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Meningococcemia: An emergent medical condition-updated review article

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Abstract

Background: Invasive meningococcal disease (IMD), caused by *Neisseria meningitidis*, is a severe and potentially fatal infection that primarily affects the upper respiratory tract. It manifests as meningitis, septicemia, or a combination of both, with other rarer forms such as pneumonia, septic arthritis, and pericarditis. IMD remains a significant public health concern despite its relatively low incidence, with a 10% case fatality rate and lasting sequelae in survivors. Surveillance and immunization are crucial in managing the disease's unpredictable epidemiology and reducing its impact.

Aim: This review examines global trends in IMD incidence, focusing on age group distributions, serogroup variations, and the role of vaccination in preventing the disease. The aim is to provide an updated overview of the current epidemiological landscape and the effectiveness of public health strategies.

Methods: The review is based on a thorough examination of 90 grey literature reports and 22 peer-reviewed publications, collected from a pool of over 2000 articles, with a focus on data from 77 countries. The analysis covers IMD incidence, serogroup distributions, and epidemiological trends from 2010 to 2019, with particular attention to the years 2017-2019.

Results: The incidence of IMD varied widely across regions, with the highest rates observed in countries like Niger and Burkina Faso. Infants and young children exhibited the highest disease burden, followed by secondary peaks in adolescents and young adults. Serogroups A, B, C, W, and Y were identified as the major causes of IMD, with serogroup B emerging as the predominant cause in many regions. Vaccination efforts have contributed to declines in serogroup A in regions such as sub-Saharan Africa.

Conclusion: This review highlights the global burden of IMD and the importance of ongoing surveillance to monitor trends and guide prevention efforts. Vaccination has proven effective in reducing the incidence of key serogroups, particularly in regions with high disease prevalence. Continued global surveillance and targeted vaccination programs remain essential in controlling IMD.

Keywords: Invasive meningococcal disease, *Neisseria meningitidis*, serogroups, vaccination, surveillance, epidemiology, public health

Introduction

Invasive meningococcal disease (IMD) is an infectious illness caused by *Neisseria meningitidis*, a Gram-negative diplococcus that colonizes the human upper respiratory tract [1]. IMD typically presents as meningitis, septicemia, or a combination of both; however, less common manifestations include pneumonia, septic arthritis, and pericarditis [2], [3]. Despite its relative rarity, IMD remains a severe condition with rapid progression, often leading to fatal outcomes within hours due to its nonspecific initial symptoms [4]. The disease carries a 10% case fatality rate, and up to 10%–20% of survivors experience lifelong disabling sequelae [5]. *N. meningitidis* possesses a polysaccharide capsule, which is a critical determinant of its virulence [6].

Twelve distinct serogroups of *N. meningitidis* have been identified: A, B, C, E, H, I, K, L, W, X, Y, and Z [7]. Of these, five serogroups—A, B, C, W, and Y—have historically been responsible for the majority of IMD cases and exhibit dynamic and unpredictable epidemiological patterns, which vary across different time periods and geographic regions [Reference Tan, Carlone and Borrow6, Reference Purmohamad8]. Recently, serogroup X has been linked to localized outbreaks in Africa [7]. The incidence of IMD is age-dependent, with the highest rates observed in infants, followed by young children [9, 10]. Secondary peaks in incidence, which vary by region, have also been noted in adolescents, young adults, and older adults [9, 10].

Due to the unpredictable nature of IMD, ongoing surveillance is essential for monitoring disease epidemiology at both the national and regional levels [11, 12]. Comprehensive surveillance programs are crucial for the timely identification of outbreaks and for tracking trends that define the disease burden over time [11]. Moreover, surveillance is indispensable in shaping public health strategies aimed at preventing IMD [13]. Immunization programs play a pivotal role in preventing the disease, with effective vaccines available for the major serogroups A, B, C, W, and Y [7]. This review seeks to examine global epidemiological data, highlighting trends in IMD incidence and the distribution of serogroups by age group and geographic location over time. The search strategy involved a thorough review of literature from PubMed publications and surveillance system data (grey literature) related to IMD. Detailed information regarding the search process, criteria for inclusion and exclusion, data extraction, collection, and analysis methods is provided in the Supplementary Material.

