Original Article :

Occupational Health Compliance and Bloodborne Pathogens Safety Practices Among Healthcare Workers: An Observational Analysis

Khalid Dakhelalah Almutairi[1], Mansour Balkhyour[2], Maged EL-Setouhy[3]

1. Ph.D. Candidate, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia
2. College of Environmental Sciences, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia
3. College of Medicine, Jazan University, Jazan, Kingdom of Saudi Arabia

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Corresponding author:

Khalid Dakhelalah Almutairi, Ph.D. Candidate, King Abdulaziz University, Jeddah, Kingdom of Saudi Arabia. E- mail: Khdd20082008@gmail.com, kdalmutairi@stu.kau.edu.sa.

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Abstract:

Background & Aims:
Globally, healthcare personnel play a crucial role in ensuring patient safety, yet their practices and compliance with infection control measures often vary. Infection control practices are vital for ensuring the safety of healthcare personnel and patients. This study aims to evaluate healthcare workers' compliance with occupational health and safety practices related to bloodborne pathogens (BBPs), identify factors influencing adherence, and provide insights into improving workplace safety through an observational analysis.

Methods:
A cross-sectional (questionnaire and observation) study was conducted on a convenient sample of 112 participants.

Results:
Practice compliance overall: out of 112 participants, 61 (54.46%) were satisfactory, while 51 (45.5%) were unsatisfactory, accounting for 100% of the assessed population. High adherence was observed in key practices, such as handwashing after exposure to blood or body fluids 108 (96.4%), wearing gloves during contact with patient fluids 110 (98.2%), and proper sharps disposal 99 (88.4%). However, compliance was poor for hand hygiene before and after glove use 29 (25.9%) and use of eye protection during procedures with a risk of fluid splashes 8 (7.1%).

Conclusion:
TWhile adherence to critical infection control measures is strong, gaps in basic practices and PPE use pose significant risks. Addressing these gaps through enhanced training programs, targeted interventions for vulnerable groups, resource allocation, and policy enforcement is essential to improving workplace safety and reducing occupational hazards.

Keywords:
Infection control measures, blood-borne pathogens, compliance, healthcare workers, occupational health and safety

Introduction:

Bloodborne pathogens (BBPs) are infectious microorganisms present in human blood and other body fluids that can cause potentially life-threatening diseases[1]. When an infected individual's blood or certain body fluids come into direct contact with another person's bloodstream, they transmit these pathogens[2]. Among the most prevalent BBPs in healthcare settings are Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and Hepatitis C Virus (HCV). The risk of transmission depends on factors such as the specific pathogen, the nature of exposure, and the availability of preventive measures like HBV vaccinations and post-exposure prophylaxis (PEP) for HIV and HCV[1].

Healthcare workers (HCWs) face a high risk of BBP exposure due to their frequent contact with blood and body fluids in clinical environments [3]. Workers across specialties-including emergency departments, intensive care units, operating rooms, laboratories, ordinary wards, and blood sampling units-are particularly vulnerable[4]. Surgeons and operating room staff face even greater risks because they are directly exposed to blood during surgical procedures and frequently use sharp instruments [5]. Similarly, nurses and phlebotomists, who handle needles and draw blood regularly, are at significant risk of needlestick injuries and BBP exposure [6,7]. Failure to follow proper safety precautions puts laboratory personnel working with blood samples and biological materials at risk. Additionally, contaminated waste and improperly discarded sharps frequently expose cleaning staff[6,7].

Several factors exacerbate BBP exposure risks, including insufficient adherence to safety protocols in high-pressure situations[8]. Inadequate training in infection control practices often leads to improper handling of sharps and inconsistent use of personal protective equipment (PPE). Furthermore, long working hours, high patient volumes, and staff burnout can diminish vigilance in following safety protocols, increasing the risk of exposure [9]. Exposure incidents are further exacerbated by poor workplace organization, limited access to sharps disposal containers, and the unavailability of safety- engineered devices.

Despite these challenges, strict adherence to safety protocols, consistent use of PPE, and effective implementation of PEP in healthcare environments largely prevent BBP transmission[10]. However, barriers such as inconsistent training, inadequate reporting systems, and uneven resource allocation across facilities hinder compliance and undermine prevention efforts. In Saudi Arabia, where the healthcare sector is rapidly expanding, the

high prevalence of bloodborne diseases among patients necessitates a critical focus on HCW protection [11,12]. To address these risks, the government has implemented national standards aligned with OSHA guidelines and WHO recommendations to reduce BBP exposure.

