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Assessment of Knowledge and Awareness Regarding Transmission and Risk Factors of HBV, HCV, and HIV among Health Sciences Students in Universities of Taiz, Yemen

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Abstract

Background

Health sciences students are at risk of occupational exposure to blood-borne pathogens, including hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV). The aim of this study was to evaluate the knowledge, awareness, attitudes, preventive practices and occupational exposure of health sciences students in Taiz, Yemen.

Methods

A descriptive analytical cross sectional study was carried on 505 health sciences students in five universities in Taiz, Yemen from September 2025 to July 2026. The sampling method for the participants was stratified sampling, based on university, discipline and academic year. A self-administered, structured questionnaire was used to collect data, which included knowledge, attitudes, preventive practices, vaccination status for HBV, and occupational exposure. Data analysis was done using descriptive statistics and Pearson's chi square tests in SPSS statistics.

Results

Mean knowledge score was 6.14 ± 1.98 out of 10, 50.7% of students had good knowledge. There were more good knowledge students at the clinical stage than pre-clinical (57.0% vs. 40.8%, $p = 0.0006$). The knowledge scores of students who had attended lectures and/or training were also higher than those who had not (61.9% compared to 34.0%, $p < 0.0001$). There were still some misconceptions about several concepts related to transmission. 26.9% reported being fully vaccinated against HBV and 46.7% reported at least one occupational needle stick or sharp object injury. 45.7% had received practical safety training. Fear of infection reduced willingness to treat infected patients among 58.8% of students.

Conclusion

The knowledge and preparedness for infection prevention among health sciences students in Taiz were found to be important gaps. Improved training in practical infection control, better levels of HBV vaccination and addressing misconceptions and fear surrounding BBIs are required to enhance occupational safety and patient care.

Introduction

Hepatitis B, Hepatitis C and the Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) are among the most serious health challenges that burden health systems globally, Health sciences students may be particularly vulnerable to exposure because their education involves clinical

training and contact with blood and other potentially infectious body fluids. [1]. Hepatitis B virus (HBV) is a major threat globally with an estimated 2.2 billion people infected and 300 million becoming chronically infected, resulting in > 600,000 deaths annually from liver complications and hepatocellular carcinoma (HCC) associated with HBV infection [2]. HIV infection is clinically defined by fewer than 200 CD4 cells per microliter of blood and/or the presence of specific opportunistic infections or malignancies, and usually develops within two to four weeks after the infection occurs [3]. According to the World Health Organization and the Global Burden of Disease statistics, chronic liver disease (CLD) and its complications, including cirrhosis and liver cancer, are still a major cause of mortality, morbidity and economic costs [4]. Hepatitis B virus (HBV) is mainly transmitted through contact with contaminated body fluids such as blood, saliva, vaginal secretions, and semen and is also transmitted from mother to child at the time of childbirth [5]. Hepatitis C virus (HCV) is transmitted mainly through blood-to-blood contact, particularly with the use of unscreened blood, unsafe injection practices and sharing needles [6]. HIV can be spread via the body fluids of an infected person, such as blood, breast milk, semen, and vaginal fluids, and from mother to fetus [7]. 95% of all participants thought that fear and concern about transmission of HIV, HBV and HCV were important influences in refusing treatment for HIV, HBV or HCV infected persons [8].. A higher level of knowledge among dentists plays a key role in shaping their attitudes and behaviors toward patients with HBV, HCV, and HIV/AIDS [9]. Students' knowledge of HBV and HCV, including their causes, transmission routes, complications, prevention, and treatment, improved significantly following the educational intervention [10]. Medical students are at an increased risk of contracting HIV, HBV, and HCV. A study conducted among 408 medical students in Northeast Ethiopia showed that(80.1%) of the students had adequate knowledge regarding HBV and HCV and their modes of transmission. However, only(50.0) of students reported safe practices concerning occupational risk of viral hepatitis infection, and (49.8%) had experienced a needlestick injury [11]. 28.4% of students fully understood how HBV, HCV, and HIV are transmitted, 70.7% had only partial understanding, and 0.007% had no understanding at all, while 81.5% were vaccinated against HBV and 19.5% were not [12]. 43.9% of students reported receiving the HBV vaccination, while 56.1% had not .Additionally, 74% reported having lessons on hepatitis risk factors, whereas 26% had not [13]. Among the 127 university students in South Delhi,India, the overall awareness level about HBV and HCV was 60%, with varying knowledge about modes of transmission [14]. A total of 930 students were examined in a Nigerian university. Knowledge of HIV, HBV, and HCV status was 55%, 36.3%, and 4.2%, respectively. It is therefore evident that university students constitute the group most vulnerable to infection [15]. A study conducted among 317 medical students at Syrian Private University, Damascus, found that 59.3% of students demonstrated an average level of knowledge, while 23% demonstrated a good level of knowledge [16]. Although the prevalence of HIV, HBV, and HCV in Saudi Arabia is relatively low compared to global rates, the key risk factors for transmission are still notably present within the community [17]. A Study involving 120 students blood samples in Sana'a City, Yemen, found a prevalence of HBV 9.17% and HCV 5%, while no cases of HIV were detected [18]. Lack of proper knowledge and awareness about transmission modes and risk factors may increase the chances of accidental infections and unsafe practices. Previous studies in other countries have revealed gaps in knowledge among medical students, but little is known about this issue in Yemen, especially in Taiz, where healthcare resources are limited

