Hepatitis B vaccination coverage and associated factor for vaccine acceptance: a cross-sectional study in health workers of the Acapulco General Hospital, Mexico

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Abstract

Objective: *to estimate the HVB vaccination coverage in healthcare personnel and to identify factors associated with the complete vaccination schedule.* **Material and methods:** *cross-sectional study among workers at the Acapulco General Hospital. HVB vaccination history, number of received doses and administration date were investigated. A complete vaccination schedule was considered when the worker received at least three doses, the first two given at two-month intervals, and the third after 6 months to 1 year.* **Results:** *52% of the workers (436/834) referred having being vaccinated against HBV once during their working life. Only 5.5% (46/834) met the complete vaccination schedule criterion. Factors associated with complete vaccination schedule were the level of education, the perceived risk of becoming infected at work and knowledge of the vaccination schedule and its effectiveness.* **Conclusions:** *coverage with the complete HBV vaccination schedule in healthcare personnel was very low. Based on the results of this study, strategies can be outlined in order to increase vaccination coverage.* (Gac Med Mex. 2014;150:395-402)

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Introduction

According to worldwide estimates of the World Health Organization (WHO), there are more than two million people infected with HBV and over 360 million live chronically infected with this virus and at risk of becoming severely ill and even dying due to a liver disease such as cirrhosis or liver cancer[1]. In the Mexican population older than 20 years, a seroprevalence of antibodies against core and surface HBV antigens of 3.3 and 0.21%, respectively, was estimated. With these data, it was calculated that by year 2000 around 1.7 million of people were already infected with HBV and that there were a little more than 100,000 chronic carriers[2]. In 2011, Panduro proposed that more recent studies estimated that there were at least three million adult persons infected in the country, and out of these, at least 300,000 were active carriers[3]. The increase in figures reported for these periods might indicate an underestimation in the first measurement or an increase in the transmission of the virus.

Due to the procedures inherent to their occupation, healthcare workers are at high risk of acquiring the HBV[4,5]. This risk is increased in personnel working at hospital settings, due to a higher frequency of contact with body fluids and use of sharp/pointed instruments (sharps)[6,7]. Various studies have found that the prevalence of HBV infection, measured through serum antibody levels in healthcare workers, ranges from 6 to 30%[10,11], even higher than that of HIV infection, which is in the 0.3-0.9% range[10,11]. In Mexico, a 0.6% frequency of hepatitis B has been reported among healthcare workers[12], with a prevalence of HBV surface antigen ranging between 0.5 and 1.2%[13].

Vaccination against HBV was adopted as the strategy to protect healthcare personnel against this infection

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since 1982[14]. Three doses of the vaccine, administered at one to six-month intervals, produce levels of protective antigens against HBV higher than 10 mIU/ml in over 95% of the people[15]. In a study to determine the prevalence of protecting levels of antibodies against HBV after a vaccination schedule in healthcare workers at the La Raza National Medical Center in Mexico, protecting levels of anti-hepatitis B surface antigen (anti-HBsAg) were found in 60% of the workers with two vaccine doses and in 86% after three doses[16].

Vaccination schedules in Mexico follow the instructions set forth by the Official Mexican Standard 036 (NOM-036). Before September 2012, the standard indicated a vaccination schedule with two doses given four weeks apart in adults[17]. Currently, three doses of a combined vaccine against hepatitis A and B are indicated after 16 years of age, and a three-dose schedule with recombinant anti-hepatitis B vaccine after 11 years[18]. The standard indicates vaccination in children with three doses, with the first administered within the first 12 hours of life, trying to cover the vaccination schedule in the first year of life. This policy is recommended because HBV infection in children populations is associated with higher rates of liver cancer than the infection at adult ages[19,20].

However, the achievement of universal coverage among workers remains a challenge. Studies in several countries report vaccination coverages ranging from 60 to 80%, depending on the field of each worker[21-23]. In Mexico, a study reported coverage with three anti-HBV vaccine doses or more in 21% of workers at a tertiary care medical unit[12].

