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Capacity And Needs Assessment Regarding Biosafety And Biosecurity Among Laboratory Technologists Of Public And Private Tertiary Care Hospitals In Peshawar: A Multi-Institutional Mixed Method Study.

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Abstract

Biosafety means to prevent oneself from pathogens while biosecurity means to prevent the environment from pathogens in terms of its unauthorized access, theft or release. This study aims to determine the current level of biosecurity and biosafety and to identify gaps and challenges faced by laboratory technologists in implementing effective biosecurity and biosafety measures. A mixed method approach was employed which obtain a comprehensive understanding of biosafety and biosecurity capacity and needs of laboratory technologists. For Quantitative part about 180 lab technologist of both public and private tertiary care hospital were surveyed using convenience sampling technique whereas for qualitative part semi-structured interviews was conducted through a purposive sampling techniques using an interview guide designed to explore their experiences and perspectives. Mostly participant's exhibits good knowledge (76.11%), attitude (87.78%), and practices (92.22%), however it is not significantly associated with gender, hospital type, or research participation. One way anova shows statistically significant difference in the knowledge ($F=4.720$, $p=0.010$) and attitude ($F=4.582$, $p=0.011$) across educational groups while post-hoc analysis revealed diploma holder as lower scorer in comparison

to the highest degrees particularly bachelor and masters. Practices remain the same for all educational groups (p=0.054). Spearman's correlation shows stronger correlation between attitude and practices (r=0.664, p<0.01). Moreover bivariate analysis found significant association between knowledge and received relevant training (p = 0.000), safety association membership (p = 0.000), and consistent PPE availability (p = 0.013). Qualitative findings revealed gaps of infrequent and outdated training, inconsistent PPE availability, and limited managerial engagement in daily safety practices. The knowledge, attitude, and practices among Laboratory technologists in Peshawar was strong, however certain gaps were found to be linked with educational level coupled with qualitative findings of weak institutional safety culture, limited resource availability and capricious training highlighting insufficient measures. Mandatory, continuing education targeted the lower qualified staff along with reliable personal protective equipment supply, and institutional commitments for proactive infrastructure can strengthening the institutional biosafety and biosecurity culture.

Introduction

This study addresses a critical gap in understanding biosafety and biosecurity among laboratory technologists in public and private care hospitals of Peshawar. By evaluating current knowledge, practices, and challenges, through interventions and training programs, lead to safer lab and public health. This research is a model for similar assessments in other regions as well.

253 lab technicians were taken from public and commercial sector's hospitals from each of Karachi's 18 towns. Technician who surveyed had experience of 5+ years out of which were 200 men and 53 women. 46.2% of laboratory workers did not wear any PPE and about 39.5% of respondents used frequently capped used syringes, compared to 10.7% who did so infrequently. As it is advised by Pakistani authorities to spoil syringes before discarding them to prevent reuse, but still only 36% of respondents follow the rules.

In terms of leadership traits, only 84.8% of participants were reporting near-miss happenings in the lab, (58.1%) followed SOPs, and 55.2% of participants consistently reported new medical conditions. In terms of safety facilities, the majority of the lab departments accepted safety protocols.

This study was carried out among the staff of selected Hospitals and Diagnostic Centers at Jashore region to evaluate the KPA of laboratory bio-safety where 42 (19.9%) females and 150 (78.1%) males. 129 (67.2%) respondents were married, 49 (25.5%) had 10+ years of experience, and 116 (64.4%) were in the age -range of 20–30 .166 (86.5%) worked in the lab for 8+ hours, and 59 (30.7%) were overweight.66 (34.4%) employees had A good biosafety knowledge, a positive attitude, and good practice. 60% of respondents had official biosafety training. A safety manual was shared with 20% of the participants. 80% have used PPE. However, 60% of participants stated that their lab lacked a fire station, and 10% of labs have eye stations and emergency shower facilities.

The pathology department accounted 24 laboratory technologists (33.3%) and biochemistry department (25%). In terms of age, the senior technician was 46 years old and the youngest was 24. Out of 24 technicians who were asked about awareness, knowledge, and biosafety precautions, 8 (33.3%) were aware of universal work precaution, 18 (75%) had received the hepatitis B vaccine, and 18 (75%) were found to have left the laboratory without washing their hands properly after finishing their shift (28).

