A Statewide Hepatitis B Vaccination Program for School Children in Hawaii: Vaccination Series Completion and Participation Rates Over Consecutive School Years

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SYNOPSIS

Objectives. The authors assessed a statewide school-based Hepatitis B (HepB) vaccination program for preadolescents in Hawaii over three consecutive school years. Factors assessed included number of schools and students participating and number of students receiving three doses of hepatitis B vaccine.

Methods. Records of the program, which targeted 4th and/or 5th graders in public and private schools, were reviewed for the period from 1996 to 1999.

Results. The proportion of participating schools increased from 76% of all schools in the state in School Year 1 to 94% in School Year 3. The proportion of children with completed consent forms who received three doses of HepB vaccine at school exceeded 80% throughout the project. In School Year 1, 10,003 (70%) of 14,333 children enrolled at participating schools received three vaccine doses in school; however, this proportion declined over subsequent school years to 51% (7,722/15,013) in School Year 2 and 24% (7,344/30,429) in School Year 3. A survey of 477 parents not consenting to school vaccination indicated that 84% of their children completed the vaccine series at a private provider office.

Conclusions. Statewide school-based HepB vaccination campaigns for at-risk populations can result in a majority of children in targeted age groups receiving three doses of hepatitis B vaccine, though declining participation may be observed as uptake in the private sector increases.

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In 1995, the Advisory Committee on Immunization Practices (ACIP) recommended universal hepatitis B (HepB) vaccine for all 11- and 12-year-old children and all children <11 years old who are Pacific Islanders or reside in households of first generation immigrants from countries where hepatitis B virus infection (HBV) is of high or intermediate (moderate) endemicity.[1] Hawaii has many residents from areas the ACIP defined as having high endemicity for HBV infection, including China, Southeast Asia, and most Pacific Islands.[2] The 2000 U.S. Census in Hawaii found that a total of 60% of Hawaii residents and 43% of Hawaii students in 4th and 5th grades are Asian or Pacific Islanders and an additional 36% of students are mixed, i.e., Asian or Pacific Islander and one or more other races.

In response to this recommendation, the State of Hawaii Department of Health embarked on a multifactorial HepB "catch-up" vaccination program. Spearheading the initiative was the "Take 3 HepB" program, a school-based HepB vaccination campaign which targeted 5th grade students (10- and 11-year-olds). This age group was selected because the cohort had not been covered by the 1991 ACIP recommendation for universal infant HepB vaccination or any subsequent school-entry HepB vaccination requirement in Hawaii.

In Hawaii, a serologic survey of Oahu adult residents indicated the rate of past infection with HBV to be one of the highest in the country, with the prevalence among Asian and Pacific Islanders of 13.6%.[3] In addition, a serologic survey in 1989 found evidence of past or current HBV infection in Honolulu school children at rates up to 15-fold higher than comparable estimates for the nation. The prevalence of past HBV infection was 9.2% in students of all races in 6th through 9th grades.[4] This study also found the highest past HBV infection rates were among Asian and Pacific Islanders, groups known to be at elevated risk of HBV-related liver cancer and cirrhosis.[5–8] The past HBV infection rates in these Honolulu school children increased with ascending grade level, supporting the hypothesis that horizontal transmission of HBV occurs throughout childhood in U.S.-born Asian and Pacific Islanders.[9]

Program description

The school-based HepB vaccination catch-up program was conducted over three consecutive school years, i.e., School Year 1: September 1996–June 1997; School Year 2: September 1997–June 1998; and School Year 3: September 1998–June 1999. All schools, both public and private, in all four counties in Hawaii (Honolulu, Maui, Hawaii, and Kauai) were requested to participate. During School Year 1 and School Year 2, enrollment was restricted to children in the 5th grade, but in School Year 3 both 4th and 5th graders were eligible. After initial planning by the Hawaii Department of Health and Department of Education staff, a private nursing agency was contracted to schedule the HepB vaccination clinics, ensure vaccine supply, obtain written consent from parents, and administer the vaccine in participating schools. A private, non-profit organization, the Queen Emma Foundation, purchased vaccine for any children not covered by federal programs. A public education media campaign was undertaken prior to commencement of the program to ensure that parents were aware of the benefits of HepB vaccination and that the vaccinations would be provided at no charge. Federally mandated Vaccine Information Statements in eight different languages, informational brochures, and consent forms were distributed to parents through the school. At the discretion of the teacher, classes were also shown a short, locally produced educational video about hepatitis B. Incentives, such as discounts on fast food or music recordings, were donated by local retail stores and provided to individual participants and classes with high vaccine series completion rates.

