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ARE HEALTH WORKERS OF PAEDIATRIC HOSPITALS LESS PRONE TO HEPATITIS B VIRUS INFECTION? A REAPPRAISAL OF A SEROEPIDEMIOLOGICAL SURVEY

Giuseppe CATANIA, Vincenzo DI CIOMMO

Bambino Gesù Children's Hospital
Piazza S. Onofrio, Rome, Italy

Corresponding author:
Vincenzo Di Ciommo
Via F. Baldelli
00146 Rome
Italy
vmaria.diciommo@opbg.net
Tel.: + 39 06 685 928 57
Fax.: + 30 06 685 928 53

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Objective – Health care workers (HCWs) are considered at risk of hepatitis B virus (HBV) infection, but the risk in those who work in paediatric hospitals has received little attention. The primary objective was to assess the prevalence of HBV infection among paediatric HCWs in comparison to those of general hospitals, on the assumption that the former are less exposed due to a lower prevalence in paediatric patients. **Methods –** Data from a pre-vaccination era were retrieved, and a cross-sectional study conducted in the setting of the vaccination campaign conducted in Latium Region (Italy) to prevent hepatitis B in HCWs. HBsAg and anti-HBsAg were tested in 1,894 HCWs of paediatric and general hospitals (1,178 and 716, respectively). Multiple logistic regression was performed to adjust for confounders related to professional and personal variables. **Results –** Overall prevalence in HCWs of HBV infection was 16.8% (95% confidence limits, CL: 15.2-18.6). General hospitals carried a significantly higher risk of HBV infection than paediatric hospitals (OR 1.77, 95% CL 1.35–2.31) after adjustment for confounding factors employment, department, working years, recent needle injury, and birth cohort, the latter being the only personal risk factor that added significantly to the effect of professional characteristics. Nurses and physicians were more exposed to needle injury, which was an independent significant risk factor of HBV infection (OR 1.60, 95%CL 1.19-2.14). **Conclusions –** HCWs of paediatric hospitals are less at risk of HBV infection than general hospitals.

Key words: Hepatitis B virus ▪ Health care workers ▪ Pediatric hospital.

Introduction

Hepatitis B virus (HBV) is a DNA virus, and can take the form of an acute disease, and of a chronic infection that in most subjects is not associated with disease, but in a minority can proceed to cirrhosis and liver cancer (1, 2). It is considered a leading problem of public health and cause of mortality from infectious disease (3).

HBV can be transmitted from an infected mother to the infant, through sexual intercourse, and by percutaneous exposure to infectious blood or body fluids, including transfusions, injections or other procedures with infected equipment, e.g. needle injuries incurred by Health Care Workers (HCWs) (3). It has been estimated that 65,600 infections from HBV can be attributed worldwide

to sharp injuries among HCWs (4). Between 29.3% of HCWs in central Italy (5) and 32.0% in a UK district hospital (6) reported at least one needle injury in the preceding year, and in two paediatric hospitals 5.4-6.5% of HCWs per year were reported in a surveillance setting (7-9). Professional risk is directly associated with prevalence of infections among patients (10), the frequency of the exposure and the probability of transmission. Western Europe is a low prevalence area, particularly for females (<2%), but between 1990 and 2005 an increase was observed (11) while in Central and Eastern Europe children remain the most affected by HBV infection with a prevalence between 4 and 5% (11).

Italy has an intermediate general prevalence of HBsAg (2-7%) (1): a survey conducted before introduction of vaccination showed an HBsAg prevalence in navy recruits of 3.4% and of any HBV marker of 17.7%, with signs of multiple injections, southern region of residence and low education as the main risk factors (12). A much lower prevalence of HBsAg – 0.4% - was found in Italy in pre-vaccination era in the paediatric age group (13).

It was our aim to reappraise the serological survey in a population of HCWs in order to elucidate prevalence of HBV infection and the risk factor of exposure to a paediatric population, presumed to carry a lower risk, in comparison of an adult one

Subjects and methods

The data reported here are part of a sero-epidemiological survey implemented as a first step of a vaccination campaign, and consequently the design is cross-sectional. The campaign was organized and funded by Regione Lazio, against hepatitis B for at risk subgroups of population: HCWs, newborn of HBsAg-positive mothers, patients on dialysis, sexual partners of HBsAg carriers, and was conducted between 1985 and 1995 (approximately).

