

Occupational Health Hazards: Prevalence and Risk Factors of Occupationally Acquired Diseases among Healthcare Professionals

Iram Jamali^{1*}, Zaib-ul-Nisa Rahimoon², Hamnah Tariq², Meghna¹, Janzuhera¹, Fizza Shabbir Ahmed¹, Ghulam Mujtaba Shah¹

ABSTRACT

OBJECTIVE: To determine the frequency and risk factors of TB, hepatitis B, hepatitis C, pneumonia and AIDS among healthcare professionals and to determine the association between occupationally acquired diseases and risk factors.

METHODOLOGY: This simple random cross-sectional study was carried out from July to October 2025, including participants who were healthcare professionals, such as doctors, nurses, dentists, technicians and special ward staff, working in urban hospitals of Sindh. A simple random sampling technique was used to select the Participants. Data were collected using a self-structured questionnaire, and descriptive and inferential statistics were applied to analyze the data.

RESULTS: A total of 264 healthcare professionals participated in the study, with a mean age of 28 ± 8 years. Blood was found to be the primary exposure source (85.2%). Percutaneous exposure was seen in (63.3%) of cases, mostly due to syringe needle stick injuries (49.6%). The reported prevalence was found to be pneumonia (8%), TB (3.8%), hepatitis B (3.4%), hepatitis C (1.5%) and AIDS (1.1%).

CONCLUSION: Occupational hazards put healthcare professionals at high risk, making them vulnerable to a lot of infectious diseases, mainly due to needle stick injuries and other percutaneous exposures. Strategies are needed to address these infections, such as awareness sessions and targeted training programs, to help them recognize the threat posed by these occupational hazards.

KEYWORDS: Occupational health hazards, needle stick injuries, healthcare professionals, infectious diseases, percutaneous exposures.

INTRODUCTION

Hazards experienced by healthcare workers at their workplace are known as occupational hazards. These hazards fall into two categories: biological and non-biological. Biological hazards are those associated with viruses, bacteria, and other microbes that cause disease. Non-biological hazards can be physical, chemical, mechanical or ergonomic¹. Healthcare workers are constantly exposed to these hazards due to their hazardous workplace environment. Mainly, encounters with bio-hazards such as Chronic Hepatitis B and C, Tuberculosis (TB), HIV, and influenza are important in this regard, as many safety programs are designed and personal protective equipment (PPE) is used to prevent these occupational diseases².

According to a systematic review, 12 articles reported high rates of needlestick injuries in studies conducted in Nigeria (about 27%) and China (about 82%) in 2020, with significant variation. If we talk about the overall prevalence, a review of 9 articles found it to be 32.4% in Ethiopia and 86.2% in China, indicating a wide variation³. Healthcare workers are highly at risk of falling victim to HBV infection because HBV is fourfold greater in HCWs in comparison to the general

population. The hazards experienced by healthcare workers are known as "occupational biological hazards (OBH)", and there is a high probability of accidentally getting pricked by contaminated needle sticks during patient care. Other forms of exposure include contact with blood and other body fluids, such as saliva, semen, and urine, on mucosal surfaces or disrupted skin⁴. It is reported by the Organization related to world health (WHO) that out of 35 million individuals of the healthcare workforce globally, about 3 million cases of percutaneous or skin penetrating injuries occur every year, causing nearly 1000 HIV infections due to percutaneous exposure. It is believed that more than 90% of these infections occur in low-resource countries. Low-resource regions, including Asia and Sub-Saharan Africa, have a high likelihood of these exposures or accidents, with an incidence rate of up to 9 exposures per healthcare worker annually⁵. The World Health Organization reports that the burden of HIV among the healthcare workforce worldwide, caring specifically for HIV infected patients, is significantly high, nearly reaching a prevalence of 2.5%⁶. According to a World Health Organization (WHO) assessment, occupational hazards were responsible for causing nearly 37% of Hepatitis B cases among healthcare workers⁷.

