

Dental Students with Hepatitis B e Antigen: A Survey of Canadian Dental Schools

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A b s t r a c t

Health care workers who are e-antigen-positive carriers of hepatitis B virus have become a significant focus of concern in the development of public health policy. In cases of needle-stick injury, the risk of transmission of HBV has been estimated at 60-fold greater if the carrier is positive for e antigen than if the carrier does not have the e antigen. Debate continues regarding proposed public health policies to restrict e-antigen-positive health care workers from performing "exposure-prone procedures." Given the potentially greater risk of disease transmission to patients and the potential career implications for infected students, dental schools must responsibly address the issue of dental students and dental school applicants who have the hepatitis B e antigen. This paper reviews the controversies surrounding this issue and reports a survey of Canadian dental schools.

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Hepatitis B virus (HBV) is one of the most common human pathogens. Worldwide, 300-350 million people are chronically infected,¹ and the highest rates of HBV infection in health care workers are found among dentists and oral surgeons.²

Chronic carriers of HBV can be identified by the presence of the hepatitis B surface antigen (HBsAg). These carriers can be further divided into 2 groups on the basis of whether another hepatitis B antigen, the e antigen (HBeAg), is also present. The carrier state for HBeAg has been recognized as a marker of high risk of infectivity.¹

HBeAg is a subparticle of the core antigen that generally reflects the occurrence of viral replication and circulating viral DNA (**Fig. 1**). In cases of needle-stick injury involving an HBeAg-positive individual, the risk of transmission of HBV has been estimated at 30%,^{3,4} which is up to 60-fold greater than the chance of transmission for an HBV carrier without the e antigen. Thus, HBV carriers who have the e antigen have become the focus of greatest concern in the development of public health policy.

Health Canada has drafted a policy⁵ that recommends mandatory HBV vaccination of dentists and other health care workers who perform what are known as "exposure-prone procedures," as well as subsequent mandatory testing to confirm immunity. If immunity does not develop, testing for HBsAg is

strongly recommended; if the person tests positive for that antigen, testing for HBeAg is also recommended. Results of screening are to be sent to public health and occupational health authorities, as well as to the health care worker's regulatory body. According to the proposed policy, health care workers who practice exposure-prone procedures and are found to carry the HBeAg should cease performing these procedures pending a review by an expert panel established by the provincial ministry of health.

To date, these recommendations have not been adopted by either the Canadian Dental Association (CDA) or the Canadian Medical Association (CMA). However, they do underscore the possible significance of this disease for selected clinicians.

Given the potential career implications for anyone who tests positive for the HBeAg, it is important that all dental schools address the issue of HBV infection in dental students and applicants to dental school. In the United Kingdom, the Committee of Vice Chancellors and Principals has issued guidelines that effectively exclude such individuals from clinical training in dentistry.^{6,7} Of possible relevance is a recent report from the United States, where a court has upheld the exclusion of an HBeAg-positive patient from a dental school.⁸ In Canada, the issue has not been formally addressed by the dental profession. This paper reviews the controversies surrounding this issue and reports a survey of Canadian dental schools.

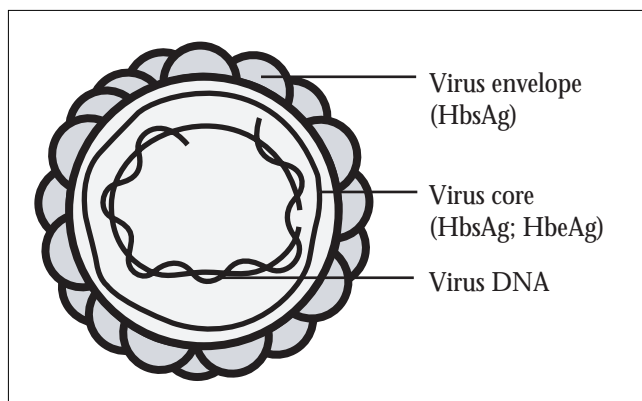


Figure 1: Structure of hepatitis B virus.

