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Prevalence, Vaccination Coverage, and Occupational Risk Factors for Hepatitis B and C Infections among Laboratory Health Workers at the Central Pediatric Teaching Hospital in Baghdad, Iraq

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ABSTRACT

Background: Hepatitis B and C infections represent critical occupational hazards for healthcare personnel, particularly among laboratory workers. Although HBV is preventable with vaccination, uptake remains inadequate in many low- and middle-income settings, while the absence of Hepatitis C virus (HCV) vaccine further complicates prevention efforts. This study aimed to determine the prevalence of Hepatitis B virus (HBV) and HCV among laboratory staff in Baghdad, assess vaccination coverage, and identify occupational risk factors to inform future safety protocols and policy reforms.

Methods: This study conducted as a five-year retrospective cohort study at the Central Pediatric Teaching Hospital in Baghdad (January 2019–December 2024), data were collected from 242 laboratory workers (93.1% response rate) via medical record reviews and structured questionnaires. Information regarding demographics, vaccination history, occupational exposures, bloodborne pathogen awareness, and personal medical background was compiled. Statistical analyses using SPSS, including descriptive and bivariate methods, were performed to identify factors associated with HBV and HCV infections.

Results: Among the 243 workers evaluated, most were female (83.1%) with a mean age of 32 years, and 81.5% were laboratory technicians; 64.6% reported direct patient contact. While 87.7% were knowledgeable about hepatitis transmission, 9.1% had inadequate training. Hepatitis B vaccination was reported by 73.3% of workers, but only 39.5% completed the full three-dose regimen, and merely 28.1% demonstrated serological immunity. Of 82 individuals reporting needlestick injuries, only 36.6% received post-exposure prophylaxis. Infection rates among participants who underwent serological testing were 2% for HBV and 9.4% for HCV. All HBV cases were among unvaccinated workers, and needlestick injuries were significantly linked to HBV infection ($p = 0.012$).

Conclusions: The study reveals gaps in HBV/HCV vaccination, immunity testing, and safety protocols among lab workers, stressing the need for mandatory vaccination, serological monitoring, and enhanced training to reduce infection risks.

Keywords: *Hepatitis B, Hepatitis C, Vaccination, Occupational Risks, Laboratory Workers.*

1. INTRODUCTION

Hepatitis B virus (HBV) and hepatitis C virus (HCV) infections remain critical occupational health threats for healthcare workers (HCWs), particularly those handling blood and bodily fluids, such as laboratory personnel. Globally, an estimated 3.5% of HCWs experience at least one needlestick injury annually, significantly elevating their risk of bloodborne pathogen exposure [1]. HBV, preventable through vaccination, continues to cause approximately 820,000 deaths yearly, primarily from cirrhosis and hepatocellular carcinoma [2]. Despite the availability of a safe and effective vaccine since 1982, HBV vaccination coverage among HCWs in low- and middle-income countries (LMICs) remains suboptimal, with rates as low as 18–39% in regions like sub-Saharan Africa and the Middle East [3]. In contrast, high-income countries report coverage exceeding 90%, underscoring disparities in healthcare infrastructure and occupational safety protocols [4].

HCV, lacking a vaccine, poses an additional challenge, with 58 million chronic infections globally [5]. Laboratory workers in pediatric settings face unique risks, including frequent handling of pediatric samples, which may involve larger volumes of blood or unconventional collection methods, increasing exposure likelihood. In Iraq, decades of conflict, economic sanctions, and underfunded healthcare systems have exacerbated occupational hazards.A 2023 report highlighted that only 54% of Iraqi HCWs reported complete HBV vaccination, with laboratory staff often overlooked in safety initiatives [6]. The Central Pediatric Teaching Hospital in Baghdad, serving high patient volumes, may face compounded risks due to resource constraints, inadequate training, and inconsistent access to personal protective equipment (PPE).

The consequences of HBV/HCV infections among HCWs extend beyond individual health, affecting workforce retention, healthcare costs, and patient safety. Post-exposure prophylaxis (PEP) for HBV, though effective, is underutilized in LMICs due to poor awareness and logistical barriers [7]. Furthermore, underreporting of occupational exposures remains prevalent, driven by stigma, lack of reporting mechanisms, and fear of professional repercussions [8]. Addressing these challenges requires context-specific data to inform targeted interventions, particularly in settings like Iraq, where political instability has disrupted healthcare delivery.

Recent studies emphasize the persistent risk of HBV/HCV among laboratory workers.A 2021 meta-analysis found HBV seroprevalence in HCWs to be 8.3% in LMICs, nearly double that of the general population [9]. Research in neighboring Jordan revealed 62% HBV vaccination coverage among HCWs, with lower rates in non-clinical staff [10]. Conversely, a 2023 study in Egypt identified HCV prevalence of 6.9% among laboratory personnel, linked to inadequate PPE use [11].