Tuberculosis is considered by WHO to be among the top ten leading causes of mortality in the world, resulting from a bacterium, i.e. mycobacterium tuberculosis, exceeding HIV/AIDS. There is a

¹Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro

²Army Medical College, Rawalpindi, Pakistan

Correspondence: irumbaloch85@gmail.com

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condition called Latent Tuberculosis Infection (LTBI) where individuals are infected with Mycobacterium tuberculosis without showing symptoms of active TB. To eliminate the disease, it is necessary to provide preventive treatment to individuals with latent tuberculosis infection (LTBI). Healthcare workers face a greater challenge compared to the general population due to exposure to TB patients at their workplace; it becomes hard to protect themselves against infection, so there is a chance that they may become infected. It is seen that there is limited data on the occurrence of latent tuberculosis infection (LTBI) in healthcare personnel due to a lack of research on this topic⁸.

Healthcare workers experience more than 2 million needle stick injuries (NSIs) every year, causing a fairly large number of occupational health risks. Injuries caused by sharp objects among healthcare workers resulted in approximately 16,000 infections of HCV, 66,000 infections of HBV and 1000 infections of HIV in the year of 2000⁹. In a 2020 meta-analysis, 87 research articles were included, involving 50,916 healthcare workers from 31 countries. According to the study, it was found that in one year, the prevalence of needle stick injuries among the healthcare workforce worldwide was recorded to be 44.5%, with the highest prevalence among healthcare workforce individuals working in South East Asia. In the healthcare workforce, dentists were at the highest risk of NSIs, with approximately 59.1% of dentists experiencing them. Hypodermic syringes were found to be the main factor causing NSIs, causing 55.1% of cases¹⁰. Different medical instruments, such as syringe needles, surgical scalpels, lancets, razors, scissors, and other surgical instruments, can cause sharp injuries and needlestick injuries. These injuries expose healthcare workers to blood-transmitted pathogens, i.e., Hepatitis B virus, Hepatitis C virus, and HIV (Human Immune Virus), through percutaneous exposure to infected blood and other body fluids. The WHO reported that injuries caused by sharp objects and needle stick injuries produce a high proportion (nearly 40%) of Hepatitis B & C cases and HIV cases in healthcare workforce individuals. The transmission rate of Hepatitis B and Hepatitis C was found to be higher than HIV (around 2-3%)¹¹.

The World Health Organization emphasizes systematic monitoring of high-risk individuals, like healthcare workers (HCWs), family members of TB patients and individuals living with HIV. Healthcare workforce members are more prone to acquire hospital-acquired TB, despite their efforts to eliminate TB worldwide. In developing and low-resource countries, which account for 87% of TB infection cases worldwide, hospital-acquired Mycobacterium tuberculosis infection is more commonly seen. It is seen in some of these countries that, in comparison between the healthcare workforce and the general population, HCWs face more than double the incidence rates of the general population. It suggests

that healthcare facilities are a main source of TB transmission¹². During outbreaks, Healthcare workers face an increased risk of infection transmission during patient care, including contact with contaminated samples and direct patient contact. For preventive measures, personal protective equipment (PPE), such as gloves, face masks, respirators, and protective clothing, is used to reduce the transmission of infectious agents. PPE is an important barrier widely used in healthcare facilities. It is protective for both healthcare workers and patients by preventing the transmission of infection¹³.

The vaccination against Hepatitis B is crucial for the prevention and elimination of the disease, and it is essential for all healthcare workers to receive it. Despite that, around 24% of healthcare workers remain unvaccinated for the hepatitis B virus worldwide¹⁴. The vaccine for tuberculosis, known as the BCG vaccine, is derived from *M. bovis* and is used worldwide to prevent TB. It is considered to reduce the spread of *M. Tuberculosis* to the bloodstream, thereby preventing severe, complicated forms of TB, i.e., Miliary TB and TB meningitis. More than a hundred million doses are administered to newborn babies every year. It is widely used, but its efficacy is limited, so there is still a risk of TB infection despite of administration of the BCG vaccination. It focuses on the need for more efficient preventive measures to control the disease¹⁵.

