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# Prevalence of body fluid exposures and associated risk factors amongst healthcare workers at Avicenne Military Hospital, Morocco

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*Abstract*

***Objectives*:** The purpose of this study is to determine the prevalence of body fluid exposures (BFE) and associated risk factors amongst healthcare workers (HCWs), and to evaluate hepatitis B (HBV) vaccination coverage, at Avicenne Military Hospital.

***Materials and methods*:** A descriptive and analytical cross-sectional study was conducted over 6 months amongst HCWs at the Avicenne Military Hospital. Data were collected using an anonymous questionnaire. Blood samples were collected from consenting participants, for assaying HBV surface antibodies.

***Results*:** One hundred thirty-four HCWs were interviewed, and 86 (64.2%) reported at least one BFE. The median age was 28 (27–34) years, with male gender predominating (54%). Percutaneous exposure was the most common BFE (95%), and the hollow bore needle the most implicated (45%). Only 34% of victims reported their BFE. The multivariate analysis showed that HCWs in a surgical department are 10 times more exposed to BFE ($P$ = 0.003; odds ratio [OR] = 10, 95% confidence interval [CI]: 2–47) compared to HCWs in medical departments ($P$ = 0.009; OR = 0.06, 95% CI: 0.007–0.49) and laboratories ($P$ = 0.04; OR = 0.1, 95% CI: 0.01–0.88). The HBV vaccination rate was 67%. Amongst HCWs tested, 42% were immune to HBV. Immune status between physicians and paramedical staff was significantly different ($P$ = 0.005; OR = 0.2, 95% CI: 0.04–0.55). The immunization rate rose significantly with seniority ($P$ = 0.016; OR = 17, 95% CI: 1.67–169).

***Conclusion*:** Our findings highlight the importance of information and continuous training on BFE for HCWs, and the development of strategies to promote and simplify access to the HBV vaccine.

Keywords: *body fluid*; *blood*; *risk*; *occupational exposure*; *healthcare workers*; *hepatitis B*; *vaccination*; *prevention*; *Morocco*

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Body fluid exposure (BFE) is defined as any contact with blood, or a biological fluid containing blood, and includes either a percutaneous injury, a projection on a mucous membrane, or on injured skin (1). Other biological fluids are considered potentially contaminating even if they are not visibly soiled with blood, such as cerebrospinal fluid, pleural fluid and genital secretions (2). BFEs represent a major and permanent risk for healthcare workers (HCWs). Many pathogens – bacteria, viruses, parasites and yeasts – can be transmitted in cases of BFE; of these pathogens, the most formidable are hepatitis B virus (HBV), hepatitis C virus (HCV) and human immunodeficiency virus (HIV). Their severity is related to the possibility of inducing chronic viremia and the severity of the infections generated. The average risk of transmission after percutaneous exposure to the blood of an infected patient is 0.3% for HIV, 0.5–3% for HCV and 2–40% for HBV (3). The procedure to be followed in the event of a BFE must be formalised, updated and accessible to all HCWs. BFE prevention strategies are mainly based on HBV vaccination, continuous training of HCWs on the preventive practices to be carried out during their daily activities, and adherence to standard hygiene precautions. The aims of this study are to elucidate the incidence rate and risk factors of BFE amongst HCWs at Avicenne Military Hospital, evaluate the HBV vaccination coverage rate, determine an appropriate management strategy for cases of BFE and encourage the application of a prevention program.

## Materials and methods

### *Materials*

This is a cross-sectional descriptive and analytical study conducted over 6 months, from July to December 2019 at Avicenne Military Hospital, Marrakech, Morocco. The study population is represented by all medical and paramedical staff – physicians, surgeons, nurses, laboratory technicians and care assistants – practising in different disciplines and care units.

### *Methods*

#### Sampling

The sampling approach used in this study was based on voluntary sampling. The different departments of Avicenne Military Hospital were contacted using a call for participation. HCWs were informed of the objectives, the interests and the progress of the study. Afterwards, a list of volunteers interested in participating in the study was established in each department. Volunteers were invited to join the hospital's Bacteriology-Virology department according to a schedule, in order to attend a presentation on the topic of BFE and to answer an anonymous self-questionnaire. The research proposal was approved by the Research and Ethics Committee of the hospital. An informed consent was obtained from the participants.

