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and

Meningococcal Disease and College Students

Recommendations of the Advisory Committee on Immunization Practices (ACIP)

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Prevention and Control of Meningococcal Disease

Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Summary

*This report summarizes and updates an earlier published statement issued by the Advisory Committee on Immunization Practices concerning the control and prevention of meningococcal disease (*MMWR *1997:46[No. RR-5]:1–21) and provides updated recommendations regarding the use of meningococcal vaccine.*

INTRODUCTION

Each year, 2,400–3,000 cases of meningococcal disease occur in the United States, resulting in a rate of 0.8–1.3 per 100,000 population (*1–3*). The case-fatality ratio for meningococcal disease is 10% (*2*), despite the continued sensitivity of meningococcus to many antibiotics, including penicillin (*4*). Meningococcal disease also causes substantial morbidity: 11%–19% of survivors have sequelae (e.g., neurologic disability, limb loss, and hearing loss [*5,6*]). During 1991–1998, the highest rate of meningococcal disease occurred among infants aged <1 year; however, the rate for persons aged 18–23 years was also higher than that for the general population (1.4 per 100,000) (CDC, National Electronic Telecommunications System for Surveillance, unpublished data).

BACKGOUND

In the United States, 95%–97% of cases of meningococcal disease are sporadic; however, since 1991, the frequency of localized outbreaks has increased (*7–8*). Most of these outbreaks have been caused by serogroup C. However, in the past 3 years, localized outbreaks caused by serogroup Y and B organisms have also been reported (*8*). The proportion of sporadic meningococcal cases caused by serogroup Y also increased from 2% during 1989–1991 to 30% during 1992–1996 (*2,9*). The proportion of cases caused by each serogroup varies by age group; more than half of cases among infants aged <1 year are caused by serogroup B, for which no vaccine is licensed or available in the United States (*2,10*).

Persons who have certain medical conditions are at increased risk for developing meningococcal disease, particularly persons who have deficiencies in the terminal common complement pathway (C3, C5-9) (*11*). Antecedent viral infection, household crowding, chronic underlying illness, and both active and passive smoking also are associated with increased risk for meningococcal disease (*12–19*). During outbreaks, bar or nightclub patronage and alcohol use have also been associated with higher risk for disease (*20–22*). In the United States, blacks and persons of low socioeconomic status have been consistently at higher risk for meningococcal disease (*2,3,12,18*). However, race and low socioeconomic status are likely risk markers, rather than risk factors, for this disease.

A recent multi-state, case-control study, in which controls were matched to case-patients by age group, revealed that in a multivariable analysis (controlling for sex and education), active and passive smoking, recent respiratory illness, corticosteroid use, new residence, new school, Medicaid insurance, and household crowding were all associated with increased risk for meningococcal disease (*13*). Income and race were not associated with increased risk. Additional research is needed to identify groups at risk that could benefit from prevention efforts.

MENINGOCOCCAL POLYSACCHARIDE VACCINES

The quadrivalent A, C, Y, W-135 vaccine (Menomune®-A,C,Y,W-135, manufactured by Aventis Pasteur) is the formulation currently available in the United States (*23*). Each dose consists of 50 µg of the four purified bacterial capsular polysaccharides. Menomune® is available in single-dose and 10-dose vials. (Fifty-dose vials are no longer available.)

Primary Vaccination

For both adults and children, vaccine is administered subcutaneously as a single, 0.5-ml dose. The vaccine can be administered at the same time as other vaccines but should be given at a different anatomic site. Protective levels of antibody are usually achieved within 7–10 days of vaccination.

Vaccine Immunogenicity and Efficacy

The immunogenicity and clinical efficacy of the serogroups A and C meningococcal vaccines have been well established. The serogroup A polysaccharide induces antibody in some children as young as 3 months of age, although a response comparable with that occurring in adults is not achieved until age 4–5 years. The serogroup C component is poorly immunogenic in recipients aged <18–24 months (*24,25*). The serogroups A and C vaccines have demonstrated estimated clinical efficacies of ≥85% in school-aged children and adults and are useful in controlling outbreaks (*26–29*). Serogroups Y and W-135 polysaccharides are safe and immunogenic in adults and in children aged >2 years (*30–32*); although clinical protection has not been documented, vaccination with these polysaccharides induces bactericidal antibody. The antibody responses to each of the four polysaccharides in the quadrivalent vaccine are serogroup-specific and independent. Reduced clinical efficacy has not been demonstrated among persons who have received multiple doses of vaccine. However, recent serologic studies have suggested that multiple doses of serogroup C polysaccharide may cause immunologic tolerance to the group C polysaccharide (*33,34*).