Despite these initiatives, there remains a pressing need for continuous education, improved resource accessibility, and stricter enforcement of safety protocols to minimize needlestick injuries and other exposure risks[12-13.] Mandatory training programs, fostering a culture of safety, and addressing organizational barriers to compliance are essential for enhancing adherence to infection control practices. Additionally, targeted research to explore barriers and organizational factors is crucial to identify effective solutions and bridge existing gaps in safety practices.

The current cross-sectional study was conducted to evaluate healthcare workers' compliance with occupational health and safety practices related to bloodborne pathogens (BBPs), identify factors influencing adherence, and to provide insights into improving workplace safety through an observational analysis.

Materials And Methods:

Research Design: This cross-sectional study was conducted between August and September 2024. 112 HCWs were recruited for this study using a questionnaire and an observation checklist.

Study Area and Population: This study was conducted at King Fahad Hospital and Al-Miqat General Hospital in the Al-Madinah Al-Munawara region, Saudi Arabia. King Fahad Hospital is a tertiary, referral, teaching, and training hospital operating under the Ministry of Health (MOH). It is accredited by the Central Board for Accreditation of Healthcare Institutions (CBAHI) and the Joint Commission International (JCI). The hospital has a 500-bed capacity and provides comprehensive medical and surgical care, including adult critical care and emergency services. Al-Miqat General Hospital is a secondary care facility under the MOH that is funded by the government. It has a 200-bed capacity and offers a range of medical and surgical services, including adult critical care and emergency management. The study population included healthcare workers (HCWs) from various specialties currently employed at both hospitals. Eligible participants comprised physicians, nurses, laboratory technicians, cleaners, and operating room technicians.

Inclusion criteria: HCWs from the selected hospitals who were directly or indirectly exposed to BBPs, both male and female, Saudi and non-Saudi, and those HCWs who gave informed consent to

participate were involved in this study.

Exclusion criteria: All HCWs on vacation, as well as any health professional who works in an office and is not at high risk of blood contact or dealing with it, were excluded.

Study Sampling: The study population was selected using a stratified sampling technique. The population is divided into distinct subgroups (physicians, nurses, technicians (laboratory and operation room and cleaners) that share similar characteristics, and a random sample is then drawn proportional to the size of each stratum.

Data Collection tool and procedure for data collection:

A self-administered questionnaire was used to collect information regarding the demographic data (age, sex, nationality, hospital department, job, qualification and years of experience) and section on the training courses on infection control, experiencing needle stick/ sharp injuries and practice grade (Table 1).

These data were collected from all 112 participants using the self-questionnaire and after 30 days, the same participants were blindly observed by four collaborators using an observational checklist tool to assess healthcare workers' compliance with safe occupational practices. The observational tool covered 4 main categories with 20 subcategories related to hand hygiene, sharp device safety, disposal and handling, and PPE. Over 7 working days, each collaborator observed 14 healthcare workers (2 HCWs per day per observer) in each study area, adhering to a schedule that matched the HCWs' duty rosters. Observations were conducted during critical tasks, such as patient procedures, specimen handling, and daily routine work, to evaluate compliance effectively. To minimize the Hawthorne effect [14], the checklist was used discreetly, and observation times varied to capture different shifts and duties. Observers recorded task compliance in real-time.

Definition for scoring practice: HCWs' levels of practice were scored as follows: "Two" for each practice rated as "satisfactory (done appropriately)," one grade for "unsatisfactory (inappropriately done)," and zero for "not done." Total HCWs' practice scores were estimated and then converted to percent scores. Scores of 75% or higher were considered "good practices," while scores below 75% were categorized as "poor practices" [15].

Data Analysis: The collected data were coded, tabulated, and statistically analyzed

using IBM SPSS Statistics (Statistical Package for Social Sciences) software version 28.0, IBM Corp., Chicago, USA, 2021. Qualitative data were described as numbers and percentages and compared using the chi- square test. The Bonferroni test was used for post hoc comparisons. Logistic regression was used to find out factors affecting good practice. The level of significance was taken at p-value ≤ 0.050, which was significant; otherwise, it was non-significant.

Table 1: Questionnaire on HCWs' demographics and experience.