19 technicians from the fields of microbiology, pathology, and biochemistry participated in this investigation. As a result, 50% of research participants in pathology had average knowledge scores and 50% had good scores, but 25% in biochemistry had average scores and 75% had good scores, and 100% in

microbiology got good grades. In the pathology department, 16.7% earned good grades and 83.3% had average ones for attitude. In biochemistry, 12.5% of students received low grades, 75% received ordinary grades, and 12.5% received high grades. In microbiology, all students received good grades. In the pathology department, 16.7% of students received poor grades, 66.7% received mediocre grades, and 16.7% received good grades. In biochemistry, 12.5% received good grades while 81.5% received medium grades.

There is a lot of data and facilities gap between the public and private Hospitals. only one laboratory has a biosafety officer 3 laboratories lack standard operating procedures, no staff training protocol is established, no immunization record is kept, and most laboratories lack incident reporting and recording. Basic personal protection equipment, such as lab coats, goggles, gloves, and masks, is readily available. However, many laboratories lack sophisticated equipment like biological safety cabinets and eyewash stations. The majority of laboratories in Karachi, Pakistan, have impaired biosafety performance

The main objective of this research is to determine the current level of biosecurity and biosafety knowledge, attitude and practices among laboratory technologists. To find gaps and challenges faced by laboratory technologists in implementing effective biosecurity and biosafety measures. The comparison of biosecurity and biosafety standards between public and private tertiary care hospitals.

The study's questionnaire was filled out by 180 individuals, yielding an estimated 19% response rate. 79% of those surveyed had high or intermediate understanding overall. Only 17.4% had taken part in official biosafety training earlier. Their knowledge boosted with work experience. Their knowledge was poor for differentiating between technical procedures that could be dangerous by producing aerosols (30.2%), high for wearing personal protective equipment and its components (92.8%), and intermediate for signs and biosafety level principles (42.1%). One hundred percent of the population knew how to properly sort rubbish.

Methodology:

This study was conducted by employing a mixed-methods approach using both quantitative and qualitative methods for comprehensive current biosafety and biosecurity capacity of lab staff and their needs. The study setting were both public and private tertiary care hospital including MTI-Lady Reading Hospital, MTI-Khyber Teaching Hospital, Rehman Medical Institute, and Alkhidmat Diagnostic Center providing a broad and representative samples of laboratory technologist. This study was conducted from June 2024 to October 2024. About 180 sample size were selected through stratified random sampling for quantitative part using open Epi online sample size calculator with 95% confidence interval, 80% power of study and estimated total population size of 340. Ethical approval was obtained Institutional Review Board of NCS University Peshawar and relevant hospital research boards. All the participants were selected using stratified random sampling from both public and private hospitals and enrolled before obtaining a signed informed consent, with identities anonymized using unique codes and data securely stored to ensure confidentiality. The participants were enrolled based on criteria which include technologist having at least one year of laboratory experience and actively involved in routine testing procedures. Those on leave or unwilling to provide informed consent were excluded accordingly. Quantitative data were collected through a structured questionnaire on demographics, knowledge, practices, and challenges related to biosafety and biosecurity. The questionnaire was administered both physically and electronically through Google form for ease of participants. Qualitative part includes semi structured interview guide with 10 participants as data saturation was reached at this point. The participants for interview was recruited through purposive sampling alongside observational checklists applied in 4-5 laboratories across the selected hospitals to capture a mix of

institutional settings. Data was analyzed using SPSS V.22 by applying both descriptive and inferential statistical techniques. Both frequency and percentage were calculated for numerical variable and data were presented through both tables and charts. Regarding inferential statistics Chi-square test for association between categorical variables, similarly t test and one way ANOVA was applied for mean comparison with p-value of <0.05 was considered statistical significant findings. The interview were audio recorded, transcribe verbatim and analyzed using thematic analysis to identify potential themes. The review of institutional biosafety protocol and incident report further complemented the accuracy of the data.

Results:

The general characteristics of the study population are summarized in Table 1. The study included a total of 180 participants, with a majority being male (150 participants, 84%) and a smaller proportion being female (30 participants, 16%). Regarding age distribution, the highest proportion of participants (46%) were aged between 22–25 years, followed by 29% aged 26–32 years, 13% aged 32–40 years, and 12% aged 41–50 years.