Due to low availability and optimization of resources, some countries conduct selective vaccination according to the field of work, prioritizing personnel working in dialysis and surgery departments and intensive care units. Accidental exposure to blood or body fluids has been reported to be associated with HBV vaccination acceptance. Other vaccination-associated factors are education level, being in contact with HBV-infected patients, educational campaigns on prevention of occupational exposure and offering free vaccination to every worker[21,23]. Conversely, factors associated with low vaccination coverage include: unavailability of the vaccine, fear of the vaccine injection and considering to be at low risk of acquiring hepatitis B[7,24].

In Mexico, the factors associated with acceptance of the vaccine in healthcare workers remain unknown. The purpose of this study was to estimate the HBV vaccination coverage in healthcare personnel and to identify factors associated with the complete vaccination schedule and, based on this evidence, to propose actions aiming to increase vaccination coverage among healthcare workers at the General Hospital of Acapulco.

Material and methods

A cross-sectional study was conducted between July and August, 2010. The sample comprised 860 workers from the Acapulco General Hospital, affiliated to the Ministry of Health from Guerrero, Mexico. A self-administered survey was applied to physicians, paramedics and custodial staff, regardless of the type of employment contract. The measuring instrument was a questionnaire with 48 closed and one open question. The instrument was tested in a clinic with the same characteristics of the one under study until the questions were understood by the participants and warranted useful answers for statistical analysis.

The questionnaire collected personal data of the workers such as: age, sex, education and occupation. With regard to the working situation of the participant, the following was recorded: post type, function, department, shift and having a job at other healthcare institution. Participants were asked about their perception on the frequency of contact with patients and with patients' blood or body fluids during their working day, on the risk of becoming ill with hepatitis B in their job and the danger of becoming ill compared with other healthcare workers and the general population. History of training on medical sharps handling and occupational accidents was inquired. There were questions on knowledge about the transmission mechanisms of viral A, B and C hepatitis, frequency of hepatitis B chronic carriers in the general population and indications, effectiveness, vaccination schedule, adverse reactions and contraindications of the HBV vaccine.

History of HBV vaccination was looked into, as well as the received number of doses and date of administration. These data allowed for those who had a complete HBV vaccination schedule to be measured. The operational definition of personnel with complete vaccination schedule was established as having received at least three doses of the vaccine, with the two first doses given two months apart and the third one with a six-month to 1-year interval. The reasons for vaccination and no vaccination, whether the participants would get vaccinated during the next vaccination campaign, why would they agree to be vaccinated, why would they not agree, their perception on the importance of being vaccinated, who should convince them

to get vaccinated, whether they consider HBV vaccination mandatory for healthcare workers and what activities should the hospital authority carry out in order for workers to be vaccinated, was also asked. The questionnaire asked if the workers had received information on the vaccine against HBV, on what year, institution and healthcare personnel that provided such information, and if they were vaccinated before or after having suffered some occupational accident with previously used sharps. With regard to wounds inflicted by used sharps, the participants were asked on the estimated number during their working life, how many injuries they suffered over the last year and what was the object they got injured with the last time; additionally, a brief description of the accident was requested.

The study was reviewed and approved by the State Research Committee of the Ministry of Health from Guerrero, Mexico, and the Universidad Autónoma de Guerrero Tropical Diseases Research Center Ethics Committee. In coordination with the hospital authorities, the survey was conducted throughout all departments and different shifts. Informed consent was authorized and signed by each participant. The participants were aware of the objective and purposes of the study. Participation was voluntary, free of charge, anonymous, confidential, and the subjects had the right to refuse to participate or to answer any of the questions. Those who participated answered the questionnaire and then placed it into an envelope. Due to the anonymous nature and confidentiality of the survey, it was not possible knowing who were not vaccinated against HBV, but the participants were verbally encouraged to attend to the preventive medicine service to ask for vaccination.