A report of risk factors among 38,788 workers from 59 hospitals in Thailand indicated that healthcare workers face occupational hazards, including psychosocial (13.1%), ergonomic (12.9%), and biological (10.0%) risk factors. Workers are also exposed to other variables that are not reported¹⁶. Needlestick injury (NSI) is not always grave, but it may lead to a serious condition if it is tainted with bodily fluids such as blood or others. For Human Immunodeficiency Virus (HIV), Hepatitis B, and Hepatitis C, the risk of a single encounter with blood contaminated with these viruses is 0.2-0.5%, 6-30%, and 0-7%, respectively. Nurses and nursing students are more prone to Needlestick injuries (NSI)¹⁷. It was reported by the International Labor Organization (ILO) that occupational risk factors caused 1.88 million deaths globally in 2016; diseases accounted for 80.7% of work-related fatalities, and injuries accounted 19.3%. 253,700 occupational injuries or illnesses were registered in hospitals of United States (US)¹⁸. Vaccination before exposure is present only for Hepatitis B Virus (HBV). The only way of protection against these sharp injuries and splash exposure (SISE) is the application of standard safety measures and protocols¹⁹.

All healthcare personnel should be required to participate in health education programs on health and safety issues related to physical dangers to increase their awareness and protect them from potential exposures arising from inadequate understanding and alertness²⁰.

This study aimed to assess the effect of disease

exposure on the well-being of healthcare professionals by examining the prevalence of occupational diseases and the associated risk factors.

METHODOLOGY

This simple random cross-sectional study was carried out from July to October 2025. Health care workers currently working in hospitals in Hyderabad, Jamshoro, Nawabshah, and Umerkot Districts were included in the study. From the 4 Health Districts, 5 hospitals were included in the study: Civil Hospital Hyderabad, LUMHS Hospital Jamshoro, Nimra Cancer Hospital Jamshoro, Civil Hospital Nawabshah & Civil Hospital Umerkot.

The HCWs were selected from different hospitals using the simple random probability sampling technique, and to calculate the sample size, we used the OpenEpi app. While adding data, we used the prevalence of needlestick injuries of 58.2% from research conducted in South Asia (10). According to the OpenEpi app, a total of 264 HCWs were recruited for the study at the 90% confidence level.

The inclusion criteria were health care workers currently employed in healthcare settings, such as doctors, nurses, dentists, and technicians, who had been in close contact with patients and were exposed to biological samples (e.g., blood, urine, saliva) and airborne droplets.

Healthcare workers who refused to participate in the study or were not directly engaged in patient care were excluded. Administrative staff were also excluded.

The data were collected using a self-structured questionnaire. A 27-item structured questionnaire was distributed among the HCWs, which included information on socio-demographic profile (age, gender, professional group, professional experience, etc.), occupational exposure details (i.e. nature of exposure, activity which led to exposure, etc.), Precautionary measures, vaccination status, medical history, family history and information on awareness and attitude regarding PPE and precautionary measures. It was distributed via both an online survey platform (like Google Forms) and in printed format.

Data collected from the questionnaire were entered into Microsoft Excel 2013 and then exported to Statistical Package for Social Sciences (SPSS) version 26.0 software for statistical analysis. Data were collected using the Google Forms platform, where participants' responses were recorded, then exported to Microsoft Excel 2013. The data were coded (cleaned) so they could be arranged for further analysis. After that, descriptive statistics were applied to determine the frequency of variables and the prevalence of occupationally acquired diseases such as Hepatitis B, Hepatitis C, TB, AIDS, and Pneumonia. These results were presented in the form of tables. Chi-square tests were applied to assess associations between risk factors and infection occurrence; p-values less than 0.05 were considered

significant.

Ethical approval was obtained from the Research Ethics Committee, Liaquat University of Medical and Health Sciences, Jamshoro. The data were kept confidential and not disclosed. The data was used solely for research purposes.

RESULTS

A total of 264 Healthcare Workers were interviewed using the questionnaire, including doctors, nurses, dentists and technicians.

