



Epidemiology of Meningococcal Disease Among College Students – United States, 2014-2016

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Meningococcal disease among college students

- In the 1990s, college freshman living in residence halls were identified as being at increased risk for meningococcal disease.¹
 - Meningococcal disease and outbreaks in young adults primarily due to serogroup C.
- The Advisory Committee on Immunization Practices (ACIP) recommended routine quadrivalent meningococcal conjugate (MenACWY) vaccine:
 - 2005: adolescents aged 11-12 years, unvaccinated college freshman living in residence halls.
 - 2010: booster dose at age 16 years.
- In the past 20 years, the overall incidence of meningococcal disease has declined 10-fold.
 - Serogroup B now the primary cause of meningococcal disease and outbreaks in young adults.

¹Bruce MG, et al. *JAMA*. 2001.

Current serogroup B meningococcal (MenB) vaccine recommendation in adolescents

- 2 MenB vaccines currently licensed in the United States:
 - MenB-4C (Bexsero[®]): 2-dose series
 - MenB-FHbp (Trumenba[®]): 2 or 3-dose series
- In 2015, ACIP recommended that a MenB vaccine series may be administered to adolescents and young adults aged 16–23 years to provide short-term protection against most strains of serogroup B meningococcal disease. The preferred age for MenB vaccination is 16–18 years (recommendation Category B).

Serogroup B meningococcal disease among college students

- Data presented to ACIP in June 2015 demonstrated that the estimated incidence of serogroup B meningococcal disease among college students aged 18-23 years was low (0.09 cases/100,000) and was similar to that of non-college students during 2009-2013.
 - Cases and incidence in college students were estimated using multiple sources¹, as no national-level data available.
- CDC shared plans to improve surveillance and report updated findings to ACIP on the incidence of disease in college students once additional data became available.

¹Proportion of cases among college students in Active Bacterial Core surveillance applied to the number of cases in the National Notifiable Diseases Surveillance System (NNDSS).

Enhanced meningococcal disease surveillance

- In 2014-2015, enhanced meningococcal disease surveillance activities were implemented to collect additional data (including college student status) and isolates on cases submitted to the National Notifiable Diseases Surveillance System (NNDSS).
- Enhanced surveillance activities conducted in 45 states (98% of U.S. population).
- CDC conducted an analysis to reassess the epidemiology of meningococcal disease among college students aged 18-24 years during 2014-2016.
 - Objective: Update ACIP on incidence and risk of serogroup B meningococcal disease in college students and review additional considerations for MenB vaccination in this group.