#### Data collection

Data for this study were collected through an individual questionnaire prepared after a literature review based on several studies conducted in the same framework, to which consenting individuals were asked to respond anonymously. The questionnaire was first tested with 15 pilot subjects selected amongst the volunteers who agreed to participate in the study, to approve the methodology, ensure correct understanding of the questions and verify the quality of answers. It was then modified and adapted to be clearly understood by HCWs. It included three sections:

- Demographics: age, gender, seniority, department and function.
- History of BFE: number of BFEs, description of circumstances of the occurrence and management of the accident: immediate care, declaration and consultation, serological control, verification of the serological status of the source patient, treatment received and progress of the BFE.
- HBV vaccination coverage: vaccination status, number of doses received, reasons for non-vaccination and verification of seroconversion.

Determination of hepatitis B surface antibodies

After completing the questionnaire, we suggested participants collect a blood sample to confirm their immunity by assaying hepatitis B surface antibody (anti-HBs). For technical reasons, we were unable to perform an anti-HBs assay for all the healthcare staff participating in the study.

### *Statistical analysis*

Statistical analysis of the data was performed using IBM SPSS statistics software (Version 20.0, IBM Corp, Armonk, NY, USA). The analysis was of two types: univariate and multivariate analyses, using binary logistic regression, by applying the chi-square test and the Fisher's exact test for comparing frequencies within subgroups. The significance level was set at 5% ($P < 0.05$).

## Results

### *Demographic characteristics and prevalence of staff subject to BFE*

Demographic characteristics and prevalence of staff sustaining BFE are shown in Table 1. During the study period, 134 HCWs comprising 48% doctors and 52% paramedical staff completed the anonymous questionnaire. Eighty-six (64.2%) of all respondents had been subjected to at least one BFE, with a mean age of those having experienced BFE being 28 years (range: 27–34); 53.7% of exposed HCWs were male; 40% had 5–10 years of seniority.

### *Circumstances and mechanism of occurrence of body fluid exposures*

The majority of incidents occurred in the patient's room (31.4%), followed by the operating room (20.9%) and laboratory (19.8%) (Table 3), and most often occurred whilst blood sampling (28.6%) and suturing (22.6%). The mechanism of exposure was accidental prick (84.1%) whilst blood splashes on damaged skin, and/or mucous membranes were reported in 11% of cases. Exposures resulted from hollow bore needles (45.6%), suture needles (24.1%) and surgical equipment (3.8%). At the moment the BFE occurred, 73% of HCWs were wearing gloves.

### *Risk factors associated with body fluid exposure*

The risk factors associated with BFE are presented in Table 3. Multivariate analysis shows that the only factor significantly associated with the occurrence of BFE was the department where HCWs practice their activity. The surgical department was identified as a risk factor according to the results. However, no statistically significant relationship was found between BFE and age, seniority, sex and function.

### *Management of body fluid exposures*

Administrative reporting of BFE was only performed in 34.1% of cases (Table 4). The reasons for this under-reporting were the underestimation of the risk



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*Table 1.* Demographic characteristics and prevalence of body fluid exposure of the population studied ($n$ = 134)

| Characteristics | Number | Percentage of responses provided in each category |
|---|---|---|
| **Age** | | |
| 20–29 | 75 | 57.3 |
| 30–39 | 36 | 27.5 |
| ≥40 | 20 | 15.2 |
| **Sex** | | |
| Male | 72 | 53.7 |
| Female | 62 | 46.2 |
| **Departments** | | |
| Laboratory | 57 | 42.9 |
| Medicine | 53 | 39.8 |
| Surgery | 23 | 17.2 |
| **Seniority** | | |
| 5–10 years | 50 | 39.1 |
| >10 years | 41 | 32.0 |
| <5 years | 37 | 28.9 |
| **Occupation** | | |
| Paramedical staff | 69 | 51.9 |
| Doctors | 64 | 48.1 |
| **History of BFE** | | |
| Yes | 86 | 64.2 |
| No | 48 | 35.8 |
| **Number of BFEs** | | |
| 1–4 | 65 | 75.6 |
| 5–9 | 11 | 12.8 |
| >10 | 10 | 11.6 |