Transmission of HBV from Health Care Workers to Patients

From 1972 to 1999, 46 health care workers transmitted HBV to their patients;⁹⁻¹⁹ this total included 9 dentists.¹⁴⁻¹⁹ The 9 dentistry-related transmissions involved clusters of patients infected by HBeAg-positive dentists (see below). None of these dentists routinely wore gloves, but when they began doing so, only one continued to transmit HBV to patients.²²

Although it seems that use of gloves has had a significant impact on transmission of HBV from health care workers to patients, exposure is not completely prevented. Studies have suggested that up to 24% of gloves leak.²⁰ Furthermore, needle-stick injuries are relatively common; a recent survey suggested that, on average, dentists are subject to almost one such injury per year.²¹ Two dentists and 8 surgeons have transmitted HBV to patients despite using gloves.^{10,12,13,22,24} These cases have all involved HBeAg-positive individuals.

It is also a significant concern that in cases involving transmission of HBV from health care workers to patients, several patients have usually been affected, which suggests that extensive morbidity is required before the situation is noticed. A recent case in which at least 75 patients were infected by a technician at an electroencephalography (EEG) clinic illustrates this point.²⁵ The transmission was identified only after a nurse noticed that some patients in a hepatitis clinic had also visited the EEG clinic. This observation prompted an investigation, and many more patients infected at the EEG clinic were subsequently identified. Thus, the identification was, to some extent, serendipitous, prompted by the relatively distinct clinical history of the patients. Whether visits to a dental office, a relatively common occurrence, would permit similar detection is doubtful.

Thus, while no transmissions from dentists have been reported since 1986 (possibly because of the universal precautions widely implemented in 1987), the assumptions that dental transmission from health care worker to patient does not occur and that universal precautions represent a definitive solution to the problem of infectivity are not justified, and complacency is not warranted.

HBV Vaccination and Treatment

HBV vaccination consists of a series of 3 injections. Serological testing for antibody formation should be performed 6 weeks to 6 months after the third injection. Seroconversion rates of 90% to 95% have been reported for immunocompetent recipients of the HBV vaccine.²⁶

Compliance of Canadian dentists with voluntary HBV vaccination programs is reportedly as high as 91%.²⁷ However, only 72% of these dentists underwent postvaccination serology tests to confirm seroconversion.²⁷ The high seroconversion rates reported above are based on studies in young adults,²⁸ whereas many dentists were over 40 years of age when the vaccine was introduced.

There is no entirely effective treatment for HBV carriers. Approximately 25% to 50% of carriers respond to alpha-interferon therapy, and 19% respond to lamivudine.²⁹ Interestingly, it has been reported that some of the more highly infectious HBeAg-positive carriers may spontaneously lose the e antigen over a period of time and thus presumably become less infectious.³⁰

Medicolegal and Ethical Issues Related to HBV-Infected Health Care Workers

The potential for transmission of bloodborne pathogens from an infected health care worker to a patient raises 2 sets of conflicting issues: those related to discrimination against the infected health care worker and those related to the duty of infected health care workers to disclose their condition before exposing patients to risks from such infections. These issues are covered, respectively, by laws regarding employment discrimination against people with disabilities and those regarding patients' rights to informed consent.

Balancing these conflicting issues has necessitated careful consideration of what constitutes "significant risk." The doctrines and practices of informed consent require disclosure only of significant risks during clinical procedures, not of all remote risks. "Significant risk" has been defined as the product of 4 factors: the nature of the risk (how the disease is transmitted), the duration of the risk (how long the individual is infectious), the severity of the risk (the potential harm to other parties) and the probability of transmission.³¹

As discussed in the earlier section "Transmission of HBV from health care workers to patients," the probability of transmission is much higher if the infected health care worker carries the e antigen. Formal recommendations on restricting the practice of health care workers have been influenced by the presence or absence of serum HBeAg.^{5,32,33}

In addition, the appropriate scope of practice and the risk to the patient are affected by the type of procedure. In the United States, the definition of exposure-prone procedures specifies "manipulation, cutting, or removal of any oral or perioral tissue, including tooth structures, during which blood from an injured [health care worker] might transmit infection to the patient."³² The proposed Canadian definition of an exposure-prone procedure refers to "major cutting or removal of any oral or perioral tissue, including tooth structures,

during which there is a potential for the patient's open tissues to be exposed to the blood of an injured health care worker."⁵