Variable	Options	Check (√)
Age (years)	21-30	[ ]
	31-40	[ ]
	41-50	[ ]
Gender	Male	[ ]
	Female	[ ]
Nationality	Saudi	[ ]
	Non-Saudi	[ ]
Hospital	Specialized	[ ]
	General	[ ]
Department	Emergency room	[ ]
	Operation room	[ ]
	Laboratory	[ ]
	Ward	[ ]
	ICU	[ ]
Job category	Physician	[ ]
	Nurse	[ ]
	Technician	[ ]
	Cleaner	[ ]
Qualification	Undergraduate	[ ]
	Graduate	[ ]
	Postgraduate	[ ]
Length of time worked at the hospital (Years)	1-5	[ ]
	6-10	[ ]
	11-15	[ ]
	16-20	[ ]
	More than 20	[ ]
Training courses on infection control (BBPs)	Yes	[ ]
	No	[ ]
Experiencing needle stick/sharp injuries	Yes	[ ]
	No	[ ]

Validity and Reliability: The checklist accurately encompassed all aspects of standard precautions to measure compliance with occupational health and BBPs safety practices. It was comprehensively reviewed by a panel of experts in infection control, occupational health, and clinical practice, who evaluated its relevance, clarity, and coverage. Observed practices with measurable outcomes, such as rates of reported needlestick injuries or adherence to PPE protocols, were validated. The consistency and stability among all observers (four collaborators) using the checklist were assessed to ensure a uniform understanding of the items [16]. Internal consistency was statistically measured using Cronbach's alpha to test reliability and validity, ensuring the checklist was clear, intelligible, and relevant. Face validity confirmed the clarity and relevance of the checklist.

Ethical Implications: The General Directorate of Health Affairs in the Madinah region, under the Ministry of Health, Kingdom of Saudi Arabia, approves the Institutional Review Board (IRB). Dated July 14, 2024, the approval aligns with IRB log 24-063. It ensures compliance with the National Committee of Bioethics (NCBE) and regulatory standards for conducting research involving human participants. This ethical clearance confirms the research adheres to protocols for protecting participant rights, confidentiality, and data integrity, as well as proper informed consent processes.

Results:

The study included 112 participants and examined the characteristics and practices of healthcare workers. All the selected candidates responded to the questionnaire questions, resulting in a 100% response rate for the questionnaire and the blind observation using an observational checklist.

Questionnaire: The sociodemographic characteristics and descriptive statistics of the study participants are presented in Table 2. The majority of participants were aged between 31 and 40 years (44.6%, n = 50), followed by those aged 41–50 years (30.4%, n = 34) and 21–30 years (25.0%, n = 28). Gender distribution was nearly equal, with males comprising 51.8% (n = 58) and females 48.2% (n = 54). Most participants were Saudi nationals (58.0%, n = 65), while 42.0% (n = 47) were non-Saudi. Job roles were evenly divided between specialized and general positions (50% each). Participants were distributed across various hospital departments, including the Emergency Room (23.2%, n = 26), Intensive Care Unit (21.4%, n = 24), Laboratory (19.6%, n = 22), Operating Room (18.8%, n = 21), and Wards (17.0%, n = 19). Nurses represented the largest professional group (45.5%, n = 51), followed by technicians (30.4%, n = 34), physicians (15.2%, n = 17), and cleaners (8.9%, n = 10). Regarding educational background, more than half of the participants were graduates

(51.8%, n = 58), while 34.8% (n = 39) were undergraduates, and 13.4% (n = 15) held postgraduate degrees. Work experience varied, with most personnel having 1–5 years of service (27.7%, n = 31), followed by 11–15 years (23.2%, n = 26), 6–10 years (20.5%, n = 23), 16–20 years (18.8%, n = 21), and more than 20 years (9.8%). Only 17.0% (n = 19) of the personnel had received training in infection control related to bloodborne pathogens (BBPs), while 83.0% (n = 93) had not. Additionally, 62.5% (n = 70) of participants reported experiencing needlestick or sharp injuries, highlighting a notable occupational hazard.

Table 2: summarizes the characteristics of the various sociodemographic variables among the study participants.

