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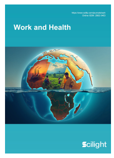

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From Incident to Insight: Impact of a Modular Re-Training Approach in a Histopathology Laboratory of a Category I Hospital in Kuching, Sarawak, Malaysia [†]

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Abstract: Chemical splash injuries are a preventable occupational hazard in histopathology laboratories. Despite regulatory frameworks, including the Occupational Safety and Health Act 1994 and Use and Standard of Chemicals Hazardous to Health (USECHH) Regulations 2000, compliance gaps persist. This study evaluated the impact of a modular re-training program combined with a structured chemical safety assessment on laboratory safety practices in a Category I hospital in Kuching, Sarawak, Malaysia. The study was prompted by a chemical splash injury to the right eye of a 27-year-old female Medical Laboratory Technologist while handling a femur bone-marrow biopsy specimen fixed in formalin and transferred to Osteosoft (an alkaline decalcifying agent, corrosive—GHS05, pH 7.0–7.3). Root-cause analysis identified inadequate personal protective equipment (PPE) use and unsafe container handling. Methodology: A modular re-training program was implemented, focusing on chemical safety, correct PPE use, safe container handling, emergency response, and legal responsibilities by adapting the Lean Six Sigma DMAIC framework. A nine-domain chemical safety checklist, adapted from institutional resources, assessed documentation, engineering controls, adherence to Safe Work Procedures (SWP), PPE, handling, storage/waste management, emergency preparedness, training/monitoring, and legal compliance. Each item was scored 0–2 (0 = non-compliant; 1 = partial; 2 = fully compliant), with total compliance categorized as <70% = Unsatisfactory, 70–89% = Acceptable, ≥90% = Good. Results: Post-training, overall compliance improved from 65.6% (Unsatisfactory) to 100% (Good). Staff achieved full PPE compliance, improved adherence to SWP, enhanced hazard awareness, and no recurrence of incidents over three months. Discussion: The modular re-training reinforced safe practices through focused, repetitive instruction, while assessment scores enabled objective monitoring and accountability. It is recommended that to implement periodic (e.g., quarterly) modular re-training for all histopathology staff focusing on high-risk chemicals, PPE requirements, safe container handling, and emergency response. This ensures continuous reinforcement of safety-critical behaviours. Conclusion: Combining modular re-training with systematic safety assessment strengthened compliance, fostered a culture of safety, and supported sustained safe chemical handling practices.

Keywords: laboratory safety; chemical exposure; training; regulatory; lean; six sigma

1. Introduction

Chemical hazards remain a significant occupational risk in healthcare laboratory settings, particularly in histopathology laboratories where workers are routinely exposed to fixatives, solvents, and decalcifying agents [1,2]. These substances, including formalin and alkaline decalcifying solutions, possess corrosive and toxic properties that can lead to acute injuries such as chemical burns and eye irritation, as well as long-term health effects which include malignancy if not properly managed [3,4]. Despite the existence of regulatory frameworks such as the Occupational Safety and Health Act 1994 and the Use and Standards of Chemicals Hazardous to Health (USECHH) Regulations 2000 in Malaysia, gaps in compliance and safe work practices continue to be reported in healthcare environments [4,5]. Occupational incidents involving chemical exposure are often preventable through hierarchy of control such as elimination, substitution, engineering control, administrative control and personal protective equipment. Frequent injuries among the workers are reported due to insufficient hazard awareness, non-adherence to standard operating procedures (SOP) and noncompliance with personal protective equipment's (PPE) [1,2,4,6–8]. In laboratory settings, improper handling of specimen containers, lack of standardized safety practices, and inconsistent reinforcement of training further contribute to increased risk [8,9]. These challenges highlight the need for continuous, structured, and context-specific training interventions that go beyond conventional one-time training approaches. This study was prompted by a chemical splash injury to the right eye of a 27-year-old female Medical Laboratory Technologist while handling a femur bone-marrow biopsy specimen fixed in formalin and transferred to Osteosoft (an alkaline decalcifying agent, corrosive-GHS05, pH 7.0–7.3).