Children with parental consent received the first dose of HepB vaccine in September–October of each school year. Subsequent clinics were scheduled to adhere to the recommended minimum intervals between doses. Children who were absent on the scheduled day of vaccination were followed up and vaccinated on the next clinic date, or at make-up clinics when appropriate. The vaccination clinics were conducted concurrently in all school districts, typically at two different schools per day. The vaccination teams spent approximately two to three hours at each school, including the time required for setting up the clinic and for post-vaccination observation. School staff and parent volunteers provided general assistance for clinic operation.

Before administering any HepB vaccine, program protocols ensured that all school clinic sites had ready access to telephones for contacting emergency responders. In addition, clinical staff members were trained in the recognition and early management of anaphylactic shock, and "crash kits" containing epinephrine and diphenhydramine were required to be present at each clinic. Clinical staff, parents, and schools were directed to report all adverse events to the Vaccine Adverse Event Reporting System of the Hawaii Department of Health or to the Centers for Disease Control and Prevention for follow-up by the Hawaii Immunization Program.

METHODS

Analysis of participation and vaccination rates

Data on the number of children whose parents/legal guardians consented to HepB vaccination, the number of children who initiated and completed the vaccination series, the dates of vaccination, and any adverse events following vaccination were obtained from records maintained by the private nursing agency. Some children for whom consents were received for school-based vaccination received one or more doses of HepB vaccine through another provider. If parents indicated that a child received one or more HepB vaccinations through a provider other than the school-based clinics, the child was recorded as having received the vaccine dose at an "outside clinic" without further verification.

The population of children in the 5th grade (and 4th grade for School Year 3) for each school year was determined from enrollment figures obtained from the Department of Education for public schools and from the Hawaii Association of Independent Schools. The proportion of consents received and the proportion of children who completed the vaccine series were compared between school years and between public and private schools using the chi square test as calculated using Epi Info version 6.04 software (α=0.05).[10]

Survey of non-participating parents

Reasons for refusing to participate and non-response in School Year 1, which accounted for only a small proportion of eligible students, were not investigated. However, the high percentage of refusals and non-response in School Year 2 prompted a survey among parents who had not consented to have their 5th grade child vaccinated in the school-based program. From the 180 participating public schools, fifteen schools with the highest proportions of non-participating students were selected for this survey. All parents at these schools who had either refused vaccination or did not return the consent form were mailed a questionnaire requesting information regarding their decision.

RESULTS

Analysis of participation and vaccination rates

The number of schools participating in the program, the total number of students statewide in the targeted grade(s), the number of students enrolled in participating schools, the number of consents received, and the number of students completing the three-dose HepB vaccination series either entirely in school or through a combination of school and outside clinics are listed in the Table, by school type and year.

The Figure illustrates the major findings observed over the three-year project period. First, the propor-

Table. Number of schools and students participating in a school-based hepatitis B vaccination program, by school type and school year (SY): Hawaii, 1996 to 1999