Data was captured using the EpiData statistical package[25]. Double data entry was performed and the electronic data bases were validated using the Validate program from the same software, which allowed for entry errors to be identified and corrected. The analysis was conducted using the CIETmap statistical package[26], simple frequency and contingency tables were obtained to estimate the effect size through the odds ratio (OR). The bivariate and multivariate analysis was performed with the Mantel-Haenszel procedure[27]. We report significant associations with a 95% confidence level. Additionally, the gain based on the adjusted risk difference (aRD) used by Rothman, the confidence intervals (IC) proposed by Miettinen, and the crude and adjusted gain, with 95% CIs, were also calculated. The model calculates the gain by multiplying the aRD by the percentage of the population requiring the intervention (PPRI). If the result of a cross-sectional study such as this is reproduced in a randomized trial, the gain may be expressed as the number of persons theoretically expected to benefit from a measure becoming widespread for each 1,000 exposed persons[28].

Results

Ninety-seven percent (834/860) of the hospital's healthcare workers participated in the study and only 26 refused to answer the questionnaire; the reason why they decided not to participate was not asked. Most participants were nursing personnel (48%, 395/834), followed by physicians (26%, 218/834) and other type of workers (26%, 218/834), such as chemists, technicians, stretcher-bearers and custodial staff. The majority of participants were females (67%, 558/834). The remaining characteristics of the surveyed personnel are shown in table 1.

Of the studied workers, 55% (461/834) responded being in contact with patients most of the time and 88% (731/834) referred being in contact with patients' blood or body fluids during their working day. Fifty-nine percent (496/834) had a perception of high risk of becoming infected with HBV in their job. Forty-nine percent (410/834) perceived themselves at higher risk of becoming infected with HBV than healthcare workers in other areas, and 77% (639/834) referred being at higher risk of HBV infection compared with the general population. Seventy-five percent (626/834) had received training on sharps handling and 55% (460/834) on occupational accidents prevention.

The proportion of personnel that referred ignoring the prevalence of chronic hepatitis B in the general population was 59% (489/834). Fifty-two percent (433/834) of participants answered correctly to the mechanism of transmission of hepatitis A, 62% (515/834) for hepatitis B and 61% (510/834) to that of hepatitis C. Thirty-nine percent (326/834) answered that hepatitis B is transmitted after an occupational accident with previously used sharps.

Indications for HBV vaccine were identified by 79% (662/834) of participants, 43% (355/834) knew about the effectiveness of the vaccine and 66% (547/834) was unaware of the HBV vaccination schedule for healthcare personnel. Twenty-six percent (221/834) answered that pain and local edema are adverse reactions to the vaccine, and 33% (276/834) were unaware of the HBV vaccine contraindications.

Table 1. Profile of workers at the Acapulco General Hospital, State of Guerrero, Mexico, (July 2010)

Factors		Personnel category					
		Physician		Nursing		Other personnel	
		n	%	n	%	n	%
Age	< 45 years	142	65%	281	71%	186	85%
	≥ 45 years	76	35%	116	29%	32	15%
Sex	Female	102	47%	342	86%	114	5%
	Male	116	53%	56	14%	104	48%
Education	Specialty or higher	122	56%	34	9%	3	1%
	College degree or lower	96	44%	363	91%	215	99%
Post type	Permanent	130	60%	289	73%	150	69%
	Temporary	87	40%	109	27%	68	31%
Job role	Head of service	10	5%	23	6%	5	2%
	Supervisor			4	1%	2	1%
	Specialist	114	52%	26	7%	3	1%
	General	70	32%	251	63%	2	1%
	Assistant			76	19%	19	9%
	Other	24	11%	18	4%	187	86%
Department assigned	Emergency department	36	17%	58	15%	23	11%
	Surgical unit	26	12%	31	8%	14	6%
	Internal medicine	23	11%	36	9%	10	5%
	Obstetrics and gynecology	32	15%	34	9%	5	2%
	Surgery and traumatology	33	15%	24	6%	8	4%
	Pediatrics	29	13%	83	21%	4	2%
	Labor and delivery unit	2	1%	42	11%	13	6%
	Outpatient clinic	15	7%	35	9%	8	4%
	Laboratory					58	27%
	Blood collection station	6	3%	1	1%	29	14%
	Other	16	7%	54	14%	46	21%
Shift	Morning	73	34%	143	36%	92	42%
	Evening	32	15%	91	23%	54	25%
	Night	23	11%	97	24%	23	11%
	Cumulative shifts weekends and holidays, daytime	15	7%	48	12%	31	14%
	Cumulative shifts weekends and holidays, night-time	4	2%	14	4%	9	4%
	All shifts	71	33%	4	1%	8	4%
Having other job	Yes	61	28%	52	13%	9	4%
	No	157	72%	346	87%	209	96%