and previous studies in my country focus on knowledge on one virus since HBV or HIV or HCV, so in this study combination Three Viruses.

Therefore, assessing the level of knowledge and awareness among medical students will help identify educational gaps and guide preventive strategies.

Methodology

Study design

This was a descriptive analytical cross sectional study conducted in Taiz City, Yemen, from September 2025 to July 2026

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Study Population

The study conducted among health science students included (Dentistry, Medicine, Medical Laboratory Sciences, Pharmacy, Nursing and Public Health/Other) at five public and private universities in four different zones in Taiz (South, East, West, and North) included Taiz University, University of Sciences and Technology (Taiz Branch), Al-Janad University for Science and Technology, Al-Saeed University, and The National University.

Inclusion Criteria:

Enrolled Health Sciences students at universities in Taiz.

Students who were willing to participate in the survey and provided informed consent.

Exclusion Criteria:

Individuals who did not fully complete the questionnaire.

Students unwilling to participate or absent during data collection.

The sampling method and sample size.

The number of sample 505 health sciences students was selected through a stratified random sampling procedure to ensure that students were distributed across five public and private universities in four different zones in Taiz (South, East, West, and North) included (Taiz University, University of Sciences and Technology - Taiz Branch, Al-Janad University for Science and Technology, Al-Saeed University, and The National University)and the faculties (Dentistry, Medicine, Medical Laboratory Sciences, Pharmacy,

Nursing and Public Health/Other) and the years of study (1st through 5th year). They were also divided into pre-clinical (1st-3rd years; n = 196, 38.8%) and clinical (4th-5th and above years,n = 309 61.2%) stage students.

Data Collection Instrument

A self administered structured questionnaire was adapted from previously published questionnaires and assessment instruments addressing knowledge, attitudes, practices, vaccination, and occupational exposure related to HBV and other blood-borne viral infections [15, 19–22] and face validated in the local context was used to collect data. The questionnaire consisted of four different parts:

1. 1. Demographic and Academic Attributes: Age, gender, university, faculty/department, academic year, completion of previous lectures and/or training in HBV/HCV/HIV and status of HBV vaccination.
2. 2. Knowledge Assessment: Ten binary and multiple choice questions pertaining to key facts about the transmission of HBV, HCV and HIV, their dynamics and prevention.
3. 3. Attitudes and Psychological Perceptions: 5 Likert-scale items for willingness to treat infected patients, perceived routine screening, fear of infection and educational mandates.
4. 4. Clinical Practices and Occupational Risk: Glove use, sharps disposal practices, history of needle stick injuries, reporting of exposure incidents and completion of hands-on safety training.

The complete English-language version of the questionnaire used in this study is provided as Supplementary File 1.

Operational Definitions and Scoring System [15, 19, 20, 21, 22].

The knowledge items were dichotomously scored, with a score of 1 given for a correct answer and 0 for an incorrect answer or for the "Don't know" response, resulting in a maximum score of 10.. Student knowledge was categorized into two levels based upon the set cut-off:

Good Knowledge: Score ≥ 70% (≥ 7 correct answers).

Moderate to Poor Knowledge: < 70% (< 7 correct answers).

Attitudinal responses were evaluated on a 4-point scale (Strongly Disagree, Disagree, Agree, Strongly Agree) and categorized into positive or negative perceptual domains based on a 70% threshold of overall score.