A total of 90 grey literature reports and 22 publications were included from an initial pool of 342 reports and 1753 publications that were screened. The final dataset encompassed data from 77 countries. Grey literature sources included national, subnational, and multinational reports, with significant contributions from the Surveillance Atlas of Infectious Diseases by the European Centre for Disease Prevention and Control (ECDC), Sistema de Redes de Vigilance de los Agents Responsible de Pneumonias y Meningitis Bactrians (SIREVA II), and the World Health Organization (WHO) Meningitis Weekly Bulletins: Inter-country Support Team – West Africa. Publicly available data varied significantly across different countries and regions globally. The data were analyzed over the past decade, with a particular focus on the final three years (2017–2019) to summarize recent trends.

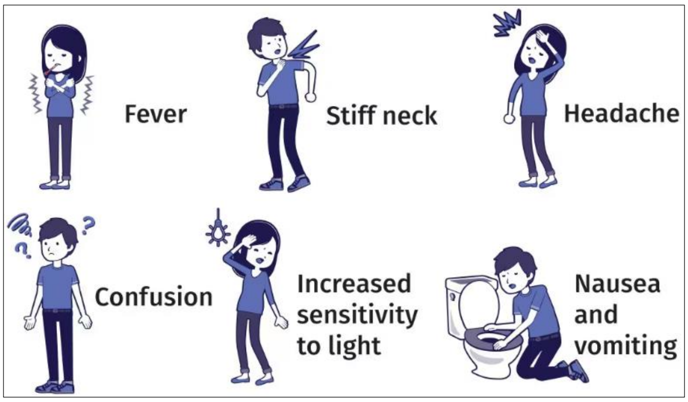

Fig 1: Meningococcal Symptoms.

Overall IMD Incidence

Data on the overall incidence of invasive meningococcal disease (IMD) per 100,000 population were available for 10 non-European countries and 31 European countries, including 30 countries reported within the European Centre for Disease Prevention and Control (ECDC) data, alongside national data from Ukraine [14–25]. Across all regions, the incidence of IMD remained relatively low from 2010 to 2019, ranging from 0.0 to 10.2 [Reference Diallo14–25]. The highest incidences were reported in Niger, which recorded 7.71 in 2015, and in Burkina Faso, with 10.2 in 2012 [15]. Excluding these countries, New Zealand consistently reported the highest incidence, reaching 2.8 per 100,000 in 2019 [22]. Conversely, Saudi Arabia, the United States, and Bulgaria consistently exhibited the lowest incidence rates, with values below 0.2 [18, 19, 21]. Several countries, such as Niger and Burkina Faso, exhibited marked peaks in incidence due to localized outbreaks [14, 15]. Incidence trends varied across regions from 2010 to 2018, with a general decline observed in the United States, South Africa, and Brazil [16, 21, 23]. In Europe, the overall incidence slightly decreased from 0.74 per 100,000 in 2010 to 0.62 in 2018 [19]. This trend of decreasing incidence was evident in countries such as Denmark, Finland, Austria, and the United Kingdom; however, Belgium and the Netherlands experienced an increase in incidence during the same period [19]. In certain European countries, such as Spain, a reduction in incidence was initially observed, followed by a more recent rise [19]. Globally, incidence trends fluctuated in countries such as Chile, New Zealand, and Russia [17, 22, 24].

IMD Incidence by Age Group

IMD incidence was recorded across all age groups in countries and regions where data were available [19–23]. The highest incidence rates were observed in infants (under 1 year of age), with incidence rates in this group typically being 2 to 5 times higher than those in young children (ages 1–4 years) and 10 times higher compared to older age groups [19–23]. Particularly high incidence rates in infants were observed between 2010 and 2018 in countries such as New Zealand, where rates ranged from 10.2 to 47.7 per 100,000, and Ireland, which reported rates between 19.3 and 38.8 [19, 22]. The second-highest incidence was recorded in young children (ages 1–4 years) [19–23]. Lithuania reported some of the highest rates in this age group, with incidences ranging from 6.8 to 18.2 during the years 2010–2018 [19]. A secondary peak in incidence was observed in adolescents and young adults, particularly in the United States, where the annual incidence of IMD was between 0.1 and 0.21 per 100,000 for those aged 16–23 years, compared to ≤0.1 for those aged 11–15 or 24–44 years between 2015 and 2018 [21]. Similar secondary peaks in this age group were noted in Canada, New Zealand, and Europe, though such patterns were not evident in Brazil [19, 20, 22, 23]. In Europe, the age group of 15–24 years exhibited higher incidence rates than the 5–14 or 25–49-year-old groups in countries like Sweden, where rates ranged from 0.58 to 1.69 for those aged 15–24, compared to 0–0.59 for those aged 5–14, and 0.12–0.39 for those aged 25–49 during 2010–2018. In contrast, in Italy, the incidence rates for those aged 15–24 (0.30–0.54) were similar to or lower than those for the 5–14-year-old group (0.36–0.54) during 2010–2014 [19]. Increased incidence rates in older adults were observed in the United States (0.13–0.15 per 100,000 for individuals aged ≥65 years from 2015–2018), Canada (0.22–0.41 for those aged ≥60 years between 2013 and 2017), and New Zealand (1.3–2.3 for individuals aged ≥70 years between 2015 and 2018), but not in Brazil [20–23]. In Europe, the incidence for adults aged ≥50 years ranged from 0.30 to 0.49, which was higher than that for those aged 25–49 years (0.19–0.26) throughout 2010–2018, with a particularly elevated incidence in those aged ≥65 years (0.33–0.63) [19]. This pattern was observed in several individual countries, including the United Kingdom, although it was not seen in others, such as the Czech Republic [19].