The HBV screening of HCW was at the time of the investigation mandatory. A questionnaire was filled for each HCW comprising demographic and employment data, past history of hepatitis, transfusions, major surgery, dental cures (in the last 6 months), needle-stick injuries, aspecific or specific anti-HBV immunoglobulin. A blood sample was tested for HBsAg and anti-HbsAg (ELISA radioimmunoassay, Abbott) and alanine-aminotransferase (ALT).

Paediatric hospitals were presumed to be at low-risk for HBV transmission and their HCWs were considered as unexposed, whereas HCWs of general hospitals were considered exposed. With a ratio of unexposed/exposed 1.6:1 (1,178 versus 716) we can detect with an alpha of 5% (significance level of 0.05) a difference between a prevalence of 20% in exposed and 10% in unexposed with a power of about 80% (1-beta, that represents a 20% probability to miss a difference as statistically significant).

Setting

The Bambino Gesù Children's Hospital, a 611-beds teaching institution is a referral hospital for child patients from middle and southern Italy. It has been the referral centre for vaccination of newborns and one of the vaccination centres for screening and vaccination of HCWs; it has provided screening and vaccination for its personnel, for another small paediatric hospital with 40 beds, and for two acute-care general hospitals (with 370 and with 323 beds, respectively). All the four hospitals are in Rome.

Screening procedures

Inclusion criteria: all HCWs, comprising: all nurses, all personnel of surgical theatres, all personnel of laboratory, pathology and x-

rays departments, blood banks, and all physicians. University graduates with clinical involvement were grouped separately as "Other clinicians". Midwives were included in the category of professional nurses. Dieticians, physiotherapists and other HCWs involved with children's rehabilitation were combined in the category of technicians; the "other" category consisted of social workers, manual skilled workers with access to medical devices, and ambulance drivers. Outpatient clinic includes HCWs devoted to blood sampling for laboratory exams. After completion of the first vaccination campaign the procedure was extended to include student nurses successively enrolled in the Nursing School and to other HCWs who were hired. Student nurses were grouped in the "other" category of hospital department.

Exclusion criteria: any person working in the hospital not as an HCW (e.g. clerk without contact with patients or wards or clinic, personnel of kitchens). HCWs were invited to the vaccination unit for screening. HCWs who tested negative were therefore candidate for vaccination. A "positive" test for anti-HBsAg was considered a test with an anti-HBsAg titre ≥10 IU/ml. Subjects with an equivocal anti-HBsAg titre between 10 and 19, considered a "positive" test of past infection by HBV were nevertheless considered as candidates for vaccination, because these were more likely to be "false positives"; in addition presence of antibodies was not regarded a contraindication to vaccination. People negative for HBsAg or with anti-HBsAg <20 IU/ml, that was considered potentially not protective were considered eligible for vaccination.

Ethics statement

Data were anonymised and ethical approval was obtained from Ethical Committee of the paediatric hospital.

Statistical analysis

Statistical software STATA (8.0) was used for all analyses. After univariate description of demographic and professional exposures, logistic multiple regression was performed with HBV infection or immunity (HbsAg or anti-HB positive) as the primary outcome of interest . The main exposure of interest was the type of the hospital (general versus paediatric), adjusting for professional and personal characteristics. For the primary outcome, HBV infection, a second, simpler model was fitted.

Results

A total of 1,178 HCWs were screened, 62.2% of whom were from the paediatric hospitals. After the screening 319 infected subjects were excluded from vaccination because of HBsAg or anti-HBsAg positivity (with a titre considered protective. i.e. ≥20 IU).

Major differences existed between HCWs of general and paediatric hospitals: among the former there were fewer student nurses, less personnel in Neonatology Departments, a longer length of employment. In addition, HCWs in general hospitals were more likely to be single, male, older, more exposed to past surgery, transfusions and recent dental care (Table 1). As most differences can be connected with different risks of HBV infection all were considered potential confounders.

Yearly incidence of at least one needle injury among HCWs was 23.5%, with no significant difference between paediatric and general hospitals (Table 1); HCWs with direct contact with patients' care (nurses and physicians) and surgical environments carried the highest risk (Table 2). Only 24.1% of the subjects who reported a history of recent needle injury received anonspecific or specific anti-HBV immunoglobulins.

