A Meningococcal Vaccination Campaign on a University Campus: Vaccination Rates and Factors in Nonparticipation

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ABSTRACT

Objectives. This study was undertaken to determine an accurate vaccination rate and identify factors influencing nonvaccination in a meningococcal vaccination campaign on a Connecticut university campus in May 1993.

Methods. Vaccination and student data were merged to determine demographic factors associated with nonvaccination. A case–control study examined reasons for nonvaccination.

Results. The estimated vaccination rate for students returning to the campus was 93%. Lower rates occurred among older students, students living off campus, graduate and nondegree students, and married students. Perceived poor access to the vaccination center was the strongest predictor of nonvaccination.

Conclusions. Higher vaccination rates may be achieved by specifically targeting students who live off campus and by providing multiple vaccination sites with extended hours. (*Am J Public Health.* 1996;86:1155–1158)

Introduction

Outbreaks of serogroup C meningococcal disease have been reported with increasing frequency over the last decade in the United States and Canada.[1-3] Unlike sporadic meningococcal disease, which usually affects children under 5 years of age, outbreaks of the disease more commonly affect older children and young adults.[1,2,4] And while vaccination is not recommended for controlling sporadic disease, vaccination is recommended in response to outbreaks of serogroup C disease.[5] However, no published studies are available on factors that influence nonparticipation in meningococcal mass vaccination campaigns.

In the first week of May 1993, three students, aged 19 to 23 years, at a state university in Connecticut developed group C meningococcal disease. In response, a 3-day mass vaccination campaign was conducted on campus. The vaccination campaign received extensive local and university media coverage. Letters were sent to all students informing them of the campaign, and similar information was posted around the campus. The campaign target population was nonvaccinated students under 30 years of age. Students who were returning to the campus in the fall were particularly encouraged to get vaccinated.

The initial estimate of vaccination coverage was 69%, based on a hand count of injections given (approximately 11 800) and a university estimate of the size of the target population (17 000). However, this estimate did not exclude students who were over 30 years of age, who were already vaccinated, or who were not attending the campus that semester. The estimated vaccination rate raised concern among elected officials and the public, with the governor of Connecticut asking, "If your students are so smart, how come only 69% got vaccinated?"[6] Given this challenge, the objectives of this study were to determine the "true" campaign vaccination rate in the target group and to identify factors that predict nonvaccination.

Methods

The study had two components: an assessment of the cohort of students eligible for vaccination, and a nested case–control study to further examine predictors of nonvaccination.

The target population included all enrolled students who attended the campus during May 1993 and who were aged 17 to 29 years. Vaccination data from logs kept during the campaign were merged with demographic data from a university computer database. Students not recorded in the vaccination logs were classified as nonvaccinated.

Students under 30 years of age during the vaccination campaign and who returned to the campus in the fall (n = 9658) were eligible for the nested case–control study. Case subjects, or nonvaccinees (n = 1026) were defined as all students not vaccinated by the campaign. Control subjects, or vaccinees, were selected from all students vaccinated by the

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This paper was accepted February 23, 1996.

TABLE 1—Cohort Study: Percentage Distribution and Odds Ratios (ORs) of Characteristics Predicting Nonvaccination in a University Meningococcal Mass Vaccination Campaign, Connecticut, May 1993

	Nonvaccinated (n = 1755), %	Vaccinated (n = 11 410), %	Crude OR	Adjusted OR[a]	95% Confidence Interval[a]
Age by year			1.4	1.14	1.1, 1.2
Off-campus resident	86	40	8.9	4.2	3.6, 4.9
Dormitory resident	14	60	1.0	1.0	
Graduate/nondegree	51	14	6.3	2.1	1.8, 2.4
Undergraduate	49	86	1.0	1.0	
Married	14	2	8.4	2.0	1.6, 2.4
Unmarried	86	98	1.0	1.0	
Left campus	40	23	2.2	1.6	1.4, 1.8
Returned	60	77	1.0	1.0	
Veteran	3	1	2.3	b	
Not veteran	97	99	1.0		
Parents live in Conn[c]	44	66	1.6	b	
Parents live elsewhere	6	13	1.0		
Female	50	50	1.0	b	
Male	50	50	1.0		
White[c]	80	82	1.2	b	
Other	9	11	1.0		

[a]From the logistic regression model.
[b]Factors not retained in the logistic regression model.
[c]Response percentages do not add up to 100% because of missing data.

