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# Physicians' Attitudes and Behaviors Regarding Hepatitis B Immunization

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**Background.** Hepatitis B virus (HBV) infections are a serious health problem in the United States, where approximately 18,000 cases are reported each year to the Centers for Disease Control. Even among health care providers, reported vaccination rates have ranged from 17% to 68%. The purpose of this study was to determine the important factors influencing physicians in an academic medical center to receive the HBV vaccination since the introduction of recombinant yeast-derived vaccines.

**Methods.** The 1282 house staff and attending physicians in a university medical center were surveyed regarding their HBV vaccination history. The characteristics of vaccinated and nonvaccinated physicians and their attitudes and concerns regarding vaccination were compared.

**Results.** Of the 813 physicians who responded, 54.0% had been vaccinated. Vaccination rates varied with level of training, from 91.9% among first- and second-year residents to 32.2% among attending physicians. Al-

though physicians in specialties at higher risk for infection were more likely to have been vaccinated, only 40.0% of pathologists and 51.9% of obstetrician-gynecologists reported having been vaccinated. Using multivariate analysis, we found important demographic predictors of HBV vaccination included physician sex and years since graduation, as well as level of training and specialty. Physicians who had been offered the vaccine were more likely to have been vaccinated.

**Conclusions.** These results show that many physicians in an academic medical center, particularly those at an early stage of their training, have received HBV vaccination. Our results suggest that programs offering hepatitis B vaccinations to physicians can be effective in reducing this group's risk of hepatitis B infections. Special efforts may be necessary to reach physicians who have completed their training.

**Key words.** Hepatitis B; immunization; physicians.  
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Hepatitis B virus (HBV) infections remain an important health problem in the United States, where approximately 18,000 cases are reported each year to the Centers for Disease Control. The actual incidence, including unreported cases, is estimated to be from 3 to 10 times greater than the number of reported cases.<sup>1</sup> Although most infections resolve without sequelae, up to 10% of those infected will develop a chronic HBV-carrier state, posing the risk of transmitting the virus to others. These carriers also risk developing more serious complications, such as chronic active hepatitis, cirrhosis, chronic liver failure, and primary hepatocellular carcinoma.<sup>2,3</sup>

Specific groups, including male homosexuals, intravenous drug users, contacts of known HBV carriers, and health care providers, have a higher risk of acquiring

HBV infections. Infections in these groups can be effectively prevented using one of several HBV vaccines.<sup>4</sup> Vaccination rates among high-risk groups, however, remain low. Even among health care providers, who should be better informed about the seriousness of hepatitis B and the availability and benefits of vaccinations, vaccination rates have been inconsistent. Studies have reported rates in different settings varying from 17% to 68%.<sup>5-12</sup>

Higher vaccination rates among health care workers have been associated with a greater perceived risk of infection, and the belief that infection carries a poor prognosis. Lower vaccination rates have been associated with concerns about vaccine efficacy, a low perceived risk of infection, and, most important, fears about vaccine safety.<sup>9-14</sup> Most studies of barriers to HBV vaccination, however, were performed before the introduction of recombinant yeast-derived HBV vaccine. Although the earlier plasma-derived vaccine has not been reported to have caused any human immunodeficiency virus (HIV)

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infections, low vaccination rates may be due to concerns about the risk of acquiring HIV infections. The newer recombinant yeast-derived vaccines may have a lower perceived risk of transmitting HIV, and thus lead to greater acceptance.

We surveyed attending and house staff physicians in an academic medical center after the introduction of the recombinant yeast-derived vaccine. Physicians as a group have a fivefold greater risk of being infected than the general population<sup>15</sup>; physicians still in training are at even greater risk.<sup>16</sup> Our objectives were to determine whether more physicians are being vaccinated than reported in studies prior to the introduction of the recombinant yeast-derived vaccine, and what factors influence physicians to become vaccinated.

## Methods

In the spring of 1989, a 25-item survey on HBV vaccination was sent to all house staff and attending physicians at a university medical center. These physicians were identified using lists provided by the medical staff and house staff offices. The medical staff list of physicians provided was cross-checked against those listed in a patient referral guide published by the hospital to verify the physicians' active involvement in patient care. A second survey was sent to those who did not respond to the initial survey.

