resentatives of regulatory public health agencies and advocacy groups, should be reached.

The feasibility study data presented in this paper help to justify the existing readiness for a mandate for universal preventive health training for child care providers. What needs to be further addressed is the question of how such training can be delivered. The consortium model that is currently being tested in California is one such model for implementation. Obviously, other approaches exist, such as centralized, statewide training. Whatever direction is taken, the ultimate goal is improved standards of health and safety for all children who receive child care services.

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Availability and Use of Hepatitis B Vaccine in Laboratory and Nursing Schools in the United States

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Synopsis

Hepatitis B is a well-documented occupational hazard for health care workers, including both laboratory and nursing personnel. Since the development of effective hepatitis B vaccines, the Immunization Practices Advisory Committee (ACIP) has recommended that health care workers receive the vaccine. In this study, 78 laboratory training programs and 83 nursing training programs were surveyed regarding availability and usage of hepatitis B vaccine. The hepatitis B vaccine was made available to students in 81 percent of the laboratory programs and 23 percent of the nursing programs.

In those programs making the vaccine available, only 59 percent of the laboratory programs and 5 percent of the nursing programs reported a high (greater than 75 percent) use by students. Concern about cost and payment for the vaccine was the most common reason (80 percent) noted by laboratory schools that did not have hepatitis B vaccina-

tion programs for students. Of the nursing schools that did not have vaccine programs, 58 percent had not yet considered a program. At laboratory schools with vaccination programs, who paid for the vaccine (hospital or school versus student) was among the most important determinants for vaccine usage by students. These findings point out that some laboratory schools and many nursing schools have not applied the ACIP recommendations to their own programs. Educational efforts and creative payment plans for the vaccine are needed to increase the availability and use of hepatitis B vaccine among laboratory and nursing students.

HEPATITIS B is a well-documented occupational hazard for health care workers, including both laboratory and nursing personnel (*1*). The risk for acquiring hepatitis B virus infection is related to both the frequency of exposure to blood and body fluids and the frequency of needlesticks (*2*). Although these frequencies vary throughout a health care worker's training and work career, the risks of these exposures are presumably high during the professional training period.

In June 1982, a plasma-derived hepatitis B vaccine was licensed. In July 1986 and February 1989, additional vaccines produced by recombinant DNA technology were licensed. Because of the availability of these effective vaccines, the Immunization Practices Advisory Committee (ACIP) of the Public Health Service and other organizations have recommended those at risk of acquiring hepatitis B infection, including nurses and laboratorians, be vaccinated against hepatitis B (*3–5*). Laboratory and nursing schools are excellent settings to reach large numbers of health care workers at risk for hepatitis B, because students are accessible and have not yet experienced intensive occupational exposure. In the United States in the 1987–88 academic year, 3,432 students were graduated from 464 medical technology programs and 1,148 students, from the 97 medical laboratory technician programs (*6*). Registered nurses graduated from U.S. nursing programs in the 1986–87 academic year numbered 23,761 from baccalaureate programs and 38,528 from associate degree programs (*7*). Several studies have examined the level of hepatitis B vaccine use by medical and surgical residents (*8*), physicians (*9,10*), and dentists (*11*). The purpose of this study was to assess how many laboratory and nursing schools have implemented hepatitis B vaccination programs for their students and to identify reasons why programs may have not yet been implemented or why student usage might be low.

Methods

The study consisted of a nationwide telephone survey of 75 randomly selected nursing schools and 75 randomly selected laboratory training schools. The laboratory training schools were selected from the list of accredited U.S. schools obtained from the Committee on Allied Health Education and Accreditation. The National League for Nursing supplied the list of accredited U.S. nursing schools. Laboratory and nursing programs were sampled separately to maintain homogeneity in sample groups. Associate and baccalaureate degree programs were considered separately in each of these two samples, but if a school provided training at both degree levels, data on each program were collected. Replacement sampling was done for schools or programs that had declared inactive status, moved or merged, or closed for the summer with no access to faculty or administrators.