*Table 2.* Circumstances and mechanism of occurrence of body fluid exposure

| Mechanisms | Number | Percentage of responses for each question |
|---|---|---|
| **Exposed place** | | |
| Patient's room | 27 | 31.4 |
| Operating room | 18 | 20.9 |
| Laboratory | 17 | 19.8 |
| Intensive care units | 12 | 14.0 |
| Emergency room | 12 | 14.0 |
| **Exposed body site** | | |
| Fingers | 62 | 75.6 |
| Hand | 14 | 17.1 |
| Eyes | 4 | 4.9 |
| Arm | 2 | 2.4 |
| **Type of exposure** | | |
| Percutaneous | 78 | 95.1 |
| Mucous membrane | 4 | 4.9 |
| **Mechanism** | | |
| Prick | 69 | 85.2 |
| Projection on mucous membrane | 5 | 6.2 |
| Projection on injured skin | 4 | 4.9 |
| Other injury | 3 | 3.7 |
| **Object used** | | |
| Hollow bore needle | 36 | 45.6 |
| Suture needle | 19 | 24.1 |
| Blade | 5 | 6.3 |
| Surgical equipment | 3 | 3.8 |
| **Activity** | | |
| Blood samples | 24 | 28.6 |
| Sutures | 19 | 22.6 |
| Recapping needle | 10 | 11.9 |
| Inserting/removing the needle | 9 | 10.7 |
| **Wearing gloves** | | |
| Yes | 98 | 73.1 |
| No | 36 | 26.9 |

(50.9%), time constraints (30.9%) and ignorance of the procedure (14.5%). Regarding immediate care after BFE exposure, washing with soap was performed by 55.3% of HCWs, followed by disinfection with antiseptic (43.5%) and pressing the wound (27.1%). The serological status of the source individual was unknown in 44% of cases, sero-negative in 15.2% of cases and HBV and HIV positive in 4.8% of cases. Outcomes were favourable in 53.2% of cases.

### *Hepatitis B vaccination and immunity*

As shown in Table 5, physicians were significantly more immune than paramedical staff ($P$ = 0.005: odds ratio [OR] = 0.2; 95% confidence interval [CI] = [0.04–0.55]). This could be related to a better level of awareness of the disease and the importance of vaccination amongst physicians. HBV immunization increased significantly with professional seniority. Staff with 5–10 years of seniority ($P$ = 0.006: OR = 19; 95% CI = [2.28–158]) and those with more than 10 years of seniority ($P$ = 0.028: OR = 11; 95% CI = [1.30–105]) were more immune than staff with less than 5 years of seniority.

Two-thirds (66.9%) of HCWs stated they were properly vaccinated against HBV, whilst 20% affirmed that they were not vaccinated, and 13.1% were unaware of their vaccination status (Table 6). The reasons for non-vaccination were the absence of vaccination campaigns organised within the hospital (69%), time constraints (19%) and unwillingness to receive the vaccine (12%). HCWs are considered definitively immune against HBV if the anti-HBs antibody level is above 100 IU/l; the result of hepatitis B antibody tests indicated that 42% of those tested had anti-HBs antibody levels above 100 IU/L versus 58% with a level below 100 IU/L.

## Discussion

The population included in our study is young, with a median age of 28 [27–34] years. The study conducted by