In terms of education, most participants held a BS degree (113 participants, 63%), while 24% had a diploma, and 13% held an MPhil degree. The participants were also categorized based on their workplace type, with 56% working in private hospitals and 44% in public hospitals.

When analyzing the roles of technical staff, the majority (74%) were staff members, followed by 15% who were departmental heads, 9% who were safety officers, and 2% who were biosafety officers.

Experience levels varied among the participants, with 32% having 1–2 years of experience, 30% with 3–5 years, 27% with 10–15 years, and 11% with 6–10 years of experience. This data provides an overview of the demographic and professional characteristics of the study population.

The figure:1 illustrate the distribution of knowledge, attitude, and practices among the study participants. In **Figure A**, the majority of participants (76.11%) demonstrated good knowledge, while 23.89% had poor knowledge. This indicates that most of the study population possesses a solid understanding of the relevant topics. In **Figure B**,

Table:1 General characteristics of the study population

Variable	Parameters	Frequency	Percentage
Gender	Male	150	84%
	Female	30	16%
Age	22-25year	83	46%
	26-32 years	52	29%
	32-40 years	23	13%
	41-50	22	12%
Level of Education	Diploma	43	24%
	BS Degree	113	63%
	M.phil	24	13%
Type of Facility	Public Hospital	80	44%
	Private Hospital	100	56%
Role of Technical Staff	Departmental Head	26	15%
	Safety Officer	17	09%
	Staff Member (Technical)	134	74%
	Biosafety Officer	3	02%
Experience	1-2 Years	58	32%
	3-5 Years	54	30%
	6-10 Years	20	11%
	10-15 Years	48	27%

an even higher proportion of participants (87.78%) exhibited a good attitude, with only 12.22% showing a poor attitude. This suggests that a positive attitude is prevalent among the majority of participants. In **Figure C**, the data shows that 92.22% of participants practiced good behaviors, whereas only 7.78% exhibited poor practices. This highlights a strong adherence to proper practices within the study group. Overall, the figures indicate a positive trend in knowledge, attitude, and practices among the participants, with the majority performing well in all three domains.