Meningococcal Serogroup Distribution

Overall Serogroup Distribution of IMD

The distribution of meningococcal serogroups causing invasive meningococcal disease (IMD) has been documented across various regions, including Quebec (Canada), the United States, Argentina, Brazil, Chile, Colombia, Venezuela, Dominican Republic, Uruguay, Paraguay, countries within the African meningitis belt (as listed in the Supplementary Material), Mozambique, South Africa, Israel, Kuwait, Belarus, Russia, China, Japan, South Korea, Australia, New Zealand, and ECDC countries [16, 17, 19, 21–24, 26–37]. The serogroups A, B, C, W, and Y were identified as the primary causes of IMD globally, though their distribution exhibited regional variability both across time and geographic location. Serogroup A was predominantly reported in Burkina Faso, Chad, Niger, and Russia. However, a notable decline in serogroup A cases has been observed in Burkina Faso, Chad, and Niger in recent years, likely due to mass vaccination campaigns targeting this serogroup in these areas [17, 33, 38]. Interestingly, between 2015 and 2017, serogroup A accounted for 10% of groupable IMD cases in China and 14%–25% in Russia between 2016 and 2018. Despite this, a significant proportion (34%–37%) of cases in Russia during the same period had undetermined serogroups [17, 28]. Furthermore, low incidences of serogroup A continue to be recorded in countries such as Germany, Italy, and Spain, where it comprised 0.4%–0.6% of IMD cases in 2018 [19].

Serogroup B emerged as the predominant cause of IMD during the study period in regions such as Europe, Israel, South Korea, Australia, New Zealand, and Quebec [19, 22, 26, 27, 30, 31]. Although serogroup B was prevalent across much of Europe, its incidence gradually decreased in certain countries, including the United Kingdom, France, and Germany [19]. In contrast, countries such as Poland and Italy maintained stable rates of serogroup B cases between 2010 and 2018 [19]. More recently (2017–2019), serogroup B was identified as the predominant cause of IMD in nearly all countries worldwide [16, 17, 19, 21–24, 26, 27, 31–33]. Notable exceptions included Brazil (15% of cases in 2018), Sweden (10%), Norway (35%), the Netherlands (36%), and the Czech Republic (43%), where serogroup B still accounted for a significant portion of IMD cases [19, 23]. Additionally, serogroup B was absent from IMD cases in African meningitis belt countries in 2019 [33]. In Russia, 37% of cases in 2018 were of undetermined serogroups, while serogroup B accounted for the largest proportion (27%) of the identified cases [17].

Serogroup C played a prominent role in the incidence of IMD, accounting for 66%, 41%, and 55% of groupable cases in Brazil, Colombia, and Venezuela, respectively [32, 39]. This serogroup was also the second-most prevalent in African meningitis belt countries between 2010 and 2019, accounting for 32% of IMD cases in the region [33, 37]. In some areas, the presence of serogroup C was transient. For instance, a significant increase in serogroup C cases was observed in Niger during an epidemic in 2015 [38]. In Europe, the prevalence of serogroup C varied by country, with an increasing trend observed in the Czech Republic, Ireland, Italy, and the United Kingdom, while a decreasing trend was noted in Austria, Belgium, Denmark, Germany, Norway, Poland, and Sweden. No major trends were observed in other European countries [19]. A rise in serogroup C cases was also recorded in the United States, increasing from 15% in 2015 to 27% in 2018, with the number of cases rising from 54 in 2015 to 99 in 2016, before slightly decreasing to 90 in 2018 [21]. Most recent data (2017–2019) indicates that serogroup C was present across all global regions, except Israel in 2018, although cases were reported in previous years [16, 17, 19, 21–24, 26, 27, 31–33]. Specifically, Brazil and the United States each recorded 27% of cases due to serogroup C, with higher percentages observed in Eastern European countries such as Poland (22%), the Czech Republic (44%), Hungary (34%), and Slovakia (17%) in 2018 [19, 21, 23].