Clinical practices and occupational exposure metrics were analyzed based on reported frequencies (Always, Sometimes, Rarely, Never) and binary exposure histories (Yes/No).

Statistical Analysis

IBM SPSS Statistics was used for data processing and statistical modelling. Frequencies and percentages were used to summarize categorical variables while mean ± standard deviation (SD) was used for continuous variables. Bivariate cross tabulations and Pearson's Chi-Square tests were used to analyze associations between independent variables (academic stage, gender, previous training, vaccination status, and occupational exposure variables) and knowledge levels. A p-value of less than 0.05 was deemed to be statistically significant.

Ethical considerations

The Medical Ethics Committee at the University of Science and Technology, Aden, Yemen, has approved the study [MEC/AD0107]. All study procedures complied with the ethical standards of both institutional and national research committees, as well as the 1964 Helsinki Declaration and its subsequent amendments. Written informed consent was obtained from all participants before their enrollment in the study.

Result

Demographic and Academic Profiles of Participants

The study participants included 505 health science students from five HEIs in Taiz, which consisted of young adults with a slight female predominance. The sample was skewed towards the higher level of training students in their clinical years with the Dentistry and Medicine disciplines having the greatest numbers. Almost 2 out of every 5 participants said they had some previous formal academic education about BBP prior to clinical rotations and all demographic and academic characteristics present **in** (Table 1**).**

Table 1
Demographic and Academic Characteristic of Participants

Statistical Variable	Sub-category / Classification	Frequency (N)	Percentage (%)
Gender	Male	224	44.4%
	Female	281	55.6%
University	Taiz University	215	42.6%
	Al-Janad University for Science and Technology	138	27.3%
	The National University	105	20.8%
	Al-Saeed University	25	5.0%
	University of Sciences and Technology (Taiz)	22	4.4%
Faculty / Department	Dentistry	169	33.5%
	Medicine	125	24.8%
	Medical Laboratory Sciences	77	15.2%
	Pharmacy	74	14.7%
	Nursing	36	7.1%
	Public Health / Other	24	4.8%
Academic Year	1st Year	42	8.3%
	2nd Year	59	11.7%
	3rd Year	95	18.8%
	4th Year	124	24.6%
	5th Year	185	36.6%
Academic Stage	Pre-clinical Stage (Years 1–3)	196	38.8%
	Clinical Stage (Years 4, 5 and above)	309	61.2%
Prior Lectures / Training	Yes	302	59.8%
	No	203	40.2%

Knowledge of HBV, HCV, and HIV Transmission

In Table 2 The students' knowledge clearly reflected a difference between traditional concepts of transmission and the modern facts of the clinical situation. Strong baseline knowledge was obtained on standard parenteral routes (e.g., sharing of contaminated needles, unscreened blood transfusion) and

the barrier properties of medical gloves among the participants. Conversely, significant gaps in knowledge and continued misconceptions were observed about non-transmissible routes (including misconceptions about breastfeeding and mosquito vector), and some gaps of knowledge or awareness on new concepts of treatment, such as the U = U (Undetectable = Untransmittable) principle and the availability of HBV vaccine.

Table 2
Knowledge of HBV, HCV, and HIV Transmission

Knowledge Assessment Statement	Correct Key	Correct N (%)	Incorrect N (%)	Don't Know N (%)
HBV can be transmitted by sharing needles	True	420 (83.2%)	43 (8.5%)	42 (8.3%)
HCV can be transmitted through sexual contact	True	275 (54.5%)	128 (25.3%)	102 (20.2%)
HIV can be transmitted via untested blood transfusion	True	379 (75.0%)	58 (11.5%)	68 (13.5%)
Sharing a toothbrush can transmit HBV/HCV/HIV	True	304 (60.2%)	108 (21.4%)	93 (18.4%)
HBV can be transmitted through breastfeeding	False	163 (32.3%)	213 (42.2%)	129 (25.5%)
Mosquitoes can transmit HIV	False	264 (52.3%)	144 (28.5%)	97 (19.2%)
Using gloves reduces infection risk	True	453 (89.7%)	44 (8.7%)	8 (1.6%)
People with HCV often have no early symptoms	True	280 (55.4%)	129 (25.5%)	96 (19.0%)
There is an effective vaccine for HBV	True	327 (64.8%)	90 (17.8%)	87 (17.2%)
Early HIV treatment makes the virus non-transmissible	True	238 (47.1%)	120 (23.8%)	147 (29.1%)

Comparative and Inferential Analysis of Knowledge Levels

The mean knowledge score was 6.14 ± 1.98 (out of 10) with a mean score of all participants. According to the ≥ 70% benchmark, 256 students (50.7%) exhibited good knowledge while 249 students (49.3%) had moderate-to-poor knowledge.