*Table 3.* Risk factors associated with body fluid exposure

| Risk factors | Number of BFE | Victim of BFE (%) | | Univariate analysis | | | Multivariate analysis | | |
|---|---|---|---|---|---|---|---|---|---|
| | *N* (%) | No | Yes | OR | CI | *P* | OR | CI | *P* |
| **Age (years)** | | | | | | | | | |
| 20–29 | 75 (57.3) | 27 (36) | 48 (64) | 1 | ----- | ---- | 1 | ----- | ----- |
| 30–39 | 36 (27.5) | 14 (39) | 22 (61) | 0.9 | 0.39–2.0 | 0.8 | 0.7 | 0.20–2.41 | 0.6 |
| ≥40 | 20 (15.2) | 6 (30) | 14 (70) | 1.3 | 0.45–3.8 | 0.6 | 0.9 | 0.14–5.28 | 0.9 |
| **Sex** | | | | | | | | | |
| Male | 72 (53.7) | 23 (32) | 49 (68) | 1 | ----- | ----- | 1 | ----- | ----- |
| Female | 62 (46.3) | 25 (40) | 37 (60) | 1.4 | 0.7–2.92 | 0.3 | 0.9 | 0.37–1.99 | 0.7 |
| **Occupation** | | | | | | | | | |
| Paramedical staff | 69 (52) | 29 (42) | 40 (58) | 0.6 | 0.28–1.19 | 0.1 | 0.8 | 0.34–1.71 | 0.5 |
| Doctors | 64 (48) | 19 (29.7) | 45 (70.3) | 1 | ----- | ----- | 1 | ----- | ----- |
| **Seniority** | | | | | | | | | |
| 5–10 years | 50 (40) | 16 (32) | 34 (68) | 1.6 | 0.67–3.90 | 0.3 | 1.7 | 0.64–4.63 | 0.3 |
| > 10 years | 41 (32) | 16 (39) | 25 (61) | 1.2 | 0.48–2.93 | 0.7 | 1.4 | 0.28–6.90 | 0.7 |
| < 5 years | 37 (29) | 16 (43.2) | 21 (56.8) | 1 | ----- | ----- | 1 | ----- | ----- |
| **Department** | | | | | | | | | |
| Medicine | 53 (40) | 26 (49) | 27 (51) | 0.1 | 0.02–0.46 | **0.003** | 0.06 | 0.007–0.49 | **0.009** |
| Surgery | 23 (17) | 2 (8.7) | 21 (91.3) | 1 | ------ | ----- | 1 | ------ | ----- |

Bold values = Statistically significant data.
OR: odds ratio; CI: 95% confidence interval; *P*: p value.

Benboubker et al. (4) at Fez University Hospital in Morocco reported a younger population with 79.7% aged between 20 and 29 years. Older average ages are found in a number of studies such as the results reported by Laraqui et al. with an average age of 40.8 ± 7.8 years (5), and Atiki at Ibn Sina Hospital in Rabat with an average age of 38.79 ± 10.81 years (6). A slight male predominance of 53.7% is observed in our series; Benboubker et al. (4) also reported a male predominance. However, female predominance is more common in the literature: 78% in Egypt (7), 56.3% in Tanzania (8), 72% in Botswana (9), 76.6% in Portugal (10) and 79% in Georgia (11). The male predominance found in our sample can be explained by the military context of the study. The average seniority in our study is eight [4–13] years, whilst a study conducted in Ethiopia observed a lower seniority with more than 70% of participants having less than 5 years of seniority (12), and a seniority beyond 20 years was found by Atiki (6).

The prevalence of BFE was 64.2% in our study. At the national level, this high prevalence remains lower than the prevalence of 68.86% found at Ibn Sina Hospital in Rabat (6) and lower than the 76.6% prevalence found by Laraqui et al. (5). Internationally, the prevalence reported in our study remains close to that found in Portugal (64.5%) (10) and in Serbia (66%) (13), lower than that found in Egypt (83.3%) (14) and higher than that found in Georgia (45%) (11), Iran (42.5%) (15) and Ethiopia (42.2%) (12). Depending on function, there is a higher prevalence amongst physicians with a rate of 70.3%, whilst the prevalence is 58% for paramedical staff, which is comparable to data obtained via surveys conducted in other centres (16–18).