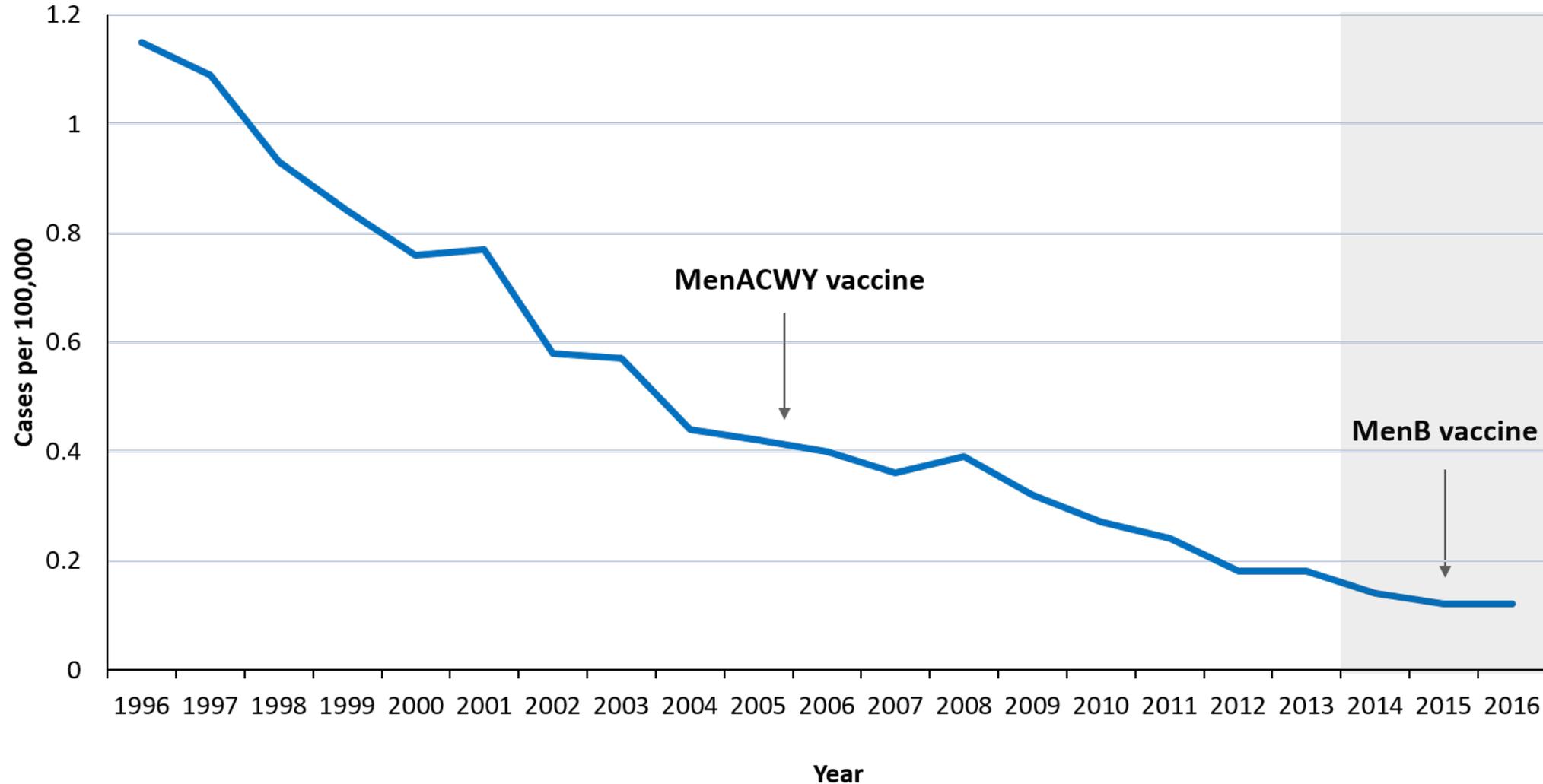
Methods

- Cases reported to NNDSS during 2014-2016 were reviewed.
- Cases aged 18-24 years were classified as college students¹ or non-college students based on information collected through enhanced surveillance activities or, in cases from non-participating states, through review of case investigation records.
- Population denominators:
 - 2015 National Center for Education Statistics Integrated Postsecondary Education Data System Fall Enrollment Survey
 - U.S. Census Bureau

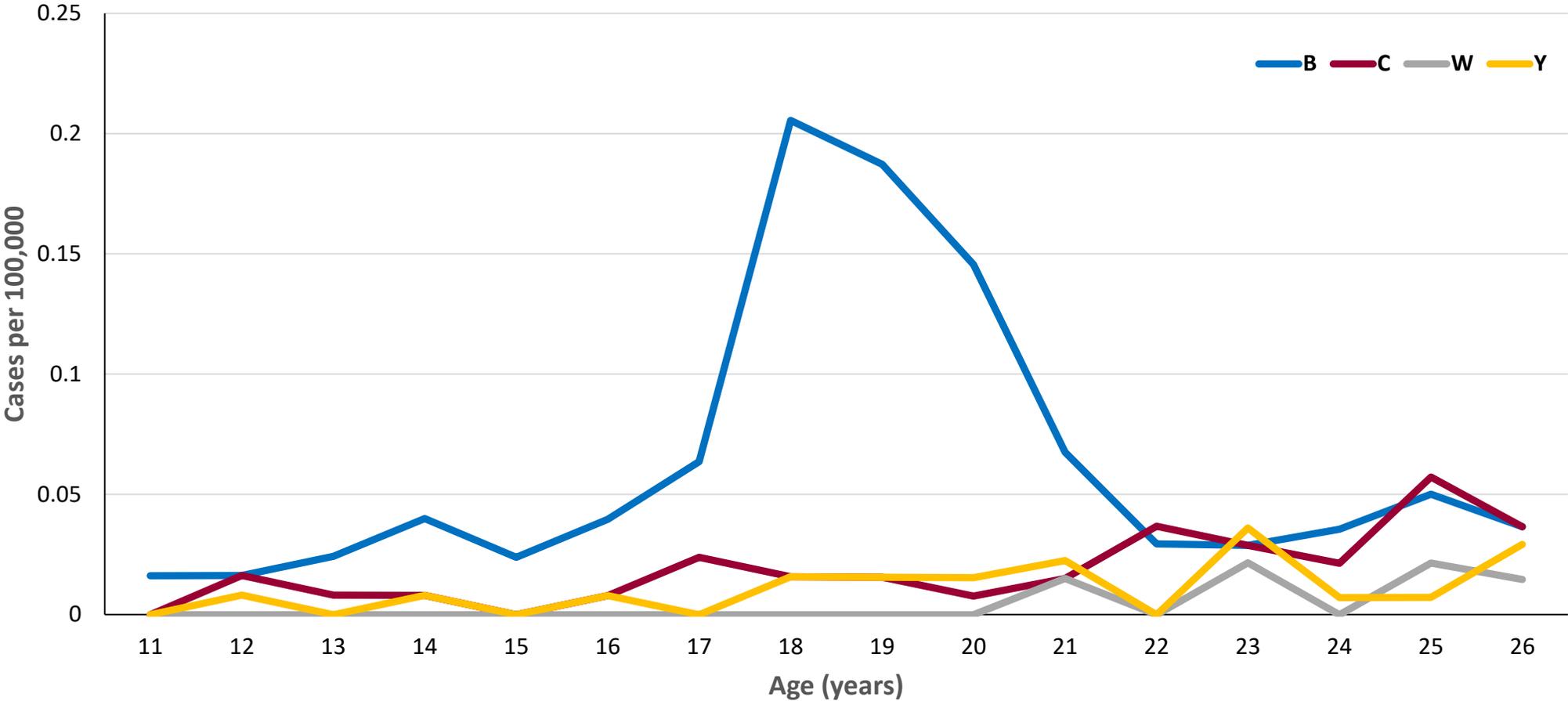
¹College student definition:

- Surveillance: Self-defined variable
- Denominator: Persons attending a post-secondary institution (includes academic, vocational, and continuing education programs).

Incidence of meningococcal disease – United States, 1996-2016



Incidence of meningococcal disease among adolescents and young adults by serogroup, 2014-2016



Source: National Notifiable Diseases Surveillance System (NNDSS) data with additional serogroup data from Active Bacterial Core surveillance (ABCs) and state health departments
Unknown serogroup and other serogroups excluded

Results

- Among the 1,178 cases reported during 2014-2016, 166 (14.1%) occurred in persons aged 18-24 years.
- College status known in 162 (97.6%) cases: 83 (51.2%) college students and 79 (48.8%) non-college students.

Characteristics of meningococcal disease among persons aged 18-24 years – United States, 2014-2016

Characteristic	All (N=162) N (%)	College students (N=83) N (%)	Non-college students (N=79) N (%)
Age (years)			
18-19	73 (45.1)	50 (60.3)	23 (29.1)
20-21	51 (31.5)	29 (34.9)	22 (27.9)
22-24	38 (23.4)	4 (4.8)	34 (43.0)
Serogroup			
B	88 (54.3)	60 (72.3)	28 (35.4)
C, W, Y	39 (24.1)	10 (12.1)	29 (36.7)
Other	23 (14.2)	8 (9.6)	15 (19.0)
Unknown	12 (7.4)	5 (6.0)	7 (8.9)
Died¹	19 (12.5)	10 (13.0)	9 (12.0)

¹ Among 152 cases with known outcome

Incidence of meningococcal disease by serogroup in persons aged 18-24 years – United States, 2014-2016

Age group	All cases [†]		Serogroup B		Serogroups C, W, or Y combined	
	Average annual cases	Average annual incidence [*]	Average annual cases	Average annual incidence [*]	Average annual cases	Average annual incidence [*]
All 18-24 year olds	54	0.17	29	0.09	13	0.04
18-19 year olds	24	0.29	16	0.19	3	0.03
20-21 year olds	17	0.19	9	0.11	3	0.04
22-24 year olds	13	0.09	4	0.03	7	0.05