Duration of Protection

In infants and children aged <5 years, measurable levels of antibodies against the group A and C polysaccharides decrease substantially during the first 3 years following a single dose of vaccine; in healthy adults, antibody levels also decrease, but antibodies are still detectable up to 10 years after vaccine administration (*25,35–38*). Similarly, although vaccine-induced clinical protection likely persists in school-aged children and adults for at least 3 years, the efficacy of the group A vaccine in children aged <5 years

may decrease markedly within this period. In one study, efficacy declined from >90% to <10% 3 years after vaccination among children who were aged <4 years when vaccinated; efficacy was 67% among children who were ≥4 years of age at vaccination (*39*).

RECOMMENDATIONS FOR USE OF MENINGOCOCCAL VACCINE

Current Advisory Committee on Immunization Practices (ACIP) guidelines (*1*) suggest that routine vaccination of civilians with the quadrivalent meningococcal polysaccharide vaccine is not recommended because of its relative ineffectiveness in children aged <2 years (the age group with the highest risk for sporadic disease) and because of its relatively short duration of protection. However, the vaccine is recommended for use in control of serogroup C meningococcal outbreaks. An outbreak is defined by the occurrence of three or more confirmed or probable cases of serogroup C meningococcal disease during a period of ≤3 months, with a resulting primary attack rate of at least 10 cases per 100,000 population. For calculation of this threshold, population-based rates are used and not age-specific attack rates, as have been calculated for college students. These recommendations are based on experience with serogroup C meningococcal outbreaks, but these principles may be applicable to outbreaks caused by the other vaccine-preventable meningococcal serogroups, including Y, W-135, and A.

College freshmen, particularly those living in dormitories or residence halls, are at modestly increased risk for meningococcal disease compared with persons the same age who are not attending college. Therefore, ACIP has developed recommendations that address educating students and their parents about the risk for disease and about the vaccine so they can make individualized, informed decisions regarding vaccination. (See *MMWR* Vol. 49, RR-7, which can be referenced in the pages following this report.)

Routine vaccination with the quadrivalent vaccine is also recommended for certain high-risk groups, including persons who have terminal complement component deficiencies and those who have anatomic or functional asplenia. Research, industrial, and clinical laboratory personnel who are exposed routinely to *Neisseria meningitidis* in solutions that may be aerosolized also should be considered for vaccination (*1*).

Vaccination with the quadrivalent vaccine may benefit travelers to and U.S. citizens residing in countries in which *N. meningitidis* is hyperendemic or epidemic, particularly if contact with the local population will be prolonged. Epidemics of meningococcal disease are recurrent in that part of sub-Saharan Africa known as the "meningitis belt," which extends from Senegal in the West to Ethiopia in the East (*40*). Epidemics in the meningitis belt usually occur during the dry season (i.e., from December to June); thus, vaccination is recommended for travelers visiting this region during that time. Information concerning geographic areas for which vaccination is recommended can be obtained from international health clinics for travelers, state health departments, and CDC (telephone [404] 332-4559; internet http://www.cdc.gov/travel/).

Revaccination

Revaccination may be indicated for persons at high risk for infection (e.g., persons residing in areas in which disease is epidemic), particularly for children who were first vaccinated when they were <4 years of age; such children should be considered for

revaccination after 2–3 years if they remain at high risk. Although the need for revaccination of older children and adults has not been determined, antibody levels rapidly decline over 2–3 years, and if indications still exist for vaccination, revaccination may be considered 3–5 years after receipt of the initial dose (*1*).

Precautions and Contraindications

Polysaccharide meningococcal vaccines (both A/C and A/C/Y/W-135) have been extensively used in mass vaccination programs as well as in the military and among international travelers. Adverse reactions to polysaccharide meningococcal vaccines are generally mild; the most frequent reaction is pain and redness at the injection site, lasting for 1–2 days. Estimates of the incidence of such local reactions have varied, ranging from 4% to 56% (*41,42*). Transient fever occurred in up to 5% of vaccinees in some studies and occurs more commonly in infants (*24,43*).

Severe reactions to polysaccharide meningococcal vaccine are uncommon (*24,32,41–48*) (R. Ball, U.S. Food and Drug Administration, personal communication). Most studies report the rate of systemic allergic reactions (e.g., urticaria, wheezing, and rash) as 0.0–0.1 per 100,000 vaccine doses (*24,48*). Anaphylaxis has been documented in <0.1 per 100,000 vaccine doses (*23,47*). Neurological reactions (e.g., seizures, anesthesias, and paresthesias) are also infrequently observed (*42,47*).

