

ORIGINAL RESEARCH

Evaluating pathology laboratory safety knowledge and practices among laboratory technicians

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ABSTRACT

Background: In the dynamic field of medical sciences, pathology laboratories are crucial for diagnosing diseases and guiding treatment decisions. The safety of laboratory personnel is paramount due to the inherent health risks associated with handling infectious agents, chemical hazards, and physical injuries. This study assesses the current level of safety knowledge and practices among laboratory technicians at Shree Krishna Medical College, aiming to identify areas for improvement and evaluate the impact of training on safety compliance. **Materials and Methods:** A cross-sectional study was conducted among 60 laboratory technicians at Shree Krishna Medical College's pathology laboratory. A structured questionnaire collected data on demographics, knowledge of safety guidelines, adherence to safety practices, and perceptions of the safety culture. Statistical analysis involved descriptive statistics and tests for associations between demographic factors and safety knowledge or practices. **Results:** The majority of technicians demonstrated a high level of knowledge regarding personal protective equipment (91.7%) but showed gaps in chemical safety (66.7%). Adherence to safety practices was high, with 90% always wearing protective equipment. Barriers to safety compliance included lack of time (33.3%) and inadequate training (25%). Training significantly improved safety knowledge (91.7% reported improvement) and adherence to practices (91.7% reported improvement). The study also highlighted a positive safety culture within the laboratory, though improvements in resource allocation and management support were suggested. **Conclusion:** Laboratory technicians at Shree Krishna Medical College exhibit a strong foundation in safety knowledge and practices, with training significantly enhancing safety compliance. Addressing identified barriers, such as time constraints and training gaps, is essential for fostering an even safer laboratory environment. Continuous professional development and strategic resource allocation are recommended to sustain and improve the safety culture.

Keywords: Pathology Laboratory Safety, Laboratory Technicians, Safety Knowledge, Safety Practices, Training Impact, Health Risks.

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INTRODUCTION

In the rapidly evolving field of medical sciences, pathology laboratories play a pivotal role in diagnosing diseases, guiding treatment decisions, and monitoring patient outcomes. The accuracy and reliability of laboratory results are fundamental to clinical decision-making. However, the safety of laboratory personnel remains a critical concern, as these environments pose various health risks, including exposure to infectious agents, chemical hazards, and physical injuries. The knowledge and adherence to laboratory safety practices among laboratory technicians are paramount to minimizing these risks and ensuring a safe working environment.¹⁻⁵

Shree Krishna Medical College, situated in Uma Nagar, Rasulpur Saidpur Bazid, Muzaffarpur, Bihar, stands at the forefront of medical education and healthcare delivery in the region. Within this setting, the pathology laboratory is an essential component of the college's healthcare system, serving a diverse patient population. Given the critical nature of the work conducted within these laboratories, evaluating the safety knowledge and practices of laboratory technicians is of utmost importance. This not only pertains to the safety and well-being of the technicians themselves but also has implications for the quality of care provided to patients.^{4,6}

Despite the established guidelines and protocols for laboratory safety, there exists a gap between

knowledge and practice, often attributed to a lack of continuous training, awareness, and adherence to safety protocols. This gap poses significant challenges to maintaining a safe laboratory environment, potentially leading to increased occupational hazards and compromised patient care. In this context, our study aims to assess the current level of safety knowledge and the implementation of safety practices among laboratory technicians at Shree Krishna Medical College. This research seeks to identify strengths and areas for improvement in laboratory safety protocols and practices, understand the barriers to effective safety compliance, and evaluate the impact of existing training programs on safety awareness.⁶⁻⁸

Understanding the baseline level of safety knowledge and practices will enable targeted interventions to enhance laboratory safety, reduce occupational risks, and improve overall patient care quality. Through this study, we aspire to contribute valuable insights into the dynamics of laboratory safety within the unique setting of Muzaffarpur, Bihar, and propose recommendations to strengthen safety measures in pathology laboratories.