Pearson's Chi-square cross-tabulations indicated that there were statistically significant differences in knowledge when compared to academic progression and previous instruction. Clinical stage students achieved a significantly higher proportion of good knowledge (57.0%, n = 176) compared to pre-clinical students (40.8%, n = 80) ($\chi^2 = 11.864$, df = 1, $p = 0.0006$). Likewise, knowledge scores were better (61.9%

good knowledge) among participants who had received previous academic lectures/training compared to those who had not (34.0% good knowledge) ($\chi^2 = 36.779$, df = 1, $p < 0.0001$). There was no significant difference between the gender and the knowledge level ($p = 0.5974$). These comparative findings are included in Table 3.

Table 3
Comparative and Inferential Analysis of Knowledge Levels

Independent Variable	Classification	Good Knowledge (≥ 70%) N (%)	Poor/Moderate Knowledge (< 70%) N (%)	χ^2 Value	Significance (p-value)
Academic Stage	Clinical Stage (Years > 3)	176 (57.0%)	133 (43.0%)	11.864	0.0006
	Preclinical Stage (Years 1–3)	80 (40.8%)	116 (59.2%)		
Prior Training / Lectures	Yes	187 (61.9%)	115 (38.1%)	36.779	< 0.0001
	No	69 (34.0%)	134 (66.0%)		
Gender	Male	117 (52.2%)	107 (47.8%)	0.279	0.5974
	Female	139 (49.5%)	142 (50.5%)		

Attitudes and Awareness

Table 4
Attitudes and Awareness of Participants

Attitudinal Statement	Strongly Disagree N (%)	Disagree N (%)	Agree N (%)	Strongly Agree N (%)
Students should undergo routine screening	111 (22.0%)	35 (6.9%)	152 (30.1%)	207 (41.0%)
Comfortable treating patients if precautions are taken	118 (23.4%)	101 (20.0%)	176 (34.9%)	110 (21.8%)
Fear of infection affects willingness to treat patients	114 (22.6%)	94 (18.6%)	207 (41.0%)	90 (17.8%)
Universities should provide infection prevention training	101 (20.0%)	50 (9.9%)	119 (23.6%)	235 (46.5%)
Social media information is important for awareness	118 (23.4%)	42 (8.3%)	153 (30.3%)	192 (38.0%)

There was significant support for institutional policies focused on prevention of exposure to health sciences students: 71.1% agreed or strongly agreed that health sciences students should be routinely screened for exposure to blood-borne pathogens and 70.1% agreed and strongly agreed that universities must provide structured training on infection prevention to health sciences students.

But there was a general lack of enthusiasm and uncertainty: 58.8% said that they were less willing to provide care to patients with HBV, HCV, or HIV because they were afraid of being infected. Furthermore, only 56.7% felt comfortable treating infected persons even when standard precautions were observed completely. The parameters of these attitudes are shown in above in Table 4.

Preventive Practices and Occupational Exposure

The compliance of routine clinical practices were sub-optimal with 62.0% saying that they always wore gloves when working with bodily fluids and 64.6% saying they always use a dedicated sharps container to dispose of needles.

Concerning HBV protection, 26.9% (n = 136) received all the required doses, 36.6% (n = 185) received none of the required doses and 36.4% (n = 184) were not aware of having been vaccinated at all. The clinical students had a significantly higher rate of vaccination completion than the pre-clinical students (30.4% vs 21.4%) ($\chi^2 = 16.920$, $p = 0.0002$).

The results of the occupational safety measures showed high exposure frequencies: 236 students (46.7%) reported at least one occupational needle-stick or sharp injury while undergoing clinical training. A significant difference from the pre-clinical students (38.8%) was observed among clinical stage students (51.8%) ($\chi^2 = 9.444$, $p = 0.0089$). A highly significant association was found between hands-on practical safety training and compliance with exposure detection and immediate reporting ($\chi^2 = 553.500$, $p < 0.0001$). Table 5 shows the distribution of practices, vaccination status and occupational risks.