Table 1 Professional and personal characteristics by type of hospital

Characteristics	Paediatric hospital n (%)	General hospital n (%)	Total (n)	p-value*
Employment				
Nurses	458 (38.9)	359 (50.1)	817	<0.001
Student nurse	262 (22.2)	65 (9.1)	327	
Porters and other	177 (15.0)	93 (12.9)	269	
Technicians	63 (5.4)	55 (7.7)	118	
Physicians	191 (16.2)	135 (18.9)	326	
Other clinicians	27 (2.3)	10 (1.4)	37	
Service				
Surgical	284 (24.1)	264 (36.9)	548	<0.001
Medical	197 (16.7)	120 (16.8)	317	
Neonatology	232 (19.7)	56 (7.8)	288	
Laboratory	79 (6.7)	81 (11.3)	160	
Other	355 (30.1)	157 (21.9)	512	
Outpatient clinic	31 (2.6)	38 (5.3)	69	
Years of work				
1-9	770 (65.4)	378 (52.8)	1,148	<0.001
10-19	339 (28.8)	249 (34.8)	588	
≥20	69 (5.9)	89 (12.4)	158	
Needle injury				
No	773 (65.6)	456 (63.7)	1,229	0.68
Yes	270 (22.9)	175 (24.4)	445	
Do not remember	135 (11.5)	85 (11.9)	220	
Sex				
Females	976 (82.9)	427 (59.6)	1,403	<0.001
Males	202 (17.2)	289 (40.4)	491	
Education				
Low intermediate	443 (37.6)	311 (43.4)	754	0.002
Higher intermediate	517 (43.9)	258 (36.3)	775	
University	218 (18.5)	147 (20.5)	365	
Marital status				
Single	609 (51.7)	259 (36.2)	868	<0.001
Married	532 (45.2)	434 (60.6)	966	
Divorced/widow	37 (3.1)	23 (3.2)	60	
Year of birth				
1960-74	459 (39.0)	134 (18.7)	593	<0.001
1950-59	398 (33.8)	277 (38.7)	675	
1940-49	219 (18.6)	193 (26.0)	412	
1916-39	102 (8.7)	112 (15.6)	214	
Transfusions				
No	1,086 (92.*2*)	674 (94.1)	1,760	0.027
Yes	49 (4.2)	31 (4.3)	80	
Do not remember	43 (3.7)	11 (1.5)	54	

Continuation of Table 1 Professional and personal characteristics by type of hospital

Characteristics	Paediatric hospital n (%)	General hospital n (%)	Total (n)	p-value*
Surgery				
No	1,010 (85.7)	603 (84.2)	1613	
Yes	123 (10.4)	108 (15.1)	231	<0.001
Do not remember	45 (3.8)	5 (0.7)	50	
Teeth care				
No	837 (71.1)	578 (80.7)	1,415	
Yes	306 (26.0)	132 (18.4)	438	<0.001
Do not remember	35 (3.0)	6 (0.8)	41	
Total	1,178 (100)	716 (100)	1,894	

*Chi-square test.

Table 2 Needle injuries (last year) by professional characteristics

Professional characteristics	HCWs*	Needlestick n (%)	No Needlestick n (%)	Does not remember n (%)	p-value**
Employment					
Nurses	817	244 (29.9)	489 (59.9)	84 (10.3)	
Student nurse	327	25 (7.7)	248 (75.8)	54 (16.4)	
Porters & other	269	47 (17.5)	205 (76.2)	17 (6.3)	
Technicians	118	22 (18.6)	90 (76.3)	6 (5.1)	<0.001
Physicians	326	103 (31.6)	167 (51.2)	56 (17.2)	
Other clinicians	37	4 (10.8)	30 (81.1)	3 (8.1)	
Service					
Surgical	548	183 (33.4)	305 (55.7)	60 (11.0)	
Medical	317	76 (24.0)	208 (65.6)	33 (10.4)	
Neonatology	288	70 (24.3)	184 (63.9)	34 (11.8)	
Laboratory	160	34 (21.3)	111 (69.4)	15 (9.4)	<0.001
Other	512	66 (12.9)	375 (73.2)	71 (13.9)	
Outpt. clinic	69	16 (23.2)	46 (66.7)	7 (10.1)	
Years of work					
1-9	1,148	249 (21.7)	769 (67.0)	130 (11.3)	
10-19	588	155 (26.4)	365 (62.1)	68 (11.6)	0.14
>20	158	41 (26.0)	95 (60.1)	22 (13.9)	
Total	1,894	445 (23.5)	1,229 (64.9)	220 (11.6)	

*Health care workers; **Chi-square test.