Table I shows the socio-demographic characteristics of the health care workers who participated in the study. The ages of HCWs ranged from 22 to 57 years, with a mean age of 28.384 ± 8.1776 years. The highest percentage (53.2%) belonged to the age group (20-25) years, while the lowest percentage (1.5%) belonged to the age group (55-60) years. Females were in the majority (58.7%) while males accounted for 41.3%. As for professional group distribution, doctors were predominant (56.8%), followed by dentists (19.7%), nurses (12.9%), and health technicians (10.6%). Regarding professional experience, the majority (76.9%) of them had less than 10 years of experience. In comparison, 23.1% had more than 10 years of experience. (Table I)

Table I: Socio-demographic Characteristics of Participants (n=264)

| Characteristics | Number (n) | % | |
|-------------------------|---|-----|------|
| Age | 20-25 | 138 | 52.3 |
| | 26-35 | 85 | 32.2 |
| | 36-45 | 26 | 9.8 |
| | 46-55 | 11 | 4.2 |
| | 55-60 | 4 | 1.5 |
| Mean \pm SD | 28.384 ± 8.1776 | | |
| Min-Max | 22 - 57 | | |
| Gender | Male | 109 | 41.3 |
| | Female | 155 | 58.7 |
| Professional group | Doctors | 150 | 56.8 |
| | Nurses | 34 | 12.9 |
| | Health Technicians and Special Ward staff | 28 | 10.6 |
| | Dentists | 52 | 19.7 |
| Professional experience | Less than 10 years | 203 | 76.9 |
| | More than 10 years | 61 | 23.1 |

Table II presents occupational exposure details (nature of exposure, type of exposure, activity leading to exposure, etc.) among healthcare workers. Regarding the source of exposure, blood/blood products had the highest proportion (84.8%), followed by saliva (43.2%), sweat (36%), urine (18.2%), Faeces (11.4%), vaginal secretions (6.4%) and semen (2.7%). Regarding the nature of exposure, the results indicate that the most common nature of exposure

was percutaneous injury (63.3%). In contrast, others reported mucosal contact (24.2%), contact with non-intact skin (24.2%), contact with intact skin (28.8%), and human bite (2.7%). Regarding activities leading to exposure, Injection administration, including recapping of needles (44.3%) and blood withdrawal (42%), were the main activities related to exposure. Other activities leading to exposure were intravenous catheter insertion, surgery in OT, disposal of sharps, laboratory procedures and other medical/surgical procedures. According to the severity of injury, injuries were divided into superficial, moderate and deep. Superficial injuries were most common (54.9%). The most common device involved in exposure was hollow-bore needles (49.6%). Regarding exposure to contaminated air droplets, 39.4% of participants were found to be exposed.

Table II: Occupational Exposure Details and Precautionary Measures Taken

| Occupational Exposure | Number (n) | % | |
|------------------------------------|----------------------------------|-----|------|
| Source of Exposure | Blood/blood products | 224 | 84.8 |
| | Saliva | 114 | 43.2 |
| | Sweat | 95 | 36 |
| | Vaginal secretion | 17 | 6.4 |
| | Semen | 7 | 2.7 |
| | Urine | 48 | 18.2 |
| | Faeces | 30 | 11.4 |
| | Not exposed | 28 | 10.6 |
| Nature of exposure | Percutaneous injury | 167 | 63.3 |
| | Mucosal contact | 64 | 24.2 |
| | Contact with non-intact skin | 64 | 24.2 |
| | Contact with intact skin | 76 | 28.8 |
| | Human bite | 7 | 2.7 |
| | Not applicable | 29 | 11 |
| An activity that leads to exposure | Blood withdrawal | 111 | 42 |
| | Intravenous catheter insertion | 56 | 21.2 |
| | Surgery in the operating theatre | 58 | 22 |
| | Injection | 117 | 44.3 |
| | Other medical procedures | 95 | 36 |
| | Disposal of sharps | 41 | 15.5 |
| | Laboratory procedures | 13 | 4.9 |
| | Not applicable | 28 | 10.6 |
| Severity of injury | Superficial | 145 | 54.9 |
| | Moderate | 43 | 16.3 |
| | Deep | 10 | 3.8 |
| | Not applicable | 66 | 25 |

| | | | |
|---|--------------------|-----|------|
| The technical device involved in exposure | Hollow-bore needle | 131 | 49.6 |
| | Scalpel/blade | 72 | 27.3 |
| | Suture needle | 51 | 19.3 |
| | Lancet | 33 | 12.5 |
| | Dental Instruments | 36 | 13.6 |
| Exposure to air droplets | Not applicable | 51 | 19.3 |
| | Exposed | 104 | 39.4 |
| | Not exposed | 160 | 60.6 |

