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WHO defeating meningitis symposium, 3rd international symposium on *Streptococcus agalactiae* disease (ISSAD) in Rio de Janeiro, Brazil: State-of-the-art overview of *S. agalactiae* meningitis

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Abstract

A World Health Organization (WHO) Defeating Meningitis Symposium took place as part of the 3rd International Symposium on *Streptococcus agalactiae* disease (ISSAD) conference which was held in Rio de Janeiro, Brazil, from October 16–18, 2023. The symposium highlighted WHO's Defeating meningitis by 2030 global road map focusing on Group B *Streptococcus* (GBS)

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Declaration of competing interest

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meningitis and provided an overview of the meningitis burden and main challenges faced to tackle the disease across the Americas, Africa, and Asia.

Keywords

Group B *Streptococcus*; Meningitis; WHO defeating meningitis by 2030 global road map

1. Introduction

Meningitis is a life-threatening infectious disease and a major global public health issue that affects millions of people across the world. People of all ages are at risk of meningitis, but young children (< 5 years old) are the most affected [1–3]. In 2019, the global meningitis burden in all ages was estimated at 236,000 deaths and 2.51 million cases, but the greatest burden was reported among children less than 5 years, with 112,000 deaths and 1.28 million cases worldwide [4]. Besides the health impacts, meningitis also imposes economic and social consequences to the patients, their family members, and entire communities. Meningitis can be caused by viruses, bacteria, fungi, and parasites, but acute bacterial meningitis is the leading cause of death and disability, with high mortality rates, causing lifelong disabilities among people following acute infection [1–3,5]. In 2019, the main agents of bacterial meningitis cases in all-ages were *N. meningitidis* (17.3 %), *S. pneumoniae* (13 %), *H. influenzae* (7.5 %), and Group B *Streptococcus* (GBS, 7.1 %). Meningitis cases and deaths can be significantly reduced by vaccination but the progress of efforts to tackle meningitis globally is still slow in comparison to other vaccine-preventable infectious diseases [6,7]. Currently, there are licensed vaccines against *N. meningitidis*, *S. pneumoniae*, and *H. influenzae* serotype b, which have greatly reduced meningitis cases due to these pathogens worldwide, especially in high-income countries [3,4].

A human GBS vaccine has not been licensed yet, but there are promising approaches in clinical trials, and it is expected that by 2026 at least one GBS vaccine will be available for maternal immunization to reduce the burden of GBS meningitis [8]. GBS can colonize the vaginal tract of pregnant women and can be vertically transmitted to the newborn before or during delivery or be horizontally acquired later by the infant. GBS may cause stillbirth, preterm birth, early-onset disease, (first 7 days of life (EOD) or late-onset disease, (day 7–90 of life (LOD) [9]. GBS is the major cause of bacterial meningitis cases (20.4 %) and deaths (22.8 %) in neonates across the globe [4]. Overall, it is estimated that GBS causes 231,000 EOD and 161,000 LOD cases occur each year, resulting in 91,000 deaths. Of the infants surviving invasive GBS disease globally, approximately 37,100 will go on to develop neurodevelopmental impairment such as hearing loss, vision loss, or cerebral palsy [2,8,10]. Intrapartum antibiotic prophylaxis (IAP) is the only preventive strategy currently available against GBS disease, but IAP is only effective at preventing EOD and its use is limited to high-income countries (HIC) mainly due to a lack of resources in LMIC [8]. In this scenario, a maternal GBS vaccine stands out as the ideal preventive measure to tackle GBS. It is estimated that a GBS vaccine could prevent 214,100 cases of invasive disease in newborns, averting 31,100 deaths and 21,400 cases of neurodevelopmental impairment from sepsis, meningitis, or pneumonia [8].

