

Cost-Effectiveness of Preimmunization Hepatitis B Screening in High-Risk Adolescents

JOEL BLOSTEIN, MPH^a
PATRICIA A. CLARK, MPH^b

SYNOPSIS

Objective. The goals of this study were to estimate seroprevalence of prior hepatitis B infection among high-risk adolescents and to determine the cost-effectiveness of prevaccination immunity screening.

Methods. The authors computed a “break-even” seroprevalence level calculated from current vaccine and administration costs. They then conducted a seroprevalence study of hepatitis B core antibody using sera previously submitted for syphilis serology from four-hundred adolescent and adult clients of sexually transmitted disease clinics. Finally, the authors compared age group-specific seroprevalence rates to the computed break-even seroprevalence.

Results. Levels of prior hepatitis B infection for all age groups were lower than the break-even seroprevalence standard from which cost-effectiveness was calculated.

Conclusions. From the findings of this study, the authors concluded that routine preimmunization screening for prior hepatitis B infection would not be cost-effective for this population.

^aDivision of Immunization, Michigan Department of Community Health, Lansing, MI

^bViral Serology/Viral Isolation, Bureau of Laboratories, Michigan Department of Community Health, Lansing, MI

Address correspondence to: Joel Blostein, Michigan Department of Community Health, Immunization Division, P.O. Box 30035, Lansing, MI 48909; tel. 517-335-9567; fax 517-335-9855; e-mail <blosteinj@state.mi.us>.

© 2001 Association of Schools of Public Health

In 1998 the Michigan Department of Community Health (MDCH) initiated a planning process for the development and support of a hepatitis B immunization program targeted to adolescent and young adult clients of sexually transmitted disease clinics, adolescent health clinics, and family planning clinics in the state. These age groups have been identified as being at increased risk of hepatitis B infection, a viral illness transmitted through sexual contact, as well as through parenteral and permucosal exposure to blood and certain body fluids (semen, vaginal secretions, and, rarely, saliva). Recommendations have been published for routine immunization of adolescents at 11 to 12 years of age and older adolescents who may be at increased risk.¹ Part of the planning process for the present study included a determination of whether clients should be screened (tested) prior to immunization for evidence of immunity or prior infection; such a status obviates the need for immunization. Because administration of hepatitis B vaccine has no effect in people who are hepatitis B carriers or who have prior immunity, such a decision is principally a matter of cost-effectiveness.²

METHODS

Computation of break-even prevalence

Cost-effectiveness of screening involves three variables: (a) cost of vaccine (including administration costs); (b) cost of testing to determine susceptibility to infection; and (c) the prevalence of prior hepatitis B infection in the population. For screening to be cost-effective, it should be less expensive than the vaccine that would be saved by not immunizing people found to have prior immunity.¹ Conversely, if the cost of screening to identify people with immunity is greater than the amount saved by not vaccinating them once they are found, then screening is not cost-effective and should not be done. This condition for cost-effective screening can be expressed mathematically as

$$S < V$$

where S = cost of screening, and V = cost of vaccine saved. The expression can be expanded to

$$S_{cl} < V_{cl-pos} \cdot P$$

where S_{cl} = cost of screening per client, V_{cl-pos} = cost of vaccine/vaccination saved for each positive client, and P = prevalence of prior hepatitis B infection in the population.

Thus, the minimum prevalence of prior infection in the population ("break-even" prevalence) needed to justify the cost of screening can be calculated as

$$P = S_{cl} / V_{cl-pos}$$

We obtained vaccine cost from the Centers for Disease Control and Prevention contract price for Recombivax hepatitis B (Merck, Whitehouse Station, NJ). The cost of screening was determined by MDCH laboratory staff and a per-test cost was computed. These costs included reagents and staff time.

Additional considerations and assumptions

Hepatitis B vaccine is given in a series of three doses. Formulations and recommended dose content vary with the age of the person: those 19 years of age or younger may be vaccinated with a pediatric formulation that costs less per dose than the adult formulation. Therefore, we computed break-even seroprevalence figures for the two age groups. Under the immunization program proposed, first doses of vaccine would be given to all study participants at the initial visit. Because prevaccination screening tests require at least one week for processing, test results would not be available at the initial visit. Thus, any savings realized from screening would be the costs of the second and third doses. We also included an administration fee in the cost of each dose of vaccine given.

Estimates of prevalence

To determine estimates of the prevalence of hepatitis B infection in the target population, we conducted a seroprevalence study. We tested for hepatitis B core antibody (anti-HBc) in 400 serum specimens originally submitted for syphilis testing from Sexually Transmitted Disease (STD) clinic clients aged 15 years and older. Personal identifiers were removed; only client age and geographic location of the clinic were linked to the test result.

We compared seroprevalence of previous hepatitis B infection between age groups and between metropolitan Detroit and outstate geographic clinic areas. We assessed statistical significance using chi-square tests (Mantel-Haenszel) with Epi-Info software.³

RESULTS

Screening test and vaccine cost data

The unit test cost of screening was \$11.40. The cost of a dose of vaccine for anyone 19 years old or younger was \$9.06; for those 20 years old and older, \$24.79. The administration fee was \$8.00 per dose regardless of client age. Thus the savings to be realized for each previously hepatitis B-infected client identified under the screening program were \$34.12 ($[\$9.06 + \$8.00] \times 2$) for those age 19 and younger and \$65.58 ($[\$24.79 + \$8.00] \times 2$) for those 20 or older.

