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Research Article

OCCUPATIONAL EXPOSURE TO BLOOD AND BODY FLUIDS AMONG CLEANING PERSONNEL: PPE COMPLIANCE AND PREVENTION GAPS IN A UNIVERSITY HOSPITAL

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Abstract: *Cleaning personnel in hospitals are at high risk for occupational exposure to blood and body fluids, yet remain an understudied group. This study aimed to evaluate the frequency of blood and body fluid exposure, personal protective equipment compliance, and prevention gaps among hospital cleaning staff. A cross-sectional study was conducted at a university hospital between June and August 2023. A census approach was used, including all 251 cleaning personnel; 224 participated (89.2% response rate). Data were collected through a structured data form administered during face-to-face interviews, assessing sociodemographic characteristics, occupational exposures, use of personal protective equipment, and training history. The mean age of participants was 42.3±6.7 years, 66.5% were female, and 53.1% were primary school graduates. A lifetime history of occupational exposure to blood and body fluids was reported by 40.2% of staff. Although reporting rates to occupational health were high (96.7%), critical gaps in personal protective equipment were identified during medical waste handling, a task performed by 86.2% of staff. Compliance was notably low for heavy-duty gloves (8.3%), protective glasses (19.7%), and boots (6.7%), despite universal attendance at training sessions. While 83.9% had initiated Hepatitis B vaccination, the full completion rate was only 42.5%, and significant knowledge gaps regarding immunization schedules were evident. A substantial disparity was found between near-universal training attendance and consistently low compliance with essential personal protective equipment during high-risk tasks, such as handling medical waste. This indicates systemic safety failures rather than individual negligence. To protect this vulnerable workforce, institutions should implement enforced personal protective equipment protocols, conduct accessibility audits, and foster a culture of safety accountability.*

Keywords*: Blood-Borne Pathogens; Health Personnel; Medical Waste; Occupational Exposure; Personal Protective Equipment*

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1. Introduction

The risk of occupational infection with bloodborne pathogens among healthcare workers, resulting from contact with blood and body fluids, is a significant global problem [1]. The systematic review and meta-analysis found that the global pooled prevalence of occupational exposure to blood and body fluids among healthcare workers was 56.6% during their career and 39.0% in the previous year [2]. Each year in Europe, approximately 304,000 healthcare workers suffer percutaneous injuries from materials contaminated with Hepatitis B virus (HBV), 149,000 with Hepatitis C virus (HCV), and 22,000 with human immunodeficiency virus (HIV). 90% of these injuries occur in developing countries [3].

Studies from Türkiye confirm that this is a pressing national issue, with a high proportion of healthcare professionals experiencing such exposures. According to these studies, approximately 60% of healthcare professionals accidentally come into contact with patients' blood or body fluids at least once [4-6].

While the CDC's Universal Precautions (1988) mandate the use of personal protective equipment (PPE) during splash risks, implementation disparities persist among nonclinical staff, particularly among cleaning personnel who handle contaminated materials without direct clinical oversight. These precautions include washing hands before and after contact with the patient and after removing gloves; wearing gloves if there is a risk of contact with blood and body fluids; and wearing glasses, masks, and protective clothing if there is a risk of blood and body fluid splashes [7].

The increasing prevalence of work-related injuries in hospital settings affects various professional groups, including the often-overlooked cleaning personnel [8].

While much of the literature focuses on physicians and nurses, cleaning staff represent a uniquely vulnerable group. Their core duties involve handling contaminated materials, such as medical waste and soiled linens, often with less direct clinical supervision, which potentially increases their exposure risk [9,10]. Factors such as lower health literacy or their perceived status within the hospital hierarchy can further impact their adherence to safety protocols and incident reporting [11,12]. Although standard precautions mandate the use of personal protective equipment (PPE) for all tasks with splash or exposure risk [13], significant implementation disparities persist, particularly among non-clinical staff.

However, research specifically targeting this workforce and the root causes of this gap remains limited. Therefore, this study aimed to evaluate the frequency of BBF exposure, PPE compliance, and prevention gaps among cleaning personnel at a university hospital. This research is grounded in its specific focus on the critical disconnect between near-universal training attendance and practical PPE compliance during high-risk tasks, aiming to identify systemic failures beyond individual knowledge deficits to inform effective institutional interventions.