In 2019, the WHO took up the call for action to speed up access to vaccinations to tackle bacterial meningitis together with partners including governments, global health organizations, civil society organizations, academia, private sector, and experts in the field and developed a Defeating meningitis by 2030 global road map. The road map aims to tackle the main causes of bacterial meningitis and sets a comprehensive vision for 2030 “Towards a world free of meningitis” [7]. The road map strategic plan is based on three visionary goals: (i) eliminate epidemics of bacterial meningitis; (ii) reduce cases of vaccine preventable bacterial meningitis by 50 % and deaths by 70 %; (iii) reduce disability and improve quality of life after meningitis of any cause. To support the achievement of the visionary goals, the road map was organized in five pillars, including prevention and epidemic control, diagnosis and treatment, disease surveillance, support and care for people affected by meningitis, and advocacy and engagement. In terms of GBS meningitis, the road map aims to foster the development and launching of an effective and affordable maternal vaccine, implement strategies for GBS surveillance and proper diagnosis and treatment on a global level, raise public and political awareness of the problem, and promote care and support for people affected by neonatal meningitis, their families, and caregivers.

The 3rd International Symposium on *Streptococcus agalactiae* disease (ISSAD) conference brought together scientists, healthcare professionals, students, and stakeholders from across the globe in Rio de Janeiro, Brazil, from October 16–18, 2023, to share and learn from the cutting-edge research on GBS disease and identify priorities to be met in the next few years to improve maternal and newborn health. The WHO Meningitis Symposium took place on the 1st day of ISSAD, and the session focused on providing an update on the global meningitis burden and an introduction to the Defeating Meningitis by 2030 Global Road Map, as well as recent data and the main challenges faced to tackle the disease in the United States, Asia, sub-Saharan Africa, and Brazil, with a particular focus on GBS neonatal meningitis burden.

2. Defeating meningitis by 2030 – global road map and overview

WHO Director-General, Dr. Tedros Adhanom Ghebreyesus, opened the WHO Meningitis Symposium by highlighting the relevance and impacts of meningitis on global public health and the motivations to develop the Defeating Meningitis by 2030 Global Road Map. The global road map has made real progress recently with the WHO pre-qualification of a new vaccine, the pentavalent meningococcal ACWYX conjugate vaccine (Men5CV), which was recommended to be included in routine immunization programs in sub-Saharan Africa by the WHO Strategic Advisory Group of Experts on Immunization (SAGE) [11,12]. Another major goal of the global road map is to have at least one affordable vaccine against GBS licensed and pre-qualified by 2026 [8] and to raise awareness of the threat of GBS disease among the general public and health ministries. Importantly, Dr. Tedros reinforced that people affected by meningitis need access to rehabilitation at the primary care level to improve patients’ quality of life and advocate for Universal Health Coverage.

Dr. Marie-Pierre Preziosi provided an overview of the Defeating Meningitis by 2030 Global Road Map framework and achievements so far. The 73rd World Health Assembly approved the global road map in November 2020, in the first resolution on the prevention and control