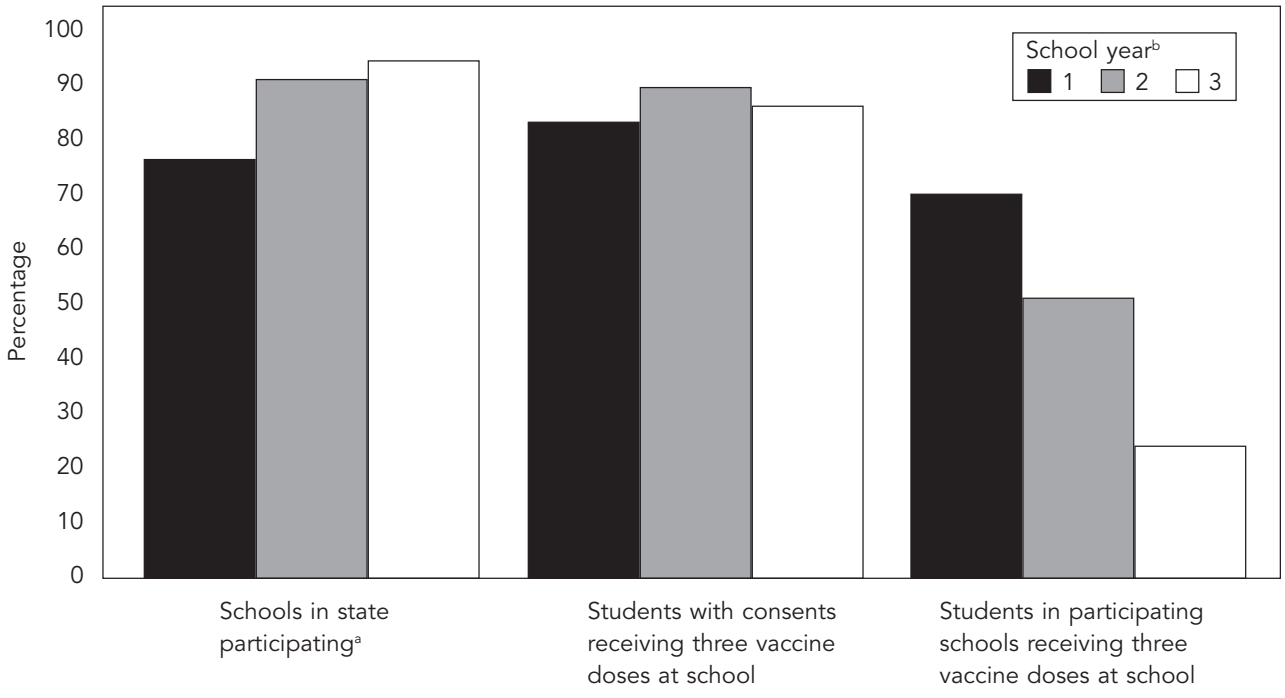
	Public schools			*Private schools*			*All schools*		
	SY1[a]	*SY2*	*SY3*[b]	*SY1*	*SY2*	*SY3*[b]	*SY1*	*SY2*	*SY3*[b]
Number of schools statewide	180	180	180	91	87	86	271	267	266
Number of schools participating	180	180	180	27	64	71	207	244	251
Number of eligible students at all schools in state[c]	13,409	13,376	26,932	2,046	1,947	3,988	15,455	15,323	30,920
Number of eligible students at participating schools	13,409	13,376	26,932	924	1,637	3,497	14,333	15,013	30,429
Number of students with consent at participating schools	11,477	8,114	8,077	563	605	435	12,040	8,719	8,512
Number of students receiving three doses at school	9,530	7,237	7,001	473	485	343	10,003	7,722	7,344
Number of students receiving three doses at school or at a combination of school and outside clinics	9,941	7,739	7,767	498	593	415	10,439	8,332	8,182

[a]School year: SY1 = 9/96 to 6/97; SY2 = 9/97 to 6/98; SY3 = 9/98 to 6/99.

[b]Includes 4th- and 5th-grade students.

[c]Excludes schools without 4th or 5th grades (i.e, junior high and high schools).

Figure. School-based hepatitis B vaccinations in Hawaii, 9/96 to 6/99



[a]Excludes schools without 4th or 5th grades.

[b]School year SY1 = 9/96–6/97; SY2 = 9/97–6/98; SY3=9/98–6/99.

tion of all schools in the state participating in the program was high, increasing from 76% of all schools in the state in School Year 1 to 94% in School Year 3; this increase was attributable to greater participation by private schools in School Year 2 and School Year 3.

Second, the proportion of children with consents who received three doses of HepB vaccine at school remained stable and exceeded 80% throughout the project period.

Third, student participation rates were high in the first year of the program. In School Year 1, consent for HepB vaccination was received for 84% (12,040/14,333) of the children enrolled at participating schools and 70% (10,003/14,333) ultimately received three doses of HepB vaccine in school. The latter figure represents 65% of the entire 5th grade cohort in the state.