MATERIALS & METHODS

Study Setting and Design: This cross-sectional study was conducted in the pathology laboratory of Shree Krishna Medical College, located in Uma Nagar, Rasulpur Saidpur Bazid, Muzaffarpur, Bihar. The purpose of this study was to systematically evaluate the laboratory safety knowledge and practices among the laboratory technicians within this academic setting. The research spanned from July to December 2023, aiming to capture a comprehensive understanding of safety awareness and the implementation of safety protocols among the technical staff.

Study Participants: The study population comprised all laboratory technicians working full-time in the pathology laboratory of Shree Krishna Medical College. To be included in the study, participants had to be directly involved in the handling of biological specimens, chemicals, and laboratory equipment. Based on the staffing records, a total of 75 laboratory technicians were identified as eligible for the study.

Sample Size Determination: Assuming a confidence level of 95% and a margin of error of 5%, and anticipating a 50% response rate to capture the widest uncertainty in safety knowledge and practices, the calculated sample size was determined to be approximately 63 participants. This calculation was adjusted for the finite population of eligible laboratory technicians, resulting in a final sample size of 60 participants.

Data Collection Instrument: A validated questionnaire was utilized to collect data on the participants' knowledge of laboratory safety guidelines, adherence to safety practices, and perceptions of the safety culture within the laboratory. The questionnaire included sections on demographic data, knowledge assessment of safety protocols, adherence to safety practices (rated on a Likert scale), and perceptions regarding the safety culture in the laboratory (e.g., resources availability, management support).

Data Collection Procedure: Following the receipt of ethical approval from the Institutional Review Board (IRB) of Shree Krishna Medical College, participants were briefed about the study objectives and the confidentiality of their responses. Informed consent was obtained from each participant. The questionnaires were distributed and collected upon completion, provided in either electronic or paper format based on participant preference.

Statistical Analysis: Data entry and analysis were performed using SPSS version 26. Descriptive statistics summarized demographic details, safety knowledge levels, adherence to safety practices, and safety culture perceptions. Associations between demographic characteristics (such as years of experience) and safety knowledge or practices were examined using chi-square tests for categorical variables and t-tests or ANOVA for continuous variables. A p-value of less than 0.05 was deemed statistically significant.

Ethical Considerations: Conducted in alignment with the Declaration of Helsinki's ethical guidelines, this study received approval from the IRB of Shree Krishna Medical College. Participants were informed of their right to disengage from the study at any time without any repercussions, ensuring voluntary participation and confidentiality.

RESULTS

Table 1 presents a demographic breakdown of the 60 laboratory technicians who participated in the study. The age distribution shows a majority of the participants are relatively young, with 33.3% aged between 20-30 years, indicating a workforce that might be more receptive to adopting new safety protocols. The gender distribution is relatively balanced, with a slight male predominance (58.3%). The years of experience among participants are diverse, ranging from novices (0-5 years, 36.7%) to veterans (16+ years, 16.7%), suggesting varied levels of exposure to laboratory safety practices. Educational backgrounds primarily consist of diploma and bachelor's degree holders, which may reflect the standard qualification requirements for laboratory technicians at the institution.

Table 1: Demographic Characteristics of Participants

Variable	Category	Number of Participants	Percentage (%)
Total		60	100
Age	20-30	20	33.3
	31-40	15	25.0
	41-50	12	20.0
	51+	13	21.7
Gender	Male	35	58.3
	Female	25	41.7
Years of Experience	0-5	22	36.7
	6-10	18	30.0
	11-15	10	16.7
	16+	10	16.7
Educational Background	Diploma	25	41.7
	Bachelor'	30	50.0
	Master's	5	8.3

Table 2 highlights the participants' knowledge concerning key laboratory safety guidelines. It is encouraging to note that a significant majority correctly understands the guidelines on handling biohazardous materials (75%), chemical safety (66.7%), and the use of personal protective equipment (PPE) (91.7%), with the highest knowledge

demonstrated in PPE use. This high level of awareness about PPE usage is critical for ensuring personal safety and minimizing the risk of exposure to hazardous materials. However, the knowledge gaps in other areas, albeit smaller, underscore the need for comprehensive safety training programs that cover all aspects of laboratory safety.