Occupational risk factors, including needlestick injuries, improper waste disposal, and prolonged shifts, are well-documented [12]. However, data specific to pediatric laboratories are scarce. A 2020 study in India noted that pediatric phlebotomists experienced 30% more needlesticks than adult-focused counterparts, attributed to child movement and smaller veins [13]. Despite WHO recommendations for routine HBV vaccination, implementation gaps persist. For instance, a 2022 survey in Pakistan found only 34% of laboratories had mandatory vaccination policies [14]. In Iraq, existing research focuses broadly on HCWs, neglecting laboratory-specific challenges [6].

Limited data exist on HBV/HCV prevalence, vaccination coverage, and occupational risks among laboratory workers in Iraqi pediatric settings. Previous studies aggregate HCWs without disaggregating roles or fail to address contextual barriers like resource limitations and political instability. This study addresses this gap by focusing on a high-risk, understudied subgroup. Protecting laboratory workers is vital for sustaining healthcare systems, particularly in high-burden regions. This study provides evidence to guide vaccination campaigns, safety protocols, and policy reforms in Baghdad, potentially reducing transmission and strengthening occupational health frameworks.

Research Objectives

1. Assess the prevalence of HBV and HCV infections among laboratory health workers at the Central Pediatric Teaching Hospital in Baghdad, considering exposure and vaccination status over five years.
2. Evaluate Hepatitis B vaccination coverage, completion rates, and post-vaccination immunity, identifying factors contributing to incomplete vaccination and lack of seroconversion.
3. Analyze occupational risk factors for HBV and HCV, including needlestick injuries, PPE use, and post-exposure prophylaxis, highlighting gaps in infection control.

2. METHODOLOGY

This five-year retrospective cohort study was conducted at the Central Pediatric Teaching Hospital within the Baghdad Al-Karkh Health Directorate, Iraq.The primary objective was to evaluate the prevalence of HBV and HCV infections, assess HBV vaccination coverage, and examine the occupational risk factors affecting laboratory health workers. The study took place at one of the largest healthcare facilities in Baghdad, providing specialized care to a diverse pediatric population. The hospital's high-volume clinical environment offered a unique opportunity to study the occupational health risks faced by laboratory workers, who are frequently exposed to blood and bodily fluids. The research spanned from January

2019 to December 2024, with data sourced from hospital records and serological testing to assess infection rates, vaccination status, and occupational risk factors.

The study population consisted of laboratory health workers, including doctors, bacteriologists, lab technicians, technologists, and support staff employed in various laboratory departments of the Central Pediatric Teaching Hospital in Baghdad during the study period. These workers were at high risk of exposure to HBV and HCV due to their involvement in handling blood and bodily fluids. Inclusion criteria required that workers were employed during the study period, provided written informed consent, and had available medical or serological data from the past five years. Exclusion criteria included workers not directly involved in handling blood or bodily fluids, those with inaccessible medical or serological records, workers employed for less than six months, and individuals who did not provide consent for participation.

A total of 242 responses were obtained from 260 eligible laboratory workers, yielding a response rate of 93.1%. This high response rate ensured that the sample adequately represented the laboratory workforce, providing sufficient power to assess the study's objectives and address the occupational health risks associated with bloodborne pathogen exposure, vaccination coverage, and related risk factors within this high-risk group. The study employed a non-probability census sampling method, including all eligible laboratory health workers who met the inclusion criteria, provided informed consent, and had available medical or serological records from the past five years.

Data collection involved a retrospective review of medical records and serological results, supplemented by a structured questionnaire adapted from the World Health Organization's bloodborne pathogen surveillance guidelines. The questionnaire encompassed five sections: demographic information (age, gender, occupation, department, duration of employment, patient contact), hepatitis B vaccination status (doses received, dates, anti-HBs test results), occupational exposure and risk factors (needlestick incidents, PPE use, post-exposure prophylaxis), knowledge and awareness (e.g., transmission modes, infection control training), and medical history and testing (HBsAg/HCV test results, treatment history). Serological testing results were validated using ELISA kits approved by the Iraqi Ministry of Health. The validity of the questionnaire was established through pilot testing (Cronbach's α=0.89), and its reliability was confirmed through independent data entry with 95% inter-rater agreement.