In the survey, physicians were asked whether they had been immunized against HBV, and if so, when and which vaccine was used. Physicians who had serologic evidence of previous exposure to hepatitis B were identified so that those with past resolved or chronic infections would be excluded. The demographic characteristics of the physicians (sex, race, years since graduation, level of training, and specialty) were determined as well as their perceptions regarding potential barriers to HBV vaccination. The survey questions on perceived barriers were based on the Health Belief Model, which has been used extensively to explain differences in health behavior and in developing interventions to change health behavior patterns.<sup>17</sup> The Health Belief Model constructs were measured using 7-point Likert scales and included the following areas: perceived risk of HBV infections, perceived severity of HBV-infection sequelae, perceived vaccine efficacy and benefits, concerns about vaccine safety and costs, perceived availability, and cues to action.

Analyses were performed to determine the proportion of physicians who had received HBV vaccination. Variations in vaccination rates as a function of each physician characteristic were compared using chi-square tests. A logistic regression model was developed to de-

termine the effects of the perceived barriers to HBV vaccination while controlling for potential confounding by physician demographic characteristics. The demographic variables for this model were first selected by entering all of the demographic variables into a stepwise logistic regression. The significance level for exit was  $\alpha = .10$ . A base demographic model was selected after also entering those a priori hypothesized two-factor interactions between demographic variables that had a significant chi-square improvement statistic ( $P < .05$ ). The individual effect of each barrier on HBV vaccination, controlling for the demographic characteristics, was then determined by separately adding each barrier to the base demographic model. The  $\beta$ -coefficients and adjusted odds ratios of being vaccinated against hepatitis B for each perceived barrier were calculated to reflect a 1 unit increase in agreement with the Likert-scaled perceived barrier.

In the final multivariate logistic regression model, the combined effects of the perceived barriers to HBV vaccination were determined. This model was constructed using the base model plus those barrier variables found independently to have an improvement chi-square of  $P < .05$  compared with the base model, and to predict a 10% or greater change in the percentage of physicians vaccinated based on the minimum and maximum response values for the barrier question.

## Results

Surveys were sent to a total of 1282 physician. Excluded from the analysis were 22 physicians who were no longer affiliated with the hospital as indicated on returned questionnaires. Two medical students appearing on the house staff list were also excluded. After two mailings, 813 physicians returned completed surveys for a response rate of 64.6%. The sex, level of training, and specialty distributions for the respondents are summarized in Table 1. Although precise information on the demographic characteristics for the nonrespondents was not available, the names and department mailing addresses on the medical staff and house staff lists were used to estimate the distributions for the total sample (Table 1). The respondents were similar to the total sample with respect to sex and specialty, but attending physicians were more likely to have responded than house staff ( $P < .05$ ).

Of the 813 physicians, 439 (54.0%) had been vaccinated. Vaccination was not indicated for an additional 47 (5.8%) physicians, who reported serologic evidence of previous HBV exposure. The remaining 327 (40.2%) physicians were unvaccinated and did not report previous HBV exposure. Among those vaccinated, 26.2% (115)

Table 1. Physician Demographic Characteristics Among Respondents and Total Sample\*

Physician Characteristic	Respondents, % (n = 813)	Total Sample, %† (N = 1282)
Sex		
Female	23.9	25.3
Male	76.1	74.7
Level of training‡		
House staff (resident)	52.6	59.7
Other, including fellow	3.4	0.0
Attending	44.1	40.3
Specialty		
Emergency medicine	3.2	2.7
Anesthesiology	9.1	8.9
Surgery	21.1	21.9
Medicine/family practice	31.5	29.7
Obstetrics/gynecology	3.5	4.0
Pediatrics	11.5	12.0
Pathology	5.3	5.0
Other	14.8	15.8

\*Total numbers for each characteristic vary owing to missing or indeterminate data.  
 †Distributions estimated from names and addresses on mailing lists.  
 ‡P < .05, chi-square comparing distribution of physician level of training for respondents with total sample.

received the recombinant yeast-derived vaccine, 58.5% (257) received the plasma-derived vaccine, and 15.3% (67) were uncertain which vaccine they had received. Figure 1 shows a precipitous shift from the use of plasma-derived vaccine to the use of recombinant yeast-derived vaccine between 1986 and 1988, after the latter