Fourth, the proportion of children participating in the program declined significantly over subsequent school years. This decline in proportion of children participating was significant ($p<0.001$) between each school year and the one prior or after. In School Year 2, 51% (7,722/15,013) and in School Year 3, 24% (7,344/30,429) of children in eligible grades at participating schools completed the three-dose vaccination series.

The proportion of children consenting at participating private schools (20.1%) was significantly ($p<0.001$) lower over the three-year project period compared with public schools (51.5%).

During the three-year project, a significantly ($p<0.001$) higher proportion of consenting students at public schools, (85.9% [23,768/27,668]) completed all three doses at school-based clinics when compared to consenting students at private schools, (81.2% [1,301/1,603]). However, if doses received through an outside clinic are considered, consenting students at participating private schools had a significantly higher ($p<0.005$) three-dose HepB vaccine series completion rate (93.9% [1,506/1,603]) than consenting students who attended public schools (92.0% [25,447/27,668]).

Differences in the proportion of consenting students were observed between counties, with Kauai having the highest rates and Honolulu the lowest for all three years (data not shown). Over the three-year period, the proportion of students with consent at participating schools in Honolulu county (45%), the most ur-

banized county, was significantly lower ($p<0.001$) when compared to the participation rates for each of the other three counties: Kauai (71%), Hawaii (56%), and Maui (55%).

More than 75,000 doses of HepB vaccine were administered at schools, with no serious adverse events reported to the Hawaii Department of Health or the Centers for Disease Control and Prevention during the three-year program period or afterward. Less severe adverse events included two probable mild hypersensitivity reactions and several fainting episodes.

Survey of non-participating parents

A total of 579 parents not consenting to vaccination or not returning the consent form were identified among the 15 schools selected for the survey, of which 477 (82%) returned the survey questionnaire. A total of 402 (84%) of the respondents indicated that their children had already completed the three-dose HepB series through an outside provider, and an additional 43 (9%) stated that it was their intention to have their child vaccinated by their primary care provider, instead of a school-based clinic.

DISCUSSION

The Centers for Disease Control and Prevention have highlighted the importance of using the narrow window of opportunity available to vaccinate Asian and Pacific Islanders through HepB vaccination "catch-up" campaigns.[11] This report documents that it is possible to successfully conduct a school-based HepB catch-up vaccination campaign across an entire state for which HepB vaccination is a public health priority. This is the first published report on a statewide school-based HepB vaccination program providing vaccination data over multiple school years and, in terms of the number of schools involved, perhaps the largest ever reported.

During the first year of this project, nearly three-fourths of the 5th grade children in participating schools received three doses of HepB vaccine at school, representing two-thirds of the entire cohort of 5th graders in the state.

In subsequent years, there was a marked decline in participation rates. In response to the lower participation rates observed in School Year 2, the Hawaii Department of Health expanded the target cohort in School Year 3 to include 4th and 5th graders. However, only 27% of the expanded School Year 3 cohort consented to vaccination, and the cost-effectiveness of continuing the school-based program in subsequent years became questionable. While the lower numbers of consenting students in later years was initially disconcerting, the results of the follow-up survey helped allay concerns that parents were electing not to have their children vaccinated against HBV. The survey findings indicate that the majority of children for whom consent was not received for HepB vaccination at school in the second year had already completed the three-dose series with their healthcare provider. These results mirror those reported by Woodruff et al. from a school-based HepB vaccination program in San Francisco, where 84% of parents refusing vaccination indicated that their child had already been vaccinated against HBV.[12]

The findings from the parental survey are supported by developments that were occurring in the community. Several months after the school-based HepB campaign was established in 1996, the Hawaii Department of Health also began a provider-based HepB vaccination program. In the provider-based program, children ages 11 years or younger could receive the HepB vaccine in their provider's office at no (or very little) out-of-pocket expense to their parents. Although figures for privately purchased HepB vaccine administered outside of school clinics during this period are not available, Department of Health records indicate that 88,955 doses of publicly funded HepB vaccine were administered to children ages 6 through 11 years outside of school clinics during 1996 through 1998. Given that the annual birth cohort for children of these ages averaged approximately 17,000 during each of these years,[13] these data suggest that a substantial number of children in the cohort were vaccinated outside of schools with public vaccine during the school-based initiative. Thus it seems quite possible that the decreased number of consents received for school-based vaccination in School Year 2 and School Year 3 reflected a diminishing pool of unvaccinated students entering the 5th grade, as increasing numbers of children had already been vaccinated at their healthcare providers.

