Hepatitis B Immunization Coverage Among Vietnamese-American Children 3 to 18 Years Old

Christopher N. H. Jenkins, MA, MPH[*], **Stephen J. McPhee, MD**[*,‡], **Ching Wong**[*], **Thoa Nguyen**[*], and **Gary L. Euler, DrPH**[§]

[*] *From the Suc Khoe La Vang! (Health Is Gold!), the Vietnamese Community Health Promotion Project, Division of General Internal Medicine, Department of Medicine, University of California, San Francisco, San Francisco, California;*

[‡] *the Institute for Health Policy Studies, University of California, San Francisco, San Francisco, California; and the*

[§] *Adult Vaccine-Preventable Diseases Branch, Epidemiology and Surveillance Division, National Immunization Program, Centers for Disease Control and Prevention, Atlanta, Georgia.*

Abstract

Objective—Persons with chronic hepatitis B virus (HBV) infection are at increased risk of chronic hepatitis, cirrhosis, and liver cancer. Although HBV infection is relatively uncommon in the United States, the disease is endemic in persons born in Southeast Asia, including Vietnamese-Americans. Current US infant immunization recommendations and state-mandated school-entry programs have left many nontargeted age-cohorts unvaccinated and at risk of infection. To assess the need for catch-up hepatitis B immunizations, this study reports the hepatitis B immunization rates of Vietnamese-American children 3 to 18 years old living in the metropolitan areas of Houston and Dallas, Texas, and the Washington, DC, area.

Design—We conducted 1508 telephone interviews with random samples of Vietnamese households in each of the 3 study sites. We asked for hepatitis B immunization dates for a randomly selected child in each household. Attempts were made to verify immunization dates through direct contact with each child's providers. Low and high estimates of coverage were calculated using reports from providers when reached ($n = 720$) and for the entire sample ($n = 1508$).

Results—Rates of having 3 hepatitis B vaccinations ranged from 13.6% (entire sample) to 24.1% (provider reports, Dallas), 10.3% to 26.4% (Houston), and 18.1% to 37.8% (Washington, DC). Children living in the Texas sites, older children, children whose families had lived in the United States for a longer time, and children whose provider was Vietnamese or who had an institutional provider were less likely to have been immunized. The odds of being immunized were greater, however, for children who had had at least 1 diphtheria, tetanus toxoid, and pertussis shot, and whose parents had heard about HBV infection, and were married.

Conclusions—The low rates of hepatitis B vaccine coverage among children and adolescents portend a generation which, too old to benefit from infant programs and school entry laws, will grow into adulthood without the protection of immunization. Increased efforts are needed

Reprint requests to (C.N.H.J.) Suc Khoe La Vang! (Health Is Gold!), Vietnamese Community Health Promotion Project, Division of General Internal Medicine, University of California, San Francisco, 44 Page St, Suite 500, San Francisco, CA 94102. E-mail: chrisj@itsa.ucsf.edu.

ABBREVIATIONS

HBV, hepatitis B virus; ACIP, Advisory Committee on Immunization Practices; CDC, Centers for Disease Control and Prevention; DTP, diphtheria, tetanus toxoid, and pertussis; VFC, Vaccines for Children

BACKGROUND

The hepatitis B virus (HBV) currently infects an estimated 100 000 to 130 000 individuals in the United States per year.[1] Although most who become infected with HBV recover, between 6% and 10% do not.[2] They are chronically infected and can transmit the virus to others. Persons with chronic HBV infection are at increased risk of chronic hepatitis, cirrhosis, and liver cancer.[3] Epidemiologic studies have shown that persons with chronic HBV infection have a risk of developing liver cancer over 200 times greater than those not infected.[4] Twenty-five percent of those who become chronically infected as infants or young children and 15% of those who become chronically infected as adolescents or adults die prematurely from chronic liver disease.[5] In the United States, ~5000 persons die each year from the effects of chronic hepatitis B.[1]

