Should College Students Be Vaccinated against Meningococcal Disease? A Cost–Benefit Analysis

Lisa A. Jackson, MD, Anne Schuchat, MD, Robin D. Gorsky, PhD, and Jay D. Wenger, MD

ABSTRACT

Outbreaks and sporadic cases of meningococcal disease among college students have prompted consideration of a policy of routine vaccination for this group. Purchase and administration of the vaccine for routine vaccination would cost $56 million per year. Savings in medical care and indirect costs would not equal this amount unless the annual rate of disease among students is at least 6.5/100 000. The actual rate among students is unknown; however, surveillance data suggest it could not be more than 1.3/100 000. At rates near this estimate, the net cost of the program would be approximately $45 million annually. More cost-effective prevention strategies might be yielded by further studies to identify students at substantial risk of meningococcal disease, or by the development of a conjugate serogroup C vaccine that could be administered during infancy. (*Am J Public Health.* 1995;85:843–845)

Introduction

Meningococcal disease is a potentially devastating infection that fortunately is relatively rare among US adults. The currently available vaccine, directed against meningococcal serogroups A, C, Y, and W135, is not recommended for routine use in the United States but is recommended for certain high-risk groups.[1] Recently, reports of sporadic cases as well as of outbreaks[2,3] of serogroup C meningococcal disease on US college campuses have raised concern that college students may have an elevated risk of acquiring meningococcal disease. This has prompted consideration of whether this group should be targeted for routine vaccination. Accordingly, a cost–benefit analysis was performed to assess the potential economic effect of such a program.

Methods

The following estimates were used to calculate the number of cases of meningococcal disease that would occur, both with and without a program of vaccination on college entry, over a 4-year period. The annual number of entering freshmen was estimated to be 2.3 million (unpublished data, American Council on Education). The rate of vaccine-preventable meningococcal disease among persons aged 18 to 22 in the United States is approximately 0.5 per 100 000 population per year.[4] Because the rate of disease specifically among college students is unknown, varying multiples of this baseline rate were used as the hypothetical rate of disease among students. It was assumed that 22% of students dropped out of school; those persons were then assumed to be at the baseline risk of disease. Vaccine efficacy was assumed to be 85%[1,5] and vaccine coverage, 80%.

The analysis was conducted from the viewpoint of society and included both direct and indirect costs. The vaccine was estimated to cost $15 per dose (Connaught Laboratories, Swiftwater, Pa). Vaccine administration was assumed to cost an additional $15 per dose. Treatment of disease was estimated to cost $8145 per case, which includes the cost of 7 days of hospitalization with one physician visit per day. The cost of hospitalization was based on a cost of $602 per day in 1988,[6] adjusted for the increase in the consumer price index for hospital services from 1986 to 1990,[7] for an estimated cost in 1992 dollars of $870 per day. The first 2 days of hospitalization were assumed to be in intensive care at twice the baseline cost per day.[8] The cost of one physician visit per day was estimated to be $45, based on a cost of $40 for an office visit in 1990,[9] adjusted at the average rate of increase from 1983 to 1990.[10] Treatment costs for cases occurring in the second, third, and fourth years after vaccination were discounted at a rate of 4%.

The side effects of the meningococcal vaccine are mild and infrequent[1,5,11]; therefore, the cost of one severe systemic reaction per 100 000 persons vaccinated was included.[12] The cost of a systemic reaction was estimated to be $1830, based on the cost of 2 days of hospitalization.

The human capital approach was used to estimate indirect costs as the value of potential future earnings lost because of premature death.[13–15] Our estimate of $1 000 000 per death was based on a 1980 estimate of the value of lifetime earnings for a male aged 20 to 24,[13] and was adjusted to 1992 dollars at the rate of increase in total hourly wages in the nonfarm business sector.[7] A fatality rate of 15% was assumed.[4]

Additional costs for care of survivors with long-term sequelae were not in-

Lisa A. Jackson, Anne Schuchat, and Jay D. Wenger are with the National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Ga. Robin D. Gorsky is with the Department of Health Management and Policy, University of New Hampshire, Durham.

Requests for reprints should be sent to Anne Schuchat, MD, Mailstop C-09, Centers for Disease Control and Prevention, 1600 Clifton Rd, Atlanta, GA 30333.

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TABLE 1—Estimated Economic Effects[a] of Routine Vaccination of College Freshmen at Varying Hypothetical Rates of Disease among College Students

	Student Disease Rate[b] (Rate per 100 000 Per Year)		
	Baseline × 2 (1.0)	Baseline × 6 (3.0)	Baseline × 15 (7.5)
Cases without vaccination	86	243	594
Cases with vaccination	28	78	190
Cases prevented by vaccination	58	165	404
Deaths without vaccination	13	36	89
Deaths with vaccination	4	11	28
Deaths prevented by vaccination	9	25	61
Cost of vaccination program[c]	56.2	56.2	56.2
Treatment costs without vaccination	0.7	1.9	4.6
Treatment costs with vaccination	0.2	0.6	1.5
Treatment costs saved by vaccination	0.5	1.3	3.1
Premature death costs without vaccination	12.9	36.3	89.2
Premature death costs with vaccination	4.1	11.6	28.5
Premature death costs saved by vaccination	8.8	24.7	60.7
Net cost[d]	46.9	30.2	−7.6
Benefit/cost	0.16	0.46	1.1

[a]All costs are expressed in millions of dollars.
[b]As a multiple of the baseline rate among 18- to 22-year-old persons (0.5 per 100 000 population per year).
[c]This includes cost of vaccine, vaccine administration, and treatment of vaccine-related side effects.
[d]Net savings are expressed as negative net costs.

cluded. Because the rate of these complications for college-aged persons is not well established but appears to be low,[16–19] it was therefore assumed, for the purposes of this analysis, that survivors did not suffer long-term effects of their disease.