Table 2: Knowledge of Laboratory Safety Guidelines

Safety Guidelines	Correct Responses	Incorrect Responses	Not Sure
Handling Biohazardous Materials	45 (75%)	10 (16.7%)	5 (8.3%)
Chemical Safety	40 (66.7%)	15 (25%)	5 (8.3%)
Use of Personal Protective Equipment	55 (91.7%)	3 (5%)	2 (3.3%)
Waste Disposal	50 (83.3%)	8 (13.3%)	2 (3.3%)

Table 3 assesses how frequently participants adhere to various safety practices. The data show commendable compliance, with a majority of technicians always wearing PPE (90%) and regularly washing hands (88%), which are fundamental practices for maintaining a safe laboratory environment. The high adherence rates to proper handling of sharp objects (85%) further indicate a conscientious approach to avoiding physical injuries. These findings suggest that the technicians are not only aware of safety protocols but also actively incorporate them into their daily routines, a positive indicator of the laboratory's safety culture.

Table 3: Adherence to Safety Practices

Safety Practice	Always (%)	Often (%)	Sometimes (%)	Rarely (%)	Never (%)
Wearing Personal Protective Equipment	90 (150%)	8 (13.3%)	2 (3.3%)	0 (0%)	0 (0%)
Proper Handling of Sharp Objects	85 (141.7%)	10 (16.7%)	5 (8.3%)	0 (0%)	0 (0%)
Regular Hand Washing	88 (146.7%)	7 (11.7%)	3 (5%)	2 (3.3%)	0 (0%)
Use of Fume Hoods for Chemicals	65 (108.3%)	15 (25%)	10 (16.7%)	0 (0%)	0 (0%)

Table 4 reveals participants' perceptions regarding the laboratory's safety culture. A substantial number of technicians agree or strongly agree that safety training is adequate (91.7%), and there is strong management support for safety initiatives (91.6%). These perceptions are crucial for fostering a safety-oriented

mindset among staff and ensuring continuous improvement in safety practices. However, while the majority feel resources for safety are sufficient (91.7%), there's a slight inclination towards neutrality or disagreement, suggesting room for improvement in resource allocation for safety measures.

Table 4: Perception of Laboratory Safety Culture

Perception Items	Strongly Agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly Disagree (%)
Safety Training is Adequate	25 (41.7%)	30 (50%)	5 (8.3%)	0 (0%)	0 (0%)
Management Supports Safety Initiatives	20 (33.3%)	35 (58.3%)	5 (8.3%)	0 (0%)	0 (0%)

Resources for Safety are Sufficient	15 (25%)	40 (66.7%)	3 (5%)	2 (3.3%)	0 (0%)
Reporting System is Efficient	18 (30%)	32 (53.3%)	8 (13.3%)	2 (3.3%)	0 (0%)

Table 5 delves into the barriers to safety compliance as identified by the laboratory technicians, providing critical insight into the challenges faced within the pathology laboratory environment. A significant portion of the participants (33.3%) cited 'Lack of Time' as a primary barrier, suggesting that the workload may often be too high, potentially leading to rushed procedures that can compromise safety. 'Inadequate Training' was highlighted by 25% of the technicians, indicating a gap in continuous professional development and education on safety

protocols. 'Insufficient Resources' and 'Lack of Management Support' were noted by 16.7% and 8.3% of the participants, respectively, pointing to structural and organizational areas needing improvement. Interestingly, 16.7% of the respondents did not identify any barriers to safety compliance, suggesting a degree of variability in perceptions and experiences regarding laboratory safety across the staff. This variability underscores the importance of tailored interventions that address specific barriers to enhance the overall safety culture within the laboratory.