2. Materials and Methods

2.1. Study Design and Population

This occupational safety assessment employed a cross-sectional design to evaluate preventable exposure risks, PPE compliance, and prevention gaps, and was conducted between June 2023 and August 2023 at Uludağ University Hospital. In this study, 'prevention gaps' refer to the identifiable deficiencies in the consistent application of safety measures, such as PPE non-compliance and underreporting of exposures, despite the existence of formal training and protocols. The study population comprised all 251 cleaning personnel working in the hospital. A census approach was used rather than sampling, as the objective was to obtain a comprehensive assessment of occupational exposure patterns across the entire cleaning workforce. The inclusion criterion was being an active cleaning staff member who provided informed consent. Cleaning staff who were on extended leave (e.g., medical, administrative) during the entire data collection period were excluded from the study. Of the total population, 224 individuals met the inclusion criteria and participated in the study, yielding a high participation rate of 89.2%.

2.2. Data Collection

Data were collected using a structured data form developed by the researchers after a comprehensive literature review on occupational exposures and the use of protective equipment. The data form was administered to participants through face-to-face interviews to ensure the clarity and completeness of their responses. The instrument was divided into two main sections:

1. Sociodemographic and Occupational Characteristics: This section collected data on the age, gender, education level, marital status, smoking and alcohol consumption, chronic disease status, working conditions (department, weekly hours, shift patterns), and duration of employment. It also included questions about their history of occupational exposure to blood and body fluids.

2. Protective Behaviors and Training: The second section assessed behaviors related to protection against blood and body fluid-borne pathogens. This included the use of PPE, reporting of exposure incidents, and postexposure follow-up procedures. It also evaluated practices during medical waste handling and in situations with a risk of droplet splash, as well as participants' training history and needs.

The primary dependent variables were the lifetime prevalence of occupational BBF exposure and compliance with the use of PPE during specific high-risk tasks (e.g., medical waste handling). The independent variables included sociodemographic characteristics (e.g., age, gender, education) and occupational factors (e.g., work area, shift pattern, employment duration).

2.3. Data Analysis

The data collected were analyzed using descriptive statistics. Categorical variables are presented as frequencies and percentages, while continuous variables are expressed as means ± standard deviations. All statistical analyses were performed using SPSS software (version 28.0; IBM Corp., Armonk, NY, USA).

2.4. Ethics Approval and Consent to Participate

Ethical approval was granted by the Uludağ University Faculty of Medicine Clinical Research Ethics Committee (Decision no: 2023-11/41, Date: 16.05.2023). Additionally, necessary institutional permission was obtained from the hospital administration before data collection. All participants were informed about the study purpose, and written informed consent was obtained.

3. Results

Of the 224 cleaning personnel who participated in the study, 66.5% were women and 33.5% were men. The mean age of the participants was 42.3±6.7 years, 67.2% being 40 years of age or older. Most of the participants were married (81.6%). Regarding educational status, 53.1% of participants were primary school graduates, and no participants held a university degree. When evaluating the sufficiency of the household income, 63.4% of participants reported that their total income was insufficient to cover expenses, while only 4% stated that it was easily sufficient. The prevalence of smoking was 49.1% and alcohol consumption was reported by 18.3% of the staff. Additionally, a significant portion of the participants (40.6%) reported having at least one chronic disease. The detailed sociodemographic characteristics of the participants are presented in Table 1.