Ethical approval was obtained from the Institutional Review Board of the Baghdad Al-Karkh Health Directorate and the Central Pediatric Teaching Hospital.Patient confidentiality was strictly maintained, and all data were anonymized for research purposes. Informed consent was not required for this retrospective study, as the data was collected in an anonymized form. Data were entered into a secure database and analyzed using SPSS (version 26). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were employed to summarize the demographic characteristics, infection rates, vaccination coverage, and occupational risk factors. Bivariate analyses, such as chi-square and Fisher's exact tests, were used to compare infection rates across age, gender, service length, PPE adherence, and vaccination status. A significance level of $p < 0.05$ was applied for all statistical analyses.

3. RESULTS

Table (1) presents the demographic and employment characteristics of the study participants (N = 243). The mean age of participants was 32 ± 10 years, ranging from 22 to 62 years, with the majority (63.4%) aged between 22 and 31 years. Female participants constituted a significant majority (83.1%), while males comprised only 16.9%. The predominant job role was laboratory technician (81.5%), followed by bacteriologists and chemists (13.6%), with doctors making up the smallest group (4.9%). In terms of workplace distribution, the highest proportion worked in technical labs (31.7%), followed by blood bank labs (23.0%) and emergency labs (10.3%), whereas the least represented were chemistry labs (2.1%) and endocrine & hormonal labs (3.3%). The mean duration of employment was 6.4 ± 7.2 years, with a range of 1 to 35 years; a significant proportion (37.4%) had 1–2 years of experience, while only 14.8% had been employed for over 11 years. Regarding occupational exposure, 64.6% of participants reported direct contact with patients, highlighting a potential risk factor for hepatitis B and C transmission. These findings provide critical insights into the workforce composition and occupational exposure of laboratory health workers, emphasizing the need for targeted vaccination and infection control measures.

Table 1: Demographic and Employment Characteristics of Study Participants (N = 243)

Variable		Frequency	%
Age (years)	**Mean ±SD (Min-Max) 32 ±10 (22- 62)**		
22- 31		154	63.4
32- 41		46	18.9
42- 51		22	9.1
52- 61+		21	8.6
Sex			
Male		41	16.9
Female		202	83.1
Job roles			
Lab technician		198	81.5

Bacteriologist, chemist	33	13.6
Doctor	12	4.9
Workplace		
Technical lab	77	31.7
Bacteriology & microbiology lab	8	3.3
hematology lab	17	7.0
Immunology & viral lab	11	4.5
Endocrine & hormonal lab	8	3.3
Chemistry lab	5	2.1
Blood bank lab	56	23.0
Consultant clinics lab	15	6.2
Emergency lab	25	10.3
blood draw lab	21	8.6
Years of employments Mean ±SD (Min- Max) 6.4 ±7.2 (1- 35)		
1- 2	91	37.4
3- 4	56	23.0
5- 6	42	17.3
7- 8	9	3.7
9- 10	9	3.7
11+	36	14.8
Direct contact with patients		
Yes	157	64.6
No	86	35.4

Table (2) reveals a high level of awareness and training among laboratory health workers at the Central Pediatric Teaching Hospital. The majority (87.7%) demonstrated awareness of hepatitis virus transmission, while 12.3% lacked this knowledge. Similarly, 88.5% of participants recognized hepatitis symptoms, with only 11.5% reporting a lack of knowledge in this area. Awareness of the needlestick injury and bloodborne pathogen policy was notably high, with 90.9% acknowledging its existence, leaving 9.1% unaware. The same proportion (90.9%) had received training in workplace infection control, while 9.1% had not undergone such training. These findings underscore a generally strong understanding of hepatitis-related risks and infection control measures among laboratory health workers, yet they highlight the need to address gaps in knowledge and training among the minority who remain unaware.

Table 2: Knowledge, Awareness, and Training in Hepatitis Infection Control among Study Participants (N = 243)

Variable	Frequency	%
Awareness of Hepatitis virus transmission		
Yes	213	87.7
No	30	12.3
Knowledge of Hepatitis symptoms		
Yes	215	88.5
No	28	11.5
Awareness of needlestick & bloodborne pathogen policy		
Yes	221	90.9
No	22	9.1
Trained in workplace infection control		
Yes	221	90.9
No	22	9.1

Figure (1) and Table (3) presents the hepatitis B vaccination status and anti-HBs serological testing results among the study participants (N = 243). The findings reveal that 178 individuals (73.3%) reported receiving the hepatitis B vaccine, while 65 (26.7%) remained unvaccinated. Among those vaccinated, only 96 participants (39.5%) completed the full three-dose regimen, whereas 65 (26.7%) received two doses, and 17 (7.0%) received only one dose. Regarding the timing of the last hepatitis B vaccination, 99 participants (40.7%) received their last dose more than two years ago, 42 (17.3%) within the last year, and 37 (15.2%) in the past six months. Notably, post-vaccination anti-HBs testing was performed in 96 participants (39.5%), while 82 (33.7%) did not undergo testing despite being vaccinated. Among those tested, only 27 individuals (28.1%) demonstrated immunity (anti-HBs positive), whereas 69 (71.9%) remained non-immune despite prior vaccination. These findings indicate gaps in vaccination coverage, incomplete vaccination schedules, and insufficient post-vaccination serological testing among laboratory health workers, highlighting potential occupational risks for hepatitis B infection.