A history of hepatitis B is a poor predictor of serum prevalence of HBV markers: it was elicited only from 9.0% of the HCWs, and of specific history of hepatitis B only from 2.5%, without difference between different hospitals. Abnormal ALT was found in 38 subjects (2.0%), none of whom was HBsAg-positive.

HBV infection

HCWs in general hospitals showed an approximately twofold odds ratio (OR) of a past HBV infection compared with HCWs of the paediatric hospitals (Table 3). A clear correlation was observed between longer duration of employment and higher prevalence of HBV infection; a similar relationship is shown with birth cohort.

Table 3 HBV markers in Health care workers by professional characteristics

Professional characteristics	HCWs*	HbsAg+ n (%)	Anti-Hbs+ n (%)	Any marker + n (%)	OR (95% CL) any marker +	Adjusted OR (95% CL) of any marker + Full model	Adjusted OR (95% CL) of any marker + Simpler model
Hospital							
Paediatric	1,178	16 (1.4)	131 (11.1)	147 (12.5)	1	1	1
General	716	20 (2.8)	152 (21.2)	172 (24.0)	2.22 (1.73-2.84)	1.73 (1.30-2.29)	1.77 (1.35- 2.31)
Employment							
Nurses	817	21 (2.6)	158 (19.3)	179 (21.9)	1	1	1
Student nurse	327	3 (0.9)	17 (5.2)	20 (6.1)	0.23 (0.14-0.38)	0.47 (0.26-0.84)	0.48 (0.27-0.84)
Porters and other	269	8 (3.0)	38 (14.1)	46 (17.1)	0.74 (0.51-1.05)	0.52 (0.34-0.80)	0.56 (0.38-0.85)
Technicians	118	3 (2.5)	18 (15.2)	21 (17.8)	0.77 (0.47-1.27)	0.66 (0.35-1.24)	0.67 (0.37-1.23)
Physicians	326	1 (0.3)	48 (14.7)	49 (15.0)	0.63 (0.45-0.89)	0.52 (0.26-1.02)	0.46 (0.32-0.68)
Other clinicians	37	-)	4 (10.8)	4 (10.8)	0.43 (0.15-1.24)	0.54 (0.15-1.89)	0.41 (0.13-1.32)
Service							
Surgical	548	13 (2.4)	76 (13.9)	89 (16.2)	1	1	1
Medical	317	5 (1.6)	51 (16.1)	56 (17.7)	1.11 (0.77-1.60)	1.29 (0.87-1.91)	1.23 (0.84-1.82)
Neonatology	288	6 (2.1)	45 (15.6)	51 (17.7)	1.11 (0.76-1.62)	1.37 (0.91-2.06)	1.33 (0.89-2.00)
Laboratory	160	2 (1.2)	31 (19.4)	33 (20.6)	1.34 (0.86-2.09)	1.63 (0.93-2.83)	1.59 (0.92-2.76)
Other	512	8 (1.6)	61 (11.9)	69 (13.5)	0.80 (0.57-1.13)	1.64 (1.11- 2.44)	1.57 (1.06-2.32)
Outpatient clinic	69	2 (2.90)	19 (27.5)	21 (30.4)	2.26 (1.28-3.97)	1.16 (0.62-2.15)	1.19 (0.65-2.18)
Years of work							
1-9	1,148	7 (0.6)	114 (9.9)	121 (10.5)	1	1	1
10-19	588	22 (3.7)	116 (19.7)	138 (23.5)	2.60 (1.98-3.42)	1.48 (1.15-1.91)**	1.57 (1.23-2.00)**
≥ 20	158	7 (4.4)	53 (33.5)	60 (38.0)	5.20 (3.53-7.64)	-	-
Needle injury							
No	1,229	23 (1.9)	160 (13.0)	183 (14. 9)	1	1	1
Yes	445	7 (1.6)	93 (20.9)	100 (22.5)	1.66 (1.26-2.18)	1.62 (1.20-2.18)	1.60 (1.19-2.14)
Do not remember	220	6 (2.73)	30 (13.6)	36 (16.4)	1.12 (0.76-1.65)	1.02 (0.66-1.58)	1.14 (0.76-1.73)
Sex							
Females	103	25 (1. 8)	193 (13.8)	193 (15.5)	1	1	-
Males	491	11 (2.2)	90 (18.3)	101 (20.6)	1.41 (1.08- 1.83)	1.33 (0.95-1.87)	
Education							
Low intermediate	754	23 (3.0)	142 (18.8)	165 (21.9)	1	1	-
Higher intermediate	775	12 (1.5)	90 (11.6)	102 (13.2)	0.54 (0.41-0.71)	0.83 (0.60-1.14)**	
University	365	1 (0.3)	51 (14.0)	52 (14.2)	0.59 (0.42-0.84)	-	