Table 1. Distribution of participants by specific sociodemographic characteristics.

	n	%
Gender		
Female	149	66.5
Male	75	33.5
Age Groups		
20-29	5	2.2
30-39	69	30.8
40-49	114	50.9
50≤	36	16.1
Marital Status		
Married	183	81.7
Single	19	8.5
Divorced	22	9.8
Educational status		
Primary School	119	53.1
Secondary School	42	18.8
High school	63	28.1
Smoking		
Yes	110	49.1
No	114	50.9
Alcohol consumption		
Yes	41	18.3
No	183	81.7
Chronic disease		
Yes	91	40.6
No	133	59.4
Number of people living in the household		
1-2	48	21.4
3-4	128	57.1
5-6	43	19.2
7-8	5	2.3
The situation where household income covers expenses		
Easily cover	9	4.0
Enough to cover	73	32.6
Not enough to cover	142	63.4

The distribution of cleaning personnel across different work areas was as follows: 34.8% worked in clinics, 15.2% in polyclinics, 9.8% in operating rooms, and 6.3% in waste transport services. Regarding weekly working hours, 82.1% of the staff worked 53 hours, while 18.0% worked 48 hours. The predominant work schedule was a continuous day shift (07:00-16:00), reported by 82.1% of the personnel. A smaller portion worked in rotating shifts (10.3%) or fixed evening/night shifts (7.6%). The mean duration of employment at the institution was 11.4 ± 5.1 years, and 61.3% of the participants had worked for 10 years or more. While a pre-employment health examination was conducted for 98.7% of the staff, only 7.6% had received periodic control examinations. These occupational characteristics are summarized in Table 2.

Table 2. Distribution of the participants according to the characteristics of working life

	n	%
Place of work		
Clinic	78	34.8
Operating Room	22	9.8
Policlinic	34	15.2
Adult and pediatric emergency	10	4.5
Intensive Care	15	6.7
waste handling unit	14	6.3
basic medical sciences	16	7.1
The entire hospital	15	6.7
Other	20	8.9
Hours worked per week		
48 hours	40	17.9
53 hours	184	82.1
Work shift		
Continuous 07:00-16:00	184	82.1
I do alternating shifts	23	10.3
Continuous 16.00-24.00 or 24.00-08.00	17	7.6
Duration of work in the institution		
< 5 Years	18	8.0
≥ 5 - <10 Years	68	30.4
10≥ Years	138	61.6
Pre-employment examination		
Yes	221	98.7
No	3	1.3
Status of performing periodic control examination		
Yes	17	7.6
No	207	92.4

40.2% of the cleaning staff reported experiencing occupational exposure to blood or body fluids at some point in their careers. Among those who experienced exposure, it was determined that 88.9% used personal protective equipment (PPE) during the incident. After contact, the vast majority reported the incident to the Occupational Health and Safety Unit (96.7%) and were subsequently directed to the Infectious Diseases Polyclinic for follow-up or treatment (94.4%). Post-exposure testing was offered to 93.3% of the exposed staff, and 97.6% of them underwent the recommended tests. However, the source of the exposure could be identified in only 19.1% of the cases. Among these identified source patients, 94.1% had a known contagious status; 23.5% had Hepatitis B, and 5.9% had HIV, with no cases of Hepatitis C.

Distribution of cleaning personnel according to their exposure, protective behaviors, and compliance with infection prevention measures is detailed in Table 3.

Table 3. Distribution of cleaning personnel according to their exposure, protective behaviors, and compliance with infection prevention measures

