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IP International Journal of Medical Microbiology and Tropical Diseases

Journal homepage: https://www.ijmmtd.org/

Original Research Article

Evaluation of the rate of *Neisseria meningitides* Infection in the United States from 2010 to 2020

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ARTICLE INFO

Article history:
Received 19-01-2022
Accepted 25-02-2022
Available online 19-04-2023

Keywords:
Meningococcal disease
Neisseria meningitides
Vaccination
United States

ABSTRACT

Background: Invasive meningococcal disease caused by *Neisseria meningitides* is a serious disease that is deadly in 5–15% and incapacitating in 12–20% of cases. There are twelve strains known so far, out of which six serogroups (A, B, C, W, X, and Y) have been found to cause Invasive meningococcal disease. Infection can cause meningitis, septicemia, bacteremic pneumonia, and bacteremia without focus and can cause long-term disability. Outbreaks of meningococcal disease are rare in the United States but recently outbreak has declared in Florida by the Centers for Disease Control and Prevention.
Aim: To study the pattern of Meningococcal infection from 2010-2020 in the United States.
Materials and Methods: All analyses for this cross-sectional study were conducted using Bact Facts Interactive which collects data from Active Bacterial Core surveillance (ABCs), a part of CDC's Emerging Infections Program
Result: All the data for percentage cases of bacteremia & pneumonia, percentage cases of bacteremia without focus, Meningitis, and total case rate of *Neisseria meningitides* infection declined down from 2010 to 2020.
Conclusion: The present study highlights that in the United States due to strict vaccination, surveillance, and usage of antibiotics at the appropriate time, the cases of *Neisseria meningitides* infection declined to a greater extent.

1. Introduction

Meningococcal disease is a serious, severe illness that is caused by *Neisseria meningitides*. In the United States, *Neisseria meningitides* is a leading cause of bacterial meningitis and sepsis, it can also cause pneumonia and focal disease, such as septic arthritis. *Neisseria meningitides* was first discovered in 1887 by Weichselbaum while studying the cerebrospinal fluid (CSF) of a patient infected with meningitis.[1] *Neisseria meningitides* is an aerobic, gram-negative diplococcus bacterium, surrounded by a polysaccharide capsule that enhances its pathogenicity. Based upon the structure of polysaccharide capsule Meningococci are classified into serogroups. So far twelve antigenically and chemically distinct polysaccharide capsules have been described. Worldwide invasive diseases have been reported by one of the six serogroups A, B, C, W, X, and Y.[2,3]

The sole reservoir of *Neisseria meningitides* is humans, it establishes as commensal diplococcus in the nasopharynx[4] in about 25% of the total population. The two most common types of meningococcal infections are meningitis and bloodstream infection, both of which can quickly become deadly. It can transmit between person-to-person by respiratory droplets or secretions with asymptomatic colonization or meningococcal disease. Bacteria attach themselves to the mucosal cells of the nasopharynx and

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https://doi.org/10.18231/j.ijmmtd.2023.012

oropharynx, multiply, and penetrate the mucosal cells of the host and enter into the bloodstream. After entering the bloodstream it can cause systemic disease and lately cross the blood-brain barrier entering cerebrospinal fluid and resulting in fulminating meningitis.

The incubation period is typically 3 to 4 days with a range of 1 to 10 days. In the United States, 50% case of meningitis is reported mostly due to invasive meningococcal disease. [5] The patient shows the typical sudden onset of fever, headache, and stiff neck, often accompanied by other symptoms, such as nausea, vomiting, photophobia (eye sensitivity to light), and altered mental status.

About 30% of invasive meningococcal infections can result in Meningococcal septicemia without causing meningitis.[5] Meningococcal septicemia is characterized by abrupt onset of fever; chills; cold hands and feet; severe aches or pain in the muscles, joints, chest, or abdomen; vomiting; diarrhea; and a petechial or purpuric rash often associated with hypotension, shock, acute adrenal hemorrhage, and multiorgan failure.[6] Additionally, in the United States, 15% of cases are of bacteremic pneumonia caused by *Neisseria meningitides* in the elderly population.