The survey instrument was a 21-item questionnaire administered by telephone interview. Telephone calls were made between May and July 1989 to program directors and student health services; instructors also completed the questionnaire when neither of the other category of respondents was available. Information was collected regarding general prematriculation immunization requirements (PMIRs), students' clinical experience, hepatitis B vaccine availability and protocol, hepatitis B testing for students, and reasons for not having a hepatitis B vaccine program. Each section of the survey focused on variables that might be related to the availability and usage of the hepatitis B vaccine by students in laboratory or nursing training schools.

Questions regarding PMIRs were based on the position statements made by the American College Health Association (*12,13*). Rationales for lack of hepatitis B vaccine programs were assessed to determine why the schools had not applied the ACIP guidelines to their programs, so that appro-

priate recommendations could be made to increase the availability and use of the hepatitis B vaccine.

Demographic information, such as number of students, geographic location, degree type, and program affiliation, was also recorded for each school. Program affiliation was defined by the location of administrative control of the complete student training program (university, college, hospital, and so forth).

For open-ended questions, a list of common responses was given to structure the discussion. Any responses not on the list were also included. Responses that were mutually exclusive, such as "recommended or strictly voluntary," were defined to assure understanding and accurate responses. The telephone survey allowed for redirected questioning and immediate corrections in the case of an inconsistent response.

A printed copy of the questionnaire was sent to each participant to increase familiarity with the survey's content. Although most copies were mailed after the interviews were completed, the accompanying letter asked the participants to contact the investigators if they wanted to clarify or change any of their previous responses.

Characteristics of training programs were compared according to each factor using the chi-square test. To control for confounding by one or more variables, results were adjusted by the standard method before comparison. All statistical analyses were carried out using the Statistical Analysis System (SAS) for mainframe computers.

Results

Of the 75 laboratory training schools and 75 nursing schools initially selected, two nursing and three laboratory programs were unreachable, and three nursing and three laboratory schools were either inactive or had changed their program organization. After these schools were replaced, all schools contacted agreed to participate in the study. For three laboratory and eight nursing programs offering multiple degrees, data were obtained for both degree levels. Thus, 78 laboratory programs and 83 nursing programs participated. The ratio of baccalaureate to associate degree programs in the two samples (table 1) was representative of those ratios in the U.S. populations of laboratory and nursing schools.

Most laboratory schools were hospital-based with enrollments of 1 to 10 students, while most nursing schools were university-based with enrollments of 11 to 50 students (table 1). None of the nursing programs were hospital-based. Most laboratory students spent more than 960 hours in clinical training, while most nursing programs required 960 or fewer total clinical hours of their students. Both types of schools had a yearly average of one to two reported student needlesticks, splashes, or other traumatic exposures to blood. Less than 5 percent of both laboratory and nursing schools reported any cases of acute hepatitis B among students in the previous 5 years. More nursing than laboratory schools had PMIRs (93 percent of nursing schools versus 56 percent of laboratory schools), while more laboratory schools provided routine hepatitis B testing to their students (41 percent of laboratory schools versus 8 percent of nursing schools).

The two major outcomes measured were the proportion of programs that made the hepatitis B vaccine available to students and the proportion of

Table 1. Selected demographic variables in U.S. laboratory and nursing schools

Variable	Laboratory (N = 78)		Nursing (N = 83)	
	Number	Percent	Number	Percent
Degree level:				
Baccalaureate	57	73	40	48
Associate	21	27	43	52
Affiliation:				
Hospital	44	56	0	...
University or college	20	26	59	71
Junior college, technical college, or community college	14	18	24	29
Enrollment (number of students):				
1–5	22	28	0	...
6–10	42	54	0	...
11–50	14	18	52	63
51–250	0	...	31	37
Time in clinical training (hours):				
1–960	24	31	50	60
960–2304	54	69	33	40
Acute cases of hepatitis B in previous 5 years:				
Any	4	5	2	2
None	73	95	80	98
Reported exposures annually:				
None	5	7	11	13
1–2	47	60	52	63
3 or more	26	33	20	24
Any prematriculation requirements:				
Yes	44	56	77	93
No	34	44	6	7
Routine testing for hepatitis B:				
Yes	31	41	7	8
No	45	59	76	92