The Vaccine Adverse Events Reporting System (VAERS) is a passive surveillance system that detects adverse events that are temporally (but not necessarily causally) associated with vaccination, including adverse events that occur in military personnel. During 1991–1998, a total of 4,568,572 doses of polysaccharide meningococcal vaccine were distributed; 222 adverse events were reported for a rate of 49 adverse events per million doses. In 1999, 42 reports of adverse events were received, but the total number of vaccine doses distributed in 1999 is not yet available (R. Ball, U.S. Food and Drug Administration, personal communication). In the United States from July 1990 through October 1999, a total of 264 adverse events (and no deaths) were reported. Of these adverse events, 226 were categorized as "less serious," with fever, headache, dizziness, and injection-site reactions most commonly reported. Thirty-eight serious adverse events (i.e., those that require hospitalization, are life-threatening, or result in permanent disability) that were temporally associated with vaccination were reported. Serious injection site reactions were reported in eight patients and allergic reactions in three patients. Four cases of Guillain-Barré Syndrome were reported in adults 7–16 days after receiving multiple vaccinations simultaneously, and one case of Guillain-Barré Syndrome was reported in a 9-year-old boy 32 days after receiving meningococcal vaccine alone. An additional seven patients reported serious nervous system abnormalities (e.g., convulsions, paresthesias, diplopia, and optic neuritis); all of these patients received multiple vaccinations simultaneously, making assessment of the role of meningococcal vaccine difficult. Of the 15 miscelleneous adverse events, only three occurred after meningococcal vaccine was administered alone. The minimal number of serious adverse events coupled with the substantial amount of vaccine distributed (>4 million doses) indicate that the vaccine can be considered safe (R. Ball, U.S. Food and Drug Administration, personal communication).

Studies of vaccination during pregnancy have not documented adverse effects among either pregnant women or newborns (*49–51*). Based on data from studies

involving the use of meningococcal vaccines and other polysaccharide vaccines during pregnancy, altering meningococcal vaccination recommendations during pregnancy is unnecessary.

ANTIMICROBIAL CHEMOPROPHYLAXIS

In the United States, the primary means for prevention of sporadic meningococcal disease is antimicrobial chemoprophylaxis of close contacts of infected persons (Table 1). Close contacts include a) household members, b) day care center contacts, and c) anyone directly exposed to the patient's oral secretions (e.g., through kissing, mouth-to-mouth resuscitation, endotracheal intubation, or endotracheal tube management). The attack rate for household contacts exposed to patients who have sporadic meningococcal disease is an estimated four cases per 1,000 persons exposed, which is 500-800 times greater than for the total population (*52*). Because the rate of secondary disease for close contacts is highest during the first few days after onset of disease in the index patient, antimicrobial chemoprophylaxis should be administered as soon as possible (ideally within 24 hours after identification of the index patient). Conversely, chemoprophylaxis administered >14 days after onset of illness in the index patient is probably of limited or no value. Oropharyngeal or nasopharyngeal cultures are not helpful in determining the need for chemoprophylaxis and may unnecessarily delay institution of this preventive measure.

Table 1. Schedule for administering chemoprophylaxis for meningococcal disease

Drug	Age group	Dosage	Duration and route of administration
Rifampin*	Children aged <1 month	5 mg/kg every 12 hrs	2 days, orally
	Children aged ≥1 month	10 mg/kg every 12 hrs	2 days, orally
	Adults	600 mg every 12 hrs	2 days, orally
Ciprofloxacin†	Adults	500 mg	Single dose, orally
Ceftriaxone	Children aged <15 years	125 mg	Single dose, IM§
Ceftriaxone	Adults	250 mg	Single dose, IM§

*Rifampin is not recommended for pregnant women because the drug is teratogenic in laboratory animals. Because the reliability of oral contraceptives may be affected by rifampin therapy, alternative contraceptive measures should be considered while rifampin is being administered.

† Ciprofloxacin is not generally recommended for persons <18 years of age or for pregnant and lactating women because the drug causes cartilage damage in immature laboratory animals. However, ciprofloxacin can be used for chemoprophylaxis of children when no acceptable alternative therapy is available.

§ Intramuscular.

Rifampin, ciprofloxacin, and ceftriaxone are all 90%–95% effective in reducing nasopharyngeal carriage of *N. meningitidis* and are all acceptable alternatives for chemoprophylaxis (*53–56*). Systemic antimicrobial therapy of meningococcal disease with agents other than ceftriaxone or other third-generation cephalosporins may not reliably eradicate nasopharyngeal carriage of *N. meningitidis*. If other agents have been used for treatment, the index patient should receive chemoprophylactic antibiotics for eradication of nasopharyngeal carriage before being discharged from the hospital (*57*).