In Canada and the United States, health care workers who are HBV carriers but in whom serum HBeAg is not detectable may perform exposure-prone procedures unless their participation in such procedures is shown to have been associated with the transmission of HBV.^{5,32} In contrast, the decision to allow HBeAg-positive health care workers to perform exposure-prone procedures is at the discretion of an expert review panel.^{5,32} More stringent guidelines have been implemented in the United Kingdom, where health care workers who test positive for HBeAg are automatically required to stop performing exposure-prone procedures.³³

HBeAg-Positive Dental Students and Dental School Applicants

There are no published reports of HBV transmission from a dental student to a patient. However, given the potential for transmission of disease to patients, particularly from individuals still developing their clinical skills, and the career implications for HBeAg-positive students, dental schools must address the issue of HBV-infected dental students and dental school applicants.

In the United Kingdom, applicants to dental schools must be vaccinated for HBV before entry and are then tested during their first year of study to ensure adequate protection. If a student is deemed to be infectious, he or she is excluded from the initial stages of the course, undergoes counselling, is advised on the implications of the infection for his or her future career and is transferred to alternative courses.^{6,7}

In North America, policies for dealing with HBeAg-positive dental school applicants and students are inconsistent, and many schools have no defined policy. Fredekind and colleagues,³⁴ of the University of the Pacific dental school, have discussed the controversies surrounding HBeAg-positive applicants to dental schools. They have suggested that dental schools have 6 options in addressing this issue:

1. Don't ask, don't tell.
2. Prescreen all applicants, and deny entry to those who are HBeAg positive.
3. Prescreen all applicants, and place successful applicants who are HBeAg positive on a nonclinical track.
4. Prescreen all applicants, and allow them to treat patients, but only with full disclosure to and informed consent from the patients.
5. Prescreen all applicants to identify those who are HBeAg positive, and match them with protected patients.
6. Encourage self-notification by applicants who are known to be HBeAg positive, and convene an expert panel for case-by-case decisions.

Policy in Canadian Dental Schools

A survey of the 10 Canadian dental schools revealed that 8 schools require successful applicants to provide documented

evidence of HBV vaccination. The 2 other dental schools encourage HBV vaccination but have no formal requirement.

Only 3 of the Canadian dental schools require applicants to undergo serological testing after HBV vaccination to confirm immunity. One additional school indicated that it is considering implementing this requirement in the foreseeable future. The remainder of Canadian dental schools continue to practice the approach that Fredekind and colleagues termed "Don't ask, don't tell."

The 3 Canadian dental schools that require applicants to undergo serological testing use the test results in the following ways.

Dental School A

All applicants are screened for HBsAg before admission. Those with a positive result are also tested for HBeAg and hepatitis B viral DNA. Those with a positive result for one or both of these tests are not considered for admission to dentistry. The decision is not subject to appeal.

Applicants who test negative for HBsAg and are accepted into dentistry must undergo HBV vaccination. After vaccination, students undergo a second test to determine if seroconversion has occurred. If not, they receive a second vaccination and are tested again. Students in whom seroconversion fails to occur after repeat vaccination are counselled as to their potential risk status during training and future practice and are tested again for HBsAg at the end of the second year, before they commence training that involves exposure-prone procedures. Those who test positive for HBsAg (i.e., infection acquired since admission to dentistry) are further tested for HBeAg and hepatitis B viral DNA. Those with a positive result for one or both of these tests may be required to withdraw from the program, a decision that can be appealed to the Practice Review Board.

Dental School B

After admission, all students are required to undergo HBV vaccination and are then serologically tested to confirm immunity. Those in whom seroconversion does not occur are counselled and then undergo testing for HBsAg. The school's policy is that the mere presence of carrier status should not be a factor in the acceptance of an applicant nor in determining his or her fitness to continue study. Students with communicable diseases such as HBV may pursue their studies as long as medical opinion indicates that their work does not pose a health or safety hazard to others.

Dental School C

After admission, all students are required to undergo HBV vaccination and are then serologically tested to confirm immunity. The results of this serological testing have no impact on admission to the program. Those in whom seroconversion does not occur are counselled regarding their potential risk for future infection, but antigen testing is not required. The dental school feels that universal precautions are an adequate safeguard against any transmission of disease from an HBsAg-positive dental student, irrespective of HBeAg status.