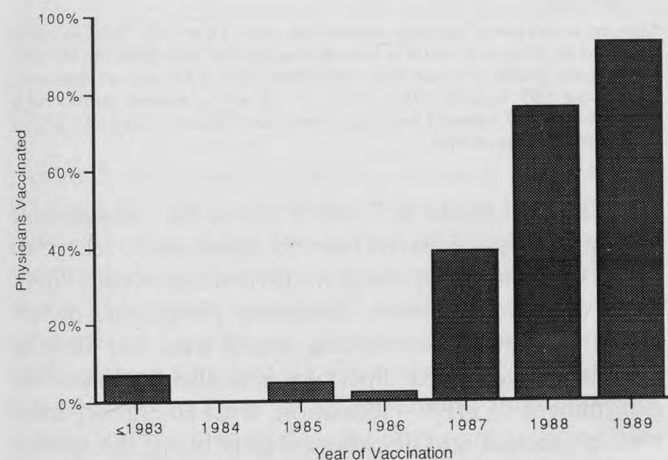


Figure 1. The graph indicates an increase in the use of yeast-derived hepatitis B vaccine. Of the 439 physicians surveyed who indicated that they had been vaccinated, 237 had received the plasma-derived vaccine, 115 had received the yeast derived, and 67 were uncertain as to which they had received. The percentage of vaccinated physicians who received the yeast-derived vaccine from 1986 to 1989 increased. (Note: The yeast-derived form of the vaccine was not approved for general use until 1986. Those physicians who indicated that they had received the yeast-derived form before this time were either part of documented experimental protocols or mistaken).

Table 2. Vaccination Rates by Physician Characteristics

Physician Characteristic	Vaccinated No. (%)	P Value*
Sex		
Female	98 (55.1)	.394
Male	335 (58.7)	
Race/ethnicity		
White	360 (57.7)	.953
Black	10 (55.6)	
Asian	41 (58.6)	
Hispanic	11 (64.7)	
Other	6 (50.0)	
Years since graduation		
0-4	216 (84.1)	<.001
5-9	127 (64.5)	
10-19	52 (36.1)	
20-29	12 (20.0)	
30+	10 (15.2)	
Level of training		
R1-R2	125 (91.9)	<.001
R3-R4	122 (76.3)	
R5-R6	74 (68.5)	
Attending	102 (32.2)	
Other, including fellow	9 (37.5)	
Specialty		
Emergency medicine†	23 (92.0)	<.001
Anesthesiology†	54 (79.4)	
Surgery†	108 (71.1)	
Medicine/family medicine	128 (55.4)	
Obstetrics/gynecology†	14 (51.9)	
Pediatrics	43 (48.9)	
Pathology†	16 (40.0)	
Others	43 (38.7)	

\*Calculated using chi-square.  
 †High-risk specialties.

became available. Pre-1986 use of recombinant yeast-derived vaccines can be explained by anecdotal reports of vaccinations used in experimental protocols.

Vaccination rates were related to several physician characteristics (Table 2). More recent medical school graduates were much more likely to have been vaccinated. Vaccination rates increased from only 15.2% of physicians who had graduated 30 or more years ago to 84.1% of those graduating in the past 4 years. Although not shown, a similar inverse relationship was found between vaccination rates and physician age, as physician age was very strongly negatively correlated to year of graduation ( $R = -.959, P < .001$ ). Physicians who were at an early stage in their training were more likely to be vaccinated. Of all first- and second-year residents 91.9% reported that they had been vaccinated, compared with 76.3% of third- and fourth-year residents, and 68.5% of fifth- and sixth-year residents. Only 32.2% of the attending physicians surveyed had been vaccinated. Among the physicians in the various specialties, many of those at higher risk for acquiring HBV infections had been vac-

cinated,<sup>15,16,18,19</sup> including 92.0% of emergency room physicians and 71.1% of surgeons (excluding obstetrician-gynecologists); however, only 40.0% and 51.9% of the pathologists and obstetrician-gynecologists, respectively, had been immunized. Vaccination rates did not differ significantly by physician sex or race.

Stepwise logistic regression was used to develop a base model that controlled for differences in physician demographic characteristics. On this multivariate analysis, sex (a dichotomous variable) as well as number of years since graduation (a continuous variable), level of training (dichotomous variable for attending vs house staff), and specialty (dummy variables for emergency medicine, pediatrics, obstetrics and gynecology, surgery, anesthesiology, pathology, and other specialties, with internal medicine and family practice for the reference group) were found to be significantly related to HBV vaccination. Also found to be significant was an interaction term between level of training and years since graduation.