of meningitis [13], and it was officially launched in September 2021. The roadmap focuses on the main agents of acute bacterial meningitis cases (*N. meningitis*, *S. pneumoniae*, *H. influenzae*, and GBS) that are preventable or potentially (soon) preventable by vaccination and defines a global strategy based on three visionary goals and five interconnected pillars. It is expected that the global road map will have impacts well beyond meningitis, including impacts on public health at large (e.g., control of other diseases caused by the same organisms that cause meningitis, limit the rise of antimicrobial resistance, lower the burden on health systems) and impacts beyond health by improving economies, education, lowering health expenditures, decreasing poverty, and helping reach the United Nations Sustainable Development Goals. The successful implementation of the road map will depend, first and foremost, on country, regional, and global engagement, and political willingness to defeat meningitis. The governance of the road map consists of two major entities, the Technical Task Force (TTF) and the Strategy Support Group (WHO, 2021a). The TTF is composed by partners and international experts from all 6 WHO regions who work together under the leadership of WHO to play an essential role, with specific responsibility for leading and coordinating the implementation of the road map, globally and regionally, by providing a forum for technical exchange and cooperation on meningitis and road map related activities. The TTF helps the Organization to ensure its accountability to Member States, in line with the resolution and the Mission of the Organization [14]. On the other hand, the Strategy Group Support includes global-level partners and sponsors, committed to the mission of defeating meningitis and to promote the road map through high-level advocacy, raising public awareness and supporting implementation activities [15]. Since the road map was launched in 2021, there has been major progress thanks to multidisciplinary coordination at country, regional, and global levels. In 2023, the Strategic Support Group was started, and the 9th meeting of the TTF had a dedicated session to GBS aiming to prioritize the efforts towards tackling GBS neonatal meningitis. The gradual realization of the visionary goals by 2030 for all forms of meningitis will result respectively in the end of more than a century of devastating epidemics, in the prevention of >2,700,000 cases and > 900,000 deaths, and in the prevention of nearly 800,000 meningitis sequelae, with >75 million disability-adjusted life years (DALYs) averted (WHO, unpublished data). Altogether, the accomplishment of the visionary goals will impact the burden of meningitis across the world, but especially in low- and middle-income countries (LMICs), towards a “world free of meningitis” [7]. Importantly and key to these achievements, the global road map aims to foster the development of global guidance on GBS prevention and the introduction of a maternal GBS vaccine by 2030, which are pivotal milestones to defeating meningitis globally.

3. The increasing importance of group B *Streptococcus* as a cause of bacterial meningitis — United States

In this session, Dr. Ruth Lynfield provided a comprehensive overview of bacterial meningitis epidemiologic trends in the US from 2008 through 2021. This presentation was derived from a study led by Dr. Namrata Prasad, which used data from two surveillance systems within the US Centers for Disease Control and Prevention’s Emerging Infections Program (EIP) Network: The Active Bacterial Core surveillance (ABCs) and the Foodborne Diseases

Active Surveillance Network (FoodNet). These platforms provide active, laboratory, and population-based surveillance data on bacterial meningitis cases among approximately 35 million people across 10 sites.

In the United States, according to EIP surveillance data, the overall incidence of bacterial meningitis due to *S. pneumoniae*, GBS, *H. influenzae*, *N. meningitidis*, and *Listeria monocytogenes* declined by 31 % between 1998 and 2007. This decline was primarily driven by a decrease in *S. pneumoniae* meningitis and was attributed to the use of the seven-valent pneumococcal conjugate vaccine (PCV7), which was introduced in the United States in 2000 [16]. Since then, additional interventions to prevent disease from these bacteria have been implemented, such as the replacement of PCV7 with the 13-valent pneumococcal conjugate vaccine (PCV13) in 2010 and updated recommendations for meningococcal vaccines. There has also been sustained use of *H. influenzae* serotype *b* vaccine, as well as continued universal screening of GBS and use of IAP among pregnant women. Considering the Global Road Map and the potential licensure of a GBS maternal vaccine, current descriptions of bacterial meningitis epidemiologic trends, including changes that happened during the COVID-19 pandemic, are necessary for the evaluation and prioritization of current and future meningitis related interventions [7].

In the study presented by Dr. Lynfield, which analyzed bacterial meningitis surveillance data between 2008 and 2021, it was expected that the introduction of PCV13 in 2010 and the COVID-19 pandemic during 2020–2021 would have the largest potential impacts on overall bacterial meningitis incidence and etiology. Thus, changes in bacterial meningitis epidemiology were evaluated in the context of these events by dividing the study period into three periods: pre-PCV13 (2008–2009), post-PCV13 and pre-COVID-19 (2010–2019), and COVID-19 (2020–2021).