The overall case-fatality ratio of meningococcal disease is 10% to 15%, even with appropriate antibiotic therapy, and can be higher in persons with meningococcemia.[5]

With the strict vaccination schedule In the United States, the frequency of meningococcal disease has declined since the peak of the disease in the late 1990s; decline have been detected among all age groups and serogroups.[7,8]There are 2 types of meningococcal vaccines available in the United States: Meningococcal conjugate or MenACWY vaccines and Serogroup B meningococcal or MenB vaccines

Which are given at 11 years of age and 16 years of age.[9] But still, the rate of diseases is highest among infants younger than 1 year, followed by children between 1 year to 4 years, and then among older people.[7,8,10] Although, Outbreaks of meningococcal disease are rare in the United States but recently a meningococcal outbreak of Serogroup C has been declared in Florida by the Centers for Disease Control and Prevention. Keeping this in mind the present study was done to examine the data from 2010 to 2020 to observe the reduction in the number of cases of Meningococcal disease in the United States.

2. Materials and Methods

All analyses for this cross-sectional study were conducted using Bact Facts Interactive which collects data from Active Bacterial Core surveillance (ABCs), a part of the Center for Disease Control and Prevention's Emerging Infections Program.[11] Active Bacterial Core surveillance is laboratory- and population-based surveillance that monitors invasive bacterial infections that cause bloodstream infections, sepsis, and meningitis in persons living in the community. The data summarize case rate, percentage cases of Bacteremia with pneumonia, Bacteremia without focus, and Meningitis. The data excludes Oregon. The collective data is from 2010 to 2020. The study used deidentified publicly available data.

3. Results

The study included cases of meningococcal infection from the year 2010 to 2020. The data was collected for all age groups.

The data were assessed for percentage cases of bacteremia & pneumonia in all the age groups. It was observed that the percentage cases declined from 0.105 percent to 0.088 percent. (Figure 1)

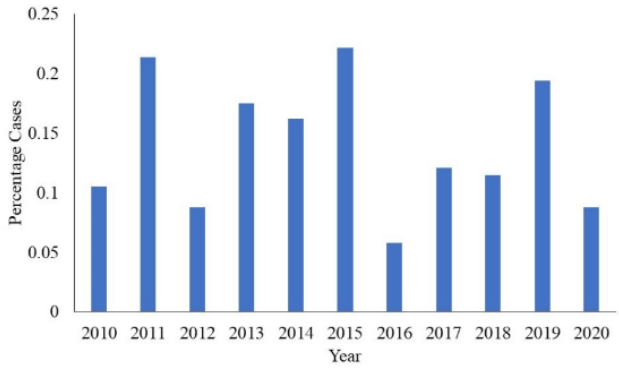

Fig. 1: Percentage of cases of bacteremia & pneumonia the United States due to *Neisseria meningitides* in all the age group from 2010 to 2020.

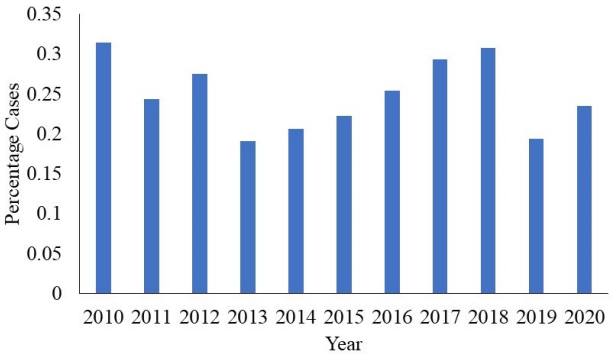

Fig. 2: Percentage of cases of bacteremia without focus in the United States due to *Neisseria meningitides* from the year 2010 to 2020.

The data expressed in Figure 2 indicates that there was a decline in the percentage of cases of bacteremia without focus from the year 2010 (0.34 percent) to 2020 (0.235 percent). Although in 2018 (0.308 percent) there was a sudden little rise in infection which was again controlled back in 2019.

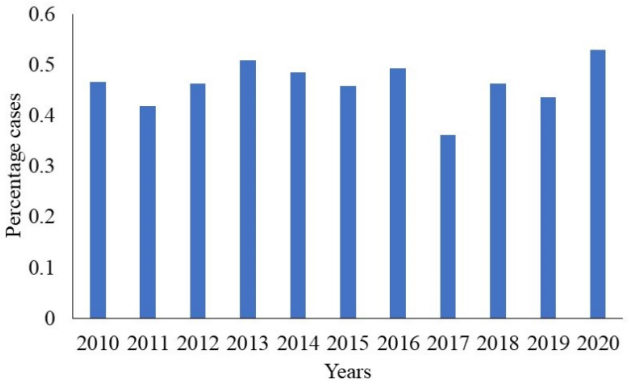

Fig. 3: Percentage of cases of Meningitis in the United States due to *Neisseria meningitides* from the year 2010 to 2020.