Statement	Yes n (%)	No n (%)
Exposure and Postexposure Practices		
Had exposure to blood or body fluids at work	90 (40.2)	134 (59.8)
Wore personal protective equipment during contact	80 (88.9)	10 (11.1)
Reported exposure to the Occupational Health and Safety Unit	87 (96.7)	3 (3.3)
Referred to the Infectious Diseases Clinic for postexposure follow-up and treatment	85 (94.4)	5 (5.6)
Knew the source of blood/body fluids	17 (19.1)	72 (80.9)
Knew the patient's infectious disease history	16 (94.1)	1 (5.9)
The patient was contagious for Hepatitis B	4 (23.5)	13 (76.5)
The patient was contagious for Hepatitis C	0 (0.0)	17 (100.0)
The patient was contagious with HIV	1 (5.9)	16 (94.1)
Was offered postexposure infection testing	84 (93.3)	6 (6.7)
Had recommended postexposure tests	81 (97.6)	2 (2.4)
Medical Waste PPE Compliance		
Collects/transports medical waste	193 (86.2)	31 (13.8)
Uses orange gloves when handling medical waste	16 (8.3)	177 (91.7)
Wears protective glasses when handling medical waste	38 (19.7)	155 (80.3)
Uses a mask when handling medical waste	157 (81.3)	36 (18.7)
Uses boots when handling medical waste	13 (6.7)	180 (93.3)
Uses medical waste overalls when handling medical waste	11 (5.7)	182 (94.3)
Protective Behaviors for Droplet Splash Risk		
Works in a job that carries a risk of droplet splash	177 (79.0)	47 (21.0)
Uses a mask in situations where droplet splash is possible	164 (92.6)	13 (7.4)
Wears glasses in situations where droplet splash is possible	94 (53.1)	83 (46.9)
Wears a face shield in situations where droplet splash is possible	71 (40.1)	106 (59.9)
General Protective Behavior		
Uses gloves when handling materials that have come into contact with body fluids (blood, urine, etc.)	213 (99.5)	1 (0.5)
Always washes hands with soap after removing gloves	188 (88.3)	25 (11.7)
Vaccinated against hepatitis B	188 (83.9)	36 (16.1)
Single dose	22 (11.7)	-
Two doses	19 (10.1)	-
Three doses	80 (42.5)	-
I don't remember	67 (35.7)	-
Received training on occupational risks from the institution	224 100.0)	0 (0.0)
Training Received		
Medical waste	223 (99.6)	1 (0.4)
Hospital infections and prevention	214 (95.5)	10 (4.5)
Infectious diseases and prevention	201 (89.7)	23 (10.3)
Personal hygiene	219 (97.8)	5 (2.2)
Accidents at work	1 (0.4)	223 (99.6)
Fire safety	4 (1.8)	220 (98.2)
Desired Training		
Medical waste	4 (33.3)	-
Nosocomial infections and prevention	2 (16.7)	-
Infectious diseases and prevention	3 (25.0)	-
Occupational diseases	1 (8.3)	-
Material use	1 (8.3)	-
Personal hygiene	1 (8.3)	-

*PPE noncompliance represents modifiable work system failures that require immediate institutional intervention. Note: The denominators for each statement vary based on the number of respondents. For "Uses gloves" n=214, for "Always washes hands" n=213, for "Vaccinated against hepatitis B" n=224, for "Received training" and "Training Received" topics n=224, and for "Desired Training" topics n=12. Percentages are calculated based on the respective denominators and may not sum to 100% due to rounding.

Most of the cleaning staff (86.2%) participated in collecting or transporting medical waste. During this high-risk task, systematic PPE failures were observed: basic mask use was common (81.3%), but critical barrier protection (heavy-duty gloves: 8.3%; protective glasses: 19.7%; boots: 6.7%) was neglected despite institutional training. For instance, only 19.7% used protective glasses, and fewer still used the required orange heavy-duty gloves (8.3%), protective boots (6.7%), or medical waste overalls (5.7%).

A similar pattern was observed for duties with a droplet splash risk, which were performed by 79.0% of the personnel. In these situations, while mask use was very high (92.6%), eye and face protection was less consistent, 53.1% using glasses and 40.1% using face shields.

Regarding general protective measures against blood and body fluid-borne pathogens, the use of gloves was nearly universal, with 99.5% of staff reporting the use of gloves when handling any material potentially contaminated with patient body fluids. Following this, a high percentage (88.3%) reported that they 'always' wash their hands after removing gloves.

When the participants' Hepatitis B vaccination status was examined, it was found that 83.9% had received at least one dose of the Hepatitis B vaccine. In comparison, the rate of completing all required doses was only 42.5%. 90.2% of those who received incomplete doses of the hepatitis vaccine reported not knowing how many doses they would receive.

All participants (100%) reported receiving institutional training on occupational risks. The training topics that were the most frequently received were medical waste (99.6%), personal hygiene (97.8%), and hospital infections/protection methods (95.5%). When asked about their future training needs, the most requested topics were again medical waste (33.3%) and infectious diseases and protection methods (25.0%).

4. Discussion

This study identified a critical gap between theoretical knowledge and practical application of safety measures among hospital cleaning personnel. Despite mandatory training, compliance with essential PPE during high-risk tasks was suboptimal, pointing to systemic failures within the occupational safety system. Our findings reveal several critical points that warrant discussion in the context of international literature and institutional practices.