When the average annual incidence of bacterial meningitis due to *S. pneumoniae*, GBS, *H. influenzae*, *N. meningitidis*, and *L. monocytogenes* was compared between 2008 and 2009 and 2010–2019, a 17 % decline was observed. This decline was largely driven by a decrease in *S. pneumoniae* meningitis incidence, but there was also a decline in *N. meningitidis* meningitis incidence. In contrast, there was no significant change in the incidence of meningitis caused by GBS or *L. monocytogenes*. Finally, a small, but statistically significant increase in *H. influenzae* meningitis incidence was observed during the same period. When overall bacterial meningitis incidence was compared between 2010 and 2019 and 2020–2021, a 40 % decline was observed. This decline was driven by a decrease in *S. pneumoniae*, *H. influenzae*, and *N. meningitidis* meningitis incidence. Again, there was no significant change in the incidence of meningitis caused by GBS or *L. monocytogenes*. These changes in incidence over time have impacted the etiologic contributions of these pathogens to bacterial meningitis cases. *S. pneumoniae* was the leading cause of meningitis, followed by GBS, across all time periods. However, the relative etiologic contribution of GBS was shown to increase, particularly during the COVID-19 pandemic period, as the incidence of meningitis due to other pathogens declined. It was also observed that changes in bacterial meningitis incidence and etiology varied by age group. Throughout the study period, meningitis incidence was highest among infants aged 0–2 months and did not change over time. Importantly, GBS was the leading etiology within this age group. Finally, it was

observed that there was no significant change in the case fatality of bacterial meningitis, overall or by pathogen, throughout the study period.

GBS-specific meningitis data collected through EIP showed that GBS meningitis among infants aged 0–3 months presented more frequently as late-onset disease (LOD) than early-onset disease (EOD) across all time periods. Additionally, there was no significant change in GBS serotype distribution among GBS meningitis cases across the years, and serotype III accounted for approximately 50 % of isolates. Finally, it was noted that meningitis represented a small proportion of all invasive GBS disease among young infants and there were distinct differences in invasive disease syndromes among EOD vs LOD.

In conclusion, in the US, the incidence of bacterial meningitis declined during 2008–2021; *S. pneumoniae*, despite declines in its incidence, remained the leading cause of bacterial meningitis, followed by GBS; there was no change in GBS meningitis incidence throughout the study period; the burden of bacterial meningitis is highest among young infants among whom GBS is the most common cause. Finally, GBS meningitis in young infants presents more frequently as LOD, which is not preventable by any currently available strategy. These findings underscore the potential value of a GBS maternal vaccine in reducing the residual burden of meningitis in the United States.

4. Defeating meningitis 2030: Asian perspective

Asia accounts for one of the highest numbers of Group B *Streptococcus* (GBS) disease cases worldwide, second only to Africa. In 2015, there were an estimated 13,400 cases of fetal infection, 95,300 cases of early-onset disease (EOD), and 17,000 cases of late-onset disease (LOD) in Asia [17]. Additionally, GBS disease was responsible for approximately 45,000 infant deaths and stillbirth that year. In 2017, Russell et al. reported maternal GBS colonization rates of 12.5 % (95 % CI, 10 %–14 %) in Southern Asia and of 11 % (95 % CI, 10 %–12 %) in Eastern Asia, both lower than the global average of 18 % (95 % confidence interval [CI], 17 %–19 %).

Hong Kong introduced universal GBS screening and intrapartum antibiotic prophylaxis (IAP) in 2012, which led to a significant drop in early-onset meningitis rates, from 0.06 (95 % CI, 0.04–0.11) to 0.02 (95 % CI, 0.003–0.05) per 1000 live births among infants born at 38 weeks or more [18]. Similarly, the incidence of early-onset sepsis dropped from 1.31 to 0.81/1000 live births (95 % CI, 0.7–0.93) $p < 0.001$. While bacterial meningitis rates decreased after IAP implementation between 2012 and 2018, cases of viral meningitis increased, possibly due to the use of newer molecular diagnostic tools capable of detecting a broader range of pathogens, including viruses like Coxsackievirus A and B, Echovirus, and EV71 [19].