To assess the independent association of the perceived barriers after controlling for differences in demographic characteristics, each barrier was then added separately to this base demographic model. The  $\beta$ -coefficients, adjusted odds ratio (OR), and 95% confidence intervals of being vaccinated, which reflect a 1 unit increase in agreement with the Likert-scaled perceived barriers, are shown in Table 3 for those barriers found to be clinically and statistically related to HBV vaccination (see Methods section). Perceived availability and cues to action were strongly associated with HBV vaccination; physicians who noted that the vaccine was readily available and who had been specifically offered it were more likely to have been vaccinated than those who had not (OR = 1.29 and 1.29, respectively), while physicians perceiving greater time and effort required for vaccination were less likely to have been vaccinated (OR = 0.65). Concerns about adverse effects, including HIV infections and local reactions, were associated with a decreased likelihood of having been vaccinated (OR = 0.82 and 0.60, respectively). Concerns about the cost of the vaccine to self and society similarly predicted a lower probability of having been vaccinated (OR = 0.68 and 0.67, respectively). Vaccinations increased among physicians who perceived that HBV infection would jeopardize their medical practice (OR = 1.15), and decreased among those who perceived greater vaccine permanence (OR = 0.85). Potential barriers not related to HBV vaccination included: concerns about HBV infection sequelae, vaccine effectiveness, risk of transmitting the virus to patients and family, and perceived risk of acquiring HBV infections (both for self and for physicians in general).

Table 3. Independent Effect of Perceived Barriers on Hepatitis B Vaccination, Adjusted for Differences in Physician Demographic Characteristics Using Logistic Regression\*

Perceived Barriers	$\beta$	Adjusted Odds Ratio	95% CI
<b>Safety</b>			
Vaccine causes significant local reaction	-0.52	0.60	0.52-0.68
Concerned about HIV infection from the vaccine	-0.20	0.82	0.71-0.95
<b>Availability</b>			
Getting vaccine takes too much time and effort	-0.43	0.65	0.58-0.74
Vaccine is readily available	0.26	1.29	1.12-1.48
<b>Cue to action</b>			
Was specifically offered vaccine	0.26	1.29	1.20-1.40
<b>Costs</b>			
Not worth vaccinating all physicians (cost)	-0.40	0.67	0.59-0.76
Costs me too much to be vaccinated	-0.39	0.68	0.59-0.78
<b>Efficacy</b>			
Vaccine provides permanent protection	-0.16	0.85	0.75-0.97
<b>Severity</b>			
HBV infection would jeopardize medical practice	0.14	1.15	1.04-1.27

\*Agreement with barrier statement measured on 7-point Likert scales. Perceived barrier statements not found to be related to hepatitis B vaccination (not shown) include: HBV vaccine is very effective; concerned about transmitting HBV to patients; concerned about transmitting HBV to family; HBV sequelae are not serious; minimal personal risk of HBV infection; and estimated percentage of physicians infected. CI denotes confidence interval.

The final model in Table 4 shows the demographic factors and the perceived barriers significantly related to HBV vaccination on using multivariate analysis. Physicians who were women, attending physicians, or less recent graduates from medical school were less likely to have been vaccinated. Specialty was also an important determinant of HBV vaccination, with emergency medicine physicians and anesthesiologists being the specialties most likely to have been vaccinated. Among the perceived barriers, physicians who had been specifically offered the vaccine were more likely to have been vaccinated. Physicians were significantly less likely to have been vaccinated if they had greater concerns about the vaccine causing a significant local reaction, taking too much time and effort to get, or not being worth the cost of vaccinating all physicians. The perception that the vaccine provided permanent protection was greater among unvaccinated physicians.

Table 4. Final Logistic Regression Model of Perceived Barriers and Demographic Characteristics Predicting Hepatitis B Vaccination by Physicians

Variable	$\beta$	Adjusted Odds Ratio	95% CI
Sex: female	-0.53	0.59	0.35-1.00
Years since graduation	-0.13	0.88	0.81-0.96
Level of training: attending	-1.74	0.18	0.08-0.41
Specialty			
Emergency medicine*	2.28	9.75	1.41-67.31
Anesthesiology*	1.26	3.53	1.37-9.11
Surgery*	0.66	1.93	1.00-3.72
Obstetrics/gynecology*	0.37	1.45	0.44-4.71
Pediatrics	-0.24	0.79	0.38-1.65
Pathology*	-0.56	0.57	0.20-1.65
Other	-0.94	0.39	0.19-0.80
Level of training * Years since graduation (interaction term)	0.08	1.08	0.99-1.18
Vaccine causes significant local reaction	-0.48	0.62	0.53-0.71
Getting vaccine takes too much time and effort	-0.24	0.79	0.69-0.91
Was specifically offered vaccine	0.26	1.29	1.18-1.42
Not worth vaccinating all physicians (cost)	-0.34	0.71	0.62-0.82
Vaccine provides permanent protection	-0.20	0.82	0.71-0.96

\*High-risk specialties.

CI denotes confidence interval.