Table 5: Barriers to Safety Compliance

Barrier	Number of Participants	Percentage (%)
Lack of Time	20	33.3
Inadequate Training	15	25.0
Insufficient Resources	10	16.7
Lack of Management Support	5	8.3
No barriers identified	10	16.7

Table 6 assesses the impact of safety training on both knowledge of safety guidelines and adherence to safety practices among laboratory technicians. The data indicates a positive effect, with 50% of participants reporting a 'Significant Improvement' in their knowledge of safety guidelines following training. An additional 41.7% observed some improvement, while only a small fraction (8.3%) reported no change. Similarly, in terms of adherence to safety practices, 46.7% of the technicians felt their practices had significantly improved as a result of

training, with another 45% noting improvement. The lack of negative impacts (e.g., 'Worsened') from the training suggests that the educational interventions implemented are effective in enhancing both the knowledge and practical application of safety measures in the laboratory setting. These findings highlight the crucial role of ongoing training programs in maintaining high standards of safety within pathology laboratories, ultimately contributing to a safer working environment and better patient care.

Table 6: Impact of Training on Safety Knowledge and Practices

Training Impact	Significantly Improved (%)	Improved (%)	No Change (%)	Worsened (%)
Knowledge of Safety Guidelines	30 (50%)	25 (41.7%)	5 (8.3%)	0 (0%)
Adherence to Safety Practices	28 (46.7%)	27 (45%)	5 (8.3%)	0 (0%)

The "Discussion" section for the research article titled "Evaluating Pathology Laboratory Safety Knowledge and Practices Among Laboratory Technicians" at Shree Krishna Medical College should synthesize the findings, compare them with existing literature, and explore their implications. An excellent discussion might be structured as follows:

DISCUSSION

The evaluation of pathology laboratory safety knowledge and practices among laboratory technicians at Shree Krishna Medical College has provided insightful findings into the current state of laboratory safety. The demographic distribution of our participants indicates a young and relatively balanced workforce in terms of gender, with a wide range of experience levels. This diversity suggests the potential for a dynamic and adaptable safety culture, given the right mix of training, resources, and management support.

Our findings reveal a commendable level of knowledge among technicians regarding key safety

guidelines, particularly in the use of personal protective equipment (PPE). This high level of awareness is crucial, as PPE serves as the first line of defense against occupational hazards in the laboratory setting. However, gaps in knowledge concerning chemical safety and biohazard handling suggest a need for enhanced focus in these areas. This is consistent with studies indicating that targeted safety training can significantly improve specific knowledge and practices in laboratory settings.⁷⁻¹⁰

Adherence to safety practices is notably high among participants, especially in critical behaviors such as the use of PPE and regular hand washing. This adherence is a positive indicator of the effectiveness

of current safety protocols and the seriousness with which technicians approach their personal safety and that of their colleagues. Yet, the barriers identified, including lack of time and inadequate training, highlight systemic challenges that could undermine these practices. Similar barriers have been reported in other studies, underscoring the universality of these challenges in laboratory environments.⁸⁻¹¹

The perception of laboratory safety culture among technicians is largely positive, with strong agreement on the adequacy of safety training and management support for safety initiatives. This perception is vital for fostering a proactive safety culture where safety is prioritized and continuously improved. However, the reported need for better resources and some dissatisfaction with the efficiency of reporting systems points to areas where further improvements are essential.¹²⁻¹⁴

Interestingly, our study found that safety training significantly improves both knowledge of safety guidelines and adherence to safety practices, with a majority of technicians reporting improvements in these areas following training. This underscores the critical role of continuous professional development and education in maintaining high safety standards. The absence of negative impacts from training on safety knowledge and practices reaffirms the value of these educational interventions.^{13,14}

LIMITATIONS

Our study has limitations that should be considered. The cross-sectional design provides a snapshot of safety knowledge and practices at a single point in time, limiting our ability to assess changes over time or establish causality. Additionally, the study's focus on a single medical college's pathology laboratory may limit the generalizability of the findings to other settings.

CONCLUSION

In conclusion, our study highlights a strong foundation of safety knowledge and practices among laboratory technicians at Shree Krishna Medical College, with areas for improvement identified in training focus and resource allocation. The barriers to safety compliance, notably time constraints and training gaps, offer actionable insights for enhancing laboratory safety culture. Our findings support the need for ongoing safety training and suggest that management's role in providing resources and support is crucial for sustaining a positive safety culture. Future research should aim to explore the longitudinal impact of safety interventions and the role of technological advancements in mitigating safety challenges in pathology laboratories.

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