Among those who have not been infected, hepatitis B and its related sequelae can be prevented through the administration of 3 doses of hepatitis B vaccine. Since 1991, the American Academy of Pediatrics and the Advisory Committee on Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC) have recommended universal immunization of all infants and high-risk adolescents.[6] In 1994, ACIP modified its recommendation to include previously unvaccinated children 11 to 12 years old (regardless of risk) and all children <11 years old living in households of Pacific Islanders and first-generation immigrants from countries of high to moderate HBV endemicity.[7] Most recently, in 1997 ACIP expanded its recommendation to all children 0 to 18 years old.[8] Immunization of children is occurring through the implementation of school-entry laws in some states; currently, states which require hepatitis B immunization of all children entering elementary school and middle school number 36 and 16, respectively.[9]

Although HBV infection is relatively uncommon in the United States, the disease is endemic in persons born in Southeast Asia, including Vietnam. Estimates of the serologic chronic HBV infection rate evidenced by the presence of the hepatitis B surface antigen among Vietnamese adults in the United States range from 7% to 14%.[10–13] High rates of chronic HBV infection among Vietnamese account in large part for their high incidence rates of liver cancer. In the United States, Vietnamese males have the highest liver cancer incidence rate of any race/ethnic group (41.8 per 100 000), over 11 times higher than the rate among white males (3.7 per 100 000).[14] The rate among Vietnamese females in the United States could not be reliably calculated because of the small number of cases. In Ho Chi Minh City, Vietnam, liver cancer is the most common tumor among men (25.3 per 100 000) and the fourth most common cancer among women (5.9 per 100 000).[15] The cancer registry in Hanoi reports that liver cancer is the third most common tumor among men (14.0 per 100 000), and the fourth most common tumor among women (3.7 per 100 000).[16]

Transmission can occur vertically, from an infected mother to her child at childbirth, or horizontally, from one infected individual to another. In the United States, the full implementation of universal infant hepatitis B vaccination could eventually eliminate vertical HBV transmission and, ultimately, horizontal transmission as well. Significant progress in the immunization of infants has been made. According to the National Immunization Survey, for example, in 1996, 84% of all children[17] and 88% of Asian/Pacific Islander[18] children 19 to

35 months old had received all 3 doses of the hepatitis B vaccine. However, current recommendations (targeting infants) and state-mandated middle school-entry programs have left many nontargeted age-cohorts unvaccinated and at risk of infection. It is estimated that failure to immunize one cohort of adolescents in the United States will result in 160 000 hepatitis B infections of which 10 000 would be chronic, resulting in 1400 deaths.[19] These unnecessary deaths could be prevented by conducting catch-up hepatitis B vaccination programs among older age-cohorts, as recommended by ACIP in 1997.

The US Public Health Service has set a goal of reducing hepatitis B infection by 80% among Asian/Pacific Islander children by 2000[20] and to further reduce the number of all cases to zero among all persons <25 years old, regardless of racial or ethnic origin, by 2010.[21]

This study reports the hepatitis B immunization rates of Vietnamese children 3 to 18 years old living in the metropolitan areas of Houston (Harris and Fort Bend Counties) and Dallas (Dallas and Tarrant Counties), Texas, and Washington, DC (the District of Columbia; Fairfax County and the City of Arlington, Virginia; and Prince Georges County and Montgomery County, Maryland).

METHODS

Participant Interviews

During the spring of 1998, we conducted computer-assisted telephone interviews with Vietnamese adults living in the Dallas/Fort Worth and Houston areas of Texas and the Washington, DC area. Before conducting interviews in the 3 sites, we published a notice in local Vietnamese newspapers and aired announcements on local Vietnamese radio stations regarding the survey to increase compliance among potential participants. The survey protocol was approved by the Committee on Human Research at the University of California, San Francisco.

Using 23 surnames that we have found in earlier research to account for 99% of Vietnamese,[22] survey participants were selected randomly from names associated with listed telephones in each area. Participants were considered eligible if they were at least 18 years old, self-identified as being Vietnamese or Chinese-Vietnamese, had at least 1 child 3 to 18 years old living in the household, and were the adult in the household most familiar with the child(ren)'s immunization records. After ranking the eligible children living in the household by age, we selected 1 child randomly by birth order and asked additional questions about that child's immunization status. Up to 5 attempts were made to reach each potential survey participant.

Measures

The survey instrument was developed in English, translated into Vietnamese, and backtranslated into English to ensure lexical equivalency, and pilot-tested. Respondents were offered the choice of answering in Vietnamese or English.