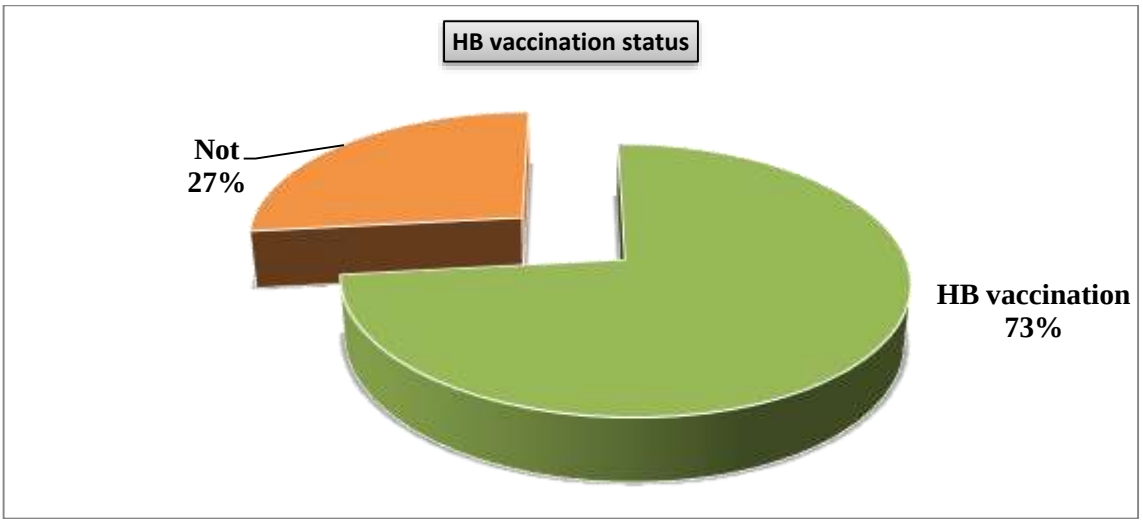

Figure 1: Hepatitis B vaccination status among study participants

Table 3: Hepatitis B Vaccination Status and Anti-HBs Serological Testing Among Study Participants (N = 243)

Variable	Frequency	%
Hepatitis B vaccination Status		
Yes	178	73.3
No	65	26.7
Doses of hepatitis B vaccination		
No vaccination	65	26.7
One dose	17	7.0
Two doses	65	26.7
Three doses	96	39.5
Date of last hepatitis B vaccination		
No vaccination	65	26.7
Last 6 months	37	15.2
Last one year	42	17.3
More two years	99	40.7
Anti-HBs test after vaccination		
Yes	96	39.5
No	82	33.7
No vaccination	65	26.7
Results of anti-HBs test (N= 96)		
Positive (immune)	27	28.1
Negative (not immune)	69	71.9

Table (4) presents data on occupational exposure to needlestick injuries, PEP, and personal protective equipment (PPE) usage among laboratory health workers at the Central Pediatric Teaching Hospital in Baghdad over a five-year period. Among the 243 participants, 82 (33.7%) reported experiencing needlestick or sharps exposure, while the majority, 161 (66.3%), had no such incidents. Regarding the frequency of exposure, 41 (16.9%) were exposed once, 20 (8.2%) twice, 9 (3.7%) three times, and 6 (2.5%) four times, with another 6 (2.5%) experiencing five or more incidents. Notably, among those exposed (N = 82), only 30 (36.6%) received PEP, whereas the majority, 52 (63.4%), did not undergo prophylactic treatment, highlighting a critical gap in post-exposure management. These findings underscore the occupational risks faced by laboratory personnel and indicate the need for enhanced preventive measures, strict adherence to PPE usage, and improved post-exposure response protocols to mitigate the risk of hepatitis B and C infections in healthcare settings.