Table 5
Preventive Practices, HBV Vaccination and Occupational Exposure

Clinical Practice & Risk Metric	Category / Classification	Frequency (N)	Percentage (%)
Glove Usage during Fluid Contact	Always	313	62.0%
	Sometimes	117	23.2%
	Rarely	55	10.9%
	Never	20	4.0%
Sharps Container Disposal	Always	326	64.6%
	Sometimes	93	18.4%
	Rarely	47	9.3%
	Never	39	7.7%
HBV Vaccination Status	Fully Vaccinated	136	26.9%
	Unvaccinated	185	36.6%
	Unknown Status	184	36.4%
Occupational Exposure (Needle-stick)	Yes	236	46.7%
	No	269	53.3%
Immediate Incident Reporting	Yes	208	41.2% (88.1% of exposed)
	No	130	25.7%
	Not Applicable (Unexposed)	167	33.1%
Hands-on Practical Training	Received	231	45.7%
	Not Received	274	54.3%

Source of Information

Analysis of primary information sources indicated that formal university lectures served as the predominant single source (29.9%), followed by combined modalities encompassing clinical rotations, internet research, and social media platforms.

Discussion

The present study evaluated the knowledge, awareness, attitudes, preventive practices, HBV vaccination status and occupational exposure to HBV, HCV and HIV among 505 health sciences students of five

universities in Taiz, Yemen. The results show that the state of preparedness of health sciences students in infection prevention is multi-faceted and goes beyond just knowledge, but also practical learning, vaccination, occupational safety and attitudes towards patients with blood-borne viral infections.

The mean score for the knowledge was 6.14 ± 1.98 on a 10 mark scale, with 50.7% having good knowledge. While about half of the respondents reached the set level, there are some significant differences between the knowledge domains. There were well recognized and well known concepts as well as concepts which lacked clarity and uncertainty. There has been some variation in knowledge between health sciences students across contexts [11–16]. In Northeast Ethiopia, 80.1% of medical students had adequate knowledge while in Syria, Mohsen et al. found that 59.3% of medical students had an average level of knowledge and only 23% had good knowledge [11, 16]. Awareness of HBV and HCV transmission among University students in South Delhi was found to be around 60% by Ara et al. [14]. The results show a wide-ranging difference in knowledge levels amongst populations, even those who have been given health-related education.

The moderate knowledge levels found in the current study could be attributed to the variance in the knowledge students received regarding infection prevention, when and how they received it and its practical application. It is important to note, however, that good knowledge was very well related to previous lectures or training in the present study. The proportion of students with good knowledge of the drug was 61.9% among those with previous training versus 34.0% among those who had not received previous training. The association observed is in line with earlier studies that found that structured educational interventions were associated with improved knowledge about viral hepatitis and prevention [10] and therefore may play an important role in the acquisition of students' knowledge, though the cross sectional design does not allow for a causal interpretation.

It is more important to know the presence of certain misconceptions than the overall knowledge classification, perhaps. This means that while a student may earn a decent overall grade, he or she may not have an understanding of individual routes of transmission that are directly important to clinical practice. This is especially relevant since HBV, HCV and HIV have many similar blood-borne routes of transmission but different epidemiological characteristics. The emphasis of current WHO recommendations is on blood and injection safety, preventing exposure to contaminated sharps, and pathogen-specific prevention [24].

The questionnaire used in the study indicated that 42.2% of the respondents thought that breastfeeding was a way of HBV transmission, which should be interpreted carefully. This response is not solely a lack of knowledge but can reflect a problem with differentiating between the transmission patterns of HBV, HCV and HIV. WHO considers exposure to infected blood and body fluids and perinatal transmission as significant pathways of HBV transmission, and the prevention of hepatitis B is possible through vaccination [23, 24]. This underscores the need to educate students on the specific modes of transmission for each virus and not treat HBV, HCV, and HIV as a similar group.

The second notable finding was the moderate number of participants that answered the HIV treatment/transmissibility question correctly. Of those who answered on the relevant item, only 47.1% answered correctly. The principle of prevention through an undetectable viral level is an integral part of the tools for HIV prevention used today. Today, WHO is saying that individuals who live with HIV and take ART and have an undetectable viral load are not sexually infectious [25]. WHO also considers undetectable viral suppression to be defined as having no risk of sexual transmission if maintained via effective treatment [25]. The relatively low percentage of correct responses in the current study might, therefore, reflect shortcomings in the way some students' knowledge is grounded in current HIV treatment-as-prevention concepts.

The academic stage and previous training will be considered.