Table 2. Saturated model of the hepatitis B vaccination schedule on year 2010 among healthcare personnel at the Acapulco General Hospital, State of Guerrero, Mexico (July 2010)

Factor	OR*	95% CI†
Level of education	5.27	2.71-10.44
Occupation	3.04	1.56-5.92
Works at other healthcare institution	0.32	0.17-0.75
Knows that hepatitis is transmitted after an occupational accident	3.83	2.02-8.84
Perception of risk of acquiring hepatitis B at work	2.57	1.31-7.46
Knows about the vaccine effectiveness	4.65	2.41-12.52
Knows the vaccination schedule for healthcare personnel	6.77	3.49-18.22
Received information on the vaccine	18.98	7.54-83.24

*Unadjusted odds ratio.
†Odds ratio 95% confidence interval.

Table 3. Multivariate analysis of factors associated with the complete hepatitis B vaccination schedule and gain estimate in workers at the Acapulco General Hospital, State of Guerrero, Mexico (July 2010)

Factor	aOR*	95% CI†	RD‡	aRD	95% CI§	Gain¶	HetX²**	p††
Higher academic degree	3.52	1.79-6.93	0.118	0.010	0.004-0.015	92	13.31	0.95
Perceiving risk of being infected with hepatitis B at work	2.52	1.18-5.42	0.045	0.021	0.003-0.038	18	5.63	0.99
Knowing about hepatitis B vaccine effectiveness	3.81	1.79-8.14	0.076	0.018	0.007-0.028	42	11.96	0.89
Knowing the hepatitis B vaccination schedule for healthcare personnel	4.48	2.08-9.64	0.101	0.002	0.001-0.003	65	14.69	0.98

*Adjusted odds ratio.
†Adjusted odds ratio 95% confidence interval.
‡Unadjusted risk difference.
§Adjusted risk difference 95% confidence interval.
¶Estimated gain for 1,000 persons.
**Heterogeneity X^2.
††p-value.

HBV vaccination coverage

Nearly half of healthcare workers (52%, 436/834) referred having been vaccinated at least once against HBV during their working life: 25% (214/834), one dose; 18% (148/834), two doses; and 7% (59/834), three or more doses. Overall, 46 healthcare workers (5.5%, 46/834) met the complete HBV vaccination schedule criterion (two doses with a four-week interval and a boost at six months).

According to personnel category, the complete vaccination schedule was achieved by 11% in the medical staff (23/217), 6% in the nursing staff (22/398) and 0.5% in other personnel categories (1/218). The model, saturated with factors associated with the complete HBV vaccination schedule in healthcare workers is shown in table 2. The multivariate analysis final model is shown in table 3. Two of the four associated factors are linked with knowledge about vaccination, one with the perceived risk of becoming infected with the virus and other with healthcare personnel academic training.

Knowing the HBV vaccination schedule, considered a feasible intervention, would achieve a greater impact in order to increase the complete vaccination schedule coverage. According to the gain estimate, if all healthcare workers were aware of the vaccination schedule, coverage would increase by 6.5% (Table 3). In descending order, according to the gain, knowing the vaccine effectiveness (4.2%) and the perception of risk of becoming infected at work (1.8%) were found to

likely have a more modest impact. Although education level was observed to be associated, implementation of interventions to modify this is highly infeasible.