Table 2. Selected variables related to the hepatitis B vaccine program in U.S. laboratory and nursing schools

Variable	Laboratory (N = 78)		Nursing (N = 83)	
	Number	Percent	Number	Percent
Hepatitis B vaccine program:				
Yes	63	81	19	23
No	15	19	64	77
Use of hepatitis B vaccine among schools with program:				
Greater than 75 percent take	37	59	1	5
Less than 75 percent take	26	41	18	95
Vaccine policy:				
Required	7	11	1	5
Recommended	40	64	8	42
Strictly voluntary	16	25	10	53
Who pays among schools with program:				
Student alone	24	38	17	90
Part student, part hospital, part university	4	6	2	10
Hospital or university	35	56	0	...
Source of student payment:				
Out-of-pocket	26	93	19	100
Tuition	2	7	0	...

'Although the nursing programs show a greater need for increased hepatitis B vaccine availability and use than do laboratory schools, there is a need to address the barriers to use of the hepatitis B vaccine by both laboratory and nursing students.'

students who received vaccine in those programs (table 2). Programs making the vaccine available for their students were defined as those that had formally sought out and identified a source from which students in their programs could receive the vaccine if they so chose. Eighty-one percent of the laboratory training schools made the hepatitis B vaccine available to their students, while only 23 percent of the nursing schools made the vaccine available ($P<.01$).

In schools that made the vaccine available, 59 percent of the laboratory schools and 5 percent of the nursing schools had 75 percent or more of their students receiving the vaccine. For laboratory schools that made the vaccine available, 75 percent required or actively recommended the vaccine to all their students, and 56 percent paid for the entire cost of vaccination. For nursing schools, only 47 percent required or actively recommended the vaccine, and the student usually paid the entire cost.

Univariate analysis showed that laboratory schools offering a baccalaureate degree, those with a hospital affiliation, and those requiring their students to complete more than 960 hours in clinical training were significantly more likely to have a hepatitis B vaccine program (table 3). The number of reported exposures, cases of hepatitis B, existent PMIRs, and the practice of routine hepatitis B testing were not significantly related to hepatitis B vaccine availability in these schools. The odds of vaccine availability in laboratory programs offering a baccalaureate degree (odds ratio [OR] = 9.5, $P<0.001$) was related primarily to school affiliation. Programs affiliated with hospitals had a higher likelihood of vaccination programs (OR = 43.0, $P<0.001$), and after adjustment for school affiliation, neither degree nor hours in clinical work significantly predicted presence of a vaccination program.

Among laboratory schools that made the hepatitis B vaccine available, the likelihood of student use of the vaccine was significantly increased in programs that were hospital-based, notified students of availability, and recommended the vaccine at orientation or at the incoming physical examination (table 4). The likelihood of students' using of an available vaccine was significantly increased if someone other than the student paid for the vaccine (OR = 8.1, $P<0.001$). That relationship held true after adjusting for time spent in clinical work, vaccine policy, and school affiliation. A similar stratified analysis showed that vaccine policy (required versus recommended versus voluntary) and affiliation (hospital versus other) also independently predicted vaccine utilization, while time in clinical work was not an independent predictor of vaccine use. The likelihood of vaccine use was also increased in schools where the student spent more than 960 hours in clinical training. A nonstandardized method of notifying the student of vaccine availability significantly decreased the likelihood of student use of available vaccine.

Univariate analysis of the nursing schools' data showed that university- and college-based programs offering baccalaureate degrees had a significantly increased likelihood of making the hepatitis B vaccine available to their students (table 5). None of the other variables were significantly associated with vaccine availability in nursing schools. Analysis of nursing students' use of the hepatitis B

Table 3. Selected characteristics of U.S. laboratory training schools associated with having a hepatitis B vaccination program

Variable	Total number with variable	Vaccination program and variable		Odds ratio	95 percent confidence interval	P
		Number	Percent			
Degree:						
Baccalaureate	57	52	91	9.5	3.0–29.8	0.001
Associate	21	11	[1]52	...	...	...
Affiliation:						
Hospital	44	43	98	43.0	4.1–1,979.9	0.001
University	20	13	65	1.86	0.4–9.3	0.389
Junior college, technical college, community college	14	7	[1]50	...	...	...
Time in clinical training:						
1–960 hours	24	14	[1]58	...	...	...
961–2,304 hours	54	49	91	7.0	1.8–29.8	0.001
Any prematriculation requirements:						
Yes	44	34	77	0.6	0.2–1.9	0.373
No	34	29	[1]85	...	...	...
Routine testing for hepatitis B:						
Yes	31	25	81	1.0	0.3–3.3	0.945
No	45	36	[1]80	...	...	...