PROSPECTS FOR IMPROVED MENINGOCOCCAL VACCINES

Serogroup A, C, Y, and W-135 meningococcal polysaccharides have been chemically conjugated to protein carriers. These meningococcal conjugate vaccines provoke a T-cell-dependent response that induces a stronger immune response in infants, primes immunologic memory, and leads to booster response to subsequent doses. These vaccines are expected to provide a longer duration of immunity than polysaccharides, even when administered in an infant series, and may provide herd immunity through protection from nasopharyngeal carriage. Clinical trials evaluating these vaccines are ongoing (*58–60*). When compared with polysaccharide vaccine, conjugated A and C meningococcal vaccines in infants and toddlers have resulted in similar side effects but improved immune response. Prior vaccination with group C polysaccharide likely does not prevent induction of memory by a subsequent dose of conjugate vaccine (*61*).

In late 1999, conjugate C meningococcal vaccines were introduced in the United Kingdom, where rates of meningococcal disease are approximately 2 per 100,000 population, and 30%–40% of cases are caused by serogroup C (*62*). In phase I of this program, infants are being vaccinated at 2, 3, and 4 months concurrently with DTP, Hib, and polio vaccines. Children aged 4–13 months are receiving "catch-up" vaccinations. Children aged 15–17 years are receiving one dose of conjugate C vaccine, and entering college students are receiving one dose of bivalent A/C polysaccharide vaccine. In phase II, scheduled to start in June 2000, a dose of conjugate vaccine will be administered to children aged 14 months–14 years and to persons aged 18–20 years who are not enrolled in college (*62*).

Conjugate meningococcal vaccines should be available in the United States within the next 2–4 years. In the interim, the polysaccharide vaccine should not be incorporated into the routine childhood immunization schedule, because the currently available meningococcal polysaccharide vaccines provide limited efficacy of short duration in young children (*39*), in whom the risk for disease is highest (*2,3*).

Because the group B polysaccharide is not immunogenic in humans, immunization strategies have focused primarily on noncapsular antigens (*10,63*). Several of these vaccines, developed from specific strains of serogroup B meningococci, have been safe, immunogenic, and efficacious among children and adults and have been used to control outbreaks in South America and Scandinavia (*64–68*). Strain-specific differences in outer-membrane proteins suggest that these vaccines may not provide protection against all serogroup B meningococci (*69*). No serogroup B vaccine is currently licensed or available in the United States.

CONCLUSIONS

N. meningitidis is a leading cause of bacterial meningitis and sepsis in older children and young adults in the United States. Antimicrobial chemoprophylaxis of close contacts of persons who have sporadic meningococcal disease is the primary means for prevention of meningococcal disease in the United States.

The quadrivalent polysaccharide meningococcal vaccine (which protects against serogroups A, C, Y, and W-135) is recommended for control of serogroup C meningococcal disease outbreaks and for use among persons in certain high-risk groups. Travelers to countries in which disease is hyperendemic or epidemic may benefit from vaccination. In addition, college freshmen, especially those who live in dormitories, should

be educated about meningococcal disease and the vaccine so that they can make an educated decision about vaccination.

Conjugate C meningococcal vaccines were recently introduced into routine childhood immunization schedules in the United Kingdom. These vaccines should be available in the United States within 2–4 years, offering a better tool for control and prevention of meningococcal disease.

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Meningococcal Disease and College Students

Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Meningococcal Disease and College Students

Recommendations of the Advisory Committee on Immunization Practices (ACIP)

Summary

This report provides information regarding the modestly increased risk for meningococcal disease among college freshmen, particularly those who live in dormitories or residence halls. It presents recommendations developed by the Advisory Committee on Immunization Practices regarding the education of students and parents about meningococcal disease and the polysaccharide meningococcal vaccine so that they can make informed decisions regarding vaccination.

INTRODUCTION

Neisseria meningitidis causes both sporadic disease and outbreaks. As a result of the control of *Haemophilus influenzae* type b infections, *N. meningitidis* has become the leading cause of bacterial meningitis in children and young adults in the United States (*1*). Outbreaks of meningococcal disease were rare in the United States in the 1980s; however, since 1991, the frequency of localized outbreaks has increased (*2*). From July 1994 through July 1997, 42 meningococcal outbreaks were reported, four of which occurred at colleges (*3*). However, outbreaks continue to represent <3% of total U.S. cases (3).