Variables		Frequency	Percentage (%)
Age (years)	21-30	28	25.0
	31-40	50	44.6
	41-50	34	30.4
Gender	Male	58	51.8
	Female	54	48.2
Nationality	Saudi	65	58.0
	Non-Saudi	47	42.0
Hospital	Specialized	56	50.0
	General	56	50.0
Department	Emergency room	26	23.2
	Operation room	21	18.8
	Lab	22	19.6
	Ward	19	17.0
	ICU	24	21.4
Job category	Physician	17	15.2
	Nurse	51	45.5
	Technician	34	30.4
	worker	10	8.9
Qualification	Undergraduate	39	34.8
	Graduate	58	51.8
	Postgraduate	15	13.4
Length of time worked at the hospital (Years)	1-5	31	27.7
	6-10	23	20.5
	11-15	26	23.2
	16-20	21	18.8
	>20	11	9.8
Training courses on infection control (BBPs)	Yes	19	17.0
	No	93	83.0
Experiencing needle stick/sharp injuries	Yes	70	62.5
	No	42	37.5

Observational practices:

The results of the adherence to standard infection control practices among personnel are shown in (Table 3). Strong compliance (≥75% adherence) was detected in washing hands immediately after contact with blood, body fluids, or contaminated materials 108 (96.4%); wearing gloves when handling fluids or body fluids 110 (98.2%) and ensuring correct glove fit/type 100 (97.3%); avoiding recapping needles or handling sharps unsafely 99 (88.4%); proper disposal of sharps 97 (86.6%); and awareness of sharp handling protocols to prevent injury to others 85 (75.9%). On the other hand, low compliance (<50% adherence) was observed in washing hands before and after using gloves 29 (25.9%) and use of eye protection during procedures with a risk of spraying body fluids 8 (7.1%). and in the accessibility of gloves at required locations 58 (51.8%).

Table 3: summarizes appropriate practices among the participants included in this study.

S.No	Observation statement items	Number	%
1	Hands should be washed before and after patient care or contaminated tools with blood.	81	73.0
2	Hands should be washed before and after using gloves.	29	25.9
3	Level of hand hygiene and corresponding handwashing routines required in each area	52	46.4
4	Wash hands immediately after contacting any blood, body fluid, secretion, excretion, or dirty substances	108	96.4
5	Compatibility of agents used to clean and wash	55	49.1
6	Contaminated needles and other contaminated sharps shall not be bent, recapped, or removed.	99	88.4
7	When handling sharp objects, staff must be aware of others in the immediate environment and take steps to control the location of the sharp objects to avoid injury to themselves and other staff.	85	75.9
8	Maintaining visual contact with the procedure site and location of the sharp device.	85	75.9
9	Activate any sharp device safety feature as soon as possible after using the device, following the manufacturer's guidelines.	81	72.3
10	Never reach into a sharps container or push other sharps into a sharps container if they're sticking out.	97	86.6
11	Don't hand a sharp to another person or place it in a location for disposal by another person.	62	55.4
12	Place all sharps into a sharp container in the area where you used them immediately after use or discard them.	64	57.1
13	Don't Separate contaminated needles from syringes and tubing or sharp containers before discarding them.	64	57.1
14	Wearing gloves when handling patient fluids or during contact with any blood and body fluids.	110	98.2
15	Correct fit and type of gloves are essential to their effectiveness in infection prevention.	109	97.3
16	Accessible locations for gloves that are required when tasks performed	58	51.8

17	A surgical mask should be worn to protect the nose and mouth during contact with blood and body fluids.	69	61.6
18	Wearing a protective eye patch or goggles when performing procedures that might induce the spraying of blood, body fluids, secretions, or excretions.	8	7.1
19	Wearing protective suits or gowns when performing procedures that might induce the spraying of blood, body fluid, secretions, or excretions	60	53.6
20	Compliance with labeling policy for disposal containers used to transport, biohazards (BBPs)	86	76.8

Practice compliance overall 61 (54.46%) of participants were graded as satisfactory "good," while 51 (45.54%) were graded as "poor," accounting for 100% of the assessed population. The results of the significant factors affecting the practice quality were illustrated. Comparatively, physicians significantly demonstrated the highest good practice adherence, 15 (88.2%), compared to other groups, with workers showing the lowest (10.0%, p = 0.001). Also, postgraduate qualifications were strongly associated with better practices 14 (93.3%) good, p = 0.002), while personnel with training on infection control had significantly better practices 15 (78.9% good, p = 0.019), but the sociodemographics of the observed group did not significantly influence the practice quality (Table 4).

Table 4a: summarizes the practice grades of the study participants and the categories of factors based on sample characteristics in this study.