In China, GBS is responsible for 27.8 % to 46.5 % of neonatal meningitis cases, with *E. coli* being the second most common pathogen [20,21]. Serotype III is the most prevalent type of GBS causing neonatal invasive disease [22,23]. A study in Japan (2016–2018) found that GBS accounted for 39 % of meningitis cases in infants aged 0–3 months [24]. A nationwide study (2016–2020) reported an increase in GBS invasive disease incidence from 0.28 to 0.45

per 1000 live births ($p = 0.021$), with meningitis cases' rates among EOD and LOD of 26.9 % and 36.5 %, respectively. Serotypes III, Ia, Ib, and V were the most common [25]. In Korea, between 1996 and 2020, GBS was the third most frequent cause of meningitis in immunocompetent children aged 3 to 23 months [26].

Asia's GBS burden is influenced by geographical and societal differences, population structure, birth rates (including preterm births), IAP program implementation, risk groups (e.g., individuals with diabetes), and strain prevalence, particularly serotype III and specific sequence types like ST17, ST19, and ST283. Both community- and healthcare-associated infections, as well as antimicrobial resistance, are additional factors.

Challenges contributing to GBS-related morbidity and mortality in Asia include variability between countries, limited access to healthcare, prior antibiotic treatment complicating diagnosis, inadequate laboratory capabilities, the rise of resistant GBS strains, and the fact that GBS invasive diseases like meningitis and sepsis are often not notifiable. There is also a lack of comprehensive public health monitoring and surveillance in real time.

All these challenges contribute to the relative lack of data in Asia, which hampers accurate burden estimates.

5. Pilot surveillance of GBS can inform the development of national plans for defeating meningitis: the Burkina Faso experience

Burkina Faso is located in sub-Saharan Africa, a region with the highest rates of maternal GBS infections. However, the country lacks a national GBS screening or surveillance program. Studies report a GBS colonization rate of 8.14 % among women of childbearing age (19–45 years) with vaginal discharge and 6.05 % among pregnant women [27] [28].

In 2022, Dr. Soufiane Sanou presented a CDC-supported study on GBS in pregnant women at delivery, conducted in the Do and Dafra Health Districts in Bobo-Dioulasso. The study aimed to determine the prevalence of GBS carriage, assess socio-demographic factors, characterize serotypes (including whole genome sequencing) and antimicrobial resistance, and track neonatal GBS infections. A total of 533 pregnant women were enrolled from health facilities following full written informed consent, with follow-up evaluations of their babies at days 2, 7, 14, and 28 post-birth. No IAP was given as this is not standard of care. The lab procedures to process the clinical specimens and to detect and isolate GBS followed the recommendations of CDC (<https://www.cdc.gov/streplab/groupb-strep/index.html>). The GBS carriage rate was 24.7 %, with serotype V being the most common (36.8 %), followed by serotypes III (19.9 %), Ia (17.6 %), Ib (14 %), II (10.3 %), and IV (1.5 %). Antimicrobial resistance in colonising isolates was found to penicillin (8.1 %), erythromycin (15.4 %), clindamycin (5.1 %), and vancomycin (2.2 %) [29].

In the context of the WHO Defeating Meningitis Global Roadmap, there is only one article published that reports surveillance data of bacterial meningitis in Burkina Faso. Meningitis incidence is higher in urban areas and most of meningitis cases (59.84 %) are detected among children under 5 years of age. Although Burkina Faso reports meningitis caused by

N. meningitidis, *S. pneumoniae*, and *H. influenzae*, no cases of GBS meningitis have been detected [30]. Priorities for the country include assessing the burden of neonatal and infant GBS, improving healthcare capacities, and establishing surveillance sites in both urban and rural areas. However, challenges such as insecurity, healthcare workload, reduced access to some regions (wintering), emerging pathogens with epidemic potential (Dengue virus, Chikungunya, etc.), and antimicrobial resistance must be addressed.