Serogroup W predominated in the African meningitis belt between 2010 and 2019, contributing to 43% of IMD cases in the region [33, 37]. Additionally, it was the leading serogroup in Chile from 2012 to 2018, accounting for 50%–73% of cases [24]. Outbreaks of serogroup W were observed in the African meningitis belt, with significant surges in Burkina Faso (2012), Togo (2016), and Chad (2019) [33, 37]. Between 2010 and 2014, serogroup W was also the predominant serogroup in Argentina (48%–56% of cases) and South Africa (39%–51%) [16, 32]. However, a decrease in serogroup W cases occurred in both countries after 2014, while serogroup B remained stable or decreased but represented an increasing percentage of cases due to the overall reduction in IMD incidence. Conversely, increases in serogroup W cases were observed in countries such as Chad, Europe, Israel, Australia, New Zealand, and Russia [16, 17, 19, 22, 27, 31–33, 37]. Since 2016, serogroup W cases have risen in Australia [31]. In New Zealand, rising numbers of serogroup W cases led to it surpassing serogroup C as the second-highest contributor to IMD, comprising 27% of IMD cases by 2019 [22]. The most recent data (2017–2019) indicates that serogroup W contributed a substantial proportion of IMD cases across countries in the Southern

Hemisphere, ranging from 19% in South Africa (2018) to 44% in Chile (2019), with Brazil showing lower incidence (4% in 2019) [16, 22–24, 31, 32]. In Europe, the percentage of IMD cases attributed to serogroup W in 2018 varied from 3% in Greece to 50% in the Netherlands, illustrating the differing trends across the continent [19].

Although serogroup Y did not emerge as a leading cause of IMD globally, it displayed an increasing trend in case numbers from 2010 to 2018 in regions such as Europe, Israel, Australia, and New Zealand [19, 22, 27, 31]. Notably, between 2013 and 2014, serogroup Y accounted for 42% of IMD cases in Japan [29]. In other countries, serogroup Y maintained a stable contribution to the overall incidence of IMD, both in regions where it was significantly prevalent, such as the United States, and in countries where it comprised a smaller proportion of cases, such as Argentina [21, 32]. In 2018, serogroup Y accounted for 29% of IMD cases in Sweden and 46% in Norway, where it was the predominant serogroup [19]. Other serogroups, including X, Z, and E, played a minor role in the global incidence of IMD [16, 17, 19, 21–24, 26, 27, 30–33, 37]. Serogroup X was primarily confined to the African meningitis belt, with only sporadic cases recorded elsewhere.

IMD Serogroup Distribution by Age Group

Data regarding the distribution of IMD serogroups by age group were compiled from a variety of regions, including Argentina, Brazil, Chile, the United States, Australia, New Zealand, and Europe [19, 21, 22, 24, 31, 32, 39]. Serogroups B, C, W, and Y were observed across all age groups; however, notable trends emerged, particularly regarding the dominant serogroups within different age groups. Serogroup B emerged as the predominant serogroup in many regions and across various age groups during the study period [19, 21, 22, 24, 31, 32, 39]. In Australia, serogroup B was responsible for 40%–100% of cases in infants and young children from 2010 to 2018, and 41%–80% of cases in the United States from 2015 to 2018 [21, 31]. In certain regions, the prevalence of serogroup B was similarly high among adolescents and young adults as it was among infants, as seen in the United States (2015–2018) and New Zealand (2018–2019) [21, 22]. However, the predominance of serogroup B was generally more pronounced in younger age groups, and this trend persisted even in the context of overall declines in serogroup B cases. For example, in Europe, serogroup B caused 75%–84% of cases among infants and young children, but only 58%–63% and 41%–51% among individuals aged 15–24 and ≥50 years, respectively, during 2010–2013. By 2016–2018, these percentages decreased to 63%–70%, 48%–50%, and 29%–30%, respectively [19]. Similarly, in Australia, the percentage of cases caused by serogroup B decreased from 86%–100% and 44%–88% in individuals aged ≤4 and ≥45 years, respectively, during 2010–2012, to 40%–62% and 10%–37% in 2016–2018 [31].