Table III demonstrates the precautionary measures taken by the healthcare workers and also their vaccination status. Most of the participants claimed that they used latex gloves (87.1%), while non-latex gloves were used by 38.6% of the participants. A very high percentage of participants reported using face masks (95.1%) during patient care. The use of goggles or glasses was reported at 37.9%. Most participants (83.7%) reported washing the contact area immediately after contact with the patient. Only 7.6% of participants reported taking no precautions at all. Regarding hand washing and sanitizing after contact with the patient, 91.7% were observed to follow safety protocols.

Regarding vaccination status, hepatitis B vaccination was done by 36.4%, tuberculosis vaccination by 9.5%, and pneumonia vaccination by 29.5% of healthcare workers. 37.9% of participants had received both HBV and TB vaccines; however, 16.3% of participants received no vaccination at all against infectious

Table III: Precautionary Measures and Vaccination Status

| Precautions | Number (n) | % | |
|--|-----------------------------------|-----|------|
| Application of Precautionary Measures | Latex gloves | 230 | 87.1 |
| | Non latex gloves | 102 | 38.6 |
| | Goggles/glasses | 100 | 37.9 |
| | Face mask | 251 | 95.1 |
| | Gown | 121 | 45.8 |
| | Apron | 160 | 60.6 |
| | Wash the contact area immediately | 221 | 83.7 |
| Sanitizing/ washing hands after contact with the patient | No precautions taken | 20 | 7.6 |
| | Yes | 242 | 91.7 |
| Vaccination status | No | 22 | 8.3 |
| | Hepatitis B vaccine | 96 | 36.4 |
| | Tuberculosis vaccine | 25 | 9.5 |
| | HBV and TB vaccine | 100 | 37.9 |
| | Pneumonia vaccine | 78 | 29.5 |
| Doses of HBV vaccine administered | Not Vaccinated | 43 | 16.3 |
| | Single dose | 67 | 25.4 |
| | Double dose | 77 | 29.2 |
| | Triple dose | 63 | 23.9 |
| | Zero | 57 | 21.6 |

diseases. Among those who received the HBV vaccine, 25.4% of participants reported receiving a single dose, 29.2% a double dose, and 23.9% a triple dose, whereas 21.6% had not received any dose at all. (Table III)

Table IV presents data and facts related to the participants' family and personal medical histories. In the reported family history of these diseases, hepatitis C was the most common (9.5%), followed by hepatitis B (8%), Tuberculosis (7.5%), pneumonia (6.8%), and AIDS (0.8%).

Regarding personal medical history, 3.4% of the participants were diagnosed with Hepatitis B, 1.5% with hepatitis C, 1.1% with AIDS, 3.8% with TB, and 8% with pneumonia at least once in their lives. Regarding blood transfusion history, 14.4% of participants reported receiving a blood transfusion, while 85.6% had not. Regarding smoking habits, 7.2% of HCWs were smokers, however 92.8% were non-smokers. Among smokers, 2.7% said they smoked once daily, 1.9% reported smoking twice in a day and 0.4% smoked thrice in a day. Regarding the laboratory tests, 17% were tested for TB, and 6.4% were tested for AIDS. (Table IV)

Table IV: Medical history and Family history of the participants

| Family History | Number (n) | % | |
|--|-------------------------|-----|------|
| Diseases running in the family | Hepatitis B | 21 | 8 |
| | Hepatitis C | 25 | 9.5 |
| | Tuberculosis | 20 | 7.5 |
| | AIDS | 20 | 0.8 |
| | Pneumonia | 18 | 6.8 |
| Medical history | | | |
| Diagnosed with any disease recently or in the past | Hepatitis B | 9 | 3.4 |
| | Hepatitis C | 4 | 1.5 |
| | AIDS | 3 | 1.1 |
| | Tuberculosis | 10 | 3.8 |
| | Pneumonia | 21 | 8.0 |
| Ever been transfused blood | Yes | 38 | 14.4 |
| | No | 226 | 85.6 |
| Smoker/non-smoker | Smoker | 19 | 7.2 |
| | Non-smoker | 245 | 92.8 |
| How many times do you smoke in a day | Once | 7 | 2.7 |
| | Twice | 5 | 1.9 |
| | Thrice | 1 | 0.4 |
| | Multiple times in a day | 6 | 2.3 |
| | Doesn't smoke | 245 | 92.8 |
| Ever tested for TB | Yes | 45 | 17 |
| | No | 219 | 83 |
| Ever tested for AIDS | Yes | 17 | 6.4 |
| | No | 247 | 93.6 |