Results

The cost of the vaccination program itself was estimated to be $56.2 million (Table 1). At a student disease rate of two times baseline, the net cost was $46.9 million. At a student rate of 15 times baseline, the savings in premature death costs were sufficient to result in a net savings of $7.6 million. The break-even point, or the rate at which the savings from the prevention of disease equaled the cost of the vaccination program, occurred at a student disease rate of 13 times baseline.

Table 2 shows the results of the sensitivity analysis, varying the value of probabilities for which there were inadequate data available. Variation in estimated treatment costs had little effect on the net cost.

Discussion

We estimate that vaccinating college students against meningococcal disease will not result in a net savings to society unless the rate of disease among this population is at least 13 times the baseline

TABLE 2—Sensitivity Analysis Using an Assumed Student Disease Rate of Baseline × 2

Variable[a]	Alternate Value	Cases Prevented	Deaths Prevented	Vaccine Program Cost ($×10^6$)	Treatment Cost Saved ($×10^6$)	Premature Death Cost Saved ($×10^6$)	Net Cost ($×10^6$)	Benefit/Cost
Results using initial values	. . .	58	9	56.2	0.5	8.8	46.9	0.16
Results using alternate values								
Vaccine coverage (80%)	50%	37	6	35.1	0.3	5.5	29.3	NC
Vaccine efficacy (85%)	95%	65	10	NC	0.5	9.8	45.9	0.18
	50%	34	5	NC	0.3	5.2	50.7	0.10
Cost of vaccine and administration ($30)	$10	NC	NC	18.7	NC	NC	9.5	0.49
	$40	NC	NC	74.9	NC	NC	65.7	0.12
Treatment cost ($8145)	$32 000	NC	NC	NC	1.8	NC	45.6	0.19
Premature death cost ($1 million)	$500 000	NC	NC	NC	NC	4.4	51.3	0.09
	$2 million	NC	NC	NC	NC	17.5	38.2	0.32
Fatality rate (15%)	5%	NC	3	NC	NC	2.9	52.8	0.06
	25%	NC	15	NC	NC	14.6	41.1	0.27

Note. Baseline rate is 0.5 per 100 000 population per year. All costs are expressed in millions of dollars. NC = no change from that of model with initial values.
[a]Initial values for each variable are shown in parentheses.

rate among 18- to 22-year-olds. Based on surveillance data, we estimate the maximum possible rate of disease among college students to be 1.3/100 000 population, or 2.6 times our baseline rate. At rates of disease near this estimate, the annual net cost of a strategy of vaccination approximates $45 million. Although the vaccine is efficacious, savings in treatment and premature death costs resulting from prevention of this relatively rare disease are small compared with the substantial cost of immunizing more than 2 million students annually.

If a prevention strategy is shown to be cost-effective, there is usually little debate over whether it should be implemented since it will ultimately conserve resources. However, a measure does not necessarily have to be cost-effective before it can be recommended for implementation. The decision of whether to implement a measure that prevents disease but requires net spending is more complex and may be influenced by factors such as the magnitude of the cost of the intervention, the intervention's acceptability, and the priority assigned to prevention of disease, as well as by the value assigned to more intangible factors, such as pain and grief suffered as a result of disease.

Our analysis raises the issue of whether a program of routine vaccination of college students against meningococcal disease would be an efficient use of health care resources. However, vaccination is still indicated for control of serogroup C outbreaks, a situation in which one-time vaccination of a defined high-risk group is likely to prevent additional cases. Further studies to identify a subset of students at substantially elevated risk of disease, or the development of a conjugate serogroup C meningococcal vaccine that could be administered during infancy to confer long-lasting protection, may allow development of more cost-effective strategies for the prevention of meningococcal disease in the United States. □

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Asthma Conference to Be Held in Chicago

The American Academy of Allergy and Immunology and the American Thoracic Society have joined together with the American College of Chest Physicians to offer a three-day conference on "Asthma: Theory to Treatment," July 15–17, 1995, in Chicago. This conference will cover asthma from both the allergist's and pulmonologist's point of view and show that a combination of both approaches will result in a more complete understanding of the disease. To receive promotional material and program information, please contact the American Thoracic Society, 1740 Broadway, New York, NY 10019-4374. To receive registration and exhibit information, please contact the American Academy of Allergy and Immunology, 611 East Wells St, Milwaukee, WI 53202-3889.