Laboratory Safety Climate Assessment and its Correlation with Safety Procedures Amongst Staff of a Reference Clinical Laboratory

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ABSTRACT

Objective: To compare and correlate safety climate standards and safety practices among different subspecialities of pathology.

Study Design: Cross-sectional study.

Place and Duration of the Study: The study was conducted at Armed Forces Institute of Pathology, Rawalpindi, Pakistan, from February to November 2022.

Methodology: Responses of 199 participants were recorded according to the validated Nordic Safety Climate Questionnaire (NOSACQ-50) and Lab Safety Survey form. The safety climate presented as seven dimensions according to the validated questionnaire was compared among different workgroups, based on subspeciality and job designation, using one-way ANOVA and independent sample t-test, respectively. Pearson's correlation was used to assess the relationship between the safety climate and safety practices.

Results: Among the safety climate dimensions, safety communication, trust in co-workers' safety competence (M=3.02) and workers trust in efficacy of safety systems (M=3.00) were the most positively perceived aspects followed by management's safety priority (M=2.98). Comparison of subspecialities showed significant differences in management safety empowerment, management safety justice, workers' safety commitment, safety communication, and trust in efficiency of safety systems ($p<0.001$ for all 5 factors). Chemical pathology workers and technical staff were workgroups with lower safety climate scores. A statistically significant positive correlation ($r=0.97$) was observed between the safety procedures and safety climate at an organisational level.

Conclusion: The results demonstrated the existence of a good safety climate within the participating laboratories of the institute. It successfully identified areas that need further safety improvements. The study will help increase awareness about occupational safety and safety culture among healthcare workers in general and clinical laboratory setups in particular.

Key Words: *Laboratory safety climate, Occupational health, Safe laboratory practices.*

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INTRODUCTION

Healthcare workers by virtue of the nature of job and the workplace environment are exposed to many biological and non-biological hazards which effect their mental health and social well-being.[1] Persons working in clinical laboratories form a small chunk of health work force. Their role is essential for assessment of health and diagnosis, prevention, or treatment of disease. Laboratory personnels handle a diverse range of specimens, including tissue samples, body fluids, hazardous substances and high-end equipment with increased risk of biological and physical hazards.[2]

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Regulatory bodies such as the Occupational Safety and Health Administration (OSHA), the Clinical and Laboratory Standards Institute (CLSI), and the College of American Pathologists (CAP) have made laboratories increasingly safe by setting guidelines and promulgating safety rules and regulations to mitigate these hazards. Guidelines and recommendations, including engineering controls, personal protective equipment use, hazard communication, and chemical and waste management to ensure laboratory, can provide results that are accurate and reliable while maintaining a safe work environment.[3]

Maintenance of good laboratory practices that are in line with the guidelines can be achieved if laboratory management and personnel are safety-conscious and have commitment to follow safety rules.[4,5] In this regard, safety climate which is the shared attitudes, perceptions, and behaviours of workgroup regarding safety within their workplace has been evaluated as a useful tool in improving safety performance in a workgroup.[6] The components of positive safety climate include leadership demonstrating a visible commitment to safety, providing neces-

sary resources, engaging employees in safety-related activities and decision-making processes, reporting and learning from safety incidents, recognising and acknowledging safe behaviours, comprehensive safety training programmes for personnels.[7] The previous studies have reported institutions with strong safety climate that focus on improving employee's safety and workers with good compliance to the standard precautions.[8] In the clinical laboratory setting, while adherence to safety protocols and practices has been traditionally emphasised, it is important to recognise the crucial factors that promote or influence a culture of safety and minimise risks. In Pakistan, a healthcare setup overall faces numerous challenges.[9] Generally, healthcare workers' safety is a neglected area. Laboratory safety practices have been assessed in different studies and results have shown that there is a lack of awareness about good and hygienic laboratory practices constraining the workers to work under unsatisfactory conditions in the clinical laboratories nationwide.[10] There is paucity of data on various components that contribute to the overall safety culture and practices.

This study aimed to assess safety climate in a clinical laboratory and investigate its correlation with safety practice, and compare the safety climate among different subspecialities of pathology to understand the challenges and opportunities for enhancing safety and mitigating potential hazards based on the different subspecialities.