The COVID-19 pandemic brought opportunities, including the expansion of molecular diagnostic tools and laboratory networks, a national plan to fight meningitis (2023–2027), and strong community involvement, supported by technical and financial partners.

6. Current panorama of bacterial meningitis in Brazil

Meningitis is a notifiable disease in Brazil, with 12,481 cases reported in 2022 (*Sistema de Informação de Agravos de Notificação (SINAN)*) [31]. The Southeast region, the most populated, accounted for the highest number of cases (6786). According to SINAN, *Streptococcus pneumoniae* is the leading cause of bacterial meningitis, followed by *Neisseria meningitidis*, *Mycobacterium tuberculosis*, and *Haemophilus influenzae*. Among children under 1 year old, *N. meningitidis* and *S. pneumoniae* are the main pathogens. A decline in bacterial meningitis cases since 2008 is largely attributed to the introduction of the meningococcal C vaccine (Meningo C) and the 10-valent pneumococcal conjugate vaccine (PCV10) in 2010, which are provided free by the national health system (*Sistema Único de Saúde* – SUS) [32].

Despite this, vaccine coverage has dropped sharply, from 57 to 60 % in 2020–2021 to just 30 % in 2022. Meningococcal meningitis cases have significantly declined since 2010, but pneumococcal meningitis remains stable at around 1000 cases per year, aside from a pandemic-related drop to 400 cases in 2020–2021. The resurgence of cases in 2022 (1100) is due to declining vaccine coverage and serotype replacement, where non-vaccine serotypes like 19 A, 3, and 6C have increased. PCV10 has effectively reduced disease from vaccine serotypes (e.g., 14, 6B, 19F) [33], but non-vaccine serotypes have risen. PCV13, which covers these serotypes, is available only in private clinics for children under 5 but is free for individuals aged 5 years or older at high risk for pneumococcal diseases, including patients living with HIV/AIDS, cancer patients, and those subjected to hematopoietic stem cell transplantation or solid organ transplantation.

Regarding GBS meningitis, although meningitis reporting is mandatory, the causative pathogen often goes unreported, which likely leads to underreporting of GBS cases. There is no national policy for GBS screening or universal IAP for pregnant women, and GBS data mainly come from regional studies, mostly from the states located on the East side of the country. Maternal GBS colonization varies across Brazil, from 4.2 % to 28.4 % [34]. In Rio de Janeiro, colonization rates ranged from 20 to 30 % from 2008 to 2015, with serotypes Ia and II prevalent [35]. After COVID-19, colonization decreased significantly (13.8 % vs 5.3 %, $p = 0.0001$), and serotype V became more common [36].

In summary, while meningitis reporting is mandatory in Brazil and *S. pneumoniae* is the leading cause of bacterial meningitis, GBS cases are likely underreported due to the lack of pathogen-specific data in the national database. GBS screening and surveillance are not standardized, and research indicates that a hexavalent GBS vaccine could be effective in Brazil, covering major serotypes with minimal risk of serotype replacement.

7. Discussion and conclusions

Data on GBS meningitis burden shows a massive heterogeneity between countries. This is a complex and multifactorial scenario driven by several variables. In HIC, meningitis surveillance is largely performed by national surveillance systems and provides data regarding the major meningitis-causing bacterial pathogens, including GBS. However, in many LMICs, meningitis reporting is not mandatory and there are no national guidelines for GBS screening and IAP use. Hence, meningitis surveillance data, including GBS neonatal meningitis, end up being underestimated in these countries and information on meningitis burden often depends on data produced by research studies in limited populations. Besides the gaps in surveillance, there are some health system issues that impair the recognition of neonatal meningitis, including GBS, such as: the non-specific symptoms of neonatal meningitis that may overlap with other symptoms associated with adaptation to extra-uterine life or non-infectious causes; neonatal meningitis may manifest rapidly and fulminant in onset, leading to the patient's death prior to a microbiological diagnosis and making etiologic assessment impossible; the workload of healthcare professionals during labour, delivery and early postnatal period, the need of technical skills to deal with neonatal meningitis and conduct proper diagnosis and treatment; and the lack of equipped microbiology laboratories with trained staff in many LMICs.