Minimum (break-even) seroprevalence

For clients 19 years of age and younger, the minimum or break-even prevalence of prior hepatitis B infection was calculated to be 33.41%; for those 20 years of age and older the minimum prevalence was calculated to be 17.38%.

Seroprevalence study

Seroprevalence of previous hepatitis B infection by age group and major geographic division is given in the Table. The overall prevalence of anti-HBc was 8.3% (33/400), and ranged from 0% in 0- to 19-year-olds to 11.8% in 20- to 21-year-olds in metropolitan Detroit. Overall, seroprevalence in those older than 19 years of age (10.4%) was significantly greater than in those 19 years of age and younger (2.0%, $p < .01$); this association was also significant ($p < .02$) in metropolitan Detroit, but not in the outstate region. The study levels of seroprevalence for all geographic areas and age groups were lower than the calculated break-even seroprevalence.

CONCLUSIONS

Based on the seroprevalence study findings, we concluded that routine preimmunization screening for prior hepatitis B infection would not be cost-effective for this population. Accordingly, the immunization program was implemented without an immunity screening component.

DISCUSSION

The estimated current annual hepatitis B incidence in the United States is between 100,000 and 150,000 cases, and an estimated 10% of those affected develop chronic infection.³ The prevalence of people with chronic hepatitis B infection in the United States is estimated to be 1 to 1.25 million. The risk of developing chronic infection varies inversely with age at infec-

tion, with perinatally infected infants at greatest risk (up to 90%). Chronic infection in turn carries an elevated lifetime risk of cirrhosis and hepatocellular carcinoma.

In addition to vertical perinatal transmission, other risk factors for infection include percutaneous or permucosal exposure to infective body fluids (blood, semen, vaginal secretions, and, rarely, saliva). In the United States the most common means of infection is sexual contact (either heterosexual or homosexual) with an infected individual. The risk of infection increases significantly upon entering the adolescent and young adult age groups.⁴

Immunization programs, like other public health initiatives, tend to have limited funding and strive to be as cost-efficient as possible. The findings of the present study helped the MDCH determine that immunity screening would not be cost-effective in this targeted population in Michigan. A New York State study of 100 inner-city adolescents also found prevaccination screening not to be cost-effective.⁵

From 1992 to 1998, an average of 451 hepatitis B cases were reported annually in Michigan (range: 393–584); 89% of reported cases during that period were among people 20 years of age and older. Whereas surveillance methods were such that some reported cases may have represented chronic hepatitis B carriers, most cases reported in Michigan over this period are believed to be incident cases. The extent of underreporting of hepatitis B cases in Michigan has not been estimated, but it may be substantial; clearly there is a considerable burden of adult-acquired hepatitis B disease in Michigan.

The State of Michigan has supported universal infant hepatitis B immunization for several years, and efforts to immunize older children not immunized in infancy at middle-school age are being implemented collaboratively by local Michigan health departments, Michigan school districts, and the MDCH. These immunization efforts focusing on infants and children

Table 1. Seroprevalence of anti-HBc in Michigan, by client age and location of clinic

Age	All Counties		Metropolitan Detroit ^a		Outstate Region	
All ages	8.3%	33/400	8.2%	18/219	8.3%	15/181
0–19 years	2.0%	2/101	0%	0/58	4.7%	2/43
20 and older	10.4%	31/299	11.2%	18/161	9.4%	13/138
20–21 years	9.5%	6/63	11.8%	4/34	6.9%	2/29
22 and older	10.6%	25/236	11.0%	14/127	10.1%	11/109

^aWayne, Oakland, Macomb counties.

are relatively recent, and so cohorts of older adolescents and adults remain largely susceptible to hepatitis B. Although we have concluded that prevalence of prior hepatitis B infection or immunity in this adolescent population was of a level low enough that screening was not cost-effective, the elevated seroprevalence among persons 20 years of age and older supports the need for hepatitis B immunization programs targeting adolescents.

REFERENCES

1. Centers for Disease Control and Prevention (US). Immunization of adolescents: recommendations of the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, the American Academy of Family Physicians, and the American Medical Association. *MMWR Morb Mortal Wkly Rep* 1996;45:2-4, 10.
2. Protection against viral hepatitis: recommendations of the Advisory Committee on Immunization Practices. *MMWR Morb Mortal Wkly Rep* 1990;39:1-26.
3. Dean AG, Dean JA, Coulumbier D, Brendal KA, Smith DC, Burton AH, et al. A word processing database, and statistics program for epidemiology on microcomputers. *Epi Info*, Version 6. Atlanta: Centers for Disease Control and Prevention(US); 1994.
4. Atkinson W, Humiston S, editors. *Epidemiology and prevention of vaccine-preventable diseases*. 5th ed. Atlanta: Centers for Disease Control and Prevention (US); 1999.
5. McQuillan GM, Coleman PJ, Kruszen-Moran D, Moyer LA, Lambert SB, Margolis HS. Prevalence of hepatitis B virus infection in the United States: the National Health and Nutrition Examination Surveys, 1976 through 1994. *Am J Public Health* 1999;89:14-18.
6. Alderman EM, Shaprio A, Spigland I, Bashir M, Fox AS. Is prevaccination screening for hepatitis B among sexually active adolescents cost-effective? *Clin Infect Dis* 1998; 26:1459-60.