Participant Survey

Demographic data included participants' age, year of immigration to the United States, highest level of education, English language proficiency, marital status, health insurance status, employment status, and poverty status. Poverty status, based on household size, was determined using criteria established by the US Department of Health and Human Services.[23]

We asked participants about the age and sex of the child who had been selected, and asked participants to find the child's shot record. For those who were able to find this record, we asked them to read the dates from the record of the first 3 doses of diphtheria, tetanus toxoid,

and pertussis (DTP) vaccine and the dates of any doses of hepatitis B vaccine. DTP immunization histories were obtained as a marker of access to care.

To measure respondents' level of knowledge about hepatitis B, we asked them about routes of transmission, whether they had ever heard of liver disease or HBV infection, and whether or not they knew that free hepatitis B shots were available to low income families or those without health insurance.

Provider Verification

To allow us to verify or obtain (when participants could not find shot records) each child's immunization status through direct consultation with providers, we asked to record the survey participant's name, the child's name, and the names and contact information of up to 3 providers who might have given the child immunizations. We asked for oral consent to contact the child's providers.

Provider names, addresses, and telephone numbers were verified (when given by survey participants) or located (when this data were incomplete) using Internet search engines, a searchable physician database available commercially on compact disk, community lists of Vietnamese providers, and long distance telephone information services. After provider contact information had been verified and entered into a database management software program, we generated personalized letters to providers on CDC letterhead. We mailed these letters to providers together with a computer-generated form with child's name, date of birth, parent's name and provider's name and address. In the letter we requested providers to complete the form with the dates of each of the child's doses of DTP and hepatitis B vaccine and to return the form to us in a pre-addressed, stamped envelope that we enclosed. If no form was received after 2 weeks, we telephoned the provider and, in some cases, faxed duplicate copies of the form. This reminder process was repeated as necessary for a six-month period from June to December, 1998.

When parents said the child had no provider, could not recall the child's provider, or refused to give consent to contact the provider, we sent letters to county health departments. With each county health department representative, we discussed the task by telephone and agreed on a date by which they would send the completed forms back to us. In Virginia, however, the State Attorney General issued a ruling that county personnel were not to comply with our request unless we first obtained written consent from the participants' parents. Although we sent letters requesting written consent to each of the 69 parents in Virginia that were affected by this ruling, we received no signed consent forms.

Immunization dates from the forms returned by providers were uploaded into the statistical analysis software with the participant survey data and matched by case.

Data Analysis

Preliminary analyses of respondent survey data examined differences between the 3 communities in sociodemographic characteristics and immunization rates, using t tests of differences in means and χ^2 tests of differences in proportions. Hepatitis B knowledge index scores (0–7) were calculated by summing the number of correct responses to the seven knowledge items.

In calculating immunization rates, we developed 2 estimates. One estimate was based on provider immunization history reports using only those cases in the denominator for which the provider acknowledged that the child in question was their patient (720 cases). A second estimate used all cases (1508) in the denominator, regardless of the outcome of our attempt to contact the provider. These 2 methods provide a range of estimates for immunization rates with

the higher point deriving from the first method and the lower point deriving from the second method. Rates were calculated from provider data only. When an immunization date furnished by a provider conflicted with a date furnished by a survey respondent, we chose to use the former date; however, when there was lack of concordance regarding a child's date of birth, we chose to use the birth date furnished by the survey respondent.

To identify predictors of immunization, we conducted multiple logistic regression analyses to identify predictors of having had 3 doses of hepatitis B vaccine. For these regression procedures, data from the 3 communities were combined. Two sets of regressions were performed, one using only cases for which the provider acknowledged that the child in question was their patient ($n = 720$) and the other using all cases ($n = 1508$). At first, we constructed full models using all measured sociodemographic and other independent variables as predictors. Then, parsimonious models were developed by eliminating variables that were not statistically significant in the full models. The analyses generated adjusted odds ratios for each covariate with 95% confidence intervals, indicating the increase or decrease in contribution made by each characteristic to the odds of attaining the outcome. For each categorical variable retained in the model, the referent category, by definition, has an odds ratio of 1.0. Analyses were performed using the LOGISTIC procedure in the SAS statistical package.[24]