METHODOLOGY

A cross-sectional study was conducted at haematology, microbiology, histopathology, and chemical pathology departments of the Armed Forces Institute of Pathology (AFIP), from February to November 2022. An approval was taken from the Institution Review Board of AFIP (IRB # FC-CHP-11/READ-IRB/22/844) and informed consents were signed by all participants. The current study used prevalence reported in the previous study, population proportion of 50%, confidence interval of 95%, and margin of error 5%. The sample size for 398 laboratory workers of the institute came out to be 195 by WHO sample size calculator.[11]

Validated Nordic Safety Climate Questionnaire (NOSACQ-50) and laboratory safety practices form adapted from WHO Lab Safety Manual were used as a research tool.[12,13] The NOSACQ-50 comprised of 50 items across seven safety climate dimensions to measure the participant's shared safety climate, the first three items pertain to the workgroup and managements' safety policies, while the remaining four items were related to employees' safety commitments (training, communication, and competency).[7] The laboratory safety practices form contained 15 questions pertaining to hand hygiene, chemical hygiene, waste disposal, use of personal protective equipment, ergonomics, and injuries record.[12] A four-point Likert scale was used to rate each item on the questionnaire. The validity of the questionnaire was tested by conducting a pilot study from February to April 2020. Acceptability and understanding for all components were assessed and found feasible for the selected population. The internal-consistency reliability of the safety climate questionnaire was tested with Cronbach's alpha for 7 dimensions of safety climate, and it was 0.77, indicating statistical reliability of the research tool. The inclusion criteria was workers with a minimum of one year of laboratory work experience and with duties of laboratory technologists, and assistants or doctors in haematology, microbiology, histopathology, and chemical pathology labortories of AFIP. The exclusion criteria was persons assigned non-technical duties like receptionists, helpers, and clerical staff. All the responses were divided into four groups based upon subspeciality (haematology, microbiology, histopathology, and chemical pathology). Non-probability convenient sampling technique was used to collect the data from all participants. The collected data was analysed using Microsoft Excel 2019 and Statistical Package for Social Sciences (SPSS) version 25. Frequencies and percentages were used to describe demographic data. Comparison of safety climates and safety practices of subspecialities were assessed with one-way ANOVA followed by post-hoc Tukey HSD test whereas independent sample t-test was used for comparison between technicians and doctors. A p-value of less than 0.05 was considered statistically significant. Pearson correlation was used to see the correlation between safety climate and safety practices among all individuals. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 199 personnel responses were included in the study. The respondents were 44% (n=87) doctors and 56% (n=112) technicians from four subspecialities of pathology. Out of all participants 62.8% (n=125) were males and 37.2% (n=74) were females. The mean age was observed to be 31.3 ± 5.88 years ranging from a minimum of 22 years to a maximum of 50 years. The mean laboratory work experience of the participants was 3 years with a minimum of 1 year and a maximum of 20 years.

Figure 1 illustrates safety climate of four subspeciality workgroups. The department of histopathology had the most positive safety climate followed by microbiology and haematology departments. The safety climate of chemical pathology was significantly low in comparison to other specialities. Workers' trust in efficacy of safety systems, their commitment to safety, safety communication and learning had higher mean scores among the safety dimensions.

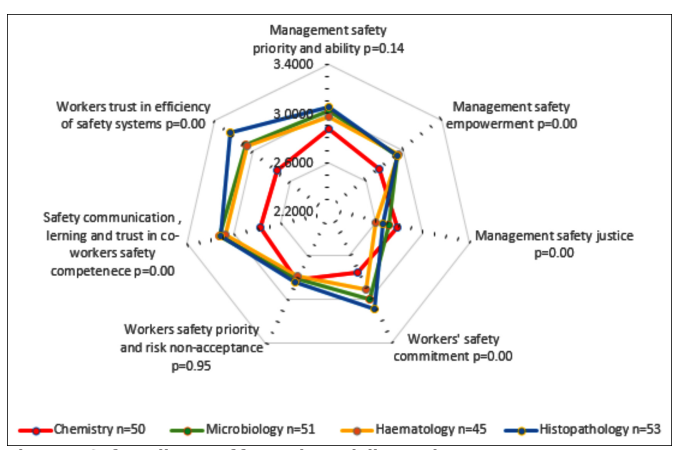

Figure 1: Safety climate of four subspeciality work group.

Table I: Comparison of safety climate dimensions according to the subspeciality.