There was a significant difference in knowledge based on academic stage. There was good knowledge reported by more clinical (57.0%) than pre-clinical (40.8%) students ($\chi^2 = 11.864$, $p = 0.0006$).

The increase in good knowledge among clinical-stage students is likely due to progressively exposing these students to clinical settings, patients, blood and body fluids, infection-control protocols, and occupational-risk issues in the workplace. This interpretation should be considered with some caution, however, due to the study design being a cross-sectional design. It is not possible to conclude that it is academic stage that causes higher knowledge. The difference may also be attributable to differences in the type of courses offered, differences in academic maturity and learning outcomes, or the level of cumulative educational exposure and/or self-directed learning.

The closer relationship seen on previous lectures or training adds to the value of formal education exposure. The present results will thus encourage the early incorporation of an educational component on viral hepatitis in health sciences and its continuation during the following years of study, instead of only in the years spent in clinical rotation.

Importantly, the results indicate that it was not only a matter of students' HBV and HCV awareness, but also of their HIV awareness. It is significant that over half did not receive practical, hands-on training in safety protocols as this indicates that while the student may have some knowledge of infection prevention, there may be a disconnect between understanding the theory and its practical application in clinical settings.

HBV vaccination

The vaccination against hepatitis B virus (HBV) is one of the most significant measures for occupational prevention since an effective vaccine is available. The present study showed that only 26.9% of the participants had received all of the required HBV vaccination doses; 36.6% did not receive any HBV vaccination and 36.4% were not aware of their vaccination status.

This low number of students reporting that they are fully vaccinated is of concern as health sciences students may come into contact with blood and potentially contaminated sharps while on clinical

education. Health workers are at a risk of occupational exposure and WHO considers hepatitis B an important occupational infection in healthcare workers and strongly recommends health workers at risk of occupational exposure be vaccinated against hepatitis B [23, 26, 27].

It is also noteworthy that a relatively large percentage of students did not know their vaccination status. This could be due to insufficient uptake of vaccines as well as issues with documentation and/or institutional monitoring. This current study, however, did not specifically explore the causes for noncompletion of vaccination or doubt about vaccination status. Vaccine availability, cost, institutional requirements and attitudes toward vaccination, are not therefore to be understood as proven explanations.

The level of vaccination coverage seen in this study was below that of some previous studies. The significant difference among studies could be attributed to the differences in institutional policy of vaccination, access to health care, national vaccination programs, or the need for students to be vaccinated prior to clinical placement. The present study however did not measure these factors directly and so further investigation is required.

From the institutional point of view, the results validate the possibility of including HBV vaccination in the clinical-readiness program, instead of vaccination being left solely at the responsibility of the student. Vaccination and occupational-health systems are key factors in the protection of the health worker from preventable occupational infections as suggested by WHO [26, 28].

Needle-stick injuries, occupational exposure.

Another significant concern was occupational exposure. In total, 46.7% of the respondents reported at least one needle-stick or sharp injury. The proportion was significantly higher among clinical-stage students than pre-clinical students (51.8% versus 38.8%; $\chi^2 = 9.444$, $p = 0.0089$).

This may be due to the higher exposure of the clinical students to invasive procedures, needles, sharps and patient care which may explain the higher ratio of clinical students compared to clinical stage students. However, this explanation was not directly measured in the present study and therefore it is considered to be plausible explanation rather than being the cause.

Occupational exposure to these viruses is still significant, as hepatitis B, hepatitis C and HIV are all known occupational infections in health care facilities [28]. Standard precautions are recommended by WHO and rely on the assumption that blood and body fluids are potentially infectious and are accompanied by protective measures, safe disposal of sharps and hepatitis B vaccination [27].

The frequency recorded in the present study is similar to the previous studies. The similarity indicates that the occupational exposure of students may constitute a wider training challenge and clinical-safety issue beyond the scope of the students in the present study.

The present study is not able to conclude that inadequate hands-on practical training is the cause of needle-stick injuries, however, the high frequency of exposure and low hands-on practical training suggest that this is a potential area of concern for the institution.

Identify preventive practices and closing knowledge–practice gap.

The results also indicated a possible knowledge-behaviour gap. While 89.7% understood that wearing gloves would minimize risk of infection, only 62.0% wore gloves when working with body fluids.

This difference is significant because people knowing about a preventative does not necessarily mean they follow it. Direct evaluation of the reasons for this discrepancy were not performed in the present study. Possible factors could be availability of protective equipment, clinical supervision, perceived risk, workload or habits that have been formed, but these must be directly investigated before they are deemed as determinants.

