

# Strategies to prevent hepatitis B virus infection in China: Immunization, screening, and standard medical practices

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## Summary

China has one of the world's highest rates of hepatitis B infection. Over the past 20 years, a series of strategies have been implemented to prevent infection with the hepatitis B virus (HBV) in China. These strategies include hepatitis B (hepB) immunization for susceptible populations such as infants and young children and for high-risk populations such as health care workers and patients, premarital health care for couples of childbearing age, and standard medical practices. A series of measures implemented by the Chinese government caused the HBV infection rate in China to decrease from 9.75% in 1992 to 7.2% in 2006. However, a report on infectious diseases indicated that more than 1 million people in China were infected with hepB in 2011. There is room for improvement. The current work analyzed the current status of and challenges for strategies to prevent HBV infection in China. This work also recommends clear guidance regarding hepB immunization for parents in rural areas, more flexible premarital health care, health education for both patients and health care workers, and routine HBV screening for high-risk health care workers.

**Keywords:** Hepatitis B virus (HBV), hepatitis B (hepB), prevention, high-risk population

## 1. Introduction

Hepatitis B (hepB) is one of the world's major health problems. Two billion people worldwide are reportedly infected with the hepatitis B virus (HBV) (1). HBV can cause both acute and chronic disease. HBV carriers have a substantially increased risk of chronic hepatitis, cirrhosis, and hepatocellular carcinoma in later life (2-4). About 600,000 people worldwide die from hepatitis B every year (1). China has one of the world's highest rates of hepB infection. A nationwide HBV serosurvey conducted in 2006 showed that 7.2% of the Chinese population ages 1-59 years were hepatitis B surface antigen (HBsAg) carriers (5). An estimated 93 million people in China are infected with HBV.

HBV infection is irreversible, but there are some strategies to prevent HBV infection by blocking HBV's

transmission. HBV can be transmitted by direct blood-to-blood contact or semen and vaginal fluid from an infected person. The common modes of transmission in developing countries are perinatal, early childhood infections, unsafe injection practices, unsafe blood transfusions, and unprotected sexual contact (1). Chinese strategies to prevent HBV by blocking its transmission are analyzed here. These strategies include HBV immunization of susceptible and high-risk populations, premarital health care for couples of childbearing age, and standard medical practices. Strategies have advanced over the past 20 years in China, but there is still room for improvement (see Table 1).

## 2. Strategies to prevent hepB in China

### 2.1. Preventive strategies for infants and young children

Infants are susceptible to HBV infection in utero, intrapartum, or postnatally through maternal transmission. Young children acquire HBV infection through close contact with their parents or other family members as part of everyday family life. Most chronic

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**Table 1. Major strategies to prevent HBV in China**

Target population	Strategies	Challenge	Suggestion
Infants and young children	HepB immunization, no longer paid by out-of-pocket but now government-subsidized.	Less hepB immunization in rural areas than in urban areas.	Clear guidance for parents regarding hepB immunization.
Couples of childbearing age	Premarital health care including HBV screening and health education.	Lack of awareness of the importance of premarital health care. Conflict in terms of the time spent receiving health care and at work.	1. Awareness of the importance of premarital health care. 2. More convenient services provided by maternal and child health centers.
High-risk health care workers and patients	1. HepB immunization. 2. standard medical practices.	HepB immunization for adults and especially for the elderly is less cost-effective.	1. Standard medical practices prior to immunization. 2. Health education for both health care workers and patients. 3. Routine HBV screening for high-risk health care workers with self-reported vaccination.

HBV infections are acquired in infancy and early childhood (6,7). People who acquire HBV infection in early life have higher levels of viral replication and severer disease than those who acquire it in later life (8,9).

Immunization at birth is the cornerstone of prevention, reducing mother to child transmission by > 95% and conferring long-term protection against clinical disease (10,11). HepB immunization was introduced in China in 1987. HepB vaccination was recommended for all infants in China pursuant to the "National Hepatitis B Immunization Plan" formulated by the Ministry of Health of the People's Republic of China in 1992. In accordance with the plan, all infants should be vaccinated with hepB vaccine three times: 24 hours after birth, 3 months later, and 6 months later. Unlike other Expanded Program on Immunization (EPI) vaccines, the hepB vaccine and injection fee are paid for out-of-pocket by parents. HepB immunization was included in the EPI in China since 2002. A hepB vaccine for children under the age of 4 was subsidized by the Chinese government starting in 2002. Parents only need pay the injection fee. From 2002 to 2007, the Global Alliance for Vaccines and Immunization (GAVI) program provided \$38,678,918 for hepB vaccination of infants in poor counties in middle and western China (12). Reform of the health care system began in China from 2009, and the prevention of hepB received greater attention as a main public health effort. All children under age 15 who were never or incompletely immunized with the hepB vaccine had to be revaccinated from 2009 to 2011. Immunization costs were borne by public health insurance.