Continuation of Table 3 HBV markers in Health care workers by professional characteristics

Professional characteristics	HCWs*	HbsAg+ n (%)	Anti-Hbs+ n (%)	Any marker + n (%)	OR (95% CL) any marker +	Adjusted OR (95% CL) of any marker + Full model	Adjusted OR (95% CL) of any marker + Simpler model
Marital status							
Single	868	15 (1.7)	95 (10.9)	110 (12.7)	1	1	-
Married	966	21 (2.2)	181 (18.7)	202 (20.9)	1.82 (1.41-2.35)	0.93 (0.68-1.26)	
Divorced/ widow	60	0 (0)	7 (11.7)	7 (11.7)	0.91 (0.40-2.05)	0.41 (0.17-0.99)	
Year of birth							
1960-74	593	5 (0.84)	36 (6.1)	41 (6.9)	1	1	1
1950-59	675	13 (1.93)	95 (14.1)	108 (16.0)	2.56 (1.75-3.76)	-	-
1940-49	412	11 (2.67)	93 (22.6)	104 (25.2)	4.55 (3.04-6.79)	1.45 (1.19-1.77)**	1.42 (1.18-1.73)*
1916-39	214	7 (3.27)	59 (27.6)	66 (30.8)	6.00 (3.82-9.44)	-	-
Transfusions							
No	1760	33 (1.88)	252 (14.3)	285 (16.2)	1	1	-
Yes	80	-	20 (25.0)	20 (25.0)	1.73 (1.02-2.91)	1.60 (0.63-2.13)	
Do not remember	54	3 (5.56)	11 (20.4)	14 (25.9)	1.81 (0.97-3.38)	1.18 (0.46-3.02)	
Surgery							
No	1,613	30 (1.86)	222 (13.8)	252 (15.6)	1	1	-
Yes	231	4 (1.73)	51 (22.1)	55 (23.8)	1.69 (1.21-2.35)	1.10 (0.74-1.61)	
Do not remember	50	2 (4.00)	10 ((20.0)	12 (24.0)	1.71 (0.88-3.31)	1.27 (0.45-3.55)	
Teeth care							
No	1,415	28 (2.0)	216 (15.3)	244 (17.2)	1	1	-
Yes	438	5 (1.1)	58 (13.2)	63 (14.4)	0.81 (0.60-1.09)	0.91 (0.66-1.26)	
Do not remember	41	3 (7.3)	9 (21.9)	12 (29.3)	1.99 (1.00-3.95)	2.53 (1.00-6.62)	
Total	1894	36 (1.9)	283 (14.9)	319 (16.8)	-	-	

*Health care workers; **OR for every increment of category.

Considering the nurses as the base-line group only student nurses showed a significantly lower OR. No major difference was evident among different services of the hospitals (except for the outpatient clinic, where older personnel no longer assigned to night duty is usually allocated). Noticeably this holds true for surgical and laboratory services as well, which are more frequently exposed to blood. Needle injuries in the last year were a significant risk factor for HBV infection. Personal characteristics showed that female sex, higher education, birth in recent decades (younger age) are "protective", whereas being married, past transfusions and major surgery were risk factors of HBV infection. It has, however, to be recognized that these factors are connected with employment. Sex, for example, is connected with employment: only 13.7% of nursing staff are males; conversely, 72.4% of physicians are males, with congruent education levels: two-thirds of HCWs with a university degree are males.

After adjustment for confounders (Table 3), general hospitals showed a lower and significant OR than in univariate analyses; sig-

nificant linear increase of OR for each category of longer employment and of birth cohort was confirmed; the effect of employment as physician, outpatient clinic, male sex, high education, being married, past transfusion and surgery was no more evident whereas "other" services were a significant exposure (negative confounding was removed). Fitting of the second, simpler model, eliminating all personal factors except for birth cohort, did not produce any major differences.

Discussion

The present sero-epidemiological study demonstrates that general hospitals carried a significantly higher risk of HBV infection among HCWs than paediatric hospitals after adjustment for potential confounders.