WHO advocates the use of a systems-based approach to infection prevention, which involves the use of simple precautions, appropriate protective equipment, safe sharps disposal, safe injection practices and hepatitis B vaccination [24, 27, 28]. Students should be taught to improve their knowledge through practice of infection control procedures and also provide clinical settings that allow for compliance.

Attitudes and fear of infection.

Attitudinal findings give one another dimension to the infection-prevention preparedness. While 71.1% agreed or strongly agreed that health sciences students need to be routinely screened, 70.1% agreed or strongly agreed that health sciences students should be trained at the university on infection prevention, 58.8% reported that fear of infection influenced their willingness to treat a patient with HBV, HCV or HIV.

Continued anxiety about patients with blood-borne infections, coupled with relatively high levels of support for infection-prevention measures, may lead students to see the importance of infection control but still view patients with blood-borne infections as a significant occupational risk. Fear and concerns about transmission of infection have been previously reported among both health workers and students and they have been identified as factors that may impact attitudes towards infected people [8, 9].

The finding may also be a result of insufficient knowledge of relative risks of the various patient-contact settings. WHO states that blood and body fluids should not be assumed to be or treated as infectious unless they have been assumed to be so and that standard precautions should be used, not assumptions as to which patients are infectious [27].

Thus, education in infection control should not just occur with regard to technical prevention, but also with regard to correct understanding of infection risks. This may keep students in appropriate precautions but not fearful or reluctant to give care to patients with HBV, HCV or HIV.

Significance for health sciences education and public health.

The results collectively indicate that the primary problem pointed out by this study is not just a lack of factual information. Instead, multiple interrelated gaps were noted: lack of knowledge, a lack of practical training, low hepatitis B vaccination coverage, significant occupational exposure and fear of treating infected patients.

Previous training and improved knowledge is a correlate of stronger structured educational programs [10]. However, with the relatively high incidence of needle-stick injuries, and lack of hands-on safety training, it may be necessary to do more than lecture. WHO places special emphasis on occupational infection prevention through the use of training, standard precautions, protective equipment, safe sharps practices and vaccine [24, 27, 28].

The gap between pre-clinical and clinical students knowledge levels also offers a great opportunity in curriculum planning. Educational programs on infection prevention should start before students enter clinical settings and start to build more as they work in the clinical setting. Safe handling of needles and sharps, wearing gloves and other PPE, preventing occupational exposures, and appropriate response and reporting following occupational exposures may be practical competency-based training.

The same should apply to HBV vaccination which should be integrated as part of institutional clinical-readiness systems. WHO has recommended hepatitis B vaccines as one of the key preventive measures for workers who are at risk because of their work activities [23, 26, 27]. Universities and teaching hospitals may therefore consider pre-checking for vaccination status prior to significant clinical exposure and also having a means to complete vaccination if needed.

The low recognition of the concept of treating infection prevention as a continuum of treatment and prevention is also a sign that HIV treatment/transmission concepts should be updated in infection prevention curricula. HIV guidance is now evolving to consider viral suppression an integral part of HIV prevention, and people with an undetectable viral load are at zero risk of sexual HIV transmission [25]. Using up-to-date HIV prevention ideas in health sciences classes could help clear up students' misconceptions and understanding of patients with HIV.

Strengths and limitations

One of the strengths of this study is that it has included 505 health sciences students from five universities in Taiz and the several dimensions of infection-prevention preparedness were assessed, not just knowledge. The study encompassed knowledge, attitudes and preventive practices, vaccination status, practical training and occupational exposure contributing to a more comprehensive evaluation of the issue at hand.

There are some restrictions that should be taken into account, however. One of the first problems with the cross-sectional design is that it does not allow for causal conclusions about the relationship between previous training and knowledge or between practical training and occupational exposure. Second, the vaccination status, and potential for training and preventive practices and for occupational

exposure, were self-reported, and thus could be subject to recall and/or reporting bias. Third, the study was performed in universities in Taiz city only, thus, may not be representative to students in other parts of Yemen. Lastly, the preventive practices reported were not directly observed, and may, therefore, not reflect what actually happens in clinical practice.

Conclusion

The overall level of knowledge about HBV, HCV and HIV among health sciences students in Taiz, Yemen, was moderate and there were still significant gaps in knowledge on transmission, prevention, and current knowledge about HIV. About half of the participants had good knowledge as defined by the researcher, and clinical-stage students and students who had been given a lecture and/or training on relevant subjects showed higher levels of knowledge.