After those efforts, hepB immunization of infants increased from 72% in 2000 to 99% in 2010 (13). Children fully vaccinated with 3 doses of hepB vaccine had a significantly lower prevalence of HBsAg (1.99%) than unvaccinated children (5.56%) (14). HepB immunization of infants has resulted in a prevalence of HBsAg among children under 5 of less than 1% and

prevented an estimated 16-20 million HBV carriers (2). But hepB immunization has not occurred at the same rates in urban and rural areas. HepB immunization in rural areas is 94.6% (15), which is lower than the national rate of 99% (13).

## 2.2. Preventive strategies for couples of childbearing age

There are data showing that new couples with HBV infection, and especially those in endemic areas, have 50% possibility of transmitting HBV to the next generation (16,17). HBV infection during pregnancy can cause HBV intrauterine transmission and damage both the mother and fetus. Gestational diabetes mellitus, antepartum hemorrhaging, and preterm deliveries are reportedly more frequent in chronic maternal HBV infection (18-20). A higher risk of a low birth weight and prematurity are noted with acute maternal HBV infection (21). During pregnancy, the immune response is depressed to prevent the rejection of the fetus. As a result, infected individuals will have a significant increase in HBV DNA and a lower level of aminotransferase (22). Given the high risk of HBV transmission from new couples to children and the danger to the mother and fetus, screening for HBV and interventions for couples warrant attention and investigation.

In China, the "Law on Chinese Maternal and Infant Health Care" was enacted in 1995. According to the law, both a man and woman desiring to be married must undergo a premarital medical examination that includes HBV screening and education. Utilization of premarital health care has increased yearly since 1995. The rate of premarital health care utilization reached 68% (9 million/ 13.6 million) in 2002 (23). From 2003 was premarital health care no longer mandatory but voluntary. Consequently, the rate of premarital health care utilization decreased to 2.7% (0.36 million/14 million) in 2004 (24). HBV infection is reportedly detected by premarital health care in about 3-6% of new

couples (25-27). Accordingly, approximately 270,000-540,000 people with HBV infection could have been detected by premarital health care in 2002, but only 10,800-21,600 people with HBV infection would have been detected by premarital health care in 2004. Since early detection of HBV infection and other diseases is missed because of the absence of premarital health care, areas such as Shanghai began to provide early detection for free starting in 2005. The rate of premarital health care utilization reached 37.1% (900,000/2,440,000) again in Shanghai in 2010 (28).

### 2.3. Preventive strategies for health care workers and high-risk patients

There is a potential for HBV transmission between health care workers and high-risk patients. Health care workers risk HBV infection during surgical, obstetrical, and dental procedures due to worker injuries and occupational blood exposure (29,30). HepB immunization of high-risk populations, and especially health care workers, is recommended (31,32). HepB immunization of health care workers has been funded by local governments or medical facilities in some areas of China, such as Beijing. After hepB immunization, 90% of health care workers were positive for hepB surface antibody (HBsAb) (33,34).

Many regulations have been implemented in China to regulate standard medical practices. These include the "Law on Infectious Disease Prevention", the "Criteria for Management of Nosocomial Infections", and the "Criteria for Management of Disinfection". Consequently, blood collection and supply are strictly regulated. Health care facilities take care to prevent nosocomial infections. As a result, transmission of HBV to patients is seldom reported in China. However, patients such as diabetics have a higher risk of HBV transmission when monitoring their blood glucose if equipment is shared or adequate hand hygiene is not used (35). Persons with diabetes are reported to have a 60% higher prevalence of HBV infection than are those without diabetes (36). HepB immunization of diabetics (type 1 and type 2 diabetes) is generally a key prevention strategy in developing countries where hepB is endemic (37,38). Diabetes patients who are under age 60 should be immunized with the hepB vaccine as soon after they are diagnosed as possible (39). In China, immunization with the hepB vaccine is now voluntary for high-risk patients such as diabetics. Thus, a government-supported strategy to promote hepB immunization of high-risk patients, such as diabetics, may be adopted in China.

### 3. The challenges of HBV prevention strategies in China

The HBV infection rate in China decreased from

9.75% in 1992 (40) to 7.2% in 2006 due to a series of measures implemented by the Chinese government (2). However, a report on infectious diseases indicated that more than 1 million people in China were infected with hepB in 2011 (41). There is room for improvement.