Table V reveals the association between occupationally acquired infections and various risk

factors, including Profession, gender, years of experience, and exposure type. A statistically significant association was found between infection and Profession ($X^2 = 15.836$, p -value = 0.001), with higher infection rates among doctors and health technicians than among other groups.

Similarly, gender showed a strong relationship with infection ($X^2 = 17.821$, p -value < 0.001), with male participants more often infected than females. No significant association was found between infection and years of experience ($X^2=0.425$, p -value = 0.515). However, infection was significantly associated with saliva exposure ($X^2=10.325$, p -value=0.001) and sweat exposure ($X^2=7.300$, p -value=0.007). The association of blood or blood product exposure with infection was not significant. Similar to that, no significant association was found with vaginal secretion exposure ($X^2=0.997$, $p=0.318$), semen exposure ($X^2=1.264$, $p=0.268$), urine exposure ($X^2=2.263$, $p=0.132$) or Faeces exposure ($X^2=1.006$, $p=0.316$). The nature of exposure, including percutaneous injury ($X^2=1.568$, $p=0.210$) and mucosal contact ($X^2=1.508$, $p=0.310$), did not show a statistically strong association with infection. These results indicate that some exposure types, such as sweat and saliva exposure, may lead to these infectious diseases. In contrast, others, such as mucosal or blood exposure, showed no meaningful or strong association in this study population.

Regarding preventive practices, the use of latex gloves ($X^2=1.399$, $p=0.237$), non-latex gloves ($X^2=0.222$, $p=0.637$), and gowns ($X^2=0.486$, $p=0.486$), showed no significant association, however, the use of goggles or glasses ($X^2=4.833$, $p=0.028$) and aprons ($X^2=9.682$, $p=0.002$) showed statistically significant association, showing that these measures have an important role in decreasing occupational exposure risk. (Table V)

DISCUSSION

The occupational activities of healthcare workers and the implementation of effective health protection measures against harmful occupational exposures represent significant challenges for the healthcare system²¹. This study provides a comprehensive cross-sectional assessment of occupational health risks among healthcare professionals in multiple hospitals in Pakistan. The mean age was 28 years; they were primarily female (58.7%) and worked as doctors (56.8%).

We found blood (84.8%) to be the most common biological material encountered, with percutaneous injury, particularly needlestick injury, as the most common cause (63.3%). Our study aligns with the results of study²², which indicated that the one-year global pooled prevalence of NSIs among HCWs was 44.5%.

Recapping of used needles (44.3%) was frequently cited as the activity leading to such incidents, whereas in a study by Mian N et al.²³ recapping of needles was

Table V: Association between Acquired Infection and Risk Factors, including Profession, gender, and years of experience