[†] Includes unknown serogroup

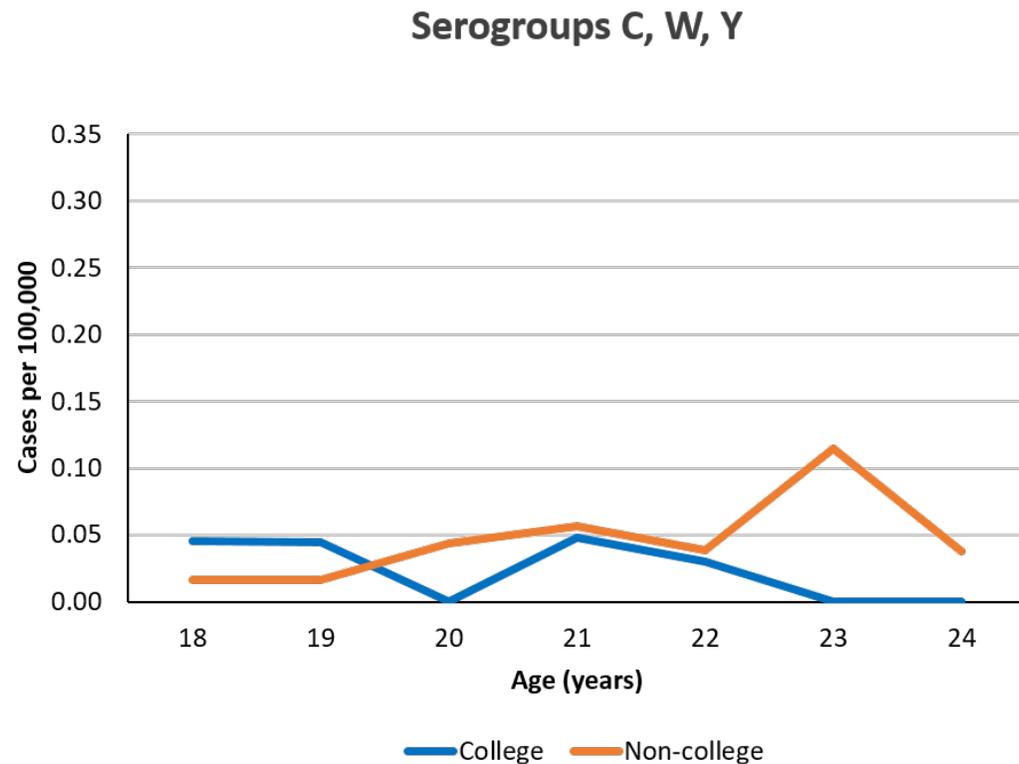
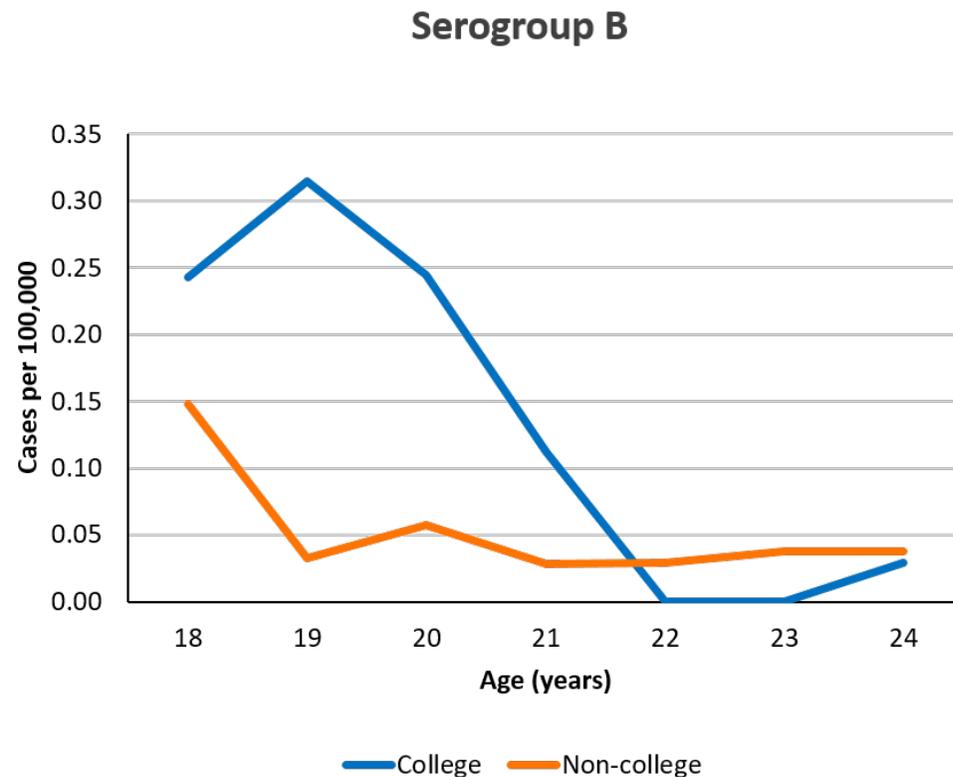
^{*} Cases per 100,000 per year