Serogroup C exhibited varied trends across age groups in Brazil, causing a majority (usually 50%–80%) of IMD cases in individuals aged 15–29 and ≥60 years from 2011 to 2018, while the percentage of cases in infants and children aged 2–4 years decreased [32, 39]. In other regions, the frequency of serogroup C was lower across all age groups, though it was sometimes more prominent in adolescent/young adult and older age groups. For example, in Europe, serogroup C caused 6%–12% of IMD in individuals aged <1 and 1–4 years during the study period, but 12%–19% of cases in those aged 15–24 and ≥50 years [19]. The incidence of serogroup W disease increased across many age groups and countries [19, 21, 22, 24, 31, 32, 39]. For instance, in Australia, serogroup W accounted for ≤7% of cases in 2012 but rose to 17%–50% by 2018 [31]. In various countries, the rise in serogroup W cases was more pronounced among older adults, as was observed in Europe and individual countries such as the Netherlands and the United Kingdom [19]. In the United States, serogroup W disease was more frequent in individuals aged ≥45 years compared to younger groups, although the percentages in older age groups decreased during 2015–2018 [21]. In contrast to many other countries, Argentina and Chile experienced declining trends in serogroup W cases among older adults and most other age groups during the study period [24, 32].

Serogroup Y was more frequently associated with older adults than other age groups across several countries [19, 21, 22, 24, 31, 32]. This was particularly evident in New Zealand (2018–2019) [22] and the United States (2015–2018) [21], along with other regions. Similarly, in Europe, serogroup Y was notably more common among adults aged ≥50 years (2010–2018), followed by adolescents and young adults, compared to younger age groups, with this trend observed in numerous individual countries [19].

Discussion

This review synthesized data from 90 surveillance reports and 22 articles covering the epidemiology of IMD across 77 countries. The distribution of IMD varied by time and geographic location, and shifts in serogroup prevalence were often unpredictable. The highest incidence rates of IMD were recorded in countries within the African meningitis belt, with relatively high rates also observed in other nations, including New Zealand, Ireland, Lithuania, and the United Kingdom. Local outbreaks, such as those in African meningitis belt countries, illustrate the dynamic nature of IMD, which can be influenced by socioeconomic and sociocultural factors. For instance, a recent study in northern Nigeria, a region that has experienced recurrent seasonal cerebrospinal meningitis epidemics, identified several contributing factors such as overcrowded housing, lack of informed decision-making regarding family health, vaccine hesitancy, and reluctance to implement precautionary measures during outbreaks, all of which hinder efforts to control IMD in the area [Reference Omoleke40]. Global data revealed that IMD affects individuals across all age groups, with the highest peaks observed in infants (aged <1 year) and young children (aged 1–4 years). Secondary peaks in incidence were noted in adolescents and young adults in the United States, Canada, New Zealand, and many European nations, coinciding with elevated carriage rates within these groups [41]. Since meningococcal disease transmission is primarily driven by social behaviors, changes in behavior within specific age groups—such as increased travel, regular attendance at social venues like bars and nightclubs, and close living arrangements among adolescents and young adults—can significantly influence the incidence of IMD in these groups [42, 43]. Increases in incidence were also noted among older adults in countries like the United States, Canada, New Zealand, and several European nations.

Serogroup B was responsible for the largest proportion of groupable IMD cases across most countries in the Americas, Europe, Australia, and New Zealand. Infants and young children were most frequently affected by serogroup B, which, in many countries, saw a decrease over time as the incidence of other serogroups increased. However, this pattern was not consistent across all regions, as some countries reported stable or even increasing levels of serogroup B disease. The introduction of protein-based meningococcal serogroup B (MenB) vaccination programs in certain countries [7], along with reports of MenB vaccine efficacy in the United Kingdom, Italy, Quebec, and South Australia [44, 47], suggest that such programs may influence the epidemiology of serogroup B. Similarly, the use of meningococcal serogroup C (MenC) vaccines in various countries may have contributed to a reduction in serogroup C cases [48]; however, serogroup C cases remained stable in certain regions and continued to represent a significant percentage of IMD in Brazil, the United States, and some African and European countries. The global emergence of serogroup W, particularly the ST-11 complex (W:cc11), highlights the unpredictable and ever-changing nature of IMD [7]. Serogroup W:cc11 became predominant in Chile in 2012 and subsequently emerged as one of the most common disease-causing serogroups in several countries across South America, Europe, Australia, and New Zealand [49]. In response, quadrivalent meningococcal serogroup A, C, W, and Y (Men ACWY) conjugate vaccines were introduced in multiple nations, and the impact of Men ACWY vaccines on serogroup W epidemiology has been observed [7, 50, 51].