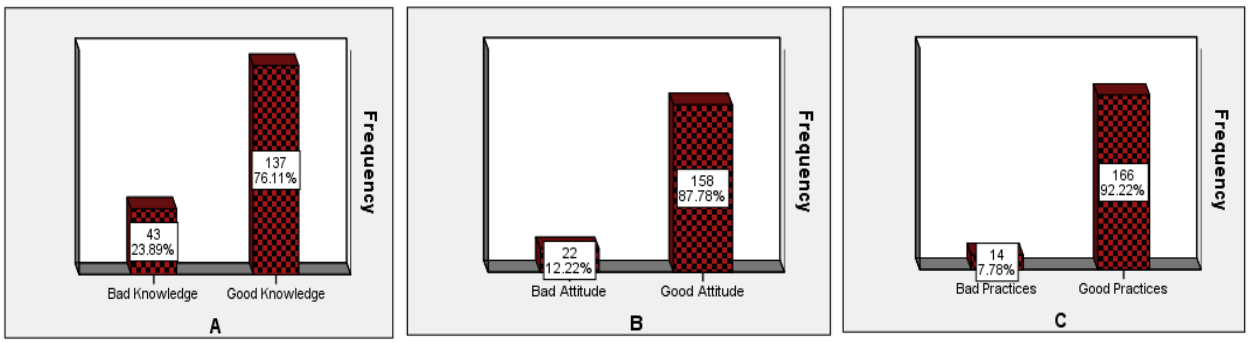

Figure: 1 Overall Knowledge, Attitude and Practices of study Participants

The table 2 presents the association between demographic factors and the Knowledge, Attitude, and Practices (KAP) scores among the study participants, with significance levels indicated by p-values. The scores for knowledge, attitude, and practices showed no statistically significant difference between male and female participants, as evidenced by p-values of 0.697, 0.154, and 0.803, respectively. This suggests that gender does not influence the KAP scores in this study. Participants from public and private hospitals exhibited no significant difference in their KAP scores, with p-values of 0.458, 0.722, and 0.213 for knowledge, attitude, and practices, respectively. A significant association was found between training and knowledge scores (p = 0.000), indicating that participants who received training had higher knowledge levels. However, no significant association was observed for attitude (p = 0.048) or practices (p = 0.760). Membership in a safety association was significantly associated with knowledge scores (p = 0.000), showing higher scores for members. However, attitude (p = 0.524) and practices (p = 0.093) were not significantly affected by this factor. No significant associations were found between participation in research projects and any of the KAP scores, with p-values of 0.577, 0.609, and 0.260 for knowledge, attitude, and practices, respectively. Knowledge scores were significantly associated with the availability of PPE (p = 0.013), suggesting that consistent availability improves knowledge. However, no significant associations were observed for attitude (p = 0.273) or practices (p = 0.450).

Table 2 : Association between Demographics and KAP Score

Variable		Knowledge			Attitude			Practices		
		*G	*B	*P	*G	*B	*P	*G	*B	*P
Gender	Male	115	35	.697	134	16	.154	138	12	.803
	Female	22	8		24	6		28	2	
Type of Facility	Public	63	17	.458	71	9	.722	76	4	.213
	Private	74	26		87	13		90	10	
Training Received	Yes	108	20	.000	118	11	.048	116	9	.760
	NO	29	23		40	11		50	5	
Staff members	Yes	105	19	.000	111	15	.524	118	8	.093
	NO	28	24		47	7		48	6	
Participation in Research Project	Yes	104	30	.577	121	13	.010	126	9	.609
	NO	33	13		37	9		40	5	
Availability of PPE	Always	110	30	.013	120	20	.273	128	12	.450
	Usually	9	7		14	2		14	2	
	Sometime	18	4		22	0		22	0	
	Never	0	2		2	0		2	0	

***G = Good, *B = Bad, *P = P-Value**

The ANOVA table 3 presents the results of a one-way analysis of variance conducted to examine whether the mean scores for different variables (responsibilities, knowledge, attitude, and practices) vary significantly across educational groups (BS/MLT, Diploma, and M.Phil).

For the variable **"Responsibilities in the Laboratory,"** the analysis indicates no significant differences between educational groups ($F = 0.802$, $p = 0.450$). This suggests that the perception of responsibilities in the laboratory is similar across the three groups.

For **"Knowledge,"** there is a significant difference between educational groups ($F = 4.720$, $p = 0.010$). This finding implies that the level of knowledge regarding biosafety and biosecurity practices varies significantly depending on the respondents' educational background.

Similarly, for **"Attitude,"** the results reveal a significant difference between the groups ($F = 4.582$, $p = 0.011$). This indicates that attitudes toward biosafety and biosecurity practices are influenced by the respondents' educational level.

Table: 4 Post-hoc analysis **(Tukey's HSD) to identify which specific groups differ.**

For **"Practices,"** the p-value is marginally above the significance threshold ($F = 2.965$, $p = 0.054$), suggesting that the reported practices related to biosafety and biosecurity do not differ significantly across educational groups but are close to showing a potential difference.

Table 3: One Way ANOVA comparing means of KAP score with Level of Education of Participants

		Sum of Squares	Df	Mean Square	F	Sig.
Knowledge	**Between Groups**	2.863	2	1.432	4.720	.010
	Within Groups	53.383	176	.303		
	Total	56.247	178			
Attitude	**Between Groups**	3.402	2	1.701	4.582	.011
	Within Groups	65.337	176	.371		
	Total	68.738	178			
Practices	**Between Groups**	2.625	2	1.313	2.965	.054
	Within Groups	77.914	176	.443		
	Total	80.539	178			

The Tukey HSD analysis in table 4 indicates that for the variable **"Knowledge,"** there are significant differences between specific groups. Diploma holders scored significantly lower compared to BS/MLT (mean difference = -0.28017, $p = 0.014$) and significantly higher than M.Phil holders (mean difference = 0.34535, $p = 0.039$). These findings suggest notable disparities in knowledge levels across education groups, highlighting that Diploma holders differ from both BS/MLT and M.Phil groups. For the variable **"Attitude,"** similar significant differences were observed. Diploma holders had significantly lower attitudes compared to BS/MLT (mean difference = -0.27812, $p = 0.032$) and significantly higher attitudes compared to M. Phil holders (mean difference = 0.42013, $p = 0.020$). This pattern suggests that attitudes towards biosafety and biosecurity practices also vary based on educational background. In contrast, for the variables **"Practices,"** no significant differences were identified between the educational groups (p-values > 0.05). This indicates that perceptions of responsibilities and reported practices in the laboratory are consistent regardless of educational level.