Safety Dimension	Chemistry n=50 (25.6%) Mean ± SD	Microbiology n=51 (26.1%) Mean ±SD	Haematology n=45 (23%) Mean ± SD	Histopathology n=53 (27%) Mean ± SD	p-value	Inter sub/speciality difference	p-value
Management safety priority	2.87 ±0.42	3.02 ±0.44	2.97 ±0.46	3.05 ±0.33	0.14	-	-
Management safety Empowerment	2.54 ±0.29	2.92 ±0.34	2.95 ±0.41	2.93 ±0.43	<0.001	Chemistry, Microbiology Chemistry, Haematology Chemistry, Histopathology	<0.001 <0.001 <0.001
Management safety justice	2.48 ±0.27	2.71 ±0.31	2.59 ±0.29	2.66 ±0.33	<0.001	Chemistry, Microbiology Chemistry, Histopathology	0.001 0.020
Workers' safety commitment	2.75 ±0.36	2.99 ±0.41	2.91 ±0.46	3.08 ±0.44	<0.001	Chemistry, Microbiology Histopathology, Chemistry	0.026 0.001
Workers safety priority and risk non-acceptance	2.82 ±0.39	2.81 ±0.53	2.79 ±0.38	2.84 ±0.38	0.95	-	-
Safety learning and trust in co-workers safety	2.78 ±0.25	3.12 ±0.36	3.07 ±0.47	3.12 ±0.36	<0.001	Chemistry, Microbiology Haematology, Chemistry Histopathology, Chemistry	<0.001 0.001 <0.001
Workers trust in efficiency of safety systems	2.64 ±0.35	3.06 ±0.40	3.06 ±0.61	3.24 ±0.34	<0.001	Chemistry, Microbiology Histopathology, Chemistry Haematology, Chemistry	<0.001 <0.001 <0.001

*One-way ANOVA (between chemical pathology, haematology, histopathology and microbiology); *Significant (p<0.05).*

Table II: Comparison of safety climate dimensions according to the job designation.

Safety Dimension	Doctors n=87 (44%) Mean ±SD	Technicians n=112 (56%) Mean ±SD	p-value
Management safety priority	3.06 ± 0.44	2.91 ± 0.39	0.01*
Management safety empowerment	2.79 ± 0.44	2.87 ± 0.37	0.14
Management safety justice	2.57 ± 0.28	2.65 ± 0.33	0.06
Workers' safety commitment	3.02 ± 0.45	2.87 ± 0.41	0.02*
Workers safety priority and risk non-acceptance	2.99 ± 0.40	2.68 ± 0.39	<0.001*
Safety learning and trust in co-workers safety	3.01 ± 0.42	3.03 ± 37	0.78
Workers trust in efficiency of safety systems	3.00 ± 0.50	3.00 ± 46	0.93

*Independent sample t-test (between Technician and Registrar); *Significant (p<0.05). The mean safety climate was calculated as an average of all seven dimensions from all respondents. Pearson correlation was applied to test if statistically significant positive correlation existed between safety practices and safety climate scores within the institution. The r-value of 0.91 was obtained which indicates a strong correlation.*

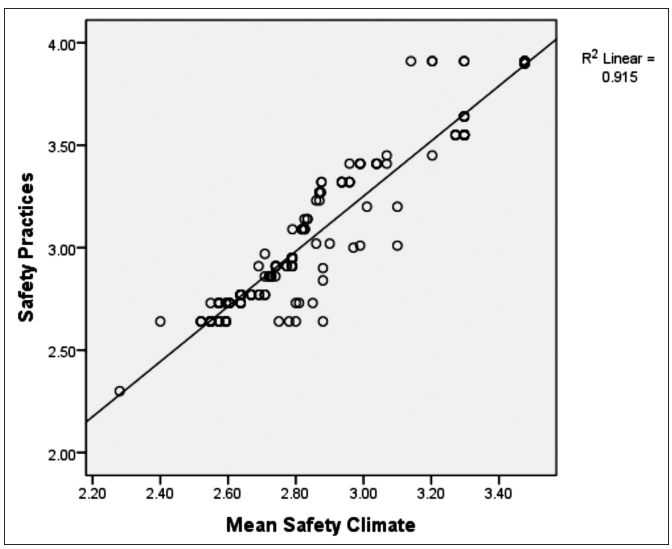

Figure 2: Correlation between safety climate and safety practices.

The post-hoc Tukey HSD test was then used to examine which specific pairs of means are significantly different with respect to 5 dimensions identified by ANOVA at 5% significant level. The difference in the average scores of 5 testable factors comparing respondents from subspecialities is shown in Table I.