Discussion

Although most Canadian dental schools have a formal requirement that successful applicants undergo HBV vaccination, only 3 of these schools require serological testing to confirm immunity and rule out an infectious carrier state. The 7 schools that do not require serological testing cited one or both of 2 principal reasons for not requiring such testing:

1. Serological testing is considered unnecessary, as universal precautions are deemed to adequately mitigate any risk of transmission of infection.
2. There is concern that a formal requirement for serological testing would be associated with the potential for charges of discrimination.

The first reason mentioned ignores the evidence that HBV can be transmitted from health care workers to patients in spite of compliance with universal precautions and infection control procedures. Reported cases of such transmission have all involved HBeAg-positive health care workers.^{10,12,13,22-24} With regard to the second reason, the law concerning discrimination against a dental school applicant with a communicable disease is changing rapidly and is relatively untested in the higher courts. However, as noted earlier, a court in the United States has upheld the exclusion of an HBeAg-positive student from a dental school.⁸

The Canadian dental school that screens applicants and excludes those with either HBeAg or hepatitis B viral DNA (dental school A above) bases its approach³⁵ on the following legal position:³⁶

Human rights legislation prohibits discrimination in relation to the denial of *any goods, services, accommodation or facilities that are customarily available to the general public* (emphasis added) on the basis of race, religious beliefs, colour, gender, physical disability, mental disability, marital status, ancestry, place of origin, source of income or family status of that person or of any other person. It has now been settled by the Supreme Court of Canada that the educational services and facilities provided by a university are services and facilities "customarily available to the public" within the meaning of the legislation and that no distinction exists between students seeking admission and those enrolled.

A university may successfully defend against a claim of discrimination, on the basis that the denial of service or facilities is reasonable and justifiable in the circumstances. For example, excluding students with certain infectious diseases from participating in a clinical placement would be discriminatory but may nevertheless be reasonable and justifiable in the circumstances having regard to the competing interest of patient safety. In order to successfully rely on health or safety considerations to justify a discriminatory rule or practice, it must be shown on the basis of authoritative and up-to-date medical, scientific or statistical information, that there is a sufficient risk to others.³⁶

Putting aside the debate about discrimination, there are several other important points that dental schools should

consider as they seek to formulate rational and consistent policies surrounding this issue.

1. Although there is a tendency to regard serological testing after HBV vaccination as a measure aimed at protecting patients, this testing also offers protection to the student or practitioner. Nonresponders to the HBV vaccine (approximately 10% of those vaccinated) can be identified and offered a second course of vaccination. Approximately 50% of initial nonresponders develop immunity after a second vaccination.²⁶
2. HBeAg carrier status is not a perfect predictor of high infectivity.
3. Transmission of HBV from HBeAg-negative health care workers has been reported. These health care workers were infected with HBV that had undergone a mutation in the precore gene, which permitted high levels of viral replication and infectivity in the absence of HBeAg expression.¹³ To identify such individuals, one Canadian dental school has already proposed testing for viral DNA in HBV carrier applicants, in addition to testing for the e antigen.³⁵
4. Up to 20% of HBeAg-positive individuals undergo seroconversion with alpha-interferon or lamivudine therapy.²⁹ Thus, an excluded applicant might be reconsidered for admission after successful treatment with one of these agents.
5. Dental schools must also consider how they will deal with nonimmune, HBsAg-negative dental students who contract HBV and become HBeAg positive during the clinical years of dental school.
6. Consideration might be given to developing a modified curriculum and professional track for such dental students. This might include specialization in areas not involving exposure-prone procedures, such as public health, or transfer to specialized medical programs that avoid surgical exposure.
7. Given that these dental students may be precluded from pursuing their chosen occupation, dental schools and dental associations might consider working with insurers to give dental students the opportunity to purchase the "own-occupation" disability insurance already available to practitioners.

Finally, as these issues are discussed, we should remind ourselves that dentists, as well as other health care providers, are more likely than their patients to contract bloodborne pathogens through exposure to infected blood. Serological testing to identify vaccinated health care workers in whom seroconversion has failed to occur (see above) and those who have lost their immune status with time²⁸ permits revaccination as appropriate.