Dependent Variable	(I) level of education of the respondent	(J) level of education of the respondent	Mean Difference (I-J)	Std. Error	Sig.	95% C.I	
						Lower Bound	Upper Bound
Knowledge	**BS MLT**	Diploma	.28017	.0988	.014	-.5137	-.0466
		M.Phil	.06518	.1238	.859	-.2276	.3580
	Diploma	BS MLT	.28017	.0988	.014	.0466	.5137
		M.Phil	.34535*	.1403	.039	.0137	.6770
	M.Phil	BS MLT	-.06518	.123	.859	-.3580	.2276
		Diploma	-.34535*	.1403	.039	-.6770	-.0137
Attitude	**BS MLT**	Diploma	-.27812*	.1093	.032	-.5365	-.0198
		M.Phil	.14201	.1370	.555	-.1819	.4660
	Diploma	BS MLT	.27812*	.1093	.032	.0198	.5365
		M.Phil	.42013*	.1552	.020	.0532	.7871
	M.Phil	BS MLT	-.14201	.1370	.555	-.4660	.1819
		Diploma	-.42013*	.1552	.020	-.7871	-.0532
Practices	**BS MLT**	Diploma	-.23482	.1193	.123	-.5170	.0473
		M.Phil	.14435	.1496	.600	-.2094	.4981
	Diploma	BS MLT	.23482	.1193	.123	-.0473	.5170
		M.Phil	.37917	.1695	.068	-.0216	.7799
	M.Phil	BS MLT	-.14435	.1496	.600	-.4981	.2094
		Diploma	-.37917	.1695	.068	-.7799	.0216

***. The mean difference is significant at the 0.05 level.**

Table 5 presents the results of Spearman's Rank Correlation analysis, which measures the strength and direction of the relationship between Knowledge, Attitude, and Practices regarding biosafety and biosecurity among the respondents. The correlation coefficient between Knowledge and Attitude is **0.529**, indicating a moderate positive correlation. This means that as the level of knowledge increases, attitudes towards biosafety and biosecurity also tend to improve. This relationship is statistically significant at the **0.01 level** ($p < 0.01$). The correlation coefficient between Knowledge and Practices is **0.424**, signifying a moderate positive correlation. This implies that better knowledge is associated with improved biosafety and biosecurity

practices. The relationship is statistically significant at the **0.01 level** ($p < 0.01$). The correlation coefficient between Attitude and Practices is **0.664**, indicating a strong positive correlation. This suggests that a positive attitude significantly aligns with better implementation of biosafety and biosecurity practices. This relationship is also statistically significant at the **0.01 level** ($p < 0.01$).

Table: 5 Spearman's Rank Correlation Between Knowledge, Attitude, and Practices

			Knowledge	Attitude	Practices
Spearman's rho	**Knowledge**	Correlation Coefficient	1.000	.529**	.424**
		Sig. (2-tailed)	.	.000	.000
		N	180	180	180
	Attitude	Correlation Coefficient	.529**	1.000	.664**
		Sig. (2-tailed)	.000	.	.000
		N	180	180	180
	Practices	Correlation Coefficient	.424**	.664**	1.000
		Sig. (2-tailed)	.000	.000	.
		N	180	180	180

****. Correlation is significant at the 0.01 level (2-tailed).**

Discussion:

PPE Usage: While most participants reported using PPE, the consistency and appropriateness of its use varied. Some interviewees mentioned inconsistent adherence to PPE protocols, such as infrequent hand hygiene or improper glove use. Its the need of hour improved training and supervision to ensure consistent and correct PPE usage.

SOP Adherence: Adherence to Standard Operating Procedures (SOPs) inconsistent across participants. Many participants were unable to follow the SOPs.

Waste Management: While the importance of proper waste management was generally acknowledged, concerns were raised regarding inadequate waste disposal infrastructure and inconsistent practices. Some interviewees reported challenges in segregating waste appropriately and accessing appropriate disposal containers.