We found no statistically significant correlation between BFE occurrence and age or seniority. However, according to a number of publications, seniority and age appear to be risk factors associated with BFE; they demonstrated that the older the age, and, therefore, the longer the seniority, the higher the risk of having a BFE (10, 19, 20). This can be explained by the fact that a longer activity period exposes the person to more risk situations, or that a more experienced and familiar person will be less careful making them susceptible to increased risk of errors and high-risk behaviour. This is in contrast with other studies that report the risk decreases with increasing years of seniority (12) because staff with more years of experience are more able to improve their qualifications. Our analysis demonstrated that there is no statistically significant correlation between the occurrence of BFE and gender. Nevertheless, other investigations have found that female gender is a risk factor associated with BFE (12, 18, 19). Otherwise, we did not find a statistically significant correlation between professional role and BFE. Nursing is often identified as a risk factor associated with BFE (10, 12, 19, 21); this is probably due to the characteristics of their practice, which involves the provision of direct patient care such as taking samples, giving injections and performing other interventions involving the use of needles and sharps, exposing nurses to a high risk of BFE. The risk of



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*Table 4.* Management of body fluid exposure ($n$ = 86 respondents)

| Applied practices | Number | Percentage of responses for each question |
|---|---|---|
| **Measures applied*** | | |
| Wash with soap | 47 | 55.3 |
| Disinfection with antiseptic | 37 | 43.5 |
| Pressing the wound | 23 | 27.1 |
| Wash with saline solution | 10 | 11.8 |
| Wash with water | 5 | 5.9 |
| **Declaration and consultation** | | |
| Not done | 56 | 65.9 |
| Done | 29 | 34.1 |
| **Reason for non-declaration** | | |
| Accident judged without risk | 28 | 50.9 |
| Time constraints | 17 | 30.9 |
| Ignorance of the procedure | 8 | 14.5 |
| **Control of serological status** | | |
| Not verified | 52 | 52.3 |
| Verified | 41 | 47.7 |
| **Serological status of the source individual** | | |
| Seronegative | 38 | 45.2 |
| Unknown | 37 | 44.0 |
| HIV | 4 | 4.8 |
| HBV | 4 | 4.8 |
| HCV | 1 | 1.2 |
| **Treatment received** | | |
| None | 81 | 94.2 |
| Antibiotic therapy | 2 | 2.3 |
| Antiretrovirals | 2 | 2.3 |
| Serotherapy | 1 | 1.3 |
| **Serological follow-up** | | |
| No follow-up | 66 | 76.8 |
| Follow-up | 20 | 23.2 |
| **Outcome** | | |
| Favourable | 42 | 53.2 |
| Unknown | 35 | 44.3 |
| Unfavourable | 2 | 2.5 |

*More than one measure may have been used.
HIV: human immunodeficiency virus; HBV: hepatitis B virus; HCV: hepatitis C virus

occurrence of BFE is related to a number of factors that we have attempted to identify through statistical analysis.

Our findings indicating that medical and laboratory staff are at lower risk of BFE than surgical staff are in agreement with other studies. Studies in Egypt and Pakistan report that working in a surgical department is considered a risk factor associated with BFE (12, 19); research conducted at Rennes University Hospital in France showed that BFEs are significantly more frequent amongst surgeons (22); and another study in a Saudi University Hospital found that surgeons had significantly higher risk of BFE than other physicians (23). This variation could be explained by the nature of the surgical activity, which increases the risk of BFE, particularly by the projection of biological fluids, cuts or pricks during interventions.

According to our results, the majority of incidents occurred in the patient's room (31.4%), followed by the operating room (20.9%), the laboratory (19.8%) and then intensive care units and the emergency room. These results concur with data reported in the literature (24–26). Percutaneous exposures are the most frequent type of BFE; they represented 95.1% of BFE in our study, which aligns with data reported in several other studies in Morocco (89%) (27), France (75.8%) (28), England (72%) (29) and Korea (86.7%) (24). The majority of BFE recorded in our study involved hollow bore needle injuries, which is in accordance with the data established in several studies (25, 27, 30, 31). The high incidence of prick-type BFE can be explained by the regular manipulation of sharp objects during the daily practice of HCWs. The interventions carrying the highest risk of BFE as identified in our study are blood sampling (29%) and suturing (23%). Various studies suggest that most BFEs occur during blood sampling, suturing, intravenous and muscle injections, and particularly needle recapping (4, 10, 13, 19, 20, 24, 31, 32). Of the subjects exposed in our research, 73.5% wore gloves, a quite satisfactory rate close to that found in developed countries such as France (75%) (33) and Italy (81%) (34). Wearing gloves is a simple way of protection; they reduce transmission of microorganisms in the event of BFE, and, indeed, during a prick, the glove decreases the viral inoculum between 46 and 86% by wiping the needle (35).

