SA 3.0 IGO.

49. mhGAP intervention guide for mental, neurological and substance use disorders in non-specialized health settings: mental health Gap Action Programme (mhGAP) – version 2.0. Geneva: World Health Organization; 2021 (https://www.who.int/publications/i/item/9789241549790).

50. Mirza Z, Mataria A, Salah H, Gedik G, Ismail A. 'Health benefits package': a centerpiece of universal health coverage. East Mediterr Health J. 2018;24(4):405–6 (https://doi.org/10.26719/2018.24.4.405).

51. Ihalainen M, Pasha Q, Rashidian A, et al. All in for Universal Health Coverage and global health security - reinforcing partner engagement in the Eastern Mediterranean Region. East Mediterr Health J. 2023;26(11):835-836 (https://doi.org/10.26719/2023.29.11.835).

52. Al-Abri SS, Abuhasan MY, Albayat SSA, Bai X, Bastaki H, Borrow R et al. Meningococcal disease in the Middle East: a report from the Global Meningococcal Initiative. J Infect. 2024;88(2):71–6 (https://doi.org/10.1016/j.jinf.2023.10.011).

53. Global Burden of Disease 2021: findings from the GBD 2021 study. Seattle: Institute for Health Metrics and Evaluation (IHME); 2024 (https://www.healthdata.org/research-analysis/gbd).

54. Introduction of Meningococcal meningitis vaccines (all strains)[online database]. Geneva: World Health Organization; 2024 (https://immunizationdata.who.int/global/wiise-detail-page/introduction-of-meningococcal-meningitis-vaccines-(all-strains)?ISO_3_CODE=&YEAR=).