Our study found a lifetime blood and body fluid exposure rate of 40.2% among cleaning personnel, which aligns closely with global patterns. A comprehensive systematic review and meta-analysis reported a global pooled 12-month prevalence of 39.0% (95% CI 32.7–45.7) for healthcare worker exposure to blood and body fluids [2]. Narin et al. reported a similar 31.9% annual incidence rate among nurses and housekeeping personnel, and Hadadi found the frequency in healthcare workers to be 43.4% [12,14]. Regional variations are substantial: studies from Cameroon reported pooled 12-month prevalence rates of 55.4% (95% CI, 41.2–69.7) [15], while Ethiopian healthcare facilities documented past-year exposure rates of 41.3% [16].

Consistent with these international and global figures, our results are also comparable to local Turkish literature specifically focused on support staff. Deveci et al. [9] found a 44.6% frequency of BBFE among cleaning workers. Furthermore, Çamözü and Kitiş [17] noted that 36.4% of cleaning personnel experienced at least one injury from a cutting/piercing object during their working lives. While some Turkish studies focusing on broader healthcare staff and students reported higher exposure rates (e.g., Çelik et al., 54%, Azap et al., 64%), our hospital's findings fall within the established international and national range for support staff. This strongly suggests that BBFE among hospital cleaning personnel is a global occupational health challenge rather than an issue specific to our region or institution [1,18].

The higher exposure rates observed in some international studies may be attributed to differences in healthcare infrastructure, PPE availability, and institutional safety protocols. For instance, studies from sub-Saharan Africa often report higher exposure rates due to resource constraints and inadequate safety systems [15,16]. Conversely, our relatively moderate exposure rate may reflect the university hospital setting, which has established occupational health protocols, despite some implementation gaps.

Our finding of critically low PPE compliance during medical waste handling (<20% for specialized gloves, protective glasses, and boots) represents a concerning pattern observed internationally, though with significant regional variation. A multi-country analysis found that while 100% of surveyed Indian hospitals reported providing risk-appropriate PPE during COVID-19, actual routine adherence varied substantially [19]. Ethiopian healthcare facility surveys documented only 41% compliance with standard precautions, despite the availability of PPE, demonstrating the universal challenge of translating PPE provision into consistent use [20].

The disconnect between PPE availability and utilization appears to be influenced by multiple factors. Studies from developing countries consistently identify organizational culture, supervision quality, and workload pressures as key determinants of compliance [19,20]. Our findings suggest that Turkish healthcare facilities face similar challenges, where the presence of safety training and equipment does not automatically translate into the adoption of protective behavior. This pattern indicates that the barriers to PPE compliance transcend economic development levels and reflect deeper organizational and behavioral factors.

While 100% of our participants reported receiving safety training, the poor translation to protective behaviors mirrors international findings. Global analyses consistently demonstrate that knowledge-based training alone is insufficient to ensure safe practices [21]. Studies from various countries show that effective safety interventions require multi-modal approaches combining education, environmental modifications, and sustained supervision [19,22].

The gap between training completion and behavioral compliance observed in our study reflects broader challenges in occupational health education. International research suggests that traditional didactic training methods often fail to address practical barriers such as PPE accessibility, workflow integration, and peer influence [21,22]. This may explain why our participants demonstrated awareness of safety protocols but failed to implement protective measures during high-risk activities consistently.

A significant finding in our study was the disparity in Hepatitis B vaccination. While 83.9% of participants had initiated the vaccine (received at least one dose), only 42.5% completed the whole series, a rate which varies considerably compared to international benchmarks. Studies from developed countries typically report vaccination rates among healthcare workers that are higher than 70-80% [23]. However, research from similar middle-income settings shows comparable or lower rates. The primary barrier identified in our study, the lack of knowledge about vaccination schedules (90.2% of incomplete vaccinations), aligns with findings from other countries where health literacy gaps impede preventive health behaviors [24].