## Discussion

This study shows that in recent years more physicians in an academic medical center were vaccinated against HBV. Based on either the number of years since graduation or level of training, more recently graduated physicians had higher vaccination rates. Vaccination rates appeared to decrease as physicians advanced in their training, from a high of 91.9% among first- and second-year residents to a low of 32.2% among attending physicians. The vaccination rates for physicians early in training and recently graduated from medical school (Table 2) compare very favorably with the rates of 17% to 68% reported in earlier studies.<sup>5-12</sup>

Although much of the increase in HBV vaccination has occurred in cohorts graduating or entering residency training after the yeast-derived vaccine was introduced, other factors, such as wider implementation of programs specifically offering HBV vaccination to house staff, could explain the higher vaccination rates. It would be interesting to compare the attitudes toward hepatitis B

vaccination of physicians who received the plasma-derived vaccine with the attitudes of those who received the yeast-derived vaccine, but the rapid transition from the plasma-derived vaccine to the yeast-derived vaccine (Figure 1) precludes a meaningful analysis of this issue. Most of the physicians who received the plasma-derived vaccine graduated before 1986, whereas those who received the yeast-derived vaccine would include many residents graduating after its introduction. Comparisons of the two groups would therefore more likely reflect the differences in attitudes among younger vs older physicians rather than the type of vaccine received.

Several other factors distinguished those physicians who had been vaccinated from those who had not. Vaccination rates varied among physician specialties, with most of the higher risk specialties having high percentages of physicians vaccinated; but a few specialties such as pathology and obstetrics-gynecology still had relatively few physicians vaccinated. This relative underutilization remains even after controlling for possible confounding factors, such as physician age (years since graduation), sex, and level of training. Caution should be taken, however, in generalizing this finding, as it may reflect institution-specific factors.

Among the attitudinal factors predicting vaccination, concerns about vaccine safety found in previous studies persist despite the availability of the yeast-derived vaccine.<sup>9-14</sup> Physicians who had not been vaccinated were more concerned about significant local reactions than those who had been vaccinated. However, given that this was a retrospective survey, this finding may reflect a comparison between anticipated problems among those not vaccinated and the actual experience of those vaccinated. There may still be some unfounded concerns about acquiring HIV infections from the vaccine, as seen in Table 3. Because of multicollinearity in the final logistic regression model, minor concerns about HIV might not be seen if these concerns were strongly correlated with another included barrier such as concerns about local reactions.

In contrast to other studies,<sup>10-13</sup> perceived risk and severity of HBV infections were not important determinants of HBV vaccination. This finding may reflect better awareness about HBV infections among all physicians, thus reducing the impact of perceived risk and severity on HBV vaccination. Instead, the factors that have gained in relative importance in determining whether a physician is vaccinated include access to the vaccine, availability and financial cost, and cues to action.

The cross-sectional design of this study limits our ability to determine conclusively the factors influencing whether physicians receive HBV vaccination. Although some physicians may have incorrectly recalled whether

they had been vaccinated, this seems unlikely, given that HBV vaccination involves three separate injections. A greater problem is that the attitudes of vaccinated physicians may have been influenced by their experience with the vaccine. Differences between vaccinated and nonvaccinated physicians may reflect attitudes that have been changed by vaccination rather than attitudes that determined vaccination. For example, the vaccine could be perceived to be more available once the physician has been vaccinated, even though, in fact, availability was not the important determinant of vaccination. Nevertheless, this study does identify attitudes that may be amenable to change, either leading to or as a result of vaccination.

In conclusion, this study suggests that if vaccines were widely available, easy to obtain, and specifically offered to physicians, higher vaccination rates for this at-risk group could be achieved. Although concerns exist about the cost-effectiveness of routine HBV vaccination, the position taken by the Occupational Safety and Health Administration of providing the vaccine for at-risk health care workers may improve the availability and offering of the vaccines.<sup>20-22</sup> While vaccination rates of physicians newly entering practice are already high, providing the vaccine to health care workers may serve to increase vaccination rates for physicians who have been in practice for more than a few years.

This study also suggests that some efforts may be necessary to educate physicians about the relatively minimal side effects associated with HBV vaccination. By vaccinating more physicians, there may be an added benefit of increasing physician awareness, leading to better HBV vaccination of other groups at risk. Wells et al<sup>23</sup> have shown that physicians' own personal health habits are reflected in what they counsel patients regarding patients' health habits. Physicians may offer HBV vaccination to more of their at-risk patients and present the vaccine in a more positive light once they have received the vaccine and have not developed any serious local reactions.

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