RESULTS

Call attempts were made to reach 12 094 potential survey respondents. Of these, 1928 (15.9%) reached nonworking numbers and 299 (2.5%) reached businesses. An additional 4726 calls (38.8%) reached families who were not eligible for interview for reasons such as not having eligible children in the household (27.5%), not being of Vietnamese or Chinese-Vietnamese ethnicity (9.7%), or not having anyone at least 18 years old in the household (0.3%). Eligibility was not determined for 3517 (29.1%) call attempts because calls reached answering machines (6.2%), busy signals (1.0%), phones that were not answered (12.5%), or because those who answered requested interviewers to call back at another time (3.9%) or refused interview before eligibility could be ascertained (5.4%). The remaining call attempts reached 1624 eligible respondents, of which 1508 agreed to complete the interview for a response rate of 93%. All but 5 interviews were conducted in the Vietnamese language.

Respondents reported a total of 1821 providers for the 1508 children who were selected for questioning about immunization status. In our attempts to obtain children's immunization status from these providers, we received responses from 1379, resulting in a provider response rate of 75.7%. Of the total of 1821 providers, 808 (44.4%) providers (for 720 children) acknowledged that the child identified in the form we had mailed to them was their patient, 487 (26.7%) denied that the child was their patient or, in the case of county public health departments, said that there was no record for the child in the county system, and 84 (4.6%) stated that the information about the child which we had furnished to them was insufficient to allow them to identify the child accurately. We were unable to contact the remaining 442 (24.3%) providers because respondents provided insufficient contact information.

Sociodemographic Characteristics

Ninety-one percent of the respondents were parents or legal guardians of the child about whom we requested immunization data. Although year of immigration ranged from 1968 to 1998, most respondents immigrated to the United States in the mid-1980s (Table 1). Approximately one third of the respondents reported limited English-language proficiency and nearly 40% had less than a high school education. Approximately a quarter of respondents reported incomes below the poverty line. Most were employed and the vast majority was married. Respondents averaged 42 years old but ranged in age from 18 to 81 years. Approximately two thirds of the respondents had health insurance (private or public) and ~30% reported that their child's

immunization provider was Vietnamese. Over half reported that their child's provider was an institution, such as a clinic, hospital, or school. Respondents in the Washington, DC area were significantly more likely to speak English well, to be more highly educated, to have health insurance, and less likely to have incomes below the poverty level in comparison to respondents in the other 2 sites. In addition, children living in the Washington, DC area were more likely to have a Vietnamese provider and less likely to have an institutional or no provider than children in the other sites.

Only 18.5% of respondents could furnish immunization data from a shot record (Table 2). Although most respondents gave the child's name, they were less forthcoming in giving the child's provider's name or their own name. Only 70% gave oral consent to contact the child's provider. Respondents in the Washington, DC area were less likely to have their child's shot record but more forthcoming in giving the child's provider's name. Despite this relative openness, however, they were less likely to give consent to contact that provider, in comparison to respondents in the other 2 sites.

Knowledge

Although approximately half of respondents had heard about liver disease and HBV infection and one third claimed to have known someone with liver disease, fewer than a quarter knew that free doses of hepatitis B vaccine were available (Table 3). Over one third agreed incorrectly that hepatitis B can be contracted from smoking cigarettes or exposure to another person's sneezing and coughing. Sharing a toothbrush and sexual intercourse were correctly identified as routes of hepatitis B transmission by approximately a half and one third of respondents, respectively. A quarter incorrectly identified lung cancer as a sequela of HBV infection but over two thirds agreed correctly that hepatitis B can cause liver cancer. On the knowledge index, ~half (53%) of respondents answered 2 or fewer questions correctly. Participants in Houston had a somewhat higher median knowledge index score (3) than those in Dallas (2) or the Washington, DC area (2).

Immunization Coverage Rates

Among the 3 study sites, low estimates of having had 3 doses of hepatitis B vaccine ranged from 10% to 18%; high estimates ranged from 24% to 38% (Table 4). Coverage rates in the Washington, DC area were significantly higher than rates in the other 2 sites. Estimates of having begun the series (as indicated by rates of having had only 1 dose of hepatitis B vaccine) ranged from 18% to 32% (low estimates) and from 32% to 45% (high estimates). Respondent-reported rates (as proportions of the total samples) were consistently lower across sites: 5.2%, 5.7%, and 1.4% in Dallas, Houston, and Washington, DC, respectively. Of the 277 respondents who had their child's shot record, 98 reported that their child had had 3 doses of hepatitis B vaccine. However, over half of these parent reports (56%) were contradicted by the child's providers who reported that the child had had no doses of hepatitis B vaccine.