Both the CDA and the CMA have expressed concerns that Health Canada is placing an inordinate focus on mandatory HBV screening of practitioners.⁵ The CDA has also expressed concerns regarding Health Canada's definition of the term "exposure-prone procedures" as it relates to dentistry. The

association argues that given the lack of evidence of transmission of HBV to dental patients since 1986, it is technically impossible to identify any dental procedure as presenting more risk than any other. Therefore, undue emphasis on enumerating categories of exposure-prone procedures as a criterion for development of health care policy may be a flawed and overly simplistic approach.

Both the CDA and the CMA feel that if Health Canada proposes to address the problem of HBV seriously and comprehensively, universal vaccination would be the most effective way to proceed. In this regard, Canada's National Advisory Committee on Immunization has recommended HBV vaccination for all individuals in high-risk groups, as well as initiation of universal childhood HBV vaccination.³⁷ Realistically, however, it would be decades before the population protection benefits of such a vaccination program would be fully realized.

Conclusion

In summary, public health policy discussions to date have focused on highly infectious HBV carriers. Although not definitive, the presence of HBeAg is a useful marker to identify this group.

Recent experience indicates that identifying transmission from an outpatient clinical source is difficult and may not occur unless there are special circumstances, including the infection of numerous patients. Furthermore, universal precautions, although useful, may not constitute an adequate safeguard in such situations.

Thus, dental schools must recognize that HBeAg-positive students training to perform exposure-prone procedures present an unknown theoretical but possibly important risk of disease transmission to patients. This risk must be acknowledged and formally addressed in policy-making. At this time, Canadian dental schools have not adopted a uniform approach, although there is general recognition that this is an issue balancing the safety concerns of patients with the human rights concerns of prospective dental students.

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References

1. Alter MJ, Mast EE. The epidemiology of viral hepatitis in the United States. *Gastroenterol Clin North Am* 1994; 23:437-55.
2. Thomas DL, Gruninger SE, Siew C, Joy ED, Quinn TC. Occupational risk of hepatitis C infections among general dentists and oral surgeons in North America. *Am J Med* 1996; 100:41-5.