The WHO Meningitis Symposium highlighted the GBS meningitis burden across the globe, the main challenges faced, and the future perspectives to tackle bacterial meningitis in alignment with the goals and vision of the Defeating Meningitis by 2030 Global Road Map. Geographical, public health, and socioeconomic heterogeneities between countries influence the current scenario of GBS meningitis worldwide. However, coordinated efforts and real progress have been made locally and globally by governments, healthcare professionals, researchers, and the civil society, in collaboration with the WHO. These efforts have improved global public health as progress towards having a GBS vaccine continues, with the overarching aim of assuring a better quality of life for pregnant women and their babies.

A maternal GBS vaccine would be a major step forward in helping countries, regions, and the global community achieve the goals put forward in the Road Map. There are several initiatives underway within the WHO to move the GBS vaccine pipeline forward. These include publishing GBS vaccine preferred product characteristics [37], publishing a full value of vaccines assessment for GBS vaccines [8], and forming a GBS vaccine technical advisory group. Additionally, WHO is working on an evidence consideration for GBS vaccine policy document and standardized assays and reagents for vaccine assessment, as well as developing GBS surveillance standards to guide countries interested in implementing GBS surveillance and adding to the evidence on GBS burden. Lastly, it is pivotal to have the scientific and patient advocacy communities for each of the four major meningitis-causing

pathogens aware of and engaged in the Defeating Meningitis by 2030 Road Map and raise awareness among national ministries of health about the burden of GBS disease. As a result of the WHO Meningitis Symposium at the 3rd ISSAD, we propose a list of recommendations to be implemented locally and globally (Box 1) to help improve GBS meningitis surveillance and to tackle the disease burden across the world but, especially, in the most affected countries.

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Data availability

Data will be made available on request.

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BOX 1 -**Recommendations to be implemented locally and globally to tackle Group B *Streptococcus* (GBS) meningitis, as a result of the WHO Meningitis Symposium at the 3rd ISSAD.**

Meningitis burden remains significant in HIC and LMIC, but this scenario is marked by prominent heterogeneity between countries. GBS neonatal bacterial meningitis is especially difficult to identify because of an overlap in syndromes and because a pathogen is rarely identified. During the Meningitis symposium, the following recommendations emerged which are aligned with the road map strategic goals and milestones:

- Improve GBS neonatal meningitis prevention by guiding the countries interested in implementing GBS screening and IAP use, especially LMICs (strategic goals 4,5, 8);
- Develop guidance on GBS surveillance, and implement accordingly at the local, regional, and global levels (strategic goals 10–12);
- Continue to support the development and licensure of an effective and affordable GBS maternal vaccine and its implementation by the national immunization programs of LMICs (strategic goals 1–3);
- Promote the early management of GBS neonatal meningitis with accessible and accurate diagnostic assays and the follow-up of colonized pregnant women to provide proper diagnostic, treatment and care of the infant GBS (strategic goals 6–9);
- Implement proper guidance and provide tools for healthcare professionals for the adequate treatment and care of neonates affected by GBS meningitis to avoid neurodevelopmental sequelae, reduce antimicrobial resistance and promote their quality of life (strategic goals 5, 9–12);
- Promote the equipment of microbiology laboratories with supplies and tools, as well as trained staff, to perform accurate diagnostics of GBS meningitis (strategic goals 6–8, 14);
- Develop dedicated strategies to raise awareness about the threat of GBS neonatal meningitis among healthcare professionals, policymakers, and civil society, including the families affected, engaging these group of people in meningitis advocacy (strategic goals 6–9, 13–19);