As anticipated, DTP coverage rates were considerably higher than those for hepatitis B. Rates of having 3 doses of DTP vaccine ranged from 20% to 29% (low estimates) and from 50% to 61% (high estimates). For all but one estimate, Houston had significantly lower DTP coverage rates than the other 2 sites. Those children vaccinated with at least 1 dose of DTP were ~8 times as likely to have received at least 1 dose of hepatitis B vaccine (high estimate, 33.8%; low estimate, 16.1%) compared with those with no DTP doses (high estimate, 4.3%; low estimate, 2.1%) ($P = .001$).

Hepatitis B vaccine coverage rates among the entire sample fell sharply with the increasing age of the child. These rates ranged from 37% at age 4 to 0% at ages 17 and 18. Of the 582 children 12 to 18 years old, only 23 (4%) had had 3 doses.

Table 5 shows the results of the multiple regression analyses for predicting having had 3 doses of hepatitis B vaccine. Regressions were run on 2 sets of children: 1) those with providers who acknowledged that the child was their patient, and 2) all children, regardless of whether or not a provider acknowledged the child as their patient. Among children in the first set, those in Dallas and Houston were approximately half as likely as children in the Washington, DC area to have had 3 doses of hepatitis B vaccine. Older children and children whose families had lived in the United States for a longer time were less likely to have had the shots. In addition, children whose provider was Vietnamese or who had an institutional provider were less likely to have been immunized in comparison with children whose provider was non-Vietnamese. The odds of being immunized were greater, however, among children who had had at least 1 DTP shot. Knowledge factors did not achieve statistical significance in the model.

When the regression analysis included all children, we found that the same predictors remained in the model with the exceptions of site (Dallas and Houston) and having a Vietnamese provider. One knowledge factor and the respondent's marital status were significant in this model. In addition, children who had an institutional provider or no provider at all were less likely to have had 3 doses of hepatitis B vaccine than children with either a Vietnamese or non-Vietnamese provider.

DISCUSSION

The data presented here show that hepatitis B immunization rates are extremely low among Vietnamese children 3 to 18 years old. These low rates are of particular concern because HBV infection is endemic among Vietnamese in the United States. Children who remain unvaccinated remain at high risk for infection and its sequelae.

The relatively higher coverage rates observed in the 3- to 5-year-old cohorts (born 1993–1995) reflect the implementation of universal infant hepatitis B immunization, which started in 1992. The low rates of hepatitis B vaccine coverage among those 6 to 18 years old, however, portend a generation that is too old to benefit from infant vaccination or school entry laws. These children will grow into adulthood without the protection of immunization. At this writing, for example, only the District of Columbia has a middle school entry law in place. Texas's planned law will come into effect in August 2000. Maryland's planned law will not take effect until 2006. Virginia has no planned law.[9]

As these unprotected children pass through adolescence, they enter a period when the risk of horizontal HBV transmission rises with the onset of sexual activity and other high-risk behaviors. Data from the National Health and Nutrition Examination Surveys, for example, indicate that the prevalence of HBV infection increases sharply after age 12.[25] Furthermore, a study of US-born Southeast Asian children has shown that 60% of the children with chronic HBV infection were born to HBsAg-negative mothers, indicating a high rate of horizontal transmission from other chronically infected members of their family or social networks.[11]

The low immunization rates reported here may stem in part from poor access to pediatric health care. Nearly one third of respondents reported that they had no health insurance—public or private—a rate almost twice the national average of 16.3%.[26] Nearly a quarter of respondents could not recall or provide sufficient provider information to enable us to contact providers. In another quarter of the cases, respondents gave provider contact information which elicited a denial from the provider that the child in question was their patient. Although some of this ambiguity on the part of survey participants may have stemmed from poor memory or a deliberate reluctance to provide accurate information, it may simply reflect a lack of familiarity with the health care system.