Variables		Practice categories (No. %)		p-value (Chi square test)
Good		Poor		
Age (years)	21-30	12 (42.9%)	16 (57.1%)	0.339
	31-40	30 (60.0%)	20 (40.0%)	
	41-50	19 (55.9%)	15 (44.1%)	
Gender	Male	32 (55.2%)	26 (44.8%)	0.876
	Female	29 (53.7%)	25 (46.3%)	
Nationality	Saudi	33 (50.8%)	32 (49.2%)	0.356
	Non-Saudi	28 (59.6%)	19 (40.4%)	
Job place(hospital)	Specialized	28 (50.0%)	28 (50.0%)	0.343
	General	33 (58.9%)	23 (41.1%)	
Department	Emergency room	14 (53.8%)	12 (46.2%)	0.054
	Operation room	16 (76.2%)	5 (23.8%)	
	Lab	7 (31.8%)	15 (68.2%)	
	Ward	12 (63.2%)	7 (36.8%)	
	ICU	12 (50.0%)	12 (50.0%)	

Note. *Significant. Homogenous categories of the studied characteristics regarding good practice had the same symbol “a and b” based on the post hoc Bonferroni test.

Table 4b: summarizes the practice grades of the study participants and the categories of factors based on sample characteristics in this study.

Variables		Practice categories (No. %)		p-value
Good		Poor		(Chi square test)
Job category	Physician	15 (88.2%) a	2 (11.8%)	0.001*
	Nurse	28 (54.9%) ab	23 (45.1%)	
	Technician	17 (50.0%) b	17 (50.0%)	
	Worker	1 (10.0%) b	9 (90.0%)	
Qualification	Undergraduate	16 (41.0%) a	23 (59.0%)	0.002*
	Graduate	31 (53.4%) a	27 (46.6%)	
	Postgraduate	14 (93.3%) b	1 (6.7%)	
Length of time worked at the hospital (Years)	1-5	14 (45.2%)	17 (54.8%)	0.599
	6-10	14 (60.9%)	9 (39.1%)	
	11-15	16 (61.5%)	10 (38.5%)	
	16-20	10 (47.6%)	11 (52.4%)	
	>20	7 (63.6%)	4 (36.4%)	
Training courses on infection control	Yes	15 (78.9%)	4 (21.1%)	0.019*
	No	46 (49.5%)	47 (50.5%)	
Experiencing needle stick/ sharp injuries	Yes	38 (54.3%)	32 (45.7%)	0.961
	No	23 (54.8%)	19 (45.2%)	

Note. *Significant. Homogenous categories of the studied characteristics regarding good practice had the same symbol "a and b" based on the post hoc Bonferroni test.

The analysis of logistic regression of factors that affect the good grade of practice was shown in (Table 5). After analyzing all demographic characteristics of the studied cases, only working in the operation department, having a physician job, having postgraduate study, and receiving courses on infection control were significant independent factors that increased the likelihood of having a good grade.

Table 5 below presents the logistic regression analysis of the study participants' four factors influencing a good practice grade.

Factors	β	SE	p-value	Odds ratio (95% CI)
Operation department	1.32	0.61	0.031*	3.74 (1.13–12.36)
Physician job	1.81	0.85	0.033*	6.12 (1.16–32.42)
Postgraduate study	2.55	1.10	0.021*	12.77 (1.47–110.60)
Education courses on infection control (BBPs)	1.87	0.63	0.003*	6.49 (1.90–22.19)
Constant	-0.76	0.28	0.006	

β: Regression coefficient. SE: Standard error. CI: Confidence Interval. *Significant (indicates statistical significance at $p < 0.05$).

Discussion:

The sociodemographic profile of the study participants provides a comprehensive snapshot of the healthcare workforce in the study setting. The age distribution, with most personnel (44.6%, *n* = 50) aged between 31 and 40 years, suggests a mid-career workforce with practical experience and familiarity with institutional protocols. However, the substantial proportion of younger personnel (25.0%, *n* = 28) aged 21–30 underscores the need for targeted training initiatives to develop foundational infection control skills early in their careers.

The nearly equal gender distribution (males: 51.8%, *n* = 58; females: 48.2%, *n*= 54) reflects a balanced workforce, which may contribute to diverse perspectives in addressing occupational safety challenges. The predominance of Saudi nationals (58.0%, *n* = 65) ensures that the study findings are representative of the local healthcare workforce, while the inclusion of non-Saudis (42.0%, *n* = 47) highlights the multicultural nature of healthcare settings in the region, consistent with previous studies in Saudi Arabia[17,18].