Washing with soap and water was carried out by only 55% of the HCWs with BFE, whilst disinfection was performed by 43% of exposed subjects, and 27% made the wound bleed even though it is contraindicated. This limited knowledge may be due to the lack of continuous training, information and awareness concerning the management of BFE; these instructions must be posted in the different departments, so that HCWs can consult them. In our study, BFEs were underreported at 34%. This is slightly higher compared to the result found at the Military Hospital Mohammed V, Rabat, which was 25.6% (36); a lower rate was recorded at the Ibn Sina Hospital in Rabat (13.69%) (4); and a similar rate was found in Tanzania (34%) (8) and Botswana (38%) (9), with the reporting gap mostly attributed to the absence of information and an underestimation of the magnitude of the risk. Although knowledge of the serological status of the source individual determines the appropriate approach to be taken, only 56% of BFE victims affirmed knowing the serological status of the source patients. In the situations of BFE where the risk of HIV infection is important, rapid and appropriate management reduced risk of transmission by 80% (37). The initiation of post-exposure prophylaxis depends on the degree of

*Table 5.* Factors associated with hepatitis B virus vaccination status

| Factors | Number *N* (%) | Immunised subjects *N* (%) | | Univariate analysis | | | Multivariate analysis | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Yes | No | OR | CI | *P* | OR | CI | *P* |
| Age | | | | | | | | | |
| 20–29 | 48 (62.3) | 31 (64.6) | 17 (35.4) | 1 | ----- | --- | 1 | ----- | --- |
| 30–39 | 20 (26) | 15 (75) | 5 (25) | 0.6 | 0.19–1.96 | 0.4 | 0.3 | 0.05–1.77 | 0.2 |
| >40 | 9 (11.7) | 4 (44.4) | 5 (55.6) | 2.3 | 0.54–9.64 | 0.2 | 2.1 | 0.15–30.72 | 0.6 |
| Sex | | | | | | | | | |
| Female | 41 (52.6) | 28 (68.3) | 13 (31.7) | 1.3 | 0.51–3.34 | 0.6 | 0.3 | 0.08–1.41 | 0.1 |
| Male | 37 (47.4) | 23 (62.2) | 14 (37.8) | 1 | ----- | ---- | 1 | ----- | ---- |
| Occupation | | | | | | | | | |
| Paramedical staff | 41 (52.6) | 34 (83) | 7 (17) | 0.2 | 0.06–0.5 | **0.001** | 0.2 | 0.04–0.55 | **0.005** |
| Doctors | 37 (47.4) | 17 (46) | 20 (55) | 1 | ----- | ---- | 1 | ----- | ---- |
| Seniority | | | | | | | | | |
| 5–10 years | 34 (45.3) | 17 (50) | 17 (50) | 19 | 2.28–158 | **0.006** | 17 | 1.67–169 | **0.016** |
| >10 years | 21 (28) | 13 (62) | 8 (38) | 11 | 1.30–105 | **0.028** | 15 | 0.79–290 | 0.07 |
| <5 years | 20 (26.7) | 19 (95) | 1 (5) | 1 | ----- | ---- | 1 | ----- | ---- |
| Department | | | | | | | | | |
| Laboratory | 44 (56.4) | 27 (61.4) | 17 (38.6) | 0.9 | 0.14–6.25 | 0.9 | 1.3 | 0.09–20.32 | 0.8 |
| Medicine | 29 (37.2) | 21 (72.4) | 8 (27.6) | 0.6 | 0.08–4.08 | 0.6 | 1.2 | 0.08–18.72 | 0.9 |
| Surgery | 5 (6.4) | 3 (60) | 2 (40) | 1 | ----- | ---- | 1 | ----- | ---- |

Bold values = Statistically significant data
OR: odds ratio; CI: 95% confidence interval; *P*: p value