Serogroup Y disease was observed worldwide, with a notable increase in cases in Europe, Israel, Australia, and New Zealand, contributing significantly to IMD in northern European countries, Australia, and New Zealand [19, 22, 31]. The proportion of IMD cases caused by serogroup Y remained stable in other nations, including those with both lower (e.g., Argentina) and higher (e.g., United States) proportions of serogroup Y. Older adults in several regions were disproportionately affected by serogroups W and Y. The introduction of MenB and MenACWY conjugate vaccines into national immunization programs, along with existing MenC conjugate vaccine programs, has likely influenced trends in the distribution of IMD serogroups [7,44, 47, 51]. Future vaccination programs should target age groups with increased vulnerability to specific serogroups or to IMD overall. Strengthening meningococcal surveillance will be essential for advancing our understanding of the evolving epidemiology of IMD. Additionally, broad serogroup coverage through vaccination is crucial for preventing IMD. While the epidemiology of IMD remains unpredictable, serogroups A, B, C, W, and Y are expected to remain the primary causative agents. Despite the availability of vaccines for these serogroups, existing immunization programs do not reach all affected age groups [Reference Parikh7]. In addressing these gaps, the WHO Global Road Map to Defeating Meningitis by 2030 aims to reduce cases and deaths caused by vaccine-preventable diseases by improving vaccine access, coverage, and disease surveillance [52].

This review focused on the incidence and serogroup distribution of IMD, key elements of basic epidemiology, and incorporated recent data (2017–2019), thus expanding the current understanding of disease trends. The findings offer valuable insight into the geographical distribution of IMD during the decade preceding the COVID-19 pandemic, providing a benchmark for future comparisons regarding the pandemic's impact on IMD epidemiology. Our analysis was limited by the availability of IMD data from grey literature sources, making it difficult to discern global trends. The representativeness of the data from countries without published reports is unknown. Additionally, the variability in surveillance systems, including differences in laboratory capabilities, case definitions, and reporting periods, hinders direct comparisons between countries and regions. Some countries reported a significant number of ungrouped cases, which complicates the determination of true serogroup distribution. For example, in Brazil, 52% of 2018 cases were reported as 'ignored serogroups,' likely representing primarily serogroups B, C, W, and Y cases that were not typed. In contrast, European data published by the ECDC were almost entirely typed. The increasing use of whole-genome sequencing will enhance serogroup typing and provide more robust data on IMD.

Emergent Interventions for Invasive Meningococcal Disease (IMD)

Invasive Meningococcal Disease (IMD) is a serious and life-threatening infection caused by *Neisseria meningitidis* that can result in meningitis, septicemia, and death if not treated promptly. Effective emergent interventions are critical in minimizing morbidity and mortality associated with this disease. The following outlines key interventions, ranging from early recognition to advanced therapeutic strategies.

1. Early Detection and Diagnosis

The first step in managing IMD is the early recognition of clinical symptoms, which include fever, headache, neck stiffness, photophobia, vomiting, and a rash (often petechial or purpuric). In severe cases, rapid progression to septic shock, altered mental status, and multi-organ failure may occur. Given the rapid progression of the disease, early diagnosis is crucial. Diagnostic methods include:

- **Blood cultures** and **cerebrospinal fluid (CSF) analysis:** Culturing the bacteria from blood or CSF is the gold standard for diagnosis, though other diagnostic tests may be used in parallel.
- **Polymerase chain reaction (PCR):** PCR testing is particularly useful in detecting *N. meningitidis* DNA in blood or CSF when cultures are negative or slow-growing.
- **Serologic tests:** These can confirm the specific serogroup of the bacteria, which is essential for determining vaccination strategies and understanding the disease's epidemiology.

2. Antibiotic Therapy

Emergent antibiotic therapy is the cornerstone of IMD treatment. Rapid administration of appropriate antibiotics is essential to improve survival rates. Empirical antibiotic therapy should begin immediately after blood and CSF samples are taken, even before confirmation of the diagnosis, due to the speed at which IMD progresses.