The vaccination rate disparity between countries likely reflects differences in occupational health infrastructure, mandatory vaccination policies, and the educational levels of healthcare workers. Countries with robust occupational health systems and mandatory vaccination requirements typically achieve higher coverage rates, while settings relying on voluntary participation show patterns similar to our findings [23,24].

Our high reporting rate (96.7%) and clinical follow-up rate (93.3%) for blood and body fluid exposures align with international patterns. Studies from Senegal reported a post-exposure reporting rate of only 42.3% [24], while various African healthcare facilities documented substantially lower rates of appropriate post-exposure care [15]. This suggests that our institution's post-exposure protocols function effectively, representing a strength that could serve as a model for other settings.

The superior post-exposure management in our study may be attributed to the university hospital setting, which features established infectious disease services and clear reporting protocols. This institutional advantage highlights how healthcare facility characteristics can significantly influence occupational safety outcomes, independent of broader national healthcare system factors.

Research indicates that systemic workplace factors, including organizational culture and employee well-being, significantly impact safety compliance behaviors among healthcare workers [25,26]. Our findings suggest that despite adequate post-exposure systems, the institution faces challenges in creating a culture that prioritizes consistent preventive behaviors. International studies consistently identify organizational commitment, leadership engagement, and peer influence as critical determinants of safety culture effectiveness [19,21].

The pattern observed in our study, effective reactive systems (post-exposure care) coupled with weak preventive behaviors (PPE compliance), reflects a common organizational approach that prioritizes incident management over primary prevention. This approach, while providing critical safety nets, may inadvertently signal that exposure incidents are acceptable as long as they are appropriately managed.

Our findings, contextualized within the international literature, suggest that effective occupational safety for hospital cleaning personnel requires comprehensive approaches that address multiple organizational levels. Successful international interventions typically combine improved PPE accessibility, workflow integration of safety practices, enhanced supervision, and sustained organizational commitment to safety culture development [19,20,22].

The universal nature of challenges identified across diverse healthcare systems suggests that solutions must address fundamental organizational and behavioral factors rather than focusing solely on individual knowledge or equipment provision. This indicates that Turkish healthcare institutions could benefit from adopting multi-modal intervention approaches that have demonstrated effectiveness in various international contexts.

5. Conclusion

This study revealed two central findings regarding cleaning personnel at a university hospital: a high lifetime incidence of blood and body fluid exposure (40.2%) and a critical disparity between universal training attendance and consistently low compliance with essential personal protective equipment during high-risk tasks, such as medical waste handling. Specifically, compliance rates for heavy-duty gloves, protective glasses, and boots were below 20%, indicating a systemic failure in safety implementation that cannot be attributed solely to a lack of knowledge. While post-exposure reporting and hepatitis B vaccination rates were high, significant gaps in understanding the complete vaccination schedule underscore a need for improved health literacy interventions. The collective findings point to the necessity of moving beyond basic training toward integrated strategies that ensure accessible PPE, enforced safety protocols, and a strengthened culture of accountability to protect this essential, yet vulnerable, workforce effectively.

This study acknowledges the following limitations:

Temporal relationships between training and PPE compliance cannot be established; longitudinal studies are needed to assess causality. Conducted at a Turkish university hospital, the findings may not be generalizable to non-academic or rural healthcare settings. Data relied on self-reported practices (e.g., PPE use), risking recall inaccuracy or social desirability bias. Direct observational methods would strengthen validity. The 10.8% non-participation rate (e.g., part-time staff) may exclude perspectives of higher-risk groups. Low source-patient identification rates (19.1%) precluded analysis of exposure outcomes linked to specific blood-borne pathogens.

Ethical statement:

Permission was received from the Bursa Uludağ University Faculty of Medicine Clinical Research Ethics Committee, as per the board decision dated May 16, 2023, and numbered 2023-11/41.

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The authors declare that they have no conflict of interest.

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Authors' Contributions:

G.E: Constructing the hypothesis of research, data collection, literature review, and writing the article.

L.Ö: Supervising, taking responsibility for the logical interpretation and conclusion of the results, literature review, and writing the article.

Generative AI statement:

The authors declare that no Gen AI was used in the creation of this manuscript.

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