[1] Reference level.

Table 4. Factors related to student use of the hepatitis B vaccine in U.S. laboratory training schools with hepatitis B vaccination programs

Variable	Total number with variable	Vaccination program and variable		Odds ratio	95 percent confidence interval	P
		Number	Percent			
Who pays:						
All hospital-colleges	39	30	77	8.1	2.7–24.4	0.001
All or part student	24	7	[1]29	...	...	...
Time in clinical training:						
1–960 hours	14	4	[1]29	...	...	...
961–2,304 hours	49	33	67	5.2	1.2–25.4	0.009
Affiliation:						
Hospital	43	31	72	8.6	1.7–54.7	0.001
University	13	3	[1]23	...	...	...
Junior college, technical college, community college	7	3	43	2.5	0.2–27.1	0.369
Vaccine policy:						
Required	7	7	100	∞	...	...
Recommended	40	27	[1]68	1.0	...	...
Strictly voluntary	16	3	19	0.1	0.0–0.5	0.001
Availability notice:						
Nonstandardized	9	1	[1]11	...	...	...
At orientation	43	31	72	20.7	2.2–945.5	0.001
At physical examination	25	21	84	42.0	3.4–1947.2	0.001

[1] Reference level.

vaccine was not feasible because only 19 of the 83 participating nursing schools made the vaccine available, and only one had more than 75 percent of students receiving the vaccine.

The factors cited most often by laboratory and nursing schools for not making the hepatitis B vaccine available to their students were different between the two disciplines (table 6). Eighty percent of the laboratory schools not offering hepatitis B vaccine were most concerned with cost and funding, and to a lesser degree had not attained an awareness to even consider the vaccine for their students (47 percent). Other reasons given by laboratory schools for not making the vaccine available included the perceptions that the students are not at risk because of either to working conditions or rural setting, that vaccination is the hospital's responsibility, and that vaccinating students should

Table 5. Selected characteristics of U.S. nursing schools associated with having a hepatitis B vaccination program

Variable	Total number with variable	Vaccination program and variable		Odds ratio	95 percent confidence interval	P
		Number	Percent			
Degree:						
Baccalaureate	40	13	33	3.0	1.0–8.6	0.044
Associate	43	6	[1]14	...	...	...
Affiliation:						
University	59	17	29	4.5	1.0–19.2	0.044
Junior college, technical college, community college	24	2	[1]8	...	...	...
Any prematriculation requirements:						
Yes	77	17	22	0.6	0.1–3.3	0.527
No	6	2	[1]33	...	...	...
Time in clinical training:						
1–960 hours	50	8	[1]16	...	...	...
961–2,304 hours	33	11	33	2.6	0.8–8.6	0.067
Routine testing for hepatitis B:						
Yes	7	2	29	1.5	0.3–8.3	0.658
No	75	16	[1]21	...	...	...

[1] Reference level.

Table 6. Variables related to absence of a hepatitis B vaccination program in U.S. laboratory and nursing schools

Variable	Laboratory (N = 15)		Nursing (N = 64)	
	Number	Percent	Number	Percent
Not yet considered	7	47	37	58
Cost or funding	12	80	33	52
Hospital's responsibility	3	20	14	22
Students not at risk	2	13	21	33
Small, rural area	3	20	5	10
No student health services	2	13	14	22
High dropout rate	0	...	1	2
Fear AIDS	0	...	2	3
Hospital employment not required	1	7	3	6
Adult learners	0	...	6	12

not be emphasized when hospital employees do not universally have the vaccine available. Two of the laboratory schools without a hepatitis B vaccine program had no student health services, so health care was not monitored or provided for any students.