Quality Improvement (QI) methodologies have increasingly been adopted in healthcare to address system-level inefficiencies and improve safety outcomes [10–13]. Targeted interventions such as modular re-training programs with simulation allow for focused, repetitive, and competency-based learning, which are essential for reinforcing safety-critical behaviours [14,15]. Unlike traditional training methods, modular approaches can be tailored to specific risk areas, enabling healthcare workers to better understand and apply safety principles in their daily tasks. Furthermore, the integration of structured assessment tools provides an objective mechanism to monitor compliance, identify gaps, and sustain improvements over time [16,17].

Chemical safety remains a critical concern in histopathology laboratories due to the routine handling of hazardous substances such as formalin and decalcifying agents [18]. These chemicals pose significant risks of acute injury, including chemical burns and ocular irritation, particularly when appropriate control measures are not consistently implemented [4].

A preliminary root cause analysis on a chemical splash incident revealed several contributory factors, including inconsistent use of personal protective equipment (PPE), unsafe handling of chemical containers, and inadequate reinforcement of standard operating procedures (SOP) and safe work procedures (SWP). Additionally, gaps were identified in strategic safety leadership, training effectiveness, monitoring mechanisms, and overall compliance with chemical safety requirements [12,13].

Prior to the intervention, there was no structured system in place to objectively assess chemical safety compliance across critical domains such as documentation, engineering controls, PPE usage, safe handling practices, and emergency preparedness. Training activities were conducted periodically; however, they were largely didactic and lacked targeted reinforcement of high-risk tasks. This resulted in variability in staff practices and limited accountability for compliance. The absence of a systematic approach to monitor and improve chemical safety practices, coupled with the occurrence of a preventable occupational incident, emphasizes the need for a focused quality improvement initiative.

The aim of this study was to evaluate the effectiveness of a modular re-training intervention in improving chemical safety compliance among laboratory personnel. Specifically, this study sought to assess changes in compliance across multiple safety domains, reinforce adherence to safe work practices, and promote a sustainable culture of safety within the laboratory setting [18].

2. Materials and Methods

This study was conducted as a Quality Improvement (QI) initiative using a pre-post intervention design in the histopathology laboratory of a Category I hospital in East Malaysia. The initiative was undertaken following a chemical splash incident involved accidental exposure to a corrosive decalcifying agent during specimen handling, resulting in an eye injury for a medical laboratory technologist and aimed to improve chemical safety compliance among laboratory personnel. This quality improvement initiative involved 9 histopathology laboratory personnel directly engaged in chemical handling activities in the unit between May 2025 until December 2025. For outcome evaluation, compliance was assessed across nine predefined safety domains using a structured checklist; therefore, the unit of analysis for the pre-post assessment was the domain-level score rather than individual staff-level observations.

To ensure methodological rigor and enhance the robustness of this Quality Improvement initiative, the intervention was systematically structured using the Lean Six Sigma DMAIC (Define-Measure-Analyse-Improve-Control) framework, a well-established model for driving data-informed and sustainable process improvement in healthcare settings [19–21]. In the Define phase, a sentinel chemical splash incident was identified as the critical safety problem, and specific improvement objectives were formulated in collaboration with key stakeholders which took 3 days. The Measure phase was conducted over two weeks involving a comprehensive baseline assessment of chemical safety compliance using a validated nine-domain checklist, enabling objective quantification of existing gaps. During the Analyse phase which took seven days, root cause analysis was conducted to identify underlying contributors based on the accident and near-miss documentation, revealing that deficiencies were predominantly associated with human factors, behavioural non-compliance, and ineffective reinforcement of standard operating procedures rather than structural or policy limitations as illustrated in Figure 1. The Improve phase was implemented for three weeks which entailed the design and implementation of a targeted modular re-training program focusing on high-risk tasks, PPE adherence, safe handling techniques, and emergency response preparedness, incorporating interactive, near-miss incident reporting and competency-based learning strategies to drive behavioural change. Finally, the Control phase, which was extended over 28 weeks, was intentionally designed to evaluate medium-term sustainability of behavioural changes and to mitigate short-term observation bias. Monitoring activities were led by the OSH unit; however, key stakeholders involved in the Define phase, including laboratory supervisors, senior medical laboratory technologists, and hospital management representatives, also actively participated in this phase. Their roles included supporting compliance monitoring, reinforcing adherence to safe work procedures (SWP), providing feedback to staff, and facilitating corrective actions where necessary. This collaborative approach strengthened accountability, promoted shared ownership of safety practices, and supported the integration of the intervention into routine laboratory operations. The application of the DMAIC framework enabled a structured, evidence-based approach to identify gaps, implement targeted interventions, and sustain improvements in chemical safety compliance within the laboratory setting