In 1998 the national DTP coverage level among children 19 to 35 months old as measured by CDC's National Immunization Survey was 95.6%.[27] However, even the high estimates of DTP coverage for Vietnamese reported here show that only ~half of the children surveyed received these shots. These DTP coverage rates, a marker for access to care, were much lower than rates in the general population and bolster the argument that poor access to care may be a significant barrier to immunizations for this population. Furthermore, the strong correlation between DTP coverage and hepatitis B vaccine coverage shows that when a child did have access to care, as indicated by DTP coverage, they were more likely to be vaccinated with the hepatitis B vaccine.

In addition, the regression equations show that the strongest negative predictors of a child having had 3 doses of hepatitis B vaccine were indicators of inadequate access to health care. Children with private-practice providers fared better than those who went to institutional providers. In the regression analysis of children with providers who acknowledged them as their patient, for example, children having an institutional provider were one third as likely to have had 3 doses, when compared with children with a non-Vietnamese provider in private practice. Perhaps of even greater concern, even when a child had access to a physician in private practice, those who had a Vietnamese provider were less than one half as likely to have had 3 doses of hepatitis B vaccine when compared with children with non-Vietnamese providers.

This last finding corroborates our earlier findings that Vietnamese patients with Vietnamese providers were less likely to have had preventive care such as general check-ups and cancer screening tests when compared with patients with non-Vietnamese providers.[22,28–30] We speculate that this characteristic can be explained in the following ways: 1) many Vietnamese physicians were trained in Vietnam before the fall of Saigon in 1975 where medical training primarily ignored preventive medicine, and 2) many Vietnamese physicians in the United States meet the needs of their patients by operating drop-in clinics which allow them to treat patients' acute complaints but little time for scheduling preventive care, such as immunizations. However, additional research should be directed at understanding Vietnamese physician behavior with regard to preventive care.

Although not strong predictors in the regression models, awareness and knowledge among survey participants were low and may represent another barrier to immunization. For example, only half of respondents had heard of liver disease. Despite the fact that one third reported that they had no health insurance, less than a quarter knew that the Vaccines for Children (VFC) program offers free hepatitis B shots, precisely for children in such families.

The finding that children living with more recent immigrants were more likely to have had 3 doses of hepatitis B vaccine, which seems counterintuitive, reflects 1989 regulations that children entering this country as immigrants are required to have had at least 1 dose of hepatitis B vaccine.[31] Although currently that requirement has been waived, since March 1998, immigrant children under age 18 whose families apply for adjustment of legal status in the United States must receive 3 doses of hepatitis B vaccine.[32]

The lack of concordance between respondent reports and provider reports of some children's hepatitis B immunizations raises concerns about the reliability of parental reports, as has been noted elsewhere.[33–35] Respondents may have confused notations on the shot record of *Haemophilis influenzae* type b vaccine immunizations with those for hepatitis B, because the former is usually recorded as Hib and the latter as HBV. Alternatively, provider records may have not included immunization information from a child's other providers. Respondents were asked, however, to name up to 3 immunization providers for their child; it could be that the lack of concordance between parental and provider reports stems from our inability to obtain responses from all providers of a given child.

Three limitations should be borne in mind when considering the results of this study. First, our sample was drawn from community members with listed telephones. We have no data, therefore, from households without telephones or with unlisted numbers. Consequently, our results may not be representative of all Vietnamese living in these communities and, furthermore, cannot be generalized to Vietnamese communities in other parts of the country. Second, our inability to contact county health departments in Virginia means that immunization rate estimates in the Washington, DC area may be somewhat lower than the rate had we been able to make those contacts. Third, although the survey response rate was high, our ability to obtain provider-verified immunization data were limited. We have attempted to address this limitation by providing 2 estimates of coverage. We feel that the true values probably lie somewhere between these 2 estimates. In any case, both low and high estimates have led us to the same conclusion—that increased efforts are needed to design successful catch-up campaigns for this population.

Interventions to promote HBV immunizations among Vietnamese children should include community education about the importance of HBV immunization for the health of their children and the availability of free vaccine through the VFC program. Equally, providers, (particularly Vietnamese providers) should be educated about the high risk for HBV infection among Vietnamese (and other Asian American and Pacific Islander immigrants), and the importance of immunizing all children. Those who provide health care to Vietnamese children should be encouraged to register as VFC providers and the names of VFC providers should be made widely known in the community. The finding that children living in the Texas sites were less likely to be immunized indicates that immunization initiatives are particularly needed there.