*Table 6.* Hepatitis B immunisation and immune status

| Immunization status | Number | Percentage of responses for each question |
|---|---|---|
| Hepatitis B vaccination | | |
| Yes | 87 | 66.9 |
| No | 26 | 20.0 |
| I don't know | 17 | 13.1 |
| Reason for non-vaccination | | |
| Absence of vaccination campaigns | 18 | 69.2 |
| Time constraints | 5 | 19.2 |
| I don't want to get vaccinated | 3 | 11.5 |
| Doses received | | |
| Three doses | 36 | 41.4 |
| I don't remember | 25 | 28.7 |
| Two doses | 15 | 17.2 |
| One dose | 11 | 12.6 |
| HBs antibody assay results | | |
| <100 UI/L | 29 | 58.0 |
| >100 UI/L | 21 | 42.0 |

HBs antibody: hepatitis B surface antibody

the risk, the type of exposure, the HIV status of the source individual and the delay between the occurrence of BFE and its management. Post-exposure prophylaxis based on triple antiretroviral therapy should be started as soon as possible, at best within 4 h and no later than 48 h, then continued for 28 days. Concerning the risk of HBV infection, three options are recommended to reduce the risk of transmission: administration of HBV specific immunoglobulins, post-exposure treatment including tenofovir and HBV vaccination if the subject is not immunised as it remains the best way to prevent infection from HBV (38). However, no recommendations are available regarding prophylaxis for HCV infection after BFE (39).

In Morocco, vaccination of HCWs is exclusively voluntary. The vaccination rate against HBV in our study is 66.9%, with only 41% of HCWs getting a complete vaccination of three doses. The most common reason noted for non-vaccination was the absence of a vaccination campaign organised within the hospital. In developed countries, for example, in France, HBV vaccination is mandatory under the legislation of January 18, 1991 (40). The excellent level of HBV vaccination coverage of HCWs has led to an almost disappearance of the risk of occupational HBV in developed countries (41). The verification of the post-vaccination response was weak with only 24.8% of vaccinated participants verifying it; this result remains higher than those provided by Laraqui (5) and Atiki (6), who, respectively, reported a rate of 1.8 and 8.6%, and the results found in Ethiopia (1.9%) (42) and Iraq, where none of the participants verified their post-vaccination response (43). Regarding factors correlated with vaccination status, it appeared from our survey that physicians are significantly



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more immune than paramedical staff. The immunisation rate also increases with professional seniority; staff having between 5 and 10 years of seniority are the most immune. However, we noted that no relationship exists between immunization status and gender or service.

Our study had several limitations. There were potential sources of bias, notably selection bias. Even if participants had the assurance that their answers were completely anonymous, social desirability bias still cannot be eliminated. Furthermore, we could not verify the responses. It could have been beneficial to include an assessment of staff practices to identify more risk factors.

In conclusion, BFE is a real danger for HCWs, hence the importance of implementing an active BFE prevention strategy. HCWs must be appropriately trained, informed and educated about this strategy. Staff training on BFE needs to be strengthened, not only to ensure the respect of safety precautions during care but also to raise awareness about the importance of reporting BFE. Our results highlight a notable under-declaration; the declaration procedures must be simplified and allow easy access to expert consultations. Likewise, the importance of vaccination against HBV should be emphasised, and it is necessary to promote and facilitate access to the vaccine. The challenge is to achieve adequate immunisation coverage. We recommend the vaccination of all personnel currently not yet immunised and the introduction of the vaccine in health schools to anticipate the prevention of infection amongst future HCWs and professionals. It is also necessary to insist on the importance confirming seroconversion by assaying anti-HBs antibodies, in view of allowing professionals to benefit from additional doses in the event of a non-response to the vaccine. In light of this study, we strongly recommend making HBV vaccination mandatory and subject to statute in Morocco, motivating HCWs to report BFE by simplifying the administrative process, and the establishment of a policy of continuous training on BFE for all HCWs.

## Ethical considerations

The protocol of this research received approval from Avicenne Military Hospital Ethics Committee Ref. No. 5/2021.

## Conflict of interest and funding

The authors declare that there are no conflicts of interest. The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

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