| Variables | Categories | Infected | Not infected | Total | Chi-square | df | p-value |
|--------------------------------------|--------------------|-----------|--------------|------------|-------------------------------|----------|------------------|
| Profession | Doctors | 19 | 131 | 150 | | | |
| | Nurses | 9 | 25 | 34 | | | |
| | Dentists | 1 | 51 | 52 | | | |
| | Health technicians | 8 | 20 | 28 | | | |
| | Total | 37 | 227 | 264 | X² = 15.836 | 3 | 0.001 |
| Gender | Male | 27 | 82 | 109 | | | |
| | Female | 10 | 145 | 155 | | | |
| | Total | 37 | 227 | 264 | X² = 17.821 | 1 | <0.001 |
| Years of Experience | Less than 10 years | 30 | 173 | 203 | | | |
| | More than 10 years | 7 | 54 | 61 | | | |
| | Total | 37 | 227 | 264 | X² = 0.425 | 1 | 0.515 |
| Blood/blood products exposure | Yes | 28 | 196 | 224 | | | |
| | No | 8 | 31 | 39 | X² = 1.805 | 1 | 0.179 |
| Saliva exposure | Yes | 7 | 107 | 114 | | | |
| | No | 30 | 120 | 150 | X² = 10.325 | 1 | 0.001 |
| Sweat exposure | Yes | 6 | 89 | 95 | | | |
| | No | 31 | 138 | 169 | X² = 7.300 | 1 | 0.007 |
| Vaginal secretions exposure | Yes | 1 | 16 | 17 | | | |
| | No | 36 | 211 | 247 | X² = 0.997 | 1 | 0.318 |
| Semen exposure | Yes | 2 | 5 | 7 | | | |
| | No | 35 | 222 | 257 | X² = 1.264 | 1 | 0.261 |
| Urine exposure | Yes | 10 | 38 | 48 | | | |
| | No | 27 | 189 | 216 | X² = 2.263 | 1 | 0.132 |
| Faeces exposure | Yes | 6 | 24 | 30 | | | |
| | No | 31 | 203 | 234 | X² = 1.006 | 1 | 0.316 |
| Nature of exposure | | | | | | | |
| Percutaneous injury | Yes | 20 | 147 | 167 | | | |
| | No | 17 | 80 | 97 | X² = 1.568 | 1 | 0.210 |
| Mucosal contact | Yes | 6 | 58 | 64 | | | |
| | No | 31 | 169 | 200 | X² = 1.509 | 1 | 0.219 |
| Contact with non-intact skin | Yes | 7 | 57 | 64 | | | |
| | No | 30 | 170 | 200 | X² = 0.664 | 1 | 0.415 |
| Contact with intact skin | Yes | 7 | 69 | 76 | | | |
| | No | 30 | 158 | 188 | X² = 2.044 | 1 | 0.153 |
| Human bite | Yes | 3 | 4 | 7 | | | |
| | No | 34 | 223 | 257 | X² = 4.964 | 1 | 0.026 |
| Precautions taken | | | | | | | |
| Latex gloves | Yes | 30 | 200 | 230 | | | |
| | No | 7 | 27 | 34 | X² = 1.399 | 1 | 0.237 |
| Non-latex gloves | Yes | 13 | 89 | 102 | | | |
| | No | 24 | 138 | 162 | X² = 0.222 | 1 | 0.637 |

| | | | | | | | |
|-----------------------------------|--|-----------|------------|------------|----------------|---|--------------|
| Goggles/glasses | Yes | 8 | 92 | 100 | | | |
| | No | 29 | 135 | 164 | $X^2 = 4.833$ | 1 | 0.028 |
| Face masks | Yes | 36 | 215 | 251 | | | |
| | No | 1 | 12 | 13 | $X^2 = 0.454$ | 1 | 0.501 |
| Gown | Yes | 15 | 106 | 121 | | | |
| | No | 22 | 121 | 143 | $X^2 = 0.486$ | 1 | 0.486 |
| Apron | Yes | 31 | 129 | 160 | | | |
| | No | 6 | 98 | 104 | $X^2 = 9.682$ | 1 | 0.002 |
| Wash the contact area immediately | Yes | 30 | 191 | 221 | | | |
| | No | 7 | 36 | 43 | $X^2 = 0.218$ | 1 | 0.640 |
| Vaccination status | Vaccinated against Hepatitis B | 10 | 86 | 96 | | | |
| | Vaccinated against TB | 9 | 16 | 25 | | | |
| | Vaccinated against both TB and Hepatitis B | 15 | 85 | 100 | | | |
| | Not vaccinated | 3 | 40 | 43 | | | |
| | Total | 37 | 227 | 264 | $X^2 = 3.326$ | 1 | 0.068 |
| Awareness and training | Yes | 27 | 193 | 220 | | | |
| | No | 10 | 34 | 44 | | | |
| | Total | 37 | 227 | 264 | $X^2 = 12.907$ | 3 | 0.005 |