The reasons reported by people for having been vaccinated against HBV were: to protect themselves, 42% (347/834); because they were at risk, 4%; because it is mandatory at work, 4%, and fear of becoming ill, 2%. The causes referred by healthcare personnel for not being vaccinated were: not knowing when to get vaccinated, 26% (220/834); nobody goes to vaccinate them; no vaccine available, 8%; been very busy, 2%; do not like it, 2%; do not trust the vaccine, 1%; because of the reactions to the vaccine, 0.5%, and only one worker answered not being at risk of becoming ill. Nine out of every ten (94%, 786/834) workers answered that they would do get vaccinated against hepatitis B that year; 59% (489/834) of the personnel reported that they would get vaccinated to protect themselves and 2% did not accept getting vaccinated against hepatitis B because they had been vaccinated previously.

Ninety-nine percent (829/834) answered that they considered important being vaccinated. Of the surveyed personnel, 63% (529/834) answered that the preventive medicine department must convince healthcare workers to get vaccinated. Ninety-three percent (775/834) answered that vaccination against hepatitis B should be mandatory among healthcare workers. The most frequent answers to the question "what has the hospital authority to do in order for workers to get vaccinated?": 37% (308/834) answered that they should be informed to get vaccinated; 35%, that there should be vaccines available, and 25%, that they should come to their workplace to get them vaccinated.

Forty six percent (382/834) of the personnel received information about the vaccine against HBV. And among these, 57% (219/382) referred that the Ministry of Health was the institution that provided the information, although the most frequent source of information was the department of preventive medicine (70%, 268/382).

With regard to vaccination before or after being injured, 52% (228/436) did it before and 11% (48/436) afterwards. Fifty-four percent (448/834) reported not having suffered any injury sustained by previously used sharps during their working life. Thirty-seven percent (142/386) suffered an injury in the previous year, and 65% (250/386) referred their last injury was produced by a syringe needle. The activity the workers were performing when they got injured was associated with administering a medication in 33% of the cases (127/386).

Discussion

By the time the investigation was developed, the NOM-036 standard indicated a two-dose hepatitis B vaccination schedule with a four-week interval, and for patients on hemodialysis, the same schedule plus a booster dose at one year[17]. Using this standard's criterion, vaccination coverage against HBV in our study would be 18%, and with the WHO current definition, coverage would be 5%, which would correspond to the theoretically protected population. However, since then, the WHO has recommended a three-injection vaccination schedule for healthcare workers[5]. This consideration results from healthcare workers being classified as people at high risk for HBV infection. Current NOM-036 standard indicates that hepatitis B vaccination for adults consists of two doses given four weeks apart and a booster dose at six months[18]. Using the three vaccine doses operating definition, we found the complete HBV vaccination schedule for healthcare personnel to be 5.5% (46/834), which falls within the range reported by other studies[9,23]. This result indicates the need to protect more than 90% of the workers at the hospital.

The vaccination schedule for children proposed by the NOM-036 standard is intended to achieve protective levels in the population in the least possible time. HBV infection in the children population results in higher rates of liver cancer than the infection at adult ages[20]. Theoretically, as long as there is universal coverage for the general population, vaccination for healthcare personnel will no longer be required, since this will be a vaccinated population. As long as this condition does not exist, healthcare workers will still have to be protected. The study conducted at La Raza Medical Center found protective levels in 86% of healthcare workers[16], implying that even if 100% of workers were vaccinated, there would still be a proportion of unprotected workers.

Reaching relatively high vaccination coverage is possible with the three-dose vaccination schedule. In Goiania, Brazil, Manso et al. found that 81% of healthcare personnel at intensive care units from private and public institutions referred having received three hepatitis B vaccination doses[21]. In the U.S.A., in 2003, Simard found 75% three-dose HBV coverage in healthcare personnel[12]. Other study at the same country, conducted in the year 2000, reported that 64% of state correctional institutions (Rhode Island, Texas, and Maryland) healthcare workers received three doses of the HBV vaccine [23]. The third dose to complete the

vaccination schedule for healthcare workers has a wide margin of time (from 6 months to one year, depending on the type of vaccine) as related to the second, which might contribute for healthcare personnel to lose the dosing time-sequence. However, we found that not knowing the HBV vaccination schedule was associated with low vaccine coverage.