Other interventions to increase vaccination levels which are strongly recommended by the Task Force on Community Preventive Services, a nonfederal body supported by the US Department of Health and Human Services, include: systems which remind or recall patients when shots are due; provider reminder/recall systems; assessment of provider performance with feedback; expansion of access by reducing travel distance to immunization sites, increasing hours sites are open, and reduction of clinic administrative barriers by providing express lane vaccination service.[36]

With the successful implementation of such interventions, hepatitis B and its sequelae could be eradicated in a generation. It is not often that medicine discovers a preventive maneuver that can dramatically reduce the incidence of liver disease—including a deadly cancer. The hepatitis B vaccine presents this opportunity. In addition to infant and school-entry immunization, catch-up HBV immunization programs should merit the highest priority.

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TABLE 1

Sociodemographic Characteristics of Vietnamese Adult Survey Respondents and Their Children by Region

	Dallas (*n* = 500)	Houston (*n* = 505)	Washington, DC (*n* = 503)	Total (*n* = 1508)
Mean year of immigration	1987	1985	1986	1986
Speaks English poorly/not-at-all (%) *	41.2	32.9	28.4	34.2
Education <12 y (%) *	48.1	34.6	33.8	38.9
Income was below poverty level (%) †	30.4	27.7	19.7	26.0
Employed (%)	69.8	67.3	72.4	69.8
Married (%)	86.0	87.1	83.3	85.5
Mean age (y), respondents	41.2	41.6	41.5	41.4
Mean age (y), children	9.8	10.1	9.6	9.8
Sex of child was female (%) *	50.8	48.5	49.7	49.7
Had health insurance (%) *	65.8	63.6	76.7	68.7
Child's provider was non-Vietnamese (%) *	17.6	8.1	10.5	12.8
Child's provider was Vietnamese (%) *	18.8	27.1	30.6	29.8
Child had institutional provider or no provider (%) *	63.6	64.8	58.9	57.4

* Comparison of 3 sites by χ² test, *P* = .001;

† *P* = .009.

TABLE 2

Proportion of Respondents Providing Child's Shot Record and Provider Contact Information by Region (%)

	Dallas (*n* = 500)	Houston (*n* = 505)	Washington, DC (*n* = 503)	Total (*n* = 1508)
Had child's shot record[*]	25.2	22.3	8.0	18.4
Respondent gave child's name[†]	98.4	94.7	95.4	96.2
Respondent gave at least 1 provider's name[‡]	79.8	78.9	83.3	80.5
Respondent gave own name	67.4	65.7	62.6	64.6
Respondent gave consent to contact provider[*]	72.2	69.7	68.4	70.1

[*] Comparison between 3 sites by χ^2 test, $P = .001$;

[†] $P = .005$;

[‡] $P = .034$.

TABLE 3

Hepatitis B Awareness and Knowledge Among Vietnamese Respondents by Region

	Dallas (n = 500)	Houston (n = 505)	Washington, DC (n = 503)	Total (n = 1508)
Ever heard of liver disease (%) [*]	41.8	52.9	45.7	46.8
Ever known someone with liver disease (%)	32.4	32.5	30.2	31.7
Ever heard about hepatitis B virus infection (%)	46.2	54.9	49.9	50.3
Knew free hepatitis B shots are available (%) [†]	20.0	25.9	24.1	23.3
Agreed can get hepatitis B from (%):				
Smoking cigarettes	36.0	35.8	32.2	34.7
Sharing a toothbrush	48.0	52.3	45.3	48.5
Sexual intercourse	30.0	32.5	32.0	31.5
Exposure to another's sneezing/coughing [†]	46.0	41.4	36.6	41.3
Agreed hepatitis B infection can cause (%):				
Lung cancer	28.4	25.2	22.3	25.3
Liver cancer	64.8	69.3	63.4	65.8
Median knowledge index score (range: 0–7)	2	3	2	2

[*] Comparison of 3 sites by chi square test, P = .015;

[†] P = .003.