The distribution of participants across key hospital departments - Emergency Room, ICU, Laboratory, Operating Room, and Ward - ensures a well-rounded assessment of infection control practices in high-risk areas. Nurses formed the largest professional group (45.5%, *n* = 51), which aligns with previous reports indicating that nurses constitute the frontline workforce, making them more susceptible to occupational hazards such as needlestick injuries[18]. Technicians (30.4%, *n* = 34) and physicians (15.2%, *n* = 17) play essential

roles in specialized care, while cleaners (8.9%, *n* = 10) are critical to maintaining hospital hygiene, yet often receive limited formal training in infection control[19].

The educational qualifications show that 58 (51.8%) of the workforce are graduates, while 39 (34.8%) are undergraduates and 15 (13.4%) are postgraduates. This distribution raises concerns about the depth of knowledge and expertise in infection control. Studies in Saudi Arabia have highlighted that higher education levels correlate with better adherence to infection prevention protocols[20]. Given that postgraduates typically receive more specialized training in healthcare practices, their lower representation may indicate a gap in advanced infection control knowledge and leadership in best practices. A study by Alotaibi et al. (2017) found that undergraduate healthcare workers had lower scores in infection control assessments compared to those with postgraduate qualifications[21]. This suggests a need for targeted training programs to ensure that even those without advanced degrees possess the necessary competencies. This suggests a need for targeted training programs to ensure that even those without advanced degrees possess the necessary competencies.

Infection Control Training and Needlestick Injuries:

The findings on infection control training are striking, with only 19 (17.0%) of participants reporting formal training. This deficiency is concerning, as it likely contributes to suboptimal practices and increased exposure to occupational hazards. The high prevalence of needlestick or sharp injuries, with 70 cases (62.5%), highlights a critical safety gap that could potentially worsen due to inadequate training and non-compliance with standard precautions.

Continuous education is a vital component of a safety-first culture. Regular safety drills, updates on the latest infection control protocols, and refresher courses on BBP prevention keep safety at the forefront of everyday practice. Tailored training programs ensure that all HCWs, regardless of role or experience, are equipped with the knowledge they need[22].

In 2002, a tertiary care center in Saudi Arabia documented the first report of needlestick and sharps injuries among HCWs[17]. Following this, researchers highlighted the serious consequences of needlestick injuries among healthcare workers in Najran, Saudi Arabia[18]. Most recently, Makeen et al. (2022) reported a continued high prevalence of these

injuries[19]. These injuries pose severe risks, including transmitting bloodborne pathogens, and highlight the urgent need for comprehensive safety protocols and regular training programs[23].

The demographic and occupational data reveal key areas for intervention. We should prioritize infection control education for younger, less experienced personnel and those without formal training. Additionally, targeted workshops for non-clinical staff, such as cleaners, are essential to ensure safety standards[24]. Addressing the high rate of needlestick injuries through enhanced safety protocols, such as adopting safety-engineered devices and post-exposure prophylaxis policies, is critical[2].

Infection Control Practices and Compliance:

The findings highlight the need for organizational policies to standardize infection control training as a mandatory onboarding and continuous education component. Tailored programs for high-risk departments, such as the ICU and emergency room, could bridge practice gaps and improve compliance. The study's results provide valuable insights into infection control practices among healthcare personnel, revealing both strengths and gaps in adherence[25].

Critical infection prevention measures, such as wearing gloves, properly disposing of sharps, and immediately handwashing after blood or body fluids exposure, demonstrated strong adherence. These practices indicate awareness of key safety protocols, which are particularly important in minimizing the risk of occupational exposure to infectious agents[1]. The operation department demonstrated significantly better adherence, likely due to stringent protocols in surgical environments. However, we observed poor compliance in hand hygiene before and after glove use (29 [25.9%]) and ensuring glove accessibility (58 [51.8%]), in contrast with findings from similar studies[26].

Low use of eye protection (8 (7.1%) during procedures that could result in body fluid splashes is concerning, as it increases the risk of exposure to infectious diseases and suggests a lack of awareness or insufficient resources[13]. Moderate adherence to practices like using protective masks 69 (61.6%) and protective suits 60 (53.6%) further suggest that some personnel may underestimate the risks associated with exposure or face barriers to accessing these resources [13].