Our study was conducted in a secondary care hospital, the most important of the Ministry of Health from Guerrero, where, in theory, high HBV vaccination coverages should be in place. This coverage is low in other tertiary care hospital units as well. In Egypt, only 16% of healthcare workers were found to have received three HBV vaccine doses in a tertiary care hospital[24]. In Mexico, Morales et al. found a 21% HBV vaccine coverage in healthcare workers at the Federico Gómez Children Hospital of Mexico[8].

The study evidenced that healthcare personnel is unaware of the prevalence of chronic hepatitis B in the general population. An acceptable percentage of 79% (662/834) knows the hepatitis B vaccination indications. Even though 43% (355/834) of the surveyed workers know about the vaccine effectiveness and 34% knows the vaccination schedule for healthcare personnel, this is likely due to hospital workers having more interest on clinical, rather than epidemiological, aspects of hepatitis. Workers who know the vaccination schedule are more likely to get vaccinated compared to those who are not aware of it. In Morocco, Djeriri found that 96% of healthcare personnel were aware of the hepatitis B vaccine efficacy[9]. In our study, knowing the vaccine efficacy as a factor associated with being vaccinated did not have clinical significance, perhaps due to the size of the study.

Personnel with specialty or master's degree academic level were more likely to have full vaccination schedules (aOR 3.53; 95% CI: 1.79-6.93) compared to those with college degree or lower level. In Egypt, Talaat found healthcare personnel with an academic degree (38%) more likely to be vaccinated compared with custodial staff (4%)[24]. Institutional policies tend to protect healthcare personnel considered to be at areas with higher risks for acquiring hepatitis B; however, the risk exists for non-medical personnel due to waste materials handling, although vaccination for these personnel is often overlooked. In Brazil, Manso found cleaning personnel to be at a 19-fold higher risk of not being vaccinated as compared to physicians[21]. Our results support that the level of education is associated with the complete vaccination schedule regardless of the type of work.

In this study, the perception of high risk for acquiring hepatitis B at work was associated with a higher likelihood of being vaccinated, if compared with the personnel that had a perception of low risk for acquiring this disease. In the U.S.A, Simard found that healthcare workers at high risk of acquiring hepatitis B were more likely to be vaccinated when compared with personnel not perceiving risk of acquiring hepatitis B (76.6 vs. 62.4%; $p < 0.05$)[12]. In Morocco, the perception of occupational risk for acquiring hepatitis B at work was measured, but no statistical significance was found[9].

Talaat found 80% of surveyed healthcare workers to be exposed to sharps [24], and we detected that 46% (386/834) of workers referred having suffered injuries with previously used sharps sometime during their working life. However, in neither of the two researches was the exposure to injuries with sharps a factor associated with the personnel completing their vaccination schedule.

In consequence, an intervention sensitizing on the risk of becoming infected with HBV and diffusing information on the vaccination effectiveness and schedule is required, according to the observed gain in the multivariate analysis model (Table 3), with a moderate impact on the complete vaccination schedule. An educational campaign directed to the hospital workers might serve this purpose. Additionally, it would be more likely to achieve changes on the short term and at lower cost than increasing the academic degree of the personnel, which was another variable associated with increased coverage.

Based on the multivariate analysis model, the identified variables that may have potential impact on increasing the hepatitis B vaccination coverage at the Acapulco General Hospital are: training on the disease and preventive measures against hepatitis B, and emphasizing on knowledge of the vaccine effectiveness and adequate timing for its administration.

We found 95% of the personnel to be at risk of HBV contagion for having incomplete vaccination schedules. This situation has to be considered in the quality plan of the institution. Vaccine supplies must be warranted for the next healthcare personnel-directed vaccination campaign, taking into account that hepatitis B vaccination comprises two initial doses and a booster dose. Although vaccination coverage is known to partially depend on availability of the vaccine[7], our study demonstrated that there are other determinants for workers to get vaccinated.

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