reported to be a practice among 88.30% of those injured. Hollow-bore needles (49.6%) were the predominant devices implicated in these exposures, consistent with previous literature²⁴, which highlights their high risk of transmitting blood-borne pathogens. The large proportion of respondents with less than 10 years of professional experience further highlights the vulnerability of early-career healthcare workers and trainees, who may have less procedural experience and limited formal training in occupational safety. Healthcare workers are routinely exposed to numerous occupational hazards due to the unique nature of their work. Hence, the preventive coping strategies were assessed in this study. Our study revealed that most respondents (95.1%) wore facemasks and (87.1%) latex gloves during clinical procedures. 83.7% of them claim to wash their hands before and after patient care. A study among operating room staff in Mardan reported similar findings²⁵.

The present study revealed that most healthcare workers had received vaccination against Hepatitis B and Tuberculosis (Hep B 36.4%, TB 9.5%, both 37.9%, none 16.3%), out of which only 23.9% are fully vaccinated for Hepatitis B, which is below that of a study conducted in Sindh, which had a complete vaccination status of 70%²⁶. Moreover, only 29.5% were vaccinated against pneumonia, compared with 43.1% reported in a study in China²⁷. 7.2% of our respondents have revealed their smoking habit, which is low as compared to 24.7% reported by a study in Italy²⁸, but comparable with 7.5% in Vietnam²⁹, 83.3% were educated about the preventive practices of Hep B, C, HIV, TB, and Pneumonia, comparable to 87.7%

among nurses in Rawalpindi³⁰.

This study's major strength lies in its comprehensive approach, combining exposure patterns, vaccination coverage, and preventive practices across multiple healthcare professions. The inclusion of diverse professional groups—doctors, dentists, nurses, technicians, and students allowed meaningful comparisons and identification of specific at-risk categories. Moreover, the use of statistical association testing enhanced the analytical depth, providing evidence of significant inter-professional differences. Its findings offer direct, actionable insights for institutional policy-making and serve as a valuable national reference for improving healthcare worker safety in Pakistan.

Limitations

Firstly, the data were self-reported, introducing recall and reporting biases. Respondents may have under- or overestimated their exposures and vaccination histories. Secondly, certain multi-response questions, such as those on specimen exposure and PPE, were formatted as multiple selections, which prevented precise quantification of exclusive categories. Thirdly, the study population, though diverse, may not fully represent all healthcare institutions across the country. Finally, serological confirmation of vaccination and exposure outcomes was beyond the study scope; therefore, all vaccination data reflect self-reported coverage rather than verified immunity.

CONCLUSION

This study reveals that occupational exposure to infectious agents is alarmingly common among healthcare professionals, with blood being the

predominant exposure medium. Despite reasonable hepatitis B vaccination coverage, significant gaps remain in full immunization and consistent PPE use, particularly among non-physician cadres. These findings demonstrate that, while in place, existing infection control practices are neither adequately enforced nor standardized. The data strongly suggest that healthcare institutions must transition from awareness-based approaches to structured, policy-driven occupational health systems. Comprehensive vaccination documentation, strict monitoring of PPE compliance, and routine health surveillance are essential to reduce occupational risk. By implementing these measures, institutions can create safer clinical environments and set a precedent for occupational safety practices nationally.

Ultimately, the results of this study serve as a call to action to protect those who protect others, ensuring that healthcare workers in Pakistan can perform their duties in environments that are both safe and sustainable.

The findings of this study highlight the urgent need for structured occupational health programs within healthcare institutions. Mandatory vaccination policies, particularly for hepatitis B, should be enforced with proper record-keeping and periodic verification of immunity. Regular infection control training, PPE compliance monitoring, and standardized exposure-reporting systems are essential to reduce preventable risks. These results also call for national policy reforms to strengthen occupational safety frameworks for healthcare workers. Future research should focus on evaluating the effectiveness of institutional interventions, expanding surveillance systems, and integrating infection prevention modules into medical and nursing education to ensure long-term sustainability.

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AUTHOR CONTRIBUTION

Jamali I: Data analysis

Rahimoon ZN: Introduction

Tariq H: Methodology

Meghna: Abstract, data collection

Janzuhera: Data collection, references

Ahmed FS: Discussion, conclusion

Shah GM: Supervising research

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