Rates of meningococcal disease remain highest for infants, but in the past decade, rates have increased among adolescents and young adults (*4*). During 1994–1998, approximately two thirds of cases among persons aged 18–23 years were caused by serogroups C, Y, or W135 and therefore were potentially preventable with available vaccines (*5*) (CDC, unpublished data) (Figure 1). Although the quadrivalent meningococcal polysaccharide vaccine is safe and efficacious (*5,6*), decisions about who to target for vaccination require understanding of the groups at risk, the burden of disease, and the potential benefits of vaccination.

New data are available regarding the risk for meningococcal disease in college students. This report reviews these data and provides medical professionals with guidelines concerning meningococcal disease and college students.

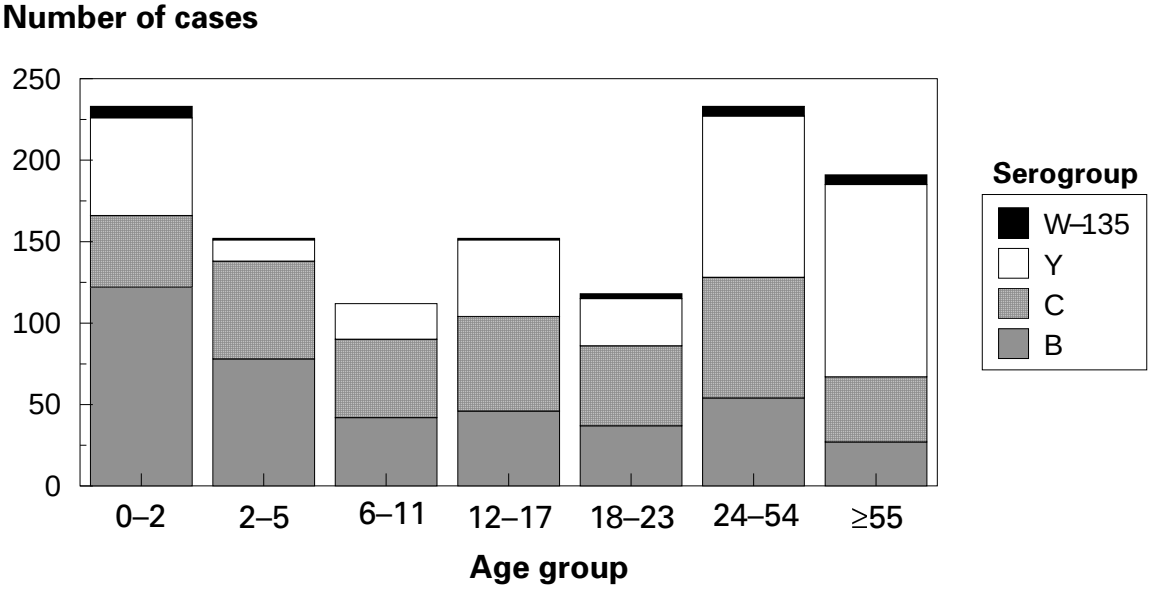
BACKGROUND

Meningococcal Disease in the Military

Military recruits and college freshmen have several common characteristics (e.g., age, diverse geographic backgrounds, and crowded living conditions). Therefore, data obtained from recruits have been used to evaluate meningococcal disease and vaccine among college freshmen.

Before 1971, rates of meningococcal disease were elevated among U.S. military recruits. Outbreaks frequently followed large-scale mobilizations, and recruits in their

FIGURE 1. Serogroup distribution of meningococcal disease cases, by age group—United States, 1994–1998



initial training camps were at substantially greater risk for disease than were regular troops (*7*). Military recruits enter military service for the first time at a few large U.S. military recruit training centers. After 8–12 weeks of initial training, they disperse to perform their military service at many different locations. During mobilization for the Vietnam conflict, outbreaks of meningococcal disease at training camps involving substantial numbers of recruits were caused by sulfadiazine-resistant strains of *N. meningitidis*. During 1964–1970, the rate of hospitalizations resulting from meningococcal disease among all active duty service members was 25.2 per 100,000 person-years (LTC Frederick Erdtmann, MD, MPH, Office of the Surgeon General, U.S. Army, briefing, 1981). These circumstances led to development of meningococcal polysaccharide vaccines (*8*). Field trials of group C polysaccharide vaccine among U.S. Army recruits demonstrated an 89.5% reduction in the rate of serogroup C meningococcal disease among vaccinated versus nonvaccinated recruits (*9,10*); thus, beginning in October 1971, all new recruits were vaccinated with the group C vaccine (*11*), and by Fall 1982, all recruits were receiving the quadrivalent polysaccharide vaccine (*7*). However, rates of meningococcal disease in U.S. Army personnel declined before the 1971 vaccination campaigns (*7*), suggesting that smaller recruit populations at training installations and the natural periodicity of outbreaks may have contributed to the decline in disease.