Ultimately, Hawaii's school-based HepB vaccination program was discontinued with the assumption that children younger than age 12 were largely being "caught-up" on HepB vaccinations administered through other providers. Because the school-based vaccination program and a general community-based HepB vaccination education initiative were conducted in all regions of the state nearly simultaneously, we are unable to definitively determine the impact of the school-based program on vaccine uptake in the private sector, independent of the effect of the community-based education activities. Our subjective assessment is that the school-based program helped to inform

and motivate parents to have children vaccinated against HBV, both in and outside of schools. Parents anecdotally related that once they recognized the benefits of vaccinating their 5th grade student, they became motivated to seek HepB vaccine for their other children. Future work should attempt to more accurately assess the effect of implementing universal school-based vaccination programs on vaccinations provided by healthcare providers.

To our knowledge, this is the first published report of a school-based HepB vaccination project in which the vaccines were administered entirely through a private contractor. The cost of vaccine administration in the school-based clinics during the first year, determined by dividing the total cost of the contract with the nursing agency by the number of doses provided in schools that year, was $13.98 per dose. This figure includes all contracted nursing staff, supplies, record-keeping, and inter-island travel costs, but excludes costs for the time of parental and school volunteers. Our HepB vaccine administration costs in School Year 1 were higher than national estimates from 1995 ($5.00),[14] and because the contract did not include adjustments for the number of vaccine doses given, the per-dose cost increased further in School Year 2 and School Year 3 as participation declined. However, school-based HepB vaccination programs have been reported to be cost-effective under a wide variety of assumptions, and the higher cost of vaccine administration may be justified by preventing HBV-related morbidity and mortality among preadolescents in our state, as these individuals appear to be at elevated risk of HBV infection compared to their peers in the United States overall.[15] We suggest that if participation rates in a proposed school-based vaccination project cannot be estimated in advance reliably, it may be preferable to link reimbursement of contractors to the number of vaccine doses administered.

The Hawaii school-based HepB vaccination program involved all public schools and an increasing number of private schools throughout the state over the three-year period. The sub-optimal participation rate among private schools during the program's first year was due, in large part, to uncertainties regarding medical liability. Private school administrators expressed that they had insufficient time to resolve liability issues prior to the program's start date. Should this type of program be undertaken elsewhere, issues unique to private schools should be identified and addressed well in advance of program initiation to ensure maximum participation.

In an analysis of a school-based HepB vaccination program in metropolitan Kansas City, Wilson et al. reported that schools with large populations of commercially insured children had low participation rates but high vaccine series completion rates, and schools with large numbers of Medicaid-eligible students had high participation rates but lower series completion rates.[16] In Hawaii, private school students had lower participation rates but higher series completion rates when vaccine doses given in the private sector are included. Assuming private school attendance is a marker of higher socioeconomic status, and therefore an indirect indicator of private health insurance coverage, our findings are consistent with those of Wilson et al.

Handal estimated that several million adolescents are not receiving the full complement of vaccines currently recommended by the ACIP.[17] Given this, and with new vaccines expected for preadolescents and adolescents on the horizon, public health officials should consider school-based vaccination clinics as a means to reach these children. Hawaii's experience involving populations at elevated risk of HBV adds to the growing body of literature indicating that school-based vaccination programs can be safe and successful.[18–21] More research is needed to assess the impact of school-based programs on vaccination practices in the private sector. If our impression is confirmed that school-based campaigns have the added value of effectively reaching parents and encouraging them to vaccinate children at their healthcare provider as well as in the classroom, school-based programs may be a particularly important tool for introducing new, or newly recommended, vaccines for older children.

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