Table 4: Occupational Exposure to Needlestick Injuries, Prophylaxis, and Personal Protective Equipment Usage among Study Participants (N = 243)

Variable	Frequency	%
Needlestick or sharps exposure at work		
Yes	82	33.7
No	161	66.3
Times of exposure in the past 5 years		
Not exposure	161	66.3
One time	41	16.9
Two times	20	8.2
Three times	9	3.7
Four times	6	2.5
Five and more	6	2.5
PEP prophylaxis after exposure (N= 82)		
Yes	30	36.6
No	52	63.4

Figure (2, 3) investigate the findings of serological testing and treatment outcomes for Hepatitis B and C among the study participants (N = 243). Hepatitis B surface antigen (HBsAg) testing was performed in 148 individuals (60.9%), while 95 (39.1%) were not tested. Among those tested, only 3 participants (2%) were found positive for HBV infection, whereas 145 (98%) tested negative. All HBV-infected individuals received treatment (serum or immunoglobulin). Regarding Hepatitis C, 160 participants (65.8%) underwent testing, whereas 83 (34.2%) did not. Of those tested, 15 participants (9.4%) were diagnosed with HCV infection and subsequently received treatment, while 145 (90.6%) tested negative. Treatment for HCV was administered to all infected individuals using Sofosbuvir, Ribavirin, Interferon, or Ledifos. These findings highlight gaps in routine serological screening among laboratory health workers and indicate a relatively low prevalence of HBV and HCV infections in this setting, though vigilance in occupational risk mitigation and vaccination remains essential.

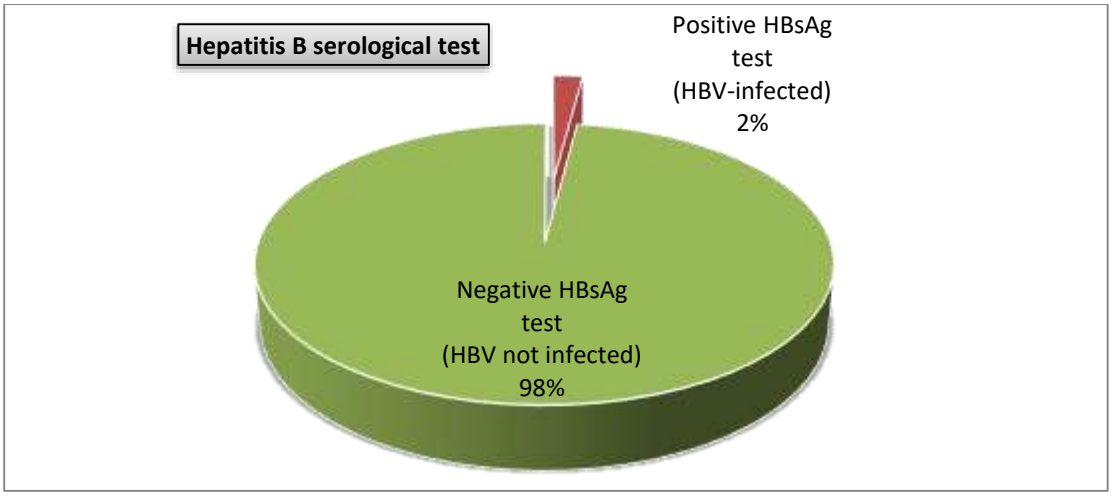

Figure 2: Prevalence of HBV infection among serological testing participants (N=148)

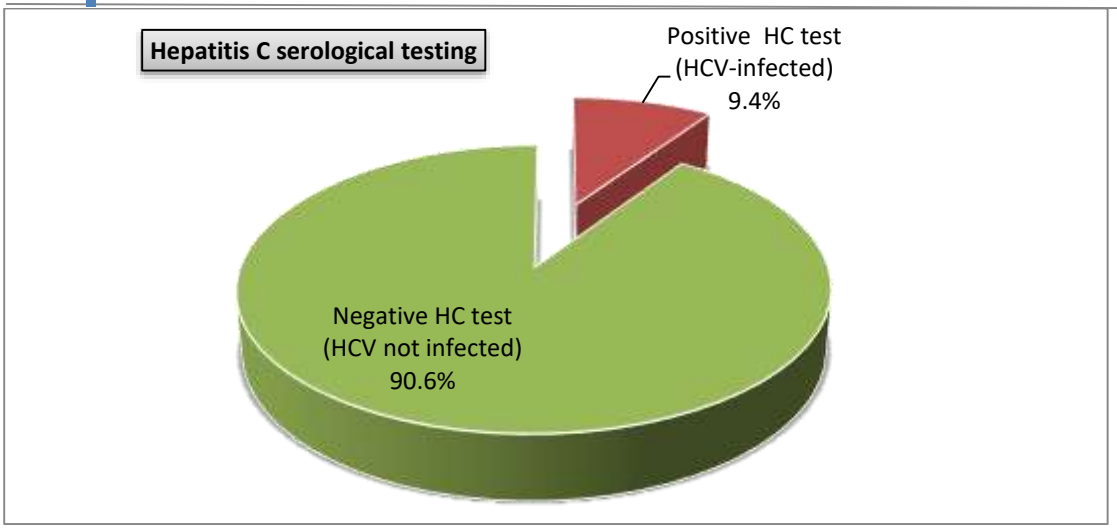

Figure 3: Prevalence of HCV infection among serological testing participants (N=160)