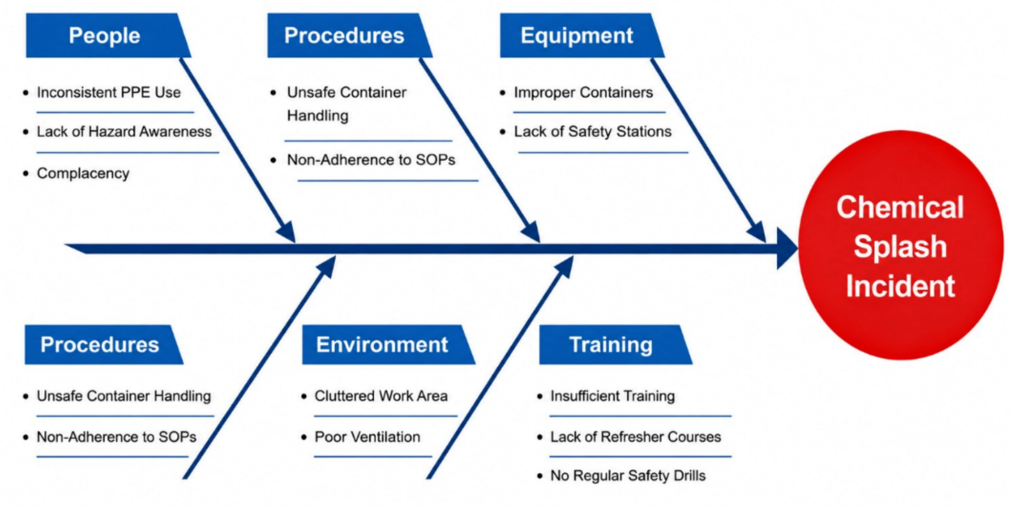

Figure 1. Fishbone (Ishikawa) diagram for the Chemical Splash Incident at Histopathology Laboratory.

A structured modular re-training program was developed and implemented, focusing on high-risk aspects of chemical handling in the laboratory which took 8 h. The training modules included [4]:

(a) Chemical hazard identification and risk awareness
(b) Proper use of personal protective equipment (PPE)
(c) Safe handling and transfer of chemical containers
(d) Safe Work Procedure (SWP) adherence
(e) Emergency response procedures (e.g., eye wash, spill management)
(f) Legal and regulatory requirements (OSH Act 1994, USECHH 2000)

The modular approach emphasized short, focused, and repetitive learning sessions to reinforce safety-critical behaviours. Training was delivered through interactive sessions, demonstrations, and scenario-based discussions. All laboratory personnel working in the unit participated in the program. The modular re-training program was conducted over a day, with each topic delivered through focused sessions of comparable duration to ensure consistent coverage and reinforcement of all key safety components.

A structured nine-domain chemical safety checklist was developed based on institutional guidelines and regulatory requirements. The checklist was designed to provide an objective assessment of compliance across key safety domains.

Domains Assessed [4]:

(a) Documentation which includes notification of accident & near-miss with record keeping
(b) Engineering controls
(c) Adherence to SWP
(d) Personal protective equipment (PPE)
(e) Chemical handling practices
(f) Storage and waste management
(g) Emergency preparedness
(h) Training and monitoring
(i) Legal and regulatory compliance

The scoring system is as in Tables 1 and 2 respectively.

Table 1. Chemical safety compliance scoring system.

Domain Score	Description
0	Non-compliant
1	Partially compliant
2	Fully compliant

Table 2. Overall compliance classification.