Incidence of meningococcal disease by serogroup in persons aged 18-24 years and relative risk among college students – United States, 2014-2016

Age group	Serogroup B			Serogroups C, W, or Y combined		
	Average annual cases	Average annual incidence*	Relative Risk (95% CI)	Average annual cases	Average annual incidence*	Relative Risk (95% CI)
All 18-24 year olds						
College student	20	0.17	3.54	3	0.03	0.56
Non-college student	9	0.05	(2.21-5.41)	10	0.05	(0.27-1.14)
18-19 year olds						
College student	12	0.28	3.10	2	0.05	2.76
Non-college student	4	0.09	(1.58-6.07)	1	0.02	(0.56-13.78)
20-21 year olds						
College student	7	0.18	4.14	1	0.02	0.48
Non-college student	2	0.04	(1.68-10.20)	2	0.05	(0.13-1.87)
22-24 year olds						
College student	<1	0.01	0.28	<1	0.01	0.16
Non-college student	4	0.03	(0.04-2.18)	7	0.06	(0.02-1.15)

* Cases per 100,000 per year

Estimated incidence of meningococcal disease among young adults by age and serogroup – United States, 2014-2016



Serogroup B Meningococcal Disease Outbreaks on College Campuses*, 2014-2016

Outbreak	State	Year started	Total cases	Undergraduate population	Primary vaccine used
1	Rhode Island	2015	2	3,750	MenB-FHbp
2	Oregon	2015	6 [†]	22,000	MenB-FHbp
3	California	2016	2	5,200	MenB-4C
4	New Jersey	2016	2	35,000	MenB-FHbp
5	Wisconsin	2016	3	29,000	MenB-4C
6	Oregon	2016	5 ⁺	25,000	MenB-4C

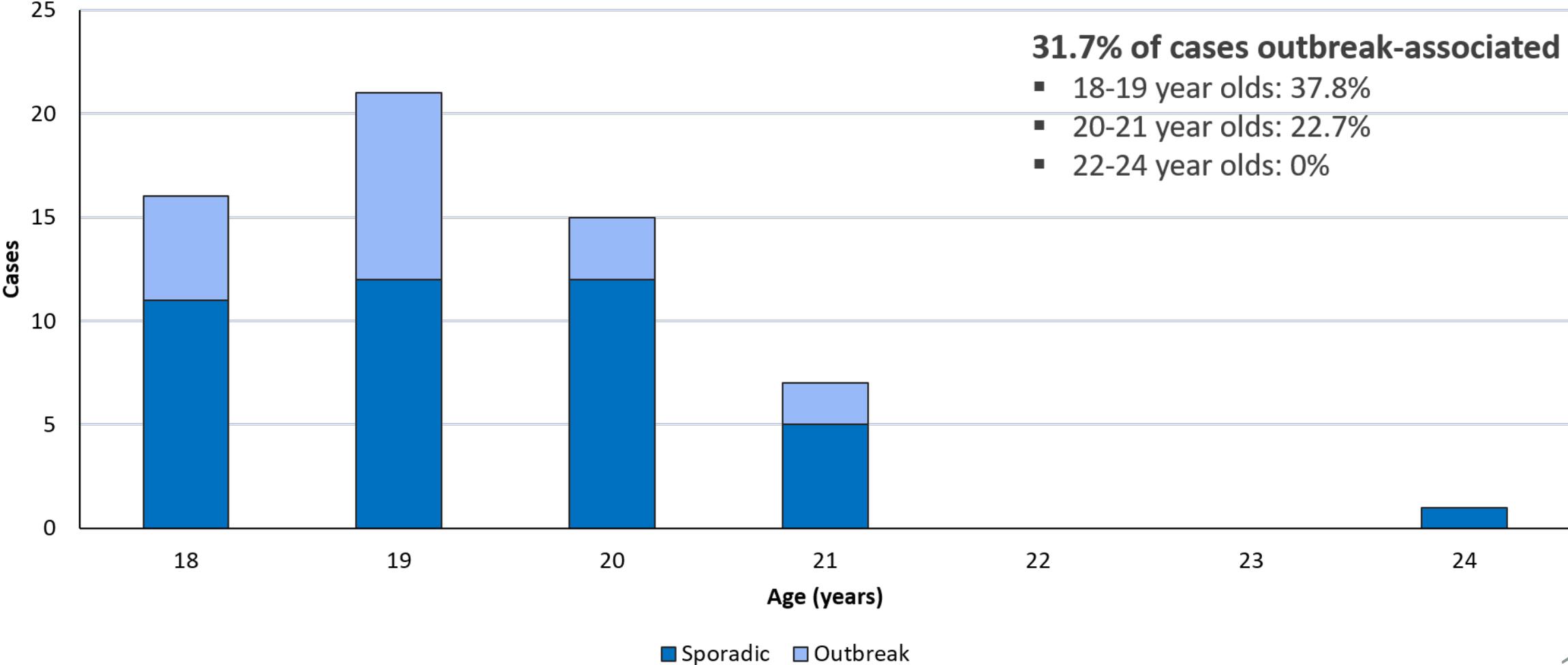
- 2 additional serogroup B meningococcal disease clusters/outbreaks on college campuses reported in 2017.