Rates of meningococcal disease remain low in the military, and large outbreaks no longer occur. Since 1990, records of all hospitalizations of active duty service members in military hospitals worldwide have been integrated with military personnel records in the Defense Medical Surveillance System (DMSS). During 1990–1998, the overall rate of hospitalizations from meningococcal disease among enlisted, active-duty service members was 0.51 per 100,000 person-years (J. Brundage, DMSS Army Medical Surveillance Activity, personal communication).

Approximately 180,000 military recruits receive a single dose of quadrivalent polysaccharide meningococcal vaccine annually. Revaccination is only indicated when military personnel are traveling to countries in which *N. meningitidis* is hyperendemic or epidemic (D. Trump, personal communication).

Before 1999, students reporting to two of the U.S. military academies routinely received meningococcal vaccine. Last year, the other academies initiated meningococcal vaccine programs.

MENINGOCOCCAL DISEASE AND COLLEGE STUDENTS

Four recent studies provide data concerning the risk for sporadic meningococcal disease among college students (Table 1) (*12–15*). The earliest of these studies was conducted during the 1990–1991 and 1991–1992 school years. A questionnaire designed to evaluate risk factors for meningococcal disease among college students was sent to 1,900 universities, resulting in a 38% response rate (*12*). Forty-three cases of meningococcal disease were reported during the 2 years from colleges with a total enrollment of 4,393,744 students, for a low overall incidence of 1.0 per 100,000 population per year. However, cases of meningococcal disease occurred 9–23 times more frequently in students residing in dormitories than in those residing in other types of accommodations. The low response rate and the inability of the study to control for other risk factors (e.g., freshman status) make these results difficult to interpret.

Table 1. Studies of the risk for meningococcal disease among college students

	Study A*	Study B†	Study C§	Study D§	Study E¶
Are college students at higher risk than the general population of similar age?	no	no	no	N/A	yes
Among college students, are freshmen at higher risk?	N/A	no	yes	no	N/A
Among college students, are students living in dormitories/ catered halls at higher risk?	yes	yes	yes	no	yes
Among college students, are freshmen living in dormitories at higher risk?	N/A	N/A	yes	yes	N/A

* Froeschle J. Meningococcal disease in college students. Clin Infect Dis 1999;29:215–6.

† Harrison LH, Dwyer DM, Maples CT, Billmann L. Risk of meningococcal infection in college students. JAMA 1999;281:1906–10.

§ Bruce M, Rosenstein NE, Capparella J, Perkins BA, Collins MJ. Meningococcal disease in college students. In: Abstracts of the 39th Annual Meeting of the Infectious Diseases Society of America, Philadelphia, PA, November 18–21, 1999:63.

¶ Neal KR, Nguyen-Van-Tam J, Monk P, O'Brien SJ, Stuart J, Ramsay M. Invasive meningococcal disease among university undergraduates: association with universities providing relatively large amounts of catered hall accomodations. Epidemiol Infect 1999;122:351–7.

N/A= not applicable.

In a retrospective, cohort study conducted in Maryland for the period 1992–1997, 67 cases of meningococcal disease among persons aged 16–30 years were identified by active, laboratory-based surveillance (*13*). Of those cases, 14 were among students attending Maryland colleges, and 11 were among those in 4-year colleges. The overall incidence of meningococcal disease in Maryland college students was similar to the incidence in the U.S. population of persons the same age (1.74/100,000 vs. 1.44/100,000, respectively); however, rates of disease were elevated among students living in dormitories compared with students living off-campus (3.2/100,000 vs. 0.96/100,000, p=0.05).

U.S. surveillance for meningococcal disease in college students was initiated in 1998; from September 1998 through August 1999, 90 cases of meningococcal disease were reported to CDC (*14*). These cases represent approximately 3% of the total cases of meningococcal disease that occur each year in the United States. Eighty-seven (97%) cases occurred in undergraduate students, and 40 (44%) occurred among the 2.27 million freshman students entering college each year (*16*). Among undergraduates, of the 71 (82%) isolates for which serogroup information was available, 35 (49%) were serogroup C, 17 (24%) were serogroup B, 15 (21%) were serogroup Y, and one (1%) was serogroup W-135. Eight (9%) students died. Of the five students who died for whom serogroup information was available, four had serogroup C isolates and one had serogroup Y.