Nursing schools most often stated that they had not yet considered a vaccine program (58 percent). Cost and funding issues, lack of student health services, belief that the hospital should be responsible for the vaccination, and a lack of perceived risk for the student were also cited by a large percentage of the nursing schools. Several nursing schools also stated that a fear of acquired immunodeficiency syndrome (AIDS) transmission and a high dropout rate (in which case vaccine would be wasted) were hindrances to implementing a hepatitis B vaccine program. Some nursing programs enrolled mostly adult students from associate or diploma programs who were already practicing registered nurses; staff in these programs did not believe it was their responsibility to make health recommendations related to the students' professional practices.

Discussion

Hepatitis B vaccine was made available to students by 81 percent of laboratory and 23 percent of nursing schools. In programs making the vaccine available, only 59 percent of the laboratory and 5 percent of nursing programs reported a high (greater than 75 percent) use by students. These findings point out that many U.S. nursing schools have not applied the ACIP recommendations to their own programs. In those nursing schools that did make the vaccine available, a large percentage of the students did not participate in the hepatitis B vaccine program. Most of the laboratory schools have followed ACIP recommendations by establishing hepatitis B vaccination programs for their students. For laboratory schools that made the hepatitis B vaccine available, payment and funding for the vaccine was one of the most important determinants for the use of vaccine by students.

To stimulate the implementation of ACIP recommendations regarding hepatitis B vaccination of students in health care occupations, efforts need to be focused on nursing programs to increase availability and students' use of the hepatitis B vaccine. Although the nursing programs show a greater need for increased hepatitis B vaccine availability

and use than do laboratory schools, there is a need to address the barriers to use of the hepatitis B vaccine by both laboratory and nursing students. A major step toward increasing the use of the hepatitis B vaccine by these students would be to make the vaccine available at no cost to the students in their training programs. If this is not possible, several payment plans could be considered to attain the goal of increased student use of the vaccine.

Special agreements with the schools' clinical affiliates might be made, trading student work in the clinics for free or subsidized vaccine from the affiliate. In situations where the students do not have a long term stay at any one affiliate, the group of clinical affiliates of the nursing or laboratory programs could arrange a pool with fractional contributions to assure that students receive vaccine. The schools' training programs themselves may set up such a pool-sharing funding from various sources. School- or hospital-based programs may choose to include the full or partial cost of vaccine in tuition or fees for the training degree, thus minimizing impact of payment for the student. Some programs may choose to have the costs shared by the student, the clinical affiliate, and the scholastic institution. Creative payment plans for student vaccination programs are important because Occupational Safety and Health Administration regulations regarding hepatitis B vaccine availability for health care workers apply only to those in an employer-employee relationship. Therefore, the students' clinical site has no legal responsibility to subsidize or pay for the students' vaccinations.

Education regarding the risk of hepatitis B in the occupational setting and the need for hepatitis B vaccine could be an effective way to increase availability of the vaccine in laboratory, and especially, nursing schools. In this study, most nursing schools without hepatitis B vaccine programs had not yet even considered a program. Administrators of schools with nursing programs should receive extensive education to make them aware of the risk of hepatitis B virus infection, the need for vaccination, and the ACIP recommendations regarding hepatitis B. Through education of the staff and administrators, the focus of responsibility for both the concern regarding hepatitis B and payment for vaccine may shift to the school program itself, resulting in more extensive application of the ACIP recommendations on hepatitis B vaccination.

This study heightened awareness not only in the 78 laboratory schools and 83 nursing schools, but also for the other allied health professions within the administrative responsibilities of the respondents. At the end of the study interview, 22 schools or associated persons such as student health services personnel requested printed copies of the Centers for Disease Control's recommendations regarding bloodborne diseases and hepatitis B vaccination protocols. Education focused toward the increased awareness and perceived need for the vaccine availability in laboratory and nursing schools is an important method to stimulate the implementation of ACIP recommendations for vaccination of health care workers and to prevent occupationally acquired hepatitis B.

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