* Where CDC consulted. 1 additional outbreak-associated case in 2014 at a Pennsylvania college linked to a 2013 New Jersey college outbreak.

[†] 1 additional case (not shown) in a close contact outside of age 18-24 years

⁺ Includes 3 additional cases reported in 2017

Sporadic and outbreak-associated serogroup B meningococcal disease cases among college students by age – United States, 2014-2016



Incidence of serogroup B meningococcal disease in persons aged 18-21 years and relative risk among college students – United States, 2014-2016

Age group	All serogroup B cases			Excluding subsequent outbreak cases		
	Average annual cases	Average annual incidence*	Relative Risk (95% CI)	Average annual cases	Average annual incidence*	Relative Risk (95% CI)
All 18-24 year olds						
College student	20	0.17	3.54	16	0.13	2.76
Non-college student	9	0.05	(2.21-5.41)	9	0.05	(1.73-4.40)
18-19 year olds						
College student	12	0.28	3.10	9	0.21	2.34
Non-college student	4	0.09	(1.58-6.07)	4	0.09	(1.17-4.71)
20-21 year olds						
College student	7	0.18	4.14	6	0.15	3.58
Non-college student	2	0.04	(1.68-10.20)	2	0.04	(1.43-8.95)

* Cases per 100,000 per year

Summary

- Incidence of serogroup B meningococcal disease in college students is low; however, college students aged 18-21 years are at increased risk compared to non-college students.
 - Incidence of serogroups C, W, and Y in this age group is lower and similar in college students and non-college students, likely in part due to the adolescent MenACWY program.
- Serogroup B college outbreaks are an important factor, though the risk remains elevated among college students even when excluding outbreak-associated cases.

MenB Vaccination of College Students

- In addition to the data presented today, the Work Group has continued to review data on MenB vaccines as it has become available (much of it previously shared with ACIP).
- To summarize the key considerations for use of MenB vaccines in college students, the Work Group discussed:
 - Burden of disease and population at risk
 - Challenges with mass vaccination during outbreak response
 - Effectiveness and duration of protection of MenB vaccines
 - Molecular features of serogroup B isolates and expected strain coverage by MenB vaccines
 - Cost-effectiveness of MenB vaccines in college students
 - Awareness and use of MenB vaccines under Category B recommendation

Burden of serogroup B meningococcal disease and population at risk

- Overall low burden of serogroup B meningococcal disease in college students:
 - Average of 20 cases and 2-4 outbreaks reported annually.
- No additional data on cases (i.e., year in school, housing, participation in fraternities/sororities) is currently available, though collection of this information planned.
 - As burden of serogroup B meningococcal disease incidence is uniformly elevated among students aged 18-20 years, freshman may not be at particularly increased risk.
- Population at risk: In 2015, nearly 9 million students aged 18-21 years enrolled in college.²

Challenges with mass vaccination for outbreak response

- Meningococcal disease outbreaks on college campuses create significant anxiety and major logistical and financial challenges.
- While MenB vaccine is recommended by ACIP during outbreaks of serogroup B disease, achieving high uptake has been difficult, especially at large universities.
 - Estimated 1st dose coverage following initial mass vaccination efforts at 6 large universities has been <60%, with even lower coverage for 2nd or 3rd doses.
- Mass vaccination during outbreaks may become more challenging if MenB vaccine uptake under Category B recommendation increases, given the potential complexity of determining number of doses previously received, which vaccine product, etc.

