

Content available at: <https://www.ipinnovative.com/open-access-journals>

IP International Journal of Medical Microbiology and Tropical Diseases

Journal homepage: <https://www.ijmmttd.org/>

Original Research Article

Evaluation of the rate of *Neisseria meningitides* Infection in the United States from 2010 to 2020Tulika Mishra ^{1,*}¹Dept. of Pathological Process and Therapeutics, American University, School of Medicine, Oranjestad, Aruba

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.

This is an Open Access (OA) journal, and articles are distributed under the terms of the [Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License](https://creativecommons.org/licenses/by-nc-sa/4.0/), which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: reprint@ipinnovative.com

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 nasopharynx⁴ 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

* Corresponding author.

E-mail address: tulikachd@gmail.com (T. Mishra).

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 meningitidis* 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 meningococemia.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)

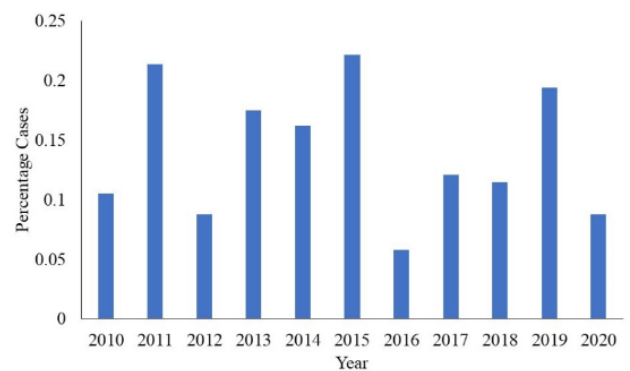


Fig. 1: Percentage of cases of bacteremia & pneumonia the United States due to *Neisseria meningitidis* in all the age group from 2010 to 2020.

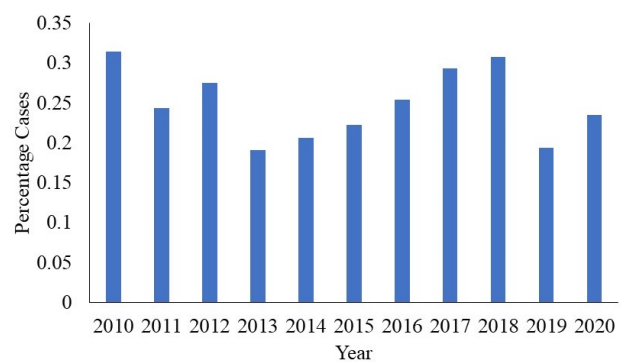


Fig. 2: Percentage of cases of bacteremia without focus in the United States due to *Neisseria meningitidis* from the year 2010 to 2020.

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.

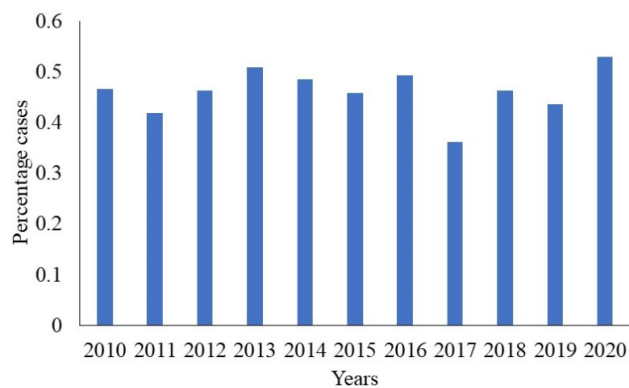


Fig. 3: Percentage of cases of Meningitis in the United States due to *Neisseria meningitidis* from the year 2010 to 2020.

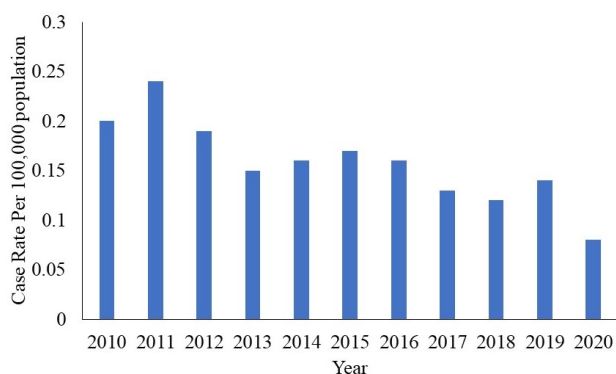


Fig. 4: Total case rate of *Neisseria meningitidis* infection per 1000,000 population.

Figure 3 expresses the percentage of cases of Meningitis due to *Neisseria meningitidis* 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 meningitidis* 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 disease¹² of which six serogroups (A, B, C, W, X & Y) are responsible for most of the infection.¹³ The case fatality rate of *Neisseria meningitidis* 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 post-exposure prophylaxis and treatment helps in stopping the spread of infection.²⁰ The vaccination strategy followed by Italy,²¹ Canada,²² and Germany²³ 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.