3. Gerberding JL. Management of occupational exposures to blood-borne viruses. *N Eng J Med* 1995; 332:441-51.
4. Panlilio AL, Shapiro CN, Schable CA, Mendelson MH, Montecalvo MA, Kunches LM, and others. Serosurvey of human immunodeficiency virus, hepatitis B virus, and hepatitis C virus infection among hospital-based surgeons. Serosurvey Study Group. *J Am Coll Surg* 1995; 180:16-24.
5. Health Canada. Proceedings of the Consensus Conference on Infected Health Care Workers: Risk for Transmission of Bloodborne Pathogens. *Can Commun Dis Rep* 24(Supp 4) July 15, 1998.
6. Kingman S. Hepatitis B status must be known for medical school. *BMJ* 1994; 308:876.
7. Scully C, Samaranyake LP. Screening for hepatitis B before admission to dental school. *Brit Dent J* 1995; 178:162.
8. U.S. Department of Health and Human Services, Office for Civil Rights, Docket #07923091. Chang v. University of Iowa School of Dentistry. 1995.
9. Weber DJ, Hoffman KK, Rutula WA. Management of the healthcare worker infected with human immunodeficiency virus: lessons from nosocomial transmission of hepatitis B virus. *Infect Control Hosp Epidemiol* 1991; 12:625-30.
10. Johnston BL, MacDonald S, Lee S, LeBlanc JC, Gross M, Schlech WF. Nosocomial hepatitis B associated with orthopedic surgery — Nova Scotia. *Can Commun Dis Rep* 1992; 18:89-90.
11. Bell DM, Shapiro CN, Ciesielski CA, Chamberland ME. Preventing bloodborne pathogen transmission from health-care workers to patients. The CDC perspective. *Surg Clin North Am* 1995; 75:1189-203.
12. Harpaz R, Von Seidlein L, Averhoff FM, Tormey MP, Sinha SD, and others. Transmission of hepatitis B virus to multiple patients from a surgeon without evidence of inadequate infection control. *N Engl J Med* 1996; 334:549-54.
13. Transmission of hepatitis B to patients from four infected surgeons without hepatitis B e antigen. The Incident Investigation Teams and others. *N Engl J Med* 1997; 336:178-84.
14. Goodwin D. An oral surgeon-related hepatitis B outbreak. *Calif Morbid* 14, 1976.
15. Hadler SC, Sorley DL, Acree KH, Webster HM, Schable CA, Francis DP. An outbreak of hepatitis B in a dental practice. *Ann Intern Med* 1981; 95:133-8.
16. Reingold AL, Kane MA, Murphy BL, Checko P, Francis DP, Maynard JE. Transmission of hepatitis B by an oral surgeon. *J Infect Dis* 1982; 145:262-8.
17. Ahtone J, Goodman RA. Hepatitis B and dental personnel: transmission to patients and prevention issues. *J Am Dent Assoc* 1983; 106:219-22.
18. Shaw FE Jr, Barrett CL, Hamm R, Peare RB, Coleman PJ, Hadler SC. Lethal outbreak of hepatitis B in a dental practice. *JAMA* 1986; 255:3260-4.
19. Outbreak of hepatitis B associated with an oral surgeon — New Hampshire. *MMWR Morb Mortal Wkly Rep* 1987; 35:132-3.
20. Korniewicz DM, Kirwin M, Cresci K, Larson E. Leakage of latex and vinyl exam gloves in high and low risk clinical settings. *Am Ind Hyg Assoc* 1993; 54:22-6.
21. McCarthy GM, Koval JJ, MacDonald JK. Occupational injuries and exposures among Canadian dentists: the results of a national survey. *Infect Control Hosp Epidemiol* 1999; 20:331-6.
22. Kane MA, Lettau LA. Transmission of HBV from dental personnel to patients. *JADA* 1985; 110:634-5.
23. Heptonstall J. Lessons from two linked clusters of acute hepatitis B in cardiothoracic surgery patients [see comments]. *Commun Dis Rep CDR Review* 1996; 6:R119-25.
24. Mukerjee AK, Westmoreland D, Rees HG. Response to the discovery of two practicing surgeons infected with hepatitis B. *Commun Dis Rep CDR Review* 1996; 6:R126-8.
25. Johnson I. Hepatitis B — EEG clinics outbreak investigation. Toronto: Ontario Ministry of Health. 1997. Final report.
26. National Advisory Committee on Immunization (NACI). Statement on hepatitis B vaccine. *CCDR* 1993; 19:104-15.

27. McCarthy GM, Koval JJ, MacDonald JK. Compliance with recommended infection control procedures among Canadian dentists: results of a national survey. *Am J Infect Control* 1999; 27:377-84.
28. Mast EE, Alter MJ. Prevention of hepatitis B virus infection among health care workers. In: Ellis RW, editor. Hepatitis B vaccines in clinical practice. New York: Dekker; 1993. p. 295-307.
29. Hoofnagle JH, Lau D. New therapies for chronic hepatitis B. *J Viral Hepat* 1997; 4(Suppl 1):41-50.
30. Lok AS, Lai CL, Leung EK, Lam ST. Spontaneous hepatitis B e antigen to antibody seroconversion and reversion in Chinese patients with chronic hepatitis B virus infection. *Gastroenterology* 1987; 92:1839-43.
31. Rozovsky FA. Consent to treatment: A practical guide. 2nd ed. Boston: Little, Brown & Co.; 1990. p. 59-64.
32. CDC. Recommendations for preventing transmission of human immunodeficiency virus and hepatitis B virus to patients during exposure-prone procedures. *MMWR* 1991; 40:1-9.
33. UK Health Departments. Protecting health care workers and patients from hepatitis B: Recommendations of the Advisory Group on Hepatitis. London: Her Majesty's Stationary Office, 1993.
34. Fredekind RE and others. The hepatitis B e-antigen positive dental school applicant. *J Dent Educ* 1999; 63(10):766-71.
35. Faculty of Medicine and Dentistry, University of Alberta. Policy regarding blood-borne pathogens.
36. Government of Alberta. Human Rights, Citizenship and Multiculturalism Act.
37. Health Canada. National Advisory Committee on Immunization (NACI). Statement on universal immunization against hepatitis B. *CDWR* 1991; 17-31:165.