Effectiveness and duration of protection of MenB vaccines

- No effectiveness data available in the United States or for adolescents; two-dose MenB-4C effectiveness among U.K. infants was 82.9% in the first year following vaccination.¹
- Data in adolescents suggest waning of antibodies after vaccination with MenB vaccines as early as 12 months after completion of the primary series.
- Evaluations conducted to-date show little-to-no impact of MenB vaccines on serogroup B carriage, suggesting that herd protection is unlikely.^{2,3,4}

Molecular features of serogroup B meningococcal disease and strain coverage MenB vaccines in college students

- Overall, serogroup B meningococcal strains in college students genetically diverse.
 - 16 sequence types among 34 isolates from 2014-2016 analyzed by whole genome sequencing.
 - 6 serogroup college outbreaks due to 5 different sequence types.
- MenB vaccines expected to cover a wide range of circulating strains in the United States, but will not prevent all cases.
 - Strain coverage of MenB vaccines in college students not determined.
 - 16 (47%) of isolates possessed one or more MenB vaccine variants included in MenB-4C or MenB-FHbp and others may still be covered by vaccines through cross-reactivity.
 - No information available on gene expression or isolate susceptibility to vaccine antigen-induced antibodies.

Cost-effectiveness of MenB vaccines in college students

- Cost-effectiveness analysis previously shared with ACIP¹ was updated with 2014-2016 serogroup B meningococcal disease incidence data.
 - Similar conclusions despite higher, more accurate incidence estimates.

	Cases Prevented	Deaths Prevented	NNV to prevent case	NNV to prevent death	Cost (\$) per QALY saved
Series at age 11 years, booster at age 16 years	19	2	152,000	1,610,000	\$10,800,000
Series at 16 years	14	1	213,000	2,229,000	\$12,700,000
Series at 18 years	15	2	198,000	1,792,000	\$11,200,000
College students only	11	1	305,000	2,765,000	\$9,600,000

Source: Ismael Ortega-Sanchez (CDC); ¹ MacNeil J. 'Considerations for use of serogroup B (MenB) vaccines in adolescents'. Advisory Committee on Immunization Practices meeting, June 2015.

NNV=number needed to vaccinated; QALY=quality-adjusted life year

Awareness and use of MenB vaccines under Category B recommendation

- There are currently gaps in awareness of MenB vaccines among parents and providers.
 - 43% of parents of adolescents aged 16-19 years report being aware of MenB vaccines; among these, 69% became aware through their child's healthcare provider.¹
 - However, only 70% of pediatricians and 21% of family practitioners report being 'very aware' of MenB vaccines.²
- Uptake of MenB vaccines among adolescents and young adults is estimated to be low.
 - Coverage of at least one dose of MenB vaccine among 16-18 year olds estimated at <10%.³
 - Uptake in college students unknown; however, only 2% of colleges specifically require MenB vaccine and 24% stock MenB vaccine.⁴

¹ Pfizer Parental Awareness and Utilization of Meningococcal Serogroup B Vaccines Survey (unpublished); ² Vaccine Policy Collaborative Initiative, PI Alison Kempe MD MPH (unpublished);

³ CDC unpublished data; ⁴ American College Health Association/CDC (unpublished)

ACIP Meningococcal Vaccines Work Group Interpretation

- Although the risk of serogroup B meningococcal disease is increased among college students, the number of preventable cases is low and number needed to vaccinate to prevent a case is high.
- Limited duration of protection of MenB vaccines and the lack of evidence for impact on carriage may limit the ability to protect college students through the period of greatest risk.
 - MenB vaccination should occur as close to college entry as possible.
- While achieving high MenB coverage during college outbreaks has been challenging, routine vaccination of all college students would also be difficult.
- Awareness and uptake of MenB vaccines is currently low.

ACIP Meningococcal Vaccines Work Group Conclusion

- The Work Group does not propose any changes to the current MenB vaccine recommendations
- CDC could provide more guidance around clinical decision-making during pre-college health visits.

Discussion

- Does ACIP agree with the Work Group interpretation?
- Are there additional data ACIP would like to review?

Thank you

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