U.S. surveillance data from the 1998–1999 school year suggest that the overall rate of meningococcal disease among undergraduate college students is lower than the rate among persons aged 18–23 years who are not enrolled in college (Table 2) (0.7 vs. 1.5/100,000, respectively) (*14,16*). However, rates were higher among specific subgroups of college students. Among the approximately 590,000 freshmen who live in dormitories (*17*), the rate of meningococcal disease was 4.6/100,000, higher than any age group in the population other than children aged <2 years, but lower than the threshold of 10/100,000 recommended for initiating meningococcal vaccination campaigns (*6*).

Of 90 students who had meningococcal disease attending college during the 1998–

Table 2. Rates of meningococcal disease, by risk group—United States, September 1998–August 1999*

Risk group	Number of cases	Population	Rate per 100,000
Children aged 2–5 years	255	14,886,569†	1.7
Persons aged 18–23 years	304	22,070,535†	1.4
Non-college students aged 18–23 years	216	14,579,322†§	1.5
College students	90	14,897,268§	0.6
Undergraduates	87	12,771,228§	0.7
Freshmen¶	40	2,285,001§	1.8
Dormitory residents	45	2,085,618§**	2.2
Freshmen¶ living in dormitories	27	591,587§**	4.6

* Bruce M, Rosenstein NE, Capparella J, Perkins BA, Collins MJ. Meningococcal disease in college students. In: Abstracts of the 39th Annual Meeting of the Infectious Diseases Society of America, Philadelphia, PA, November 18–21, 1999:63.

† 1998 census data.

§ NCES, U.S. Dept of Education, 1996–1997.

¶ Students enrolled in any postsecondary education for the first time.

** National College Health Risk Behavior Survey (NCHRBS)—United States, 1995.

1999 school year, 50 were enrolled in a case-control study and matched to 148 controls by school, sex, and undergraduate vs. graduate status (*14*). In a multivariable analysis, freshmen living in dormitories were at higher risk for meningococcal disease. In addition, white race, radiator heat, and recent upper respiratory infection were associated with disease.

In contrast to the United States, overall rates of meningococcal disease in the United Kingdom are higher among university students compared with non-students of similar age (*15*). From September 1994 through March 1997, university students had an increased annual rate of meningococcal disease (13.2/100,000) compared with non-students of similar age in the same health districts (5.5/100,000) and in those health districts without universities (3.7/100,000). As in the United States, regression analysis revealed that "catered hall accommodations," the U.K. equivalent of dormitories, were the main risk factor. Higher rates of disease were observed at universities providing catered hall accommodations for >10% of their student population compared with those providing such housing for <10% of students (15.3/100,000 vs. 5.9/100,000). The increased rate of disease among university students has prompted the United Kingdom to initiate routine vaccination of incoming university students with a bivalent A/C polysaccharide vaccine as part of a new vaccination program (see *MMWR* 2000; Vol.49, No. RR-6 which can be referenced in the pages preceding this report) (*18*).

MENINGOCOCCAL VACCINE AND COLLEGE STUDENTS

On September 30, 1997, the American College Health Association (ACHA), which represents about half of colleges that have student health services, released a statement recommending that "college health services [take] a more proactive role in alerting students and their parents about the dangers of meningococcal disease," that "college students consider vaccination against potentially fatal meningococcal disease," and that "colleges and universities ensure all students have access to a vaccination program for those who want to be vaccinated" (Dr. MarJeanne Collins, Chairman, ACHA Vaccine Preventable Diseases Task Force, personal communication). Parent and college student advocates have also encouraged more widespread use of meningococcal vaccine in college students. In a joint study by ACHA and CDC, surveys were sent to 1,200 ACHA-member schools; of 691 responding schools, 57 (8%) reported that preexposure meningococcal vaccination campaigns had been conducted on their campus since September 1997. A median of 32 students were vaccinated at each school (range: 1–2,300) (J. Capparella, unpublished data). During the 1998–1999 school year, 3%–5% of 148 students enrolled in a case-control study reported receiving prophylactic meningococcal vaccination (*14*). Before the 1999 fall semester, many schools mailed information packets to incoming freshmen; data are not yet available regarding the proportion of students who have been vaccinated.