Despite this moderate level of knowledge, important gaps in infection-prevention preparedness were identified. The rate of HBV immunization was low, a significant number of students were not sure about their immunization status, and almost half reportedly had at least one needle-stick or sharp injury. In addition, over half of the participants reported not receiving hands-on practical health and safety training, and the fear of infection affected the willingness of many students to treat patients with HBV, HCV, or HIV.

The general conclusion from the findings here is that theoretical learning alone may not be enough to have prepared adequate learners for clinical practice. A holistic strategy that combines formal education, hands-on infection control training, hepatitis B vaccination, occupational safety efforts, and proper knowledge of risk for transmission is required. Enhancing these elements in health science education and health care practice settings could be beneficial to mitigate health care worker hazards and enhance health care worker readiness in Yemen.

Recommendation :

The following recommendations are suggested based on the results of this study:

1.Strengthen infection-prevention education

The universities need to reinforce and update regularly their teaching material on HBV, HCV, and HIV transmission, prevention, vaccination, occupational exposure, and current concepts on HIV treatment.

2.Teach about infection control before clinical training.

Education about HBV/HCV/ HIV and infection control should be structured and delivered in the pre-clinical years and continue to be repeated during the clinical years, especially before students have significant patient contact.

3.Improve hands-on practical training

Competency based in-practice learning for standard precautions, safe use of personal protective equipment, safe handling and disposal of sharp objects, prevention of needle stick injuries and management of occupational exposure should be offered by universities and teaching hospitals.

4.Ensure that Hepatitis B vaccination programs are implemented for students.

Health sciences students should be given full access to HBV vaccination, and consideration should be given to verifying students have had the vaccination prior to clinical placement at the university. Pupils must also be provided with clear guidance on the need to fulfil the recommended vaccination schedule.

5. Establish systematic occupational-exposure reporting

Clear, easily accessed and confidential reporting processes at teaching institutions should be developed for needle stick and other work exposures and students should be aware of what to do immediately after exposure.

6. Strengthen clinical supervision and infection-control monitoring

Clinical supervisors need to remind students of standard precautions and observe them during clinical training, especially when they are using needles, sharps, or handling blood or body fluids.

7. Clarify misunderstandings and concern about those who are infected

Misconceptions about transmission of HBV, HCV and HIV should be targeted specifically in educational programs, along with the need to use appropriate standard precautions. It may assist students to differentiate between the real risks and the misconceptions they might have had from casual contact and help to minimize unecessary fear when dealing with patients with an infection.

8. Incorporate new HIV prevention ideas into curriculum

To provide current and evidence-based information, the teaching should incorporate current HIV prevention concepts, such as the link between effective antiretroviral therapy, viral suppression, and sexual transmission risk.

9. Conduct further research across Yemen

Further multicenter studies in other governorates and universities in Yemen should be done to see if the results found in Taiz are representative of the health sciences students in Yemen.

10. Measure the effectiveness of educational interventions in the future.

Future research is needed to evaluate the impact of infection-control interventions, both structured theoretical and practical, on knowledge, vaccination uptake, preventive practices and occupational safety outcomes over time.

Declarations

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Not applicable

Authors Contributions

Raeef Ali Alkhulidi contributed to conceptualization, methodology, supervision and manuscript drafting. Khaldon Al-Buriahy provided supervision and overall guidance for the study. Omar Mustafa Alqurashi contributed to data analysis , Sarah Ali Al-Zamzami , Abdullqader Al-Mashraqi, Wadhah Abdullah Al-jebzi, Mohammed M.A.M Saleh were responsible for data collection

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Data Availability

The raw data supporting the findings of this study are available from the corresponding author upon reasonable request.

Ethics approval and consent to participate

The Medical Ethics Committee at the University of Science and Technology, Aden, Yemen, has approved the study [MEC/AD0107]]. All study procedures complied with the ethical standards of both institutional and national research committees, as well as the 1964 Helsinki Declaration and its subsequent amendments. Written informed consent was obtained from all participants before their enrollment in the study

Consent for publication

All authors reviewed and approved the final version of the manuscript and consent for publication

Competing interests

The authors declare that they have no competing interests

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Supplementary Files

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- HCVHBVHIV.xlsx

- HBVHCVHIVQuestionnaireEnglish.pdf