Challenges and Barriers to Effective Implementation:

Resource Limitations: A significant barrier identified by participants was the lack of adequate resources. Limitations in the availability of PPE, specialized equipment, and appropriate waste disposal facilities.

Inadequate Training: Many participants reported insufficient or outdated training on biosafety and biosecurity protocols. The training received was often perceived as theoretical and lacking practical application. This emphasizes the need for more comprehensive and engaging training programs that incorporate hands-on simulations and real-world scenarios.

Complacency and Risk Perception: Complacency and a perceived low risk were identified as significant challenges. Some interviewees reported a tendency to overlook safety protocols, particularly in routine tasks. This highlights the need for continuous reinforcement of awareness campaigns to maintain a high level of vigilance.

Training and Education Needs:

Effectiveness of Current Training: Participants reported mixed experiences with existing training programs. Some found the training informative, while others felt it was inadequate or outdated. There was a general consensus that training should be more interactive and engaging, incorporating practical exercises, case studies, and opportunities for hands-on experience.

Identifying Training Gaps: Participants expressed a need for more specific training on topics such as:

Risk assessment: Understanding the specific hazards associated with different biological agents and implementing appropriate control measures.

Incident response: Developing and practicing emergency response procedures in case of accidental spills or exposures.

Biosecurity threats: Understanding the potential threats to laboratory security, such as theft, misuse, and intentional release of biological agents.

Management Support and Leadership:

Variability in Management Support: The level of support received from management varied significantly across participants. Some reported strong support, with readily available resources and a culture of safety. Others reported a lack of support, with limited resources, inadequate communication, and insufficient attention to safety concerns.

Importance of Strong Leadership: Participants emphasized the crucial role of strong leadership in promoting a culture of safety. Effective leadership involves actively engaging with laboratory personnel, addressing safety concerns promptly, and ensuring compliance with safety protocols.

The findings of this study highlight several key areas for improvement in biosafety and biosecurity practices within the laboratory setting. These include:

Enhanced Training Programs: Implementing comprehensive and engaging training programs that address the specific needs and challenges of laboratory personnel. This includes incorporating practical exercises, hands-on simulations, and regular refresher courses to maintain awareness and competence.

Improved Resource Allocation: Ensuring adequate resources are available to support safe laboratory operations. This includes providing sufficient PPE, ensuring the availability of appropriate equipment and facilities, and allocating adequate budgets for safety-related upgrades and maintenance.

Strengthening Management Support: Fostering a strong safety culture through effective leadership, clear communication, and consistent enforcement of safety protocols. This includes actively addressing safety concerns, providing regular feedback, and recognizing and rewarding safe work practices.

Addressing Complacency: Implementing strategies to address complacency and maintain a high level of awareness and vigilance among laboratory personnel. This may include regular safety audits, near-miss reporting systems, and incorporating safety discussions into regular team meetings.

Tabulated Findings from Interviews

Definitions and Importance of Biosafety and Biosecurity

Interviewee	Definition of Biosafety	Definition of Biosecurity	Key Challenges Identified
Definitions and Importance of Biosafety and Biosecurity			
Participant 1	Measures to protect personnel.	Prevent unauthorized access to pathogens.	Lack of clarity on overlapping aspects.
Participant 6	Keeping oneself safe.	Protecting the environment from pathogens.	None directly identified.
Participant 7	Safety protocols for personnel.	Preventing theft or misuse of pathogens.	Inconsistent implementation.
Participant 8	Preventing lab accidents.	Security measures for biological agents.	Lack of access to advanced resources.
Participant 9	Worker safety.	Controlling pathogen access.	Lack of coordination.
Biosafety Levels and Risk Assessment			
Participant 2	Familiar with BSL-1 and BSL-2.	Regular but limited by equipment.	Lack of BSL-3 resources.
Participant 6	Implemented PPE in routine assessments.	Conducts personal audits for safety.	Infrastructure gaps noted.
Participant 9	Limited understanding.	Relies on senior staff.	Lack of training.
Participant 10	Moderate knowledge of levels.	Ad hoc assessments.	Limited technical expertise.
Use of Personal Protective Equipment (PPE)			
Participant 3	Gloves, masks, and lab coats.	Varies across departments.	Non-compliance.
Participant 6	Gowns, gloves, masks.	Strong adherence; management supports usage.	Limited resource availability in others.
Participant 9	Gloves, masks.	Adherence is low.	Lack of discipline.
Participant 10	Gloves, masks, lab coats.	Protocols followed moderately.	PPE shortages.
Training and Skill Development			
Participant 4	Attended basic and advanced workshops.	Lack of follow-up sessions.	Infrequent updates.
Participant 6	Attended numerous seminars.	Emerging risk topics not included.	Lack of updated curriculum.
Participant 7	Basic training only.	No advanced-level training.	No funding for training.
Participant 8	Attended relevant workshops.	Outdated training content.	No emphasis on updates.
Participant 9	Attended occasional training.	Practical aspects not covered.	Poor scheduling.