TABLE 4

Low and High Estimates of Hepatitis B Vaccine (HepB) and DTP Coverage Rates (With 95% Confidence Intervals) Among Vietnamese Children 3 to 18 Years Old by Region (%), 1998

	Dallas		Houston		Washington, DC		Total	
	Low ($n = 500$)	High ($n = 282$)	Low ($n = 505$)	High ($n = 197$)	Low ($n = 503$)	High ($n = 241$)	Low ($n = 1508$)	High ($n = 720$)
Had 1 HepB dose*	17.8 (14.1, 21.2)	31.6 (26.2, 37.0)	14.1 (11.1, 17.1)	36.0 (29.3, 42.7)	21.7 (18.1, 25.3)	45.2 (38.9, 51.5)	17.9 (16.0, 19.8)	37.6 (34.1, 41.1)
Had 2 HepB doses*	16.0 (12.8, 19.2)	28.4 (23.1, 33.7)	11.5 (8.7, 14.3)	29.4 (23.0, 35.8)	20.7 (17.2, 24.2)	43.2 (36.9, 49.5)	16.1 (14.2, 18.0)	33.6 (30.1, 37.1)
Had 3 HepB doses*	13.6 (10.6, 16.6)	24.1 (19.1, 29.1)	10.3 (7.6, 13.0)	26.4 (20.2, 32.6)	18.1 (14.7, 21.5)	37.8 (31.7, 43.9)	14.0 (12.2, 15.8)	29.3 (26.0, 32.6)
Had 1 DTP dose†	32.6 (28.5, 36.7)	57.8 (52.0, 63.6)	23.2 (19.5, 26.9)	59.4 (52.5, 66.3)	30.4 (26.4, 34.4)	63.4 (57.3, 69.5)	28.7 (26.4, 31.0)	60.1 (56.5, 63.7)
Had 2 DTP doses‡	30.0 (26.0, 34.0)	53.2 (47.4, 59.0)	19.8 (16.3, 23.3)	50.8 (43.8, 57.8)	29.8 (25.8, 33.8)	62.2 (56.2, 68.3)	26.5 (24.3, 28.7)	55.6 (52.0, 59.2)
Had 3 DTP doses‡	28.4 (24.4, 32.4)	50.4 (44.6, 56.2)	20.4 (16.9, 23.9)	52.3 (45.3, 59.3)	29.4 (25.4, 33.4)	61.4 (55.3, 67.5)	26.1 (23.9, 28.3)	54.6 (51.0, 58.2)

Note: Low coverage rates are calculated using the entire sample; high coverage rates are calculated using only those children with a provider who confirmed that the child was their patient.

*Comparison of low and high rates at 3 sites by χ^2 test, $P < .01$.

†Comparison of low rates at 3 sites by χ^2 test, $P < .01$; comparison of high rates at 3 sites by χ^2 test not significant.

‡Comparison of low rates at 3 sites by χ^2 test, $P < .01$; comparison of high rates at 3 sites by χ^2 test, $P < .05$.

TABLE 5

Multiple Logistic Regression Analyses: Predictors of Having Had 3 Doses of Hepatitis B Vaccine Among Vietnamese Children 3 to 18 Years Old, 1998

Variable	Children With Providers Who Acknowledged Child as Patient (n =720)*		All Children (n = 1508)†	
	Adjusted OR	95% CI	Adjusted OR	95% CI
Dallas	0.49	0.28, 0.85	0.78	0.49, 1.26
Houston	0.43	0.23, 0.78	0.69	0.42, 1.12
Each additional year of child's age	0.75	0.70, 0.81	0.77	0.73, 0.82
Each additional year since immigration	0.95	0.91, 0.99	0.95	0.92, 0.98
Respondent had heard about HBV infection	1.52	0.91, 2.54	1.62	1.05, 2.51
Respondent was married	2.01	0.86, 4.72	2.65	1.21, 5.77
Child's provider was Vietnamese	0.44	0.22, 0.88	0.64	0.36, 1.14
Child had institutional provider	0.32	0.16, 0.65	—	—
Child had institutional or no provider	—	—	0.47	0.27, 0.81
Child had at least 1 DTP shot	7.93	4.45, 14.14	13.23	8.64, 20.27

Note: OR = odds ratio; CI = confidence interval; — = term not applicable in equation.

*
Ninety-eight observations were deleted due to missing values for explanatory variables.

†
Two hundred sixteen observations were deleted due to missing values for explanatory variables.