Table (5) presents the association between occupational and behavioral risk factors and HBV infection among serological testing laboratory health workers (148). The overall prevalence of HBV infection was low, with only 3 cases (2.0%). Age did not show a significant association with HBV infection (p=0.810), as all cases were among younger participants (22-31 years). Gender also showed no significant relationship (p=0.615), with infections observed only in females (2.5%). Job roles were not significantly associated (p=0.656), as infections occurred exclusively among lab technicians (2.6%). Work setting showed no statistical significance (p=0.761), though infections were more frequent in technical labs (3.8%) and blood draw labs (8.3%). Years of employment did not significantly impact HBV prevalence (p=0.455), though cases were found in those with 1-4 years of experience. Direct patient contact was not significantly associated (p=0.324), with cases occurring among those with patient exposure (3.1%). However, hepatitis B vaccination status showed a notable trend, as all infections occurred in unvaccinated workers (10.4%), but this was not statistically significant (p=0.174). A significant association was observed between HBV infection and needlestick or sharps exposure at work (p=0.029), with a higher infection rate (5.2%) among exposed individuals. Additionally, HBV infection was significantly associated with the number of exposures in the past five years (p=0.033), particularly among those exposed twice (13.3%). PEP use was also significant (p=0.020), with infections occurring only in those who did not receive PEP (8.3%). These findings highlight the importance of vaccination, adherence to safety protocols, and PEP utilization in preventing HBV infection among laboratory workers.

Table 5: Association Between Occupational and Behavioral Risk Factors and HBV Infection among Serological Testing Study Participants (N=148)

Variables	HBV infection		Total	P-value
	Yes	No		
	3 (2.0)	145 (98.0)	148 (100.0)	
Age (years)				
22- 31	3 (3.3)	89 (96.7)	92 (62.2)	0.810
32 & above	0 (0.0)	56 (100.0)	56 (37.8)	
Sex				
Male	0 (0.0)	29 (100.0)	29 (19.6)	0.615
Female	3 (2.5)	116 (97.5)	119 (80.4)	
Job roles				
Lab technician	3 (2.6)	113 (97.4)	116 (78.4)	0.656
Doctor, Bacteriologist, chemist	0 (0.0)	32 (100.0)	32 (21.6)	
Workplace				
Technical lab	2 (3.8)	51 (96.2)	53 (35.8)	0.761
blood draw la	1 (8.3)	11 (91.7)	12 (8.1)	
Other lab	0 (0.0)	83 (100.0)	83 (56.1)	
Years of employments				
1- 2	1 (2.0)	49 (98.0)	50 (33.8)	0.455
3- 4	2 (6.0)	31 (96.0)	33 (22.3)	
5 & above	0 (0.0)	65 (100.0)	65 (43.9)	
Direct contact with patients				
Yes	3 (3.1)	95 (96.9)	98 (66.2)	0.324

No	0 (0.0)	50 (100.0)	50 (33.8)	
Hepatitis B vaccination Status				
Yes	0 (0.0)	119 (100.0)	119 (80.4)	0.174
No	3 (10.4)	26 (89.6)	29 (19.6)	
Needlestick or sharps exposure at work				
Yes	3 (5.2)	55 (94.8)	58 (39.2)	**0.029**
No	0 (0.0)	90 (100.0)	90 (60.8)	
Times of exposure in the past 5 years				
One time	1 (3.4)	28 (96.6)	29 (19.6)	**0.033**
Two times	2 (13.3)	13 (86.7)	15 (10.1)	
Three times and more	0 (0.0)	13 (100.0)	13 (8.8)	
Not exposure	0 (0.0)	91 (100.0)	91 (61.5)	
PEP prophylaxis after exposure (N= 57)				
Yes	0 (0.0)	21 (100.0)	21 (36.8)	**0.020**
No	3 (8.3)	33 (91.7)	36 (63.2)	