#### 3.1. HepB immunization of infants and young children

Preventive strategies for infants and young children in China have proven successful. These strategies are estimated to have a cost-effectiveness of 1:51.01 (1:49.59 in urban areas, 1:51.91 in rural areas) (42). Even though there is greater cost-effectiveness in rural areas, the rate of hepB immunization is lower in rural areas than in urban areas. There may be two reasons for this difference. One is that rural families migrate more frequent than urban families. Typically, a surplus labor force moves from rural areas to urban areas to find work. Therefore, infants of rural families are more likely to fail to take all 3 hepB doses as part of immunization. The other is that parents' knowledge of HBV infection and immunization is the main factor influencing the rate of hepB immunization (15,43). Parents in rural areas have less knowledge of HBV than those in urban areas, so rural health care workers are responsible for informing parents of when and where to receive hepB immunization if they migrate elsewhere to find work (44).

#### 3.2. Premarital health care for couples of childbearing age

About 30-50% of HBV infections occurred through perinatal and early childhood close contact; 90% of infants infected with HBV develop chronic infections and 30-50% of children infected with HBV develop chronic infections from the age of one to four years (1). Premarital health care is also hugely cost-effective because of its low cost (less than US \$15) and it had the potential to block 30-50% of HBV infections, subsequently reducing the direct economic burden of hepB. The direct economic burden of hepB is estimated to be more than US \$1600 per Chinese citizen annually. If hepB develops into severe hepB, the direct economic burden will be almost 95% of a family's annual income (45). Given the potential to decrease the economic burden of hepB, premarital health care is a cost-effective way to block HBV transmission. However, the rate of utilization of premarital health care decreased sharply after it was no longer mandatory but voluntary. Even though it is now provided for free, the rate of premarital health care utilization has only increased slightly. A survey has shown that the main reasons for the low rate of premarital health care utilization are attitudes and time spent (46). Some couples think that voluntary care means that the care is not necessary. Some forego care because of the conflict between work and health care. Young people need to know the

importance of premarital health care. Maternal and child health centers that are responsible for premarital health care should be government-subsidized to provide services outside the regular work week to make them more convenient.

### 3.3. HepB immunization and standard medical practices for health care workers and high-risk patients

Both hepB immunization of health care workers and high-risk patients and standard medical practices have proven effective in China (33,34). However, adults, and particularly the elderly have a lower response rate to hepB immunization than do young children (47). HepB immunization of the elderly (> 60) is not recommended given its lack of cost-effectiveness (48). Standard medical practices and health education are effective ways to block transmission from health care workers to patients. First, standard medical practices should be emphasized throughout an entire medical procedure and should be taught to personnel ranging from medical students to professors. Second, health care workers should receive detailed information clarifying procedures risking HBV infection and be informed of precautions. Health care workers should take care to assure the hygiene of medical instruments and take precautions. Finally, health education should be provided to patients, *e.g.* diabetics who are at risk for HBV infection should be taught how to avoid infection when monitoring their blood glucose levels. Without question, health care workers are responsible for providing health education to patients. People are accustomed to relying on health care workers for health knowledge since that knowledge is a sign of their authority. Therefore, health care workers play an important role in improving the health literacy of people (49). Unfortunately, health care workers reportedly have limited knowledge of the prevention and treatment of hepB in rural areas. Rural health care workers were able to correctly answer only about 70% of questions about HBV and some of their knowledge of hepB improved little (less than 80%) after health education due to low levels of literacy (50). Ways to improve the knowledge of hepB among health care workers should be prioritized especially in rural areas. Given the low levels of literacy, consistent techniques should be adopted until most rural health care workers have the appropriate knowledge. Increased knowledge can lead to a more positive attitude and subsequently encourage good practices by both health care workers and patients.

HBV screening of high-risk populations is recommended (51). Serological testing of at-risk health care workers is crucial to preventing further HBV transmission (35). On one hand, health care workers found to have an HBV infection benefit by being treated as early as possible. On the other hand, identifying

health care workers who are infected allows them to be transferred away from patients so that they do not transmit the infection. Levels of HBV DNA and hepBe antigen should be monitored in health care workers who have an HBV infection to facilitate blocking of further transmission. HBV screening combined with self-reported vaccination may be efficient and less expensive.

## 4. Conclusion

China has one of the world's highest rates of HBV infection. Many strategies including hepB immunization, premarital health care, and standard medical practices have been used to control HBV infection over the past 20 years. The HBV infection rate in China decreased from 9.75% in 1992 to 7.2% in 2006 due to the implementation of these strategies. But there is still room for improvement. Clear guidance for parents regarding hepB immunization can help to promote hepB immunization especially in rural areas. Premarital health care should be adequately utilized by the population and provided flexibly by maternal and child health centers. Standard medical practices should be prioritized over hepB immunization of health care workers and high-risk patients. Health education for both health care workers and patients is needed. Serologic HBV testing of at-risk health care workers is also necessary

## Acknowledgements

This work was supported by the National Natural Science Fund for Young Scholars of China (81000177, Yuesi Zhong).

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(Received November 23, 2012; Revised January 28, 2013; Accepted February 5, 2013)