Editorial

World Meningitis Day and the World Health Organization's roadmap to defeat bacterial meningitis in the COVID-19 pandemic era

World Meningitis Day, which happens every year on April 24th, reminds us that despite the huge threat imposed by the COVID-19 pandemic worldwide, there are many other challenging infectious diseases that should not be neglected. More than 2.5 million cases and 236,000 deaths due to meningitis were reported in 2019 (GBD, 2019), and acute bacterial meningitis is the most common bacterial infection of the central nervous system. The largest burden of meningitis is seen in children up to 5 years old and in low- and middle-income countries, especially in the meningitis belt of sub-Saharan Africa. However, outbreaks of the disease occur in all continents of the world, showing that this is a matter of global public health (Zainel et al., 2021; Wall et al., 2021).

The World Health Organization roadmap on defeating meningitis by 2030 tackles the main causes of acute bacterial meningitis, including *Neisseria meningitidis* (meningococcus), *Streptococcus pneumoniae* (pneumococcus), *Haemophilus influenzae* and *Streptococcus agalactiae* (group B *Streptococcus*, GBS), which together are responsible for more than 90% of all acute bacterial meningitis cases. With the goals to eliminate outbreaks and epidemics, reduce the number of cases and deaths, as well as improve quality of life after meningitis, the roadmap is based on 5 pillars: prevention and epidemic control, diagnosis and treatment, disease surveillance, support and care for people affected by meningitis, and advocacy and engagement (WHO, 2020).

Vaccination is a key aspect of the World Health Organization's roadmap. Introduction and expansion of vaccination against meningococcus, pneumococcus and *H. influenzae* has drastically reduced meningitis-related cases (Rodgers et al., 2020; Zainel et al., 2021; Wall et al., 2021). Nearly 50% and 70% of countries worldwide currently have high coverage ($\geq$80%) for pneumococcal and *H. influenzae* vaccines, respectively (International Vaccine Access Center (IVAC, 2021). However, the case fatality rate of meningitis has remained the same, and most of these vaccines confer protection to only a portion of serogroups or serotypes that can be found within these bacterial species, raising concerns about the emergence of non-vaccine variants (Zainel et al., 2021; Wall et al., 2021). In addition, antimicrobial resistance is an emerging and concerning aspect in most, if not all, of the 4 major meningitis-related pathogens (WHO, 2017; CDC, 2019).

As the COVID-19 pandemic has shown, improving prevention, diagnosis and surveillance of a global public health threat

demands global cooperation. In this regard, global surveillance of meningitis needs to be expanded, particularly in low- and middle-income countries with high disease rates. Meningitis surveillance in the meningitis belt of sub-Saharan Africa has been supported by the MenAfriNet consortium, established in 2014 (Patel et al., 2019). Worldwide, a Global Meningitis Genome Partnership has been formed to improve strain identification and global tracking of meningococcus, pneumococcus, *H. influenzae* and GBS (Rodgers et al., 2020). Whole-genome sequencing data can enable a more effective public health response to bacterial meningitis pathogens by contributing to improved diagnosis, improved knowledge on pathogen evolution and optimization or development of vaccines.

There are, however, other external and maybe unpredictable variables that can affect the already dynamic epidemiology of infectious diseases, which underline the importance of a global and sustained surveillance approach. As a contagious human-to-human spread disease, the development of bacterial meningitis and transmission of related pathogens is dependent on close contact between the source and the susceptible host, which can be favored in crowded environments and cooler seasons. Anthropogenic-related climate change may have an impact on meningitis incidence (Mazamay et al., 2020). Moreover, measures implemented worldwide to mitigate the spread of SARS-CoV2, such as increased use of antiseptics and disinfectants and social distancing, can reduce meningitis incidence (Luciani et al., 2021). On the other hand, the viral infection itself may represent an opportunity for secondary bacterial infections (Singh et al., 2021). Furthermore, the widespread use of antibiotics during the pandemic may promote the emergence and dissemination of antimicrobial resistance among bacterial pathogens (Lucien et al., 2021), including those associated with acute bacterial meningitis.

Although undeniably complex, the scenario imposed by COVID-19 has strengthened our efforts and capacity for global public health response, showing that coordinated actions are needed to tackle infectious diseases effectively. This World Meningitis Day amid the COVID-19 pandemic is a moment to reflect and consider that although the present is a result of the past, it is the greatest resource to lead us to a better future.

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