Lower prevalences were found in two surveys of general hospitals of middle Italy at the same prevaccination screening of the present study (33.7% and 23.3%, respectively); significant risk factors were male sex, age, history of dental treatment, blood transfusions, or needlestick injuries, work as surgeons and as nurses (14, 15). HBsAg and any HBV marker prevalence were distinctly higher in south Italy (4.8% and respectively 42.4%), without significant difference in comparison of workers of an electric plant (16). Surprisingly, the HBsAg prevalence was found to be lower in Rumanians HCW than in general population (2.1% versus 5.6%) (17), while reached 8.1% in another country of Balkans (18).

We found a much higher prevalence than in a North-American paediatric hospital (9.6%) (19). In Toronto 10% of HCWs with frequent blood exposure showed a positive marker versus 2% without, and at the final multivariate analysis the strongest determinant was not the hospital employment but the birth place outside North America/United Kingdom (20).

Increasing age, male sex, and non-white ethnicity were significantly, independently associated with higher prevalence of anti-HBs/anti-HBc in another paediatric hospital, and occupational group, years of work, blood or patient contact, foreign country of birth and education level had no association. Overall prevalence was 12.5% and the comparison with blood donors, excluding HCWs with history of hepatitis, disclosed an higher prevalence only in older physicians (>40 years-old) (21), and needle injury was confirmed as an independent significant risk factor of HBV infection.

Our results seem to confirm the hypothesis raised by King et al. that a lower risk of HBV infection in paediatric hospitals is due to different patients cared for (21). Major strengths of the present survey are completeness of the mandatory screening, and same population background risk of HBV infection. The first one eliminates potential selection biases, due to different compliance of differently exposed HCWs, and the second permits an unbiased comparison.

Data on professional and personal risk factors were collected before the outcome (HBV positive markers) was known; the only possible reason for prior knowledge of HBV markers in absence of past history of hepatitis would be occasional finding of abnormal ALT in HBsAg carriers, but none of HBsAg-positive HCWs showed abnormal ALT. So a recall bias can be confidently excluded. Moreover, the screening was conducted in the context of a vaccination campaign, not addressing any specific hypothesis, and also interviewer information bias can be excluded. Moreover, even if our results are gathered in a specific context, they apply in populations not exposed to anti-HBV vaccination and can suggest risk factors potentially useful in a global perspective.

Limitation of study

Some limitations of the study need to be noted. No adjustment for birthplace was possi-

ble, an important risk factor for higher HBV infection in the south of Italy (12). However, there is no reason to assume a difference in geographic origin between HCWs of general and those of paediatric hospitals. Since anti-HBc was not tested, underestimation of HBV infection can be presumed (20, 22). A comparison of the present study's HBV prevalence (12.5%) can therefore only be made with a similar study in Toronto (7.7%) (21). However, in the latter study only volunteers were examined (25.7% of HCWs), with possible selection of more conscious HCWs, who can adopt more stringent precautions than non-participants. Storch found exactly the same prevalence as the present survey (12.5%) (22) testing anti-HBs and anti-HBc but not HBsAg.

Another potential concern in our study is misclassification of area of work: HCWs can be allocated to a different area of the hospital, so attributing the HBV infection risk to the final department at the time of the survey, and obscuring the effect of an exposure in the original service. This can bias the OR of the exposure toward null if the chance of changing department is the same whatever the HBV infection status (non-differential misclassification). The only situation that could have resulted in differential misclassification would have been the removal of HBsAg carriers from a high-risk area to a service where exposure of patients is minimized; only seven HCWs with a known history of clinical hepatitis B were potentially infectious (HBsAg-positive), and only two were in "Other services", where they had been placed after reallocation from clinical services, whereas the other five still worked in clinical services. It is unlikely, therefore, that a differential misclassification played a major role in the results of this study. Lastly, the professional risk of infection was confined to needlestick, so omitting other means of injuries from sharp instruments in the laboratories or surgical theaters, like scissors or lancets.

Conclusion

In conclusion, the present survey shows that HCWs of paediatric hospitals are less exposed to HBV infection than those of general hospitals. A unique feature of the study is completeness of enrollment in the screening. Its results can be used to target vaccinal policies in countries without universal vaccination against HBV. In developed countries, where vaccines have gained a wide diffusion, susceptible HCWs can be yet unprotected for incomplete coverage, due to poor individual acceptance.

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Authors' contributions: Conception and design: VDC; Acquisition, analysis and interpretation of data: GC, VDC; Drafting the article VDC; Revising it critically for important intellectual content: GC, VDC.

Conflict of interest: The authors declare that they have no conflict of interest.

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