TABLE 2—Case-Control Study: Reasons Given for Nonvaccination in a University Meningococcal Mass Vaccination Campaign

	No. (n = 574)	%
Was at low or no risk of contracting meningitis	291	51
Was off campus all semester[a]	102	18
Had already left the campus that semester	78	14
Did not have enough time	60	11
Was concerned about side effects from vaccine	52	9
Had medical reasons[a,b]	42	7
Was not aware that vaccinations were provided	38	7
Got vaccinated elsewhere	33	6
Feared vaccination may adversely affect exam performance	32	6
Was afraid of getting the vaccination	30	5
Was already vaccinated in the last 5 years[a]	26	5
Was not aware that vaccination was free	15	3
Did not care	10	2

[a]Persons ineligible for vaccination and excluded from further analyses.
[b]Included pregnancy, allergy to vaccines, and an acute febrile illness.

campaign. Vaccinees were frequency matched to nonvaccinees by age at a ratio of 2:1. A mailed, self-administered questionnaire was used to collect data about campaign reach, peer pressure for vaccination, and knowledge about and perceived risk of meningococcal disease, and to reaffirm vaccination status. The first of three mailings was on February 10, 1994.

Associations between independent variables and the outcome of nonvaccination were examined by contingency table analyses and logistic regression. In the case-control study, all analyses were stratified by age group to account for the frequency matching. In the logistic regression analyses, all study factors and two-way interaction terms were entered into a multivariable model. The only factors retained in the final models were age and those factors predictive of nonvaccination ($P < .05$).

Results

Student Cohort

A total of 12 374 persons were vaccinated. This included 11 410 students in the target population, 128 students who were at least 30 years of age, and 836 persons that included staff and students from other campuses. A thorough search of the university's student database showed that there were 13 165 students in the target population for the campaign. Thus, the vaccination rate was calculated to be 87% (11 410/13 165), as opposed to the initial estimate of 69%.

The age distribution of the target population was skewed, with 72% of the population under 23 years of age. The rate of nonvaccination increased almost linearly with age, from only 3% of 18-year-old students to 50% of 29-year-old students.

The distribution of personal characteristics by vaccination status among the target population is shown in Table 1. Age was an important risk factor for nonvaccination, with the odds of nonvaccination increasing geometrically by 14% for each year of age; thus, students aged 29 years were approximately 4.2 times as likely to be nonvaccinated as students aged 18 years (1.14 to the 11th power).

Case-Control Study

In the case-control study, the response rate was 69% (1331/1930) among vaccinees and 58% (591/1026) among nonvaccinees. Women were more likely to respond than men; the response rate varied from 76% for females vaccinees to 51% for males nonvaccinees. Students who had lived off campus at the time of the campaign were more likely to respond than those who had lived in dormitories. That response rate varied from 72% for off-campus vaccinees to 48% for dormitory nonvaccinees.

Twenty-two students whose reported vaccination status did not match the vaccination logs were excluded from the analysis. Of the remaining 1900 respondents, 574 were nonvaccinees. Table 2 shows the reasons given for nonvaccination. Many students gave more than one reason.

Students who were off campus during the semester of the outbreak, who had medical reasons for nonvaccination, or

who had been vaccinated against meningococcal disease in the last 5 years were not eligible for vaccination. These 170 students were excluded from further analyses, as were 33 who reported being vaccinated elsewhere. This left 371 nonvaccinees available for analyses of risk factors for nonvaccination.

Vaccinees were more likely ($P < .001$) than nonvaccinees to have received information about the campaign from print media (81% vs 68%), informal contacts (65% vs 46%), and formal university contacts (27% vs 13%). There was little difference in their exposure to broadcast media (69% vs 66%).