- **First-line antibiotics:** Broad-spectrum antibiotics such as **cephalosporins** (e.g., ceftriaxone or cefotaxime) or **penicillin G** are commonly used. These antibiotics are effective against *Neisseria meningitidis* and penetrate the cerebrospinal fluid effectively.
- **Adjunctive therapy:** Corticosteroids (e.g., dexamethasone) may be used to reduce inflammation, particularly in cases of meningitis, to minimize neurological damage and the risk of hearing loss.

However, their use in septicemic cases is less clear and remains controversial.

- **Antibiotic stewardship:** Once the pathogen and its sensitivities are identified, treatment should be adjusted based on culture results to optimize efficacy and reduce the risk of resistance.

3. Fluid Resuscitation and Hemodynamic Support

Given the rapid progression of septic shock in IMD, early and aggressive fluid resuscitation is critical to maintain blood pressure and prevent multi-organ failure. The main components of this intervention include:

- **Crystalloid infusion:** The administration of isotonic fluids, such as normal saline or Ringer's lactate, helps to restore intravascular volume.
- **Vasopressor support:** In cases where fluid resuscitation is insufficient, vasopressors like **norepinephrine** are used to maintain perfusion to vital organs.
- **Monitoring:** Continuous monitoring of vital signs, urine output, and serum lactate levels is necessary to assess the effectiveness of interventions and guide further treatment.

4. Respiratory Support

In severe cases, IMD may lead to respiratory failure, requiring mechanical ventilation. This intervention is particularly relevant for patients who develop septic shock or multi-organ failure.

- **Oxygen therapy:** Administering supplemental oxygen helps address hypoxia and supports respiratory function.
- **Intubation and mechanical ventilation:** In patients who develop respiratory distress or failure, endotracheal intubation and mechanical ventilation may be required.

5. Close Monitoring and Intensive Care

Due to the rapid progression and potential complications of IMD, intensive monitoring and care in a critical care unit (ICU) may be necessary for severely ill patients. This includes:

- **Neurological monitoring:** Patients with meningitis or encephalitis require close observation for signs of increased intracranial pressure, which may require interventions such as mannitol or hyperventilation.
- **Dialysis:** In cases of kidney failure due to septic shock, renal replacement therapy may be required.
- **Multidisciplinary care:** Collaboration among infectious disease specialists, intensivists, neurologists, and other healthcare professionals is vital in managing the complex needs of IMD patients.

6. Vaccination and Public Health Measures

Once a case of IMD is confirmed, public health measures must be taken to prevent further spread. These include:

- **Post-exposure prophylaxis (PEP):** Close contacts of individuals diagnosed with IMD should receive **antibiotic prophylaxis** (e.g., rifampin or ciprofloxacin) to reduce the risk of transmission.
- **Vaccination:** Meningococcal vaccines (e.g., MenACWY, MenB) are recommended in populations at high risk for IMD. For instance, individuals in close contact with an infected person or those in endemic areas should be vaccinated to reduce the risk of future cases.

7. Surgical Intervention

In rare cases, surgical intervention may be needed to manage complications such as gangrene in septicemia, which may require debridement or amputation of necrotic tissue. This intervention is typically reserved for patients with severe septic shock and evidence of tissue ischemia. Emergent interventions for IMD focus on rapid diagnosis, timely antibiotic administration, aggressive fluid resuscitation, respiratory support, and intensive care monitoring. Vaccination programs and post-exposure prophylaxis are essential components of public health strategies to prevent further outbreaks. Given the high mortality rate and the potential for rapid deterioration, IMD demands immediate and coordinated medical interventions to improve patient outcomes.