Table (6) presents the association between occupational and behavioral risk factors and HCV infection among serological testing laboratory health workers (160). The prevalence of HCV infection was 6.2% (n=15), while 93.8% (n=145) tested negative. Age was significantly associated with HCV infection (p=0.002), with increasing prevalence in older age groups: 3.1% in 22-31 years, 13.8% in 32-41 years, 18.8% in 42-51 years, and 29.4% in 52-61+ years. Sex showed no significant difference (p=0.713), with males (11.5%) and females (9.0%) having comparable infection rates. Job roles were not significantly associated (p=0.273), though bacteriologists/chemists had a higher prevalence (16.7%) than lab technicians (8.7%). Workplace differences were not significant (p=0.174), though the hematology lab showed the highest infection rate (36.4%). Years of employment showed a significant association (p=0.001), with no cases among those with 1-2 years of experience and a peak of 37.5% in the 9-10 years group. Direct patient contact was not significantly associated (p=0.775). Infection control training had a highly significant protective effect (p=0.001), with only 4.2% of trained workers infected compared to 56.3% of untrained workers. Needlestick/sharps exposure significantly increased infection risk (p=0.001), affecting 19.7% of exposed workers versus 3.0% of non-exposed. Frequency of exposure was also significant (p=0.013), with rates rising from 12.9% (one-time exposure) to 100% (five-time exposure). PEP use was protective (p=0.012), as infection was higher among those who did not receive PEP (40.0%) compared to those who did (10.0%).These findings highlight the importance of infection control training, PEP administration, and minimizing sharps exposure to reduce HCV transmission risk.

Table 6: Association Between Occupational and Behavioral Risk Factors and HCV Infection among Serological Testing Study Participants (N=160)

Variables	HCV infection		Total 160 (100.0)	P-value
	Yes 15 (6.2)	No 145 (93.8)		
Age (years)				
22- 31	3 (3.1)	95 (96.9)	98 (61.3)	**0.002**
32 -41	4 (13.8)	25 (86.2)	29 (18.1)	
42- 51	3 (18.8)	13 (81.3)	16 (10.0)	
52- 61+	5 (29.4)	12 (70.6)	17 (10.6)	
Sex				
Male	3 (11.5)	23(88.5)	26 (16.2)	0.713
Female	12 (9.0)	122 (91.0)	134 (83.8)	
Job roles				
Lab technician	11 (8.7)	116 (91.3)	127 (79.4)	0.273
Bacteriologist, chemist	4 (16.7)	20 (83.3))	24 (15.0)	
Doctor	0 (0.0)	9 (100.0)	9 (5.6)	
Workplace				
Technical lab	6 (9.7)	56 (90.3)	62 (38.8)	0.174
Hematology lab	4 (36.4)	7 (63.6)	11 (6.8)	
Blood bank lab	1 (3..1)	31 (96.9)	32 (20.0)	
Blood draw lab	2 (18.2)	9 (81.8)	11 (6.9)	
Emergency lab	2 (15.4)	11 (84.6)	13 (8.1)	
Other lab	0 (0.0)	31 (100.0)	31 (19.4)	
Years of employments				
1- 2	0 (0.0)	55 (100.0)	55 (34.4)	**0.001**
3- 4	1 (3.2)	30 (96.8)	31 (19.4)	

5- 6	2 (6.9)	27 (93.1)	29 (18.1)	
7- 8	1 (11.1)	8 (88.9)	9 (5.6)	
9- 10	3 (37.5)	5 (62.5)	8 (5.0)	
11 +	8 (28.6)	20 (71.4)	28 (17.5)	
Direct contact with patients				
Yes	11 (10.2)	97 (89.8)	108 (67.5)	0.775
No	4 (7.7)	48 (92.3)	52 (32.5)	
Training control infection				
Yes	6 (4.2)	138 (95.8)	144 (90.0)	**0.001**
No	9 (56.3)	7 (43.7)	16 (10.0)	
Needlestick or sharps exposure at work				
Yes	12 (19.7)	49 (80.3)	61 (38.1)	**0.001**
No	3 (3.0)	96 (97.0)	99 (61.9)	
Times of exposure in the past 5 years				
One time	4 (12.9)	27 (87.1)	31 (19.4)	**0.013**
Two times	3 (17.6)	14 (82.4)	17 (10.6)	
Three times	3 (50.0)	3(50.0)	6 (3.8)	
Four times	1 (50.0)	1 (50.0)	2 (1.2)	
Five times	4 (100.0)	0 (0.0)	4 (2.5)	
Not exposure	0 (0.0)	100 (100.0)	100 (62.5)	
PEP prophylaxis after exposure (N= 60)				
Yes	4 (10.0)	36 (90.0)	40 (66.7)	**0.012**
No	8 (40.0)	12 (60.0)	20 (33.3)	

DISCUSSION

This retrospective study on HBV and HCV infection risks, vaccination coverage, and occupational exposures among laboratory health workers at the Central Pediatric Teaching Hospital in Baghdad provides valuable insights into gaps in safety and prevention protocols. The findings underscore both progress and ongoing challenges in safeguarding HCWs from bloodborne pathogens, in comparison to recent global and regional studies.