Table 3 shows the distribution of factors affecting vaccination status. Nonvaccinees were much more likely to report that access to the vaccination center was difficult.

The results from the case–control study were extrapolated to determine a "corrected" vaccination rate for students returning to campus, adjusted for students who were not on campus that semester, who were previously vaccinated, or who had medical reasons for nonvaccination. Students who were vaccinated elsewhere were considered nonvaccinated in the campaign. The vaccination rate among students returning to the campus was estimated at 93%. This was higher than the 87% determined from the cohort analysis, which did not adjust for these factors.

TABLE 3—Case–Control Study: Percentage Distribution and Odds Ratios (ORs) of Factors Predicting Nonvaccination in a University Meningococcal Mass Vaccination Campaign

	Nonvaccinated Case Subjects (n = 371), %	Vaccinated Control Subjects (n = 1326), %	Crude OR[a]	Adjusted OR[a,b]	95% Confidence Interval[b]
Off-campus resident	87	60	4.9	2.1	1.3, 3.3
Dormitory resident	13	40	1.0	1.0	
Graduate/nondegree student	60	39	2.0	2.1	1.3, 3.2
Undergraduate	40	61	1.0	1.0	
Married	20	8	1.6	1.7	1.0, 3.0
Unmarried	80	92	1.0	1.0	
Female	53	49	1.2		
Male	47	51	1.0		
Poorly informed	27	4	8.8	1.8	1.0, 3.3
Well informed	71	95	1.0	1.0	
Poor access	65	5	33.7	25.3	16.9, 37.9
Easy access	35	95	1.0	1.0	
No peer pressure	56	12	10.4	5.7	3.9, 8.4
Any peer pressure	40	88	1.0	1.0	
Believed it's not a severe disease	10	5	2.4		
Believed it's a severe disease	81	91	1.0		
Believed self at no/low risk of contracting meningitis	78	41	5.7	4.5	3.0, 6.6
Believed self at risk of contracting meningitis	19	58	1.0	1.0	
Concerned about injector gun	44	39	1.3		
Not concerned about gun	52	60	1.0		

[a]All odds ratios are age adjusted to account for frequency matching.
[b]From the logistic regression model.

Discussion

This university meningococcal vaccination campaign was much more successful than was first realized. First, and most importantly, there were no additional cases of meningococcal disease associated with this outbreak. Second, the corrected estimate of the vaccination rate among students returning to the campus in the fall was 93%. This estimate is much higher than the original estimate of 69% because the number of students in the target population had been incorrectly estimated. This could have been avoided by thoroughly searching the student database instead of estimating student numbers. Moreover, participation was extremely high even though the campaign took place in the last week of semester; the timing of the campaign is reflected among the reasons for nonvaccination, which included having already left the campus that semester and concern that vaccination may adversely affect exam performance.

We identified several population subgroups that were less likely to be vaccinated. Students living off campus at the time of the campaign, graduate and nondegree students, and married students were the least likely to get vaccinated. Students living off campus were the largest of the nonvaccinated subgroups, representing 40% of the target population and 86% of nonvaccinated students. Importantly, one of the students who developed meningitis lived off campus.

The strongest predictor of nonvaccination was a perception of poor access to the vaccination center. After adjustment for other factors, nonvaccinated students were 25 times more likely than vaccinated students to consider access to the vaccination center poor. If it is vital to vaccinate all students, access is an issue, and multiple vaccination sites with extended hours should be considered.

Interpreting the results of this study requires that several factors be considered. First, in the cohort analysis, some students were misclassified by vaccination status, such as those previously vaccinated or those vaccinated elsewhere. In the case–control study, however, students vaccinated elsewhere added only 0.6% to the total vaccination rate. Second, the case–control study was conducted 8 months after the vaccination campaign, and students may not have accurately recalled their attitudes at that time.

Third, we found differential response rates, by sex and residence, in the case–control study. Women were more likely to respond than men. Because sex was not associated with nonvaccination in the cohort study, we did not consider this difference important. Students who had

lived off campus at the time of the campaign were also more likely to respond than those who lived in dormitories. However, even if all nonvaccinated nonrespondents believed that access to the campaign was not a problem, the data would still show perceived poor access to be a strong predictor of nonvaccination for both dormitory and off-campus residents.