Total Score (%)	Compliance Level
<70%	Unsatisfactory
70–89%	Acceptable
≥90%	Good

Baseline (pre-intervention) assessment was conducted using the checklist to determine the initial level of compliance. Following the implementation of the modular re-training program, a post-intervention assessment was conducted using the same tool after 28 weeks. Compliance scores were calculated as percentages based on the total achievable score across all domains. Descriptive analysis was performed to compare pre and post intervention compliance levels. The effectiveness of the intervention was evaluated based on the magnitude of improvement in compliance scores and the absence of recurrent incidents during the follow-up period.

Ethics Approval Statement

This Quality Improvement initiative was conducted as part of internal safety enhancement activities within the hospital. No patient data was involved, and all staff participation was aligned with institutional policies on workplace safety and training.

3. Results

A total of nine domains of chemical safety practices were assessed before and after the implementation of the modular re-training program. Baseline assessment demonstrated an overall compliance score of 65.6%, which was categorized as unsatisfactory. Following the intervention, the compliance score improved to 100%, classified as good, indicating a substantial enhancement in adherence to chemical safety practices. Improvements were observed across all assessed domains, including documentation, personal protective equipment (PPE) usage, adherence to safe work procedures (SWP), chemical handling practices, and emergency preparedness. Full compliance (score = 2) was achieved in all domains post-intervention, reflecting uniform adherence among staff.

To evaluate the effectiveness of the intervention, a paired comparison analysis was conducted using domain-level scores before and after the intervention. Given the ordinal nature of the scoring system (0–2 scale) and the small sample size (n = 9 domains), a Wilcoxon signed-rank test was considered appropriate. The analysis demonstrated a statistically significant improvement in compliance scores following the intervention ($p < 0.05$), indicating that the modular re-training program had a meaningful impact on safety practices. Additionally, the magnitude of improvement was substantial, with all domains showing positive changes and no domains demonstrating deterioration. The median domain score increased from partially compliant (score = 1) at baseline to fully compliant (score = 2) post-intervention. Table 3 illustrates the pre and post intervention compliance scores.

The intervention demonstrated strong practical significance, with an absolute improvement of 34.4 percentage points in overall compliance (from 65.6% to 100%). This represents a complete transition from an unsatisfactory to a fully compliant safety environment. The uniform improvement across all domains suggests that the intervention was not only effective but also consistently applied across different aspects of laboratory safety. During the three-month follow-up period, no recurrence of chemical-related incidents was reported. Continuous monitoring indicated sustained adherence to PPE usage, SWP compliance, and safe handling practices.

Table 3. Pre- and post-intervention compliance scores.

Domain	Pre-Intervention Score	Post-Intervention Score
Documentation	1	2
Engineering Controls	1	2
SWP Adherence	1	2
PPE Usage	1	2
Chemical Handling	1	2
Storage & Waste Management	1	2
Emergency Preparedness	1	2
Training & Monitoring	1	2
Legal Compliance	1	2

4. Discussion

This quality improvement initiative demonstrated that a structured modular re-training program, combined with systematic assessment, can substantially enhance chemical safety compliance in a histopathology laboratory setting. The observed improvement from 65.6% to 100% compliance, along with the absence of incident recurrence during the follow-up period, suggests that targeted behavior-focused interventions can effectively address gaps in workplace safety practices.

4.1. Link to Safety Culture

The findings of this study highlight the critical role of safety culture in influencing compliance with occupational health and safety practices. Safety culture refers to the shared values, beliefs, and norms that shape safety behaviours within an organisation. Prior to the intervention, inconsistencies in PPE usage and SWP adherence reflected a reactive safety culture, where compliance was variable and not consistently reinforced. Near-miss incident was not documented and no analysis was done. The findings being integrated into the modular training program along with the preventive measures with higher management involvement which made the program establish a safety and risk-based culture at workplace. The implementation of modular re-training, coupled with structured monitoring, contributed to a shift towards a more proactive safety culture. Subsequently, the need for near-miss documentation & reporting is being acknowledged as part of the Notification of Dangerous Occurrence, Poisoning and Occupational Disease (NADOPOD) program at workplace with risk analysis necessity for the accident and near-miss incident in compliance with Occupational Safety and Health (NADOPOD) 2004 Regulations. Regular reinforcement of safety practices, increased awareness of chemical hazards, and visible commitment from management and the OSH unit helped strengthen accountability and standardization [12]. This aligns with existing literature indicating that sustained improvements in safety outcomes require not only technical controls but also cultural transformation within the workplace [12,13,22].