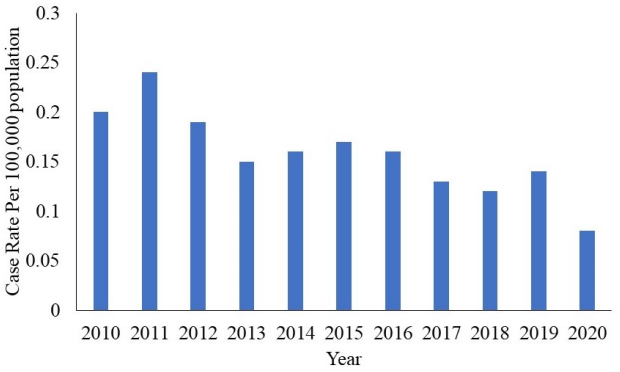

Fig. 4: Total case rate of *Neisseria meningitides* infection per 1000,000 population.

Figure 3 expresses the percentage of cases of Meningitis due to *Neisseria meningitides* infection. The data reveal that there is a slight rise in the percentage of cases of meningitis from the year 2010 (0.465 percent) to year 2020 (0.529 percent).

In Figure 4 total case rate per 1000,000 population is expressed, showing that the total case rate of *Neisseria meningitides* infection declined from 0.2 to 0.08 by 2020.

4. Discussion

The rate of Meningococcal diseases has changed substantially since the introduction of vaccines. Twelve different serogroups can cause invasive meningococcal disease[12] of which six serogroups (A, B, C, W, X & Y) are responsible for most of the infection.[13] The case fatality rate of *Neisseria meningitides* infection remains high (5-15 %) despite of treatment.[14–16] And survivors can have long-term significant sequelae where near about 20-25% suffers from a long-term disability.[17] Meningococcal infection negatively affects the quality of life of patients, their families, caregivers, and their extended networks.[18,19] All the data, collected from Bact Facts Interactive, Active Bacterial Core surveillance (ABCs), Centers for Diseases Control & Prevention, expressed that with the passage of time, the case reports for bacteremia, pneumonia, bacteremia without focus, and meningitis decline down from the year 2010 to year 2020. Although, in 2010 also the percentage of infected cases was not so high, and during the decade it kept on declining despite of various variants of pathogen.

This decline in the number of cases is due to vaccination. As vaccination is always quoted as the best strategy to fight back against invasive meningococcal diseases.[13] Additionally, immediate antibiotic for past-exposure prophylaxis and treatment helps in stopping the spread of infection.[20]The vaccination strategy followed by Italy,[21] Canada,[22] and Germany[23] showed that with the introduction of Paediatric meningococcal C vaccination, serogroup C cases in children declined, which is in corroboration with our observation. Another important factor that helped in declining the number of meningococcal cases is the strict and strong surveillance system of Enhanced Meningococcal diseases Surveillance (EMDS), centers for diseases Control & Prevention. EMDS collects isolates from all the states and large jurisdiction health departments, assesses them, and keeps a check on the infection rate. 98-99% of the United state population remains under surveillance and immediate steps are taken to stop the spread of infection.[24]

5. Conclusion

In conclusion, the present study highlights that in the United States due to strict vaccination, surveillance, and usage of antibiotics at the appropriate time, the cases of Neisseria meningitidis infection declined to a greater extent, and for the ongoing outbreak this would be in the solution.

6. Ethical Statement

This study does not involve any ethical issues as data was collected from the Centers for Diseases Control & Prevention.

7. Author's Contribution

The author contributed to the conception and design of the study, analyzed the data, and also approved the final version of the manuscript.

8. Conflicts of Interest

The authors declare that there are no conflicts of interest.

9. Source of Funding

None.

10. Acknowledgement

None.

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Cite this article: Mishra T. Evaluation of the rate of *Neisseria meningitides* Infection in the United States from 2010 to 2020. *IP Int J Med Microbiol Trop Dis* 2023;9(1):66-69.