Finally, the vaccination campaign occurred at the end of the semester and was particularly aimed at students who intended to return the following semester. Analysis of the cohort of students enrolled at the time of the campaign found that returning to the campus was a significant predictor of vaccination. The attitudes assessed in the case–control study were those of students who did return.

Conclusions

Mass vaccination campaigns at universities can be highly successful. Accurate counts of the target population are important in calculating the vaccination rate. Higher vaccination rates may be achieved by specifically targeting students who live off campus and by providing multiple vaccination sites with extended hours. □

Acknowledgments

We thank Scott Brown, PhD, Henry Rolka, Daniel Sosin MD, MPH, Lisa Jackson, MD, John Horan, MD, MPH, Laura Fehrs, MD, and James Hadler, MD, MPH, for advice and criticism.

References

1. Jackson LA, Schuchat A, Reeves MW, Wenger JD. Serogroup C meningococcal outbreaks in the United States: an emerging threat. *JAMA.* 1995;273:383–389.
2. Hume SE. Mass voluntary immunization campaigns for meningococcal disease in Canada: media hysteria. *JAMA.* 1992;267: 1833–1838.
3. Schwartz B, Moore PS, Broome CV. Globae-pidemiology of meningococcal disease. *Clin Microbiol Rev.* 1989;2(suppl):S118–124.
4. Centers for Disease Control. Laboratory-based surveillance for meningococcal disease in selected areas, United States, 1989–1991. *MMWR Morb Mortal Wkly Rep.* 1993; 42(SS-2):21–30.
5. Centers for Disease Control. Meningococcal vaccines. *MMWR Morb Mortal Wkly Rep.* 1985;34(18):255–259.
6. Spencer-Molloy F, Farrish K. Capitol visit leaves many hurt, angry. *Hartford Courant.* May 26, 1993:B11.l

HIV Infection and Risk Behaviors among Male Port Workers in Santos, Brazil

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ABSTRACT

Objectives. This paper measured the extent to which human immunodeficiency virus (HIV) infection has spread among the male working-class population of Santos, Brazil.

Methods. Questionnaires on risk behaviors and blood tests were administered to a random sample (n = 395) of male port workers employed by the Santos Port Authority.

Results. Although the rate of HIV infection among these men—the working-class male population of Santos—remains low (1.1%), self-reported behavioral risks for HIV infection are common.

Conclusions. There is still time to prevent a widespread outbreak of HIV infection among the heterosexual population of Santos and of the transportation corridors emanating from that city. (*Am J Public Health.* 1996;86:1158–1160)

Introduction

A historically important distinction in describing the global acquired immunodeficiency syndrome (AIDS) pandemic has been that of pattern I and pattern II epidemics.[1] The pattern I epidemic occurs predominantly among men in developed countries, affecting primarily homosexuals and intravenous drug users. The pattern II epidemic occurs in some developing countries, spreading mainly through sexual contact between men and women. Notable in the pattern II epidemic are a nearly equal distribution of AIDS between the sexes and a concentration of human immunodeficiency syndrome (HIV) in impoverished areas of large cities and along transportation routes.[2] Although the reasons for the different courses of the AIDS epidemic are not entirely understood, one implication is that the pattern II epidemic may eventually occur among heterosexual populations wherever the social conditions of the developing world exist, be they south of the equator or in the South Bronx. Similarly, homosexually active men and intravenous drug users are in danger of HIV infection whether they live in New York or New Delhi.

AIDS in Brazil began as a pattern I epidemic, manifesting primarily among homosexual men and injection drug users.[3] More recently, reported AIDS cases among heterosexuals in Brazil have risen rapidly with a concomitant decline in the male:female ratio.[3] Thus, Brazil may now hold the unfortunate distinction of hosting both pattern I and pattern II epidemics. Little evidence yet exists as to whether HIV infection is becoming prevalent among heterosexual residents of major

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This paper was accepted December 15, 1995.