Conclusion

Invasive meningococcal disease (IMD), caused by *Neisseria meningitidis*, continues to be a significant health concern, despite its relatively low global incidence. This review has underscored the importance of understanding regional variations in disease trends and the role of vaccination in mitigating its impact. The highest rates of IMD are observed in infants and young children, with secondary peaks in adolescents and young adults. Surveillance data from across 77 countries revealed fluctuations in disease incidence, with some regions, like sub-Saharan Africa, experiencing periodic outbreaks. These findings emphasize the dynamic nature of IMD epidemiology and the necessity for real-time data to inform public health interventions. Serogroups A, B, C, W, and Y remain the most common causes of IMD globally, although their prevalence varies by region. The decline in serogroup A cases, particularly in countries like Burkina Faso and Niger, is largely attributed to successful vaccination campaigns. In contrast, serogroup B has become more prominent in many regions, including Europe, Australia, and New Zealand. The varying incidence of different serogroups highlights the unpredictable nature of the disease and the importance of adaptive vaccination strategies that target the most prevalent serogroups in specific regions. Furthermore, the incidence of IMD is not uniform across all age groups. Infants under one year of age exhibit the highest rates, with a marked decrease observed in older children and adults. This age-dependent pattern stresses the need for targeted immunization programs for the most vulnerable populations, especially in countries with high incidence rates. Despite the relatively low overall incidence of IMD globally, localized outbreaks continue to pose significant threats, particularly in regions with inadequate vaccination coverage. In conclusion, continued surveillance, timely vaccination efforts, and the development of new vaccines targeting a broader range of serogroups are essential in reducing the global burden of IMD. Immunization programs have shown considerable success in preventing the disease, particularly in high-risk regions, and further investments in these programs will be crucial in controlling future outbreaks. Public health authorities must remain vigilant and responsive to the evolving epidemiological trends of IMD, ensuring that effective prevention and control measures are in place to protect at-risk populations.

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التسمم السحائي: حالة طبية طارئة - مقال مراجعة محدث

الملخص

الخلفية: مرض السحايا الغازي(IMD) ، الذي تسببه *نيسرية السحايا*، هو عدوى شديدة وقاتلة محتملة تؤثر بشكل أساسي على الجهاز التنفسي العلوي. يظهر المرض على شكل التهاب السحايا، التسمم الدموي، أو مزيج من الاثنين مع أشكال أخرى نادرة مثل الالتهاب الرئوي، التهاب المفاصل التسممي، والتهاب التامور. يظل مرض السحايا الغازي مصدر قلق كبير في الصحة العامة على الرغم من قلة حدوثه نسبيًا، حيث يصل معدل الوفيات إلى 10% وتترتب على المرض عواقب طويلة الأمد للناجين. يعتبر المراقبة والتطعيم أمرين حاسمين في إدارة علم الأوبئة غير المتوقع للمرض وتقليل تأثيراته.

الهدف: تهدف هذه المراجعة إلى دراسة الاتجاهات العالمية في معدل حدوث مرض السحايا الغازي، مع التركيز على توزيع الفئات العمرية، تباين المجموعات المصلية، ودور التطعيم في الوقاية من المرض. الهدف هو تقديم نظرة محدثة عن المشهد الوبائي الحالي وفعالية استراتيجيات الصحة العامة.

الأساليب: استندت المراجعة إلى فحص دقيق لـ 90 تقريرًا من الأدبيات الرمادية و22 منشورًا خاضعًا للمراجعة من الأقران، تم جمعها من أكثر من 2000 مقال، مع التركيز على بيانات من 77 دولة. تغطي التحليل معدلات حدوث مرض السحايا الغازي، توزيع المجموعات المصلية، والاتجاهات الوبائية من 2010 إلى 2019، مع إيلاء اهتمام خاص للسنوات 2017-2019.

النتائج: تفاوت معدل حدوث مرض السحايا الغازي بشكل كبير عبر المناطق، حيث كانت أعلى المعدلات في دول مثل النيجر وبوركينا فاسو. أظهر الأطفال الرضع والأطفال الصغار أكبر عبء للمرض، تليهم ذروة ثانوية في المراهقين والشباب. تم تحديد المجموعات المصليةA ، B، C، W، و Yكأسباب رئيسية للمرض، مع ظهور المجموعة المصلية B كأسباب سائدة في العديد من المناطق. ساهمت جهود التطعيم في انخفاض معدلات المجموعة المصلية A في مناطق مثل منطقة إفريقيا جنوب الصحراء .

الخلاصة: تسلط هذه المراجعة الضوء على العبء العالمي لمرض السحايا الغازي وأهمية المراقبة المستمرة لمتابعة الاتجاهات وتوجيه جهود الوقاية. أثبت التطعيم فعاليته في تقليل معدل حدوث المجموعات المصلية الرئيسية، خاصة في المناطق ذات الانتشار العالي للمرض. تظل المراقبة العالمية المستمرة وبرامج التطعيم المستهدفة أمرين أساسيين في مكافحة مرض السحايا الغازي .

الكلمات المفتاحية: مرض السحايا الغازي، *نيسرية السحايا*، المجموعات المصلية، التطعيم، المراقبة، علم الأوبئة، الصحة العامة.