In order to investigate safety climate divergences between doctors' and technicians' responses, an independent sample t-test was used. The doctors showed high level of safety climate as shown in Table II. There was a significant difference in the safety commitment, prioritising safety and risk non-acceptance. The doctors' perception about management safety priority is also better as compared to the technicians. However, there is no significant difference between the doctors and technicians for the remaining factors.

DISCUSSION

The purpose of the current study was to compare and correlate safety climate with safety practices among different subspeciality and workgroups in a clinical laboratory. The validated research tool (NOSACQ-50) was used to achieve the goal. The results of the study demonstrated positive safety climate within the laboratories. The current result reflects that workgroups have compatible standards of qualification and knowledge pertaining to safety and workers positively understand the practice of safety trainings, safety inspections of the organisation and believe that the management is positively concerned for well-being of its employees (Figure 2).

The result of this study showed that the histopathology and microbiology laboratories had comparable safety climate scores, followed by haematology whereas the chemical pathology laboratory had low safety climate. A systemic

review of healthcare professionals' perceptions on patient safety by Okuyama *et al.* reported similar findings that safety climate may differ among different subspeciality units of the same organisation.[13] Singer *et al.* worked on patient safety climate across 92 US hospitals. This study has reported differences among respondents according to the work disciplines.[14] The emergency department workgroup in this study was identified as having low safety climate which was likely due to the fast pace of work in the department. Similarly, significant differences among the chemical pathology and other three groups in the current study can be attributed to high-workload and short test report turn-around time in chemical pathology laboratories. Additionally, the frequent use of fully automated analyzers to match workload need in chemistry laboratories as compared to direct contact with specimens and bio-hazard faced among other subspecialities might have a role.[15]

Kristensen, *et al.* reported that the clinical personnels with a managerial position have a more positive perception of safety than frontline clinicians.[16] This observation is comparable with the findings of the current study. These showed that doctor's response about management safety priority, own safety priority, and risk of non-acceptance were more positive as compared to that of laboratory technicians. This is most likely due to higher education and more safety awareness among doctors. Similar findings of suboptimal safety practices among frontline staff have been observed in a study by Jan Muhammad *et al.*[17] The study attributed the observations to lack of training and low education of technical staff.

Clinical laboratory safety research from Pakistan has reported the need for improvement in safety practices in the clinical laboratories though better performance was observed by laboratories that were accredited or certified which highlights the importance of institutional policies on safety outcomes.[18,19] Though there have been studies on laboratory safety in Pakistan, compliance to safety rules has been the only outcome reported, whereas in the current study, focus on safety climate evaluation is also a determinant of safety outcomes. The relationship has been studied previously in healthcare professionals in the international literature, and each study came to the conclusion that fostering positive safety climate has a favourable impact on workplace and outcomes. The current study has comparable results which indicated positive correlation between safety climate and safety practices in a laboratory setup.[20,21]

This study identified management safety justice as a weak dimension with average safety dimension score of 2.48, 2.71, 2.59, and 2.66 among the chemistry, microbiology, haematology, and histopathology laboratory, respectively. The dimension reflects workers' perceptions regarding fair management dealing in case of safety-related problems and ensuring safe work practices in all working conditions.

The current study has focused on neglected aspect of safety climate in addition to safety practices alone. Responses from different specialities of pathology were included across climate dimensions including management and personnel-related aspects with findings suggesting that in addition to placement of safety rules and their enforcement efforts for enhancement of safety climate by improving policies, encouragement of workers towards safety participation is a proactive approach that may significantly improve safety practices. However, multicentred studies with advanced research design and with further assessment of different outcomes are recommended.

CONCLUSION

The study revealed a strong correlation between safety climate and safety practices where safety practices are dependent on safety climate and improvement in overall safety climate.

ETHICAL APPROVAL:
An ethical approval was taken from Institutional Review Board prior to study (IRB # FC-CHP-11/READ-IRB/22/844).

PARTICIPANTS' CONSENT:
Informed consent was taken from all participants of the study.

COMPETING INTEREST:
The authors did not have any competing interest to declare.

AUTHORS' CONTRIBUTION:
MR, ZH: Worked on literature review, selecting study design data collection, data analysis, manuscript writing.
MU, SI: Worked on results analysis and interpretation of data.
MA, MY: Provided critical review for approval of the version to be published.
All authors approved the final version of the manuscript to be published.

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