In this study, 73.3% of participants reported receiving HBV vaccination, yet only 39.5% completed the three-dose regimen. This aligns with recent studies from low-resource settings, such as a 2022 Egyptian study where 85% of HCWs were vaccinated, but only 45% completed the series [15]. However, the present study's vaccination coverage falls short of the World Health Organization (WHO) recommended 90% target for high-risk groups [16]. Notably, post-vaccination anti-HBs testing were performed in only 39.5% of vaccinated participants, with 71.9% lacking protective immunity (anti-HBs ≥10 mIU/mL). This mirrors findings from a Nigerian study, where 68% of vaccinated HCWs were non-immune, underscoring the need for routine serological monitoring and booster doses [17]. The absence of HBV infections among vaccinated participants (0/178 vs. 3/65 unvaccinated) reinforces vaccination's protective role, consistent with global evidence [18]. However, the non-significant p-value (p=0.174) for this association may reflect the small sample size of HBV cases (n=3), a limitation observed in similar single-center studies [19].

A concerning 33.7% of participants reported needlestick/sharps injuries in the past five years, with only 36.6% receiving PEP. This contrasts sharply with a 2023 Pakistani study, where 25% of exposed HCWs received PEP, primarily due to poor reporting systems and PEP shortages [20]. The significant association between needlestick exposure and HBV infection (p=0.037) and the absence of infections among PEP recipients (0/30 vs. 3/52 untreated; p=0.046) highlight PEP's critical role in HBV prevention. However, the lack of association between PEP and HCV risk (p=0.112) aligns with evidence that PEP protocols for HCV remain underdeveloped, given the absence of an HCV vaccine [21].

HCV prevalence (9.4%) exceeded HBV (2%), with infections rising significantly with age (3.1% in 22–31-year-olds vs. 29.4% in ≥52-year-olds; p=0.002) and years employed (37.5% in 9–10-year employees; p=0.001). This mirrors a 2021 Iraqi study where HCV seroprevalence among HCWs increased from 3% to 18% with advancing age, reflecting cumulative exposure risks [22]. Notably, 19.7% of needlestick-exposed participants contracted HCV versus 3% unexposed (p=0.001), emphasizing the virus's higher transmissibility compared to HBV. However, the absence of HCV cases among doctors contrasts with a Jordanian study where physicians had higher HCV rates due to invasive procedures [23], suggesting variability in role-specific risks.

While 90.9% of study participants reported infection control training, the 9.1% untrained group had significantly higher HCV rates (56.3% vs. 4.2%; p=0.001). This aligns with a 2023 meta-analysis linking inadequate training to a 3.5-fold increase in bloodborne infections among HCWs [24]. However, the high baseline awareness (87.7% knew transmission routes) exceeds rates in similar settings, such as a Kenyan study where only 62% of laboratory staff understood HBV risks [25], suggesting successful local training initiatives.

Contrary to a 2022 Iranian study showing male HCWs had higher HBV risks [26], all HBV cases in this cohort were female (p=0.648), possibly reflecting the sample's gender imbalance (83.1% female). Similarly, the lack of HBV cases among

doctors conflicts with a Brazilian study attributing elevated risks to physicians' procedural roles [27], highlighting context-specific risk factors.

Strengths and Limitations

Strengths include granular data on vaccination schedules and serological outcomes, rarely captured in similar studies. Limitations encompass its single-center design, small HBV case count, reducing statistical power, and self-reported exposure data may introduce recall bias, a common issue in retrospective occupational studies [28].

CONCLUSIONS

This study highlights critical gaps vaccination coverage, serological immunity, and occupational safety protocols among laboratory health workers, emphasizing the urgent need for targeted interventions to mitigate HBV and HCV infection risks. While HBV prevalence was low and limited to unvaccinated individuals, HCV infections were more common, particularly among older workers and those with long-term employment or needlestick exposures. Incomplete HBV vaccination schedules, inadequate post-vaccination immunity testing, and underutilization of post-exposure prophylaxis further underscore the need for comprehensive vaccination programs, enhanced safety measures, and regular infection control training. Addressing these gaps through mandatory vaccination, routine serological monitoring, improved PEP access, and targeted training can significantly reduce infection risks, safeguarding both healthcare workers and patients in high-risk settings.

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