Cost-effectiveness of meningococcal vaccine in college students

From a societal perspective, the economic costs and benefits of vaccinating a) a cohort of 591,587 freshmen who live in dormitories and b) all freshman enrolled in U.S. colleges, regardless of housing status (n=2.4 million) were evaluated, assuming the benefits of vaccination would last 4 years (Scott et al, unpublished data). Best and

worst case scenarios were evaluated by varying cost of vaccine and administration (range: $54–$88), costs per hospitalization ($10,924–$24,030), value of premature death based on lifetime productivity ($1.3–$4.8 million), cost of side effects of vaccine per case ($3,500–$12,270 per one million doses), and average cost of treating a case of sequelae ($0–$1,476). Vaccination coverage (60% and 100%) and vaccine efficacy (80% and 90%) were also varied for evaluation purposes.

Vaccination of freshmen who live in dormitories would result in the administration of approximately 300,000–500,000 doses of vaccine each year, preventing 15–30 cases of meningococcal disease and one to three deaths each year. The cost per case prevented would be $600,000–$1.8 million, at a cost per death prevented of $7 million to $20 million.

Vaccination of all freshman would result in the administration of approximately 1.4–2.3 million doses of vaccine each year, preventing 37–69 cases of meningococcal disease and two to four deaths caused by meningococcal disease each year. The cost per case prevented would be $1.4–2.9 million, at a cost per death prevented of $22 million to $48 million.

These data are similar to data derived from previous studies (*19*). They suggest that for society as a whole, vaccination of college students is unlikely to be cost-effective (Scott et al, unpublished data).

RECOMMENDATIONS FOR USE OF MENINGOCOCCAL POLYSACCHARIDE VACCINE IN COLLEGE STUDENTS

College freshmen, particularly those who live in dormitories, are at modestly increased risk for meningococcal disease relative to other persons their age. Vaccination with the currently available quadrivalent meningococcal polysaccharide vaccine will decrease the risk for meningococcal disease among such persons. Vaccination does not eliminate risk because a) the vaccine confers no protection against serogroup B disease and b) although the vaccine is highly effective against serogroups C, Y, W-135, and A, efficacy is <100%.

The risk for meningococcal disease among college students is low; therefore, vaccination of all college students, all freshmen, or only freshmen who live in dormitories or residence halls is not likely to be cost-effective for society as a whole. Thus, ACIP is issuing the following recommendations regarding the use of meningococcal polysaccharide vaccines for college students.

- Providers of medical care to incoming and current college freshmen, particularly those who plan to or already live in dormitories and residence halls, should, during routine medical care, inform these students and their parents about meningococcal disease and the benefits of vaccination. ACIP does not recommend that the level of increased risk among freshmen warrants any specific changes in living situations for freshmen.
- College freshmen who want to reduce their risk for meningococcal disease should either be administered vaccine (by a doctor's office or student health service) or directed to a site where vaccine is available.

- The risk for meningococcal disease among non-freshmen college students is similar to that for the general population. However, the vaccine is safe and efficacious and therefore can be provided to non-freshmen undergraduates who want to reduce their risk for meningococcal disease.
- Colleges should inform incoming and/or current freshmen, particularly those who plan to live or already live in dormitories or residence halls, about meningococcal disease and the availability of a safe and effective vaccine.
- Public health agencies should provide colleges and health-care providers with information about meningococcal disease and the vaccine as well as information regarding how to obtain vaccine.

Additional Considerations about Vaccination of College Students

Although the need for revaccination of older children has not been determined, antibody levels decline rapidly over 2–3 years (*6*). Revaccination may be considered for freshmen who were vaccinated more than 3–5 years earlier (*5*). Routine revaccination of college students who were vaccinated as freshmen is not indicated.

College students who are at higher risk for meningococcal disease because of a) underlying immune deficiencies or b) travel to countries in which *N. meningitidis* is hyperendemic or epidemic (i.e., the meningitis belt of sub-Saharan Africa) should be vaccinated (6). College students who are employed as research, industrial, and clinical laboratory personnel who are routinely exposed to *N. meningitidis* in solutions that may be aerosolized should be considered for vaccination (*6*).

No data are available regarding whether other closed civilian populations with characteristics similar to college freshman living in dormitories (e.g., preparatory school students) are at the same increased risk for disease. Prevention efforts should focus on groups in whom higher risk has been documented.

CONCLUSIONS

College freshmen, especially those who live in dormitories, are at a modestly increased risk for meningococcal disease compared with other persons of the same age, and vaccination with the currently available quadrivalent meningococcal polysaccharide vaccine will decrease their risk for meningococcal disease. Continued surveillance is necessary to evaluate the impact of these recommendations, which have already prompted many universities and clinicians to offer vaccine to college freshmen.

Consultation on the use of these recommendations or other issues regarding meningococcal disease is available from the Meningitis and Special Pathogens Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, CDC (telephone: [404] 639-3158).

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