Departmental and Professional Variations in Compliance:

Physicians and postgraduate-educated personnel exhibited the highest compliance, reflecting the influence of

advanced knowledge and specialized training on adherence to infection control measures. Additionally, infection control training was strongly associated with better practices, underscoring the importance of structured education programs in promoting adherence. The high-risk nature of surgical procedures and the stricter enforcement of safety measures likely encouraged personnel in the operating room to demonstrate better practices[27].

The p-value analysis indicated no statistically significant association between practice grades and variables such as age, gender, nationality, job specialization, length of time worked, and experience with needlestick/sharp injuries. The small sample size (112 participants) may limit the study's generalizability to broader healthcare populations. Furthermore, we conducted the study in two healthcare settings in Saudi Arabia, which limited regional diversity and excluded rural environments. Thus, these factors do not appear to influence compliance levels significantly. On the other hand, the operation room staff showed the highest compliance, 16 (76.2%), while laboratory staff exhibited the lowest compliance, 7 (31.8%). Physicians had the highest compliance, 15 (88.2%), while workers demonstrated the poorest compliance, 1 (10.0%), likely due to differences in training and responsibilities. The notably low compliance among laboratory personnel (31.8%) may be due to multiple factors, including high workload, frequent exposure to hazardous materials, and possible gaps in infection control training. Additionally, laboratory staff may not perceive themselves as at high risk compared to other healthcare workers, leading to lower adherence to safety protocols[28]. To address this issue, targeted interventions are necessary. Hospitals should implement regular infection control training programs specifically tailored for laboratory personnel, emphasizing the risks associated with exposure to bloodborne pathogens and the importance of adherence to safety protocols. Additionally, reinforcing compliance through periodic assessments, providing easy access to personal protective equipment (PPE), and fostering a culture of safety within the laboratory environment can help improve adherence rates. Higher compliance among postgraduate HCWs 14 (93.3%) compared to graduates 31 (53.4%) and undergraduates 16 (41.0%) highlights the role of education in fostering better understanding and adherence to infection control practices [19].

HCWs who received formal infection control training demonstrated significantly better compliance: 15 (78.9%) than 46 (49.5%). This finding emphasizes the

importance of regular and effective training programs. Logistic regression analysis identified four key predictors of excellent practice: being a physician, working in the operation department, having postgraduate education, and receiving infection control training. These factors emphasize the role of professional responsibility, the working environment, and structured education in fostering adherence to infection control measures.

Delimitations and Limitations:

The study was conducted in 2 specific healthcare settings (within Saudi Arabia), limiting the focus to this region and potentially excluding diverse healthcare environments, such as rural. The relatively small sample size of 112 participants limits the ability to generalize the findings to all healthcare personnel, particularly those outside the study's setting or population demographics. The study emphasized observational data and did not include qualitative insights, such as interviews or focus groups that might provide a deeper context for the findings. The study assessed training history based on participants' recall without verifying the training programs' content, frequency, or quality.

Conclusions:

The study emphasizes the strengths in compliance with essential occupational bloodborne pathogen infection prevention protocols, especially among highly trained and specialized staff. Nonetheless, considerable deficiencies in adherence to fundamental practices, including hand cleanliness and the utilization of personal protective equipment (PPE), highlight the necessity for focused interventions. By rectifying these deficiencies by implementing safety measures, healthcare facilities may cultivate a more secure atmosphere for patients and personnel. These findings urge stakeholders to invest in enduring solutions for sustained infection control improvement.

Recommendation:

Several interventions are recommended to improve infection control adherence: Infection control education should be standardized as part of onboarding and continuous professional development, particularly targeting younger and less experienced personnel. Training programs tailored for cleaners and laboratory workers should be implemented to ensure they understand occupational risks and safety measures. Adoption of safety-engineered devices, improved reporting systems, and post-exposure prophylaxis policies should be enforced to reduce the incidence of needlestick injuries. High-risk areas such as the ICU, emergency room, and laboratory should receive customized infection control training and stricter compliance

monitoring. Ensuring easy access to gloves, masks, eye protection, and protective suits, along with training on their importance, could help bridge current compliance gaps. Periodic assessments should be conducted to evaluate infection control adherence and identify areas needing improvement.

Additional Information:

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