Participant 10	Basic training attended.	Limited practical exposure.	Lack of expert trainers.
Management and Infrastructure Support			
Participant 2	Moderate support.	Poor ventilation in labs.	Insufficient space.
Participant 3	Limited involvement.	Infrastructure gaps.	No maintenance budgets.
Participant 5	Minimal involvement in daily practices.	Outdated equipment, no biosafety officer.	Poor resource allocation.
Participant 6	Strongly supportive of PPE policies.	Infrastructure gaps noted.	Limited resources for compliance
Participant 7	Minimal engagement.	Broken equipment.	No repair schedules.
Participant 8	Rare interaction.	Outdated safety equipment.	Lack of attention to detail.

This qualitative study provides valuable insights into the perceptions and practices of laboratory personnel regarding biosafety and biosecurity. The findings highlight several key challenges and areas for improvement, including the need for enhanced training, improved resource allocation, and stronger management support. These findings have significant implications for laboratory managers, safety officers, and policymakers seeking to improve the safety and security of laboratory operations.

Biosafety requires a nation to maintain and protect its own safety. Laboratory biosecurity describes the protection, control, and accountability for Valuable Biological Materials agents and toxins within laboratories, in order to prevent their loss, theft, misuse, diversion of, unauthorized access, or intentional unauthorized release. The World Health Organization states that standard measure are intended to lower the risk of blood borne infection and other diseases from both known and unknown sources. They represent the fundamental stage of infection control.

Our study indicated that 76.11 % of the laboratory professionals had good knowledge in Peshawar regarding biosafety and biosecurity which is comparable to 49.1% observed in the study that was done by Wemboo Afiwa, Halatoko and Essozimnasondou in togo. This study does not support the findings of our study because in togo only 37.7% of the staff members had received formal training for biosafety and biosecurity.

Our study also indicated that 23.89% of the laboratory staff had poor knowledge of biosafety and biosecurity which is comparable to 18.7% in the study carried out by Tahar bajjou in Morocco. This study has almost the same result as ours but the participants in Morocco had less experience.

Our research suggested that 92.22% of the participants had good practice towards biosafety and biosecurity and a similar study was conducted in Yemen by Nabil Alabher which suggested that 59% had good practice because majority of the private hospital's participants had good practice towards biosafety and biosecurity than those of public hospitals

CONCLUSIONS:

The findings of this study provides a comprehensive overview of the demographic and professional characterestics as well as the knowledge,attitude and practice(KAP) related to biosafety and The findings biosecurity among laboratory technologist. The result indicate predominantly young and male workforce with higher proportion ton participant working in private hospitals. Most participants had a bachelor degree and biosafety officer constituted majority of technical staff rules. Notably, the study

highlight significant association between educational background, training and membership in safety association with knowledge and attitude underscoring the importance of formal education and professional development and shaping biosafety and biosecurity awareness.
Knowledge, attitude and practice were generally high among participants. The availability of personal protective equipment played an important role in knowledge of the participants.
Educational level impacted on knowledge and attitude especially with those having diploma degree but practice were generally same among all educational level which means that educational level does not affect practice among participants.

LIMITATIONS:
We were not able to recruit the number of male and female equally in our study.
the sample size were not distributed equally to all the education level participants.
The sample size for the interviews were small.

Recommendation:
The participants need to pay attention to the use of personal protective equipments and get training on biosafety and biosecurity.
The participants practices needs to be checked on regularly by the inspection team.
trainings and workshops for biosafety and biosecurity needs to be arranged for the laboratory professionals.

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