References

- Rouphael NG, Stephens DS. *Neisseria meningitidis*: Biology, Microbiology and Epidemiology. *Methods Mol Biol.* 2012;799:1–20. doi:10.1007/978-1-61779-346-2_1.
- Swartley JS, Marfin AA, Edupuganti S. Capsule switching of *Neisseria meningitidis*. *Proc Natl Acad Sci USA.* 1997;94(1):271–6.
- Brandtzaeg P, Van Deuren M. Classification and pathogenesis of meningococcal infections. *Methods Mol Biol.* 2012;799:21–35. doi:10.1007/978-1-61779-346-2_.
- Pizza M, Rappuoli R. *Neisseria meningitidis*: pathogenesis and immunity. *Curr Opin Microbiol.* 2015;23:68–72. doi:10.1016/j.mib.2014.11.006.
- Available from: <https://www.cdc.gov/vaccines/pubs/pinkbook/mening.html>.
- Tsheten T, Wangchuk S, Mynak M, Lhaden T. Case report on meningococcal septicemia in Kalabazaar. *Int J Sci Rep.* 2016;3(1):15–8.
- Cohn AC, Macneil JR, Harrison LH, Hatcher C, Theodore J, Schmidt M, et al. implications for prevention of meningococcal disease. *Clin Infect Dis.* 1998;50(2):184–91. doi:10.1086/649209.
- Cohn AC, Macneil JR, Clark TA, Ortega-Sanchez IR, Briere EZ, Meissner HC, et al. Prevention and control of meningococcal disease: recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep.* 2013;62(2):1–28.
- Available from: <https://www.cdc.gov/vaccines/vpd/mening/index.html>.
- Report ABCS. Emerging Infections Program Network, *Neisseria meningitidis*, 2012. Centers for Disease Control and Prevention; 2013. [Accessed 2 January 2023]. Available from: www.cdc.gov/abcs/reports-findings/survreports/mening12.html.
- Available from: <https://www.cdc.gov/abcs/bact-facts-interactive-dashboard.html>.
- Dwilow R, Fanella S. Invasive meningococcal disease in the 21st century—an update for the clinician. *Curr Neurol Neurosci Rep.* 2015;15(3):2. doi:10.1007/s11910-015-0524-6.
- Hedari CP, Khinkarly RW, Dbaibo GS. Meningococcal serogroups A, C, W-135, and Y tetanus toxoid conjugate vaccine: a new conjugate vaccine against invasive meningococcal disease. *Infect Drug Resist.* 2014;7:85–99. doi:10.2147/IDR.S36243.
- Raja NS, Parasakthi N, Puthucheary SD, Kamarulzaman A. Invasive meningococcal disease in the University of Malaya Medical Centre, Kuala Lumpur, Malaysia. *J Postgrad Med.* 2006;52(1):23–9.
- Fransen F, Heckenberg SGB, Hamstra HJ, Feller M, Boog CJP, Van Putten J, et al. Naturally occurring lipid A mutants in *Neisseria meningitidis* from patients with invasive meningococcal disease are associated with reduced coagulopathy. *PLoS Pathog.* 2009;5(4):1000396. doi:10.1371/journal.ppat.1000396.
- Kinlin LM, Spain CV, Ng V, Johnson CC, White ANJ, Fisman DN, et al. Environmental exposures and invasive meningococcal disease: an evaluation of effects on varying time scales. *Am J Epidemiol.* 2009;169(5):588–95.
- Sadarangani M, Scheifele DW, Halperin SA, Vaudry W, Saux NL, Tsang R, et al. investigators of the Canadian Immunization Monitor‑ing Program A. Outcomes of invasive meningococcal disease in adults and children in Canada between 2002 and 2011: a prospective cohort study. *Clin Infect Dis.* 2015;60(8):27–35.
- Strifer L, Morris SK, Dang V, Tu HAT, Minhas RS, Jamieson FB, et al. The health burden of invasive meningococcal disease: a systematic review. *J Pediatr Infect Dis Soc.* 2016;5(4):417–30.
- Olbrich KJ, Müller D, Schumacher S, Beck E, Meszaros K, Koerber F, et al. Systematic review of invasive meningococcal disease: sequelae and quality of life impact on patients and their caregivers. *Infect Dis Ther.* 2018;7(4):421–38.
- Bröker M, Cooper B, Detora LM, Stoddard JJ. Critical appraisal of a quadrivalent CRM(197) conjugate vaccine against meningococcal serogroups A, C W-135 and Y (Menveo) in the context of treatment and prevention of invasive disease. *Infect Drug Resist.* 2011;4:137–47. doi:10.2147/IDR.S12716.
- Neri A, Pezzotti P, Fazio C, Vacca P, D’Ancona FP, Caporali MG, et al. Epidemiological and molecular characterization of invasive meningococcal disease in Italy. *PLoS One.* 2008;10(10):139376. doi:10.1371/journal.pone.0139376.
- Siu T, Tang W, Dawar M, Patrick DM. Impact of routine immunization using meningococcal C conjugate vaccine on invasive meningococcal disease in British Columbia. *Can J Public Health.* 2008;99(5):380–2.
- Hellenbrand W, Elias J, Wichmann O, Dehnert M, Frosch M, Vogel U, et al. Epidemiology of invasive meningococcal disease in Germany, 2002–2010, and impact of vaccination with meningococcal C conjugate vaccine. *J Infect.* 2013;66(1):48–56.
- [Assessed on 4 January 2023]. Available from: <https://www.cdc.gov/meningococcal/surveillance/index.html>.

Author biography

Tulika Mishra, Professor  <https://orcid.org/0000-0001-6119-8792>

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