4.2. Human Factors Perspective

From a human factors and ergonomics perspective, the root causes of the incident were predominantly related to behavioural and system interaction issues rather than the absence of policies or infrastructure. Factors such as complacency, inadequate hazard perception, and improper handling techniques contributed to unsafe practices. The modular training approach addressed these issues by focusing on task-specific competencies, cognitive awareness, and practical application. By simplifying complex procedures into targeted learning modules, the intervention reduced cognitive overload and enhanced retention of safety-critical information [23]. Additionally, the use of demonstrations and scenario-based learning improved situational awareness and decision-making during high-risk tasks. These findings support the principle that safety interventions should be designed to align with human capabilities and limitations to reduce error likelihood.

4.3. Behavior-Based Safety (BBS) Approach

The success of this intervention can also be explained through the lens of behavior-based safety (BBS), which emphasizes the modification of unsafe behaviours through observation, feedback, and reinforcement. Prior to the intervention, unsafe behaviours such as inconsistent PPE use and improper container handling were likely normalized due to lack of monitoring and reinforcement. The modular re-training program functioned as a behavioural intervention, reinforcing desired safety behaviours through repetition, feedback, and increased awareness. The structured checklist further supported BBS principles by providing a mechanism for continuous observation and objective measurement of compliance [24]. Achieving 100% compliance across all domains suggests that the intervention effectively influenced both individual behavior and collective practice within the laboratory.

4.4. Integration with Quality Improvement and Lean Principles

The application of the DMAIC framework provided a structured approach to identifying, analyzing, and addressing safety gaps. This aligns with Lean Six Sigma principles, where process standardization and continuous monitoring are essential for reducing variation and improving outcomes [25–28]. The use of a measurable compliance tool allowed for objective evaluation and facilitated data-driven decision-making, which is a key strength of this initiative [29]. Furthermore, the intervention demonstrates that low-cost, high-impact strategies, such as targeted training and structured audits, can produce meaningful improvements without requiring extensive infrastructural changes. This is particularly relevant in resource-constrained governmental healthcare settings.

4.5. Integration of Lean Six Sigma DMAIC Framework

To strengthen the methodological rigor of this Quality Improvement initiative, the intervention was structured using the Lean Six Sigma DMAIC (Define-Measure-Analyse-Improve-Control) framework, which provides a systematic and data-driven approach to process improvement and sustainability of outcomes [19,20,26,27,30,31]. In the Define phase, the problem was identified following a chemical splash incident involving a Medical Laboratory Technologist in the histopathology laboratory, which highlighted critical safety gaps in chemical handling practices. Preliminary assessment revealed inconsistencies in personal protective equipment (PPE) usage, unsafe specimen container handling, and inadequate adherence to safe work procedures (SWP). The primary objective was therefore to improve chemical safety compliance and prevent recurrence of similar incidents, with key stakeholders including laboratory personnel, the Occupational Safety and Health (OSH) unit, and hospital management.

In the Measure phase, baseline compliance was assessed using a structured nine-domain chemical safety checklist covering documentation, engineering controls, PPE usage, SWP adherence, chemical handling, and emergency preparedness. Each domain was scored on a standardized scale (0–2), and overall compliance was expressed as a percentage. The baseline assessment demonstrated a compliance level of 65.6%, categorized as unsatisfactory, thereby confirming the need for targeted intervention. Subsequently, in the Analyse phase, root cause analysis identified that the incident and low compliance levels were primarily attributed to human factors and behavioural issues, including inconsistent PPE use, unsafe container handling techniques, insufficient reinforcement of SWP, limited emphasis on high-risk tasks during training, and the absence of systematic monitoring and accountability mechanisms, rather than deficiencies in existing policies or guidelines

In response, the Improve phase involved the development and implementation of a modular re-training program targeting the identified gaps. The intervention emphasized reinforcement of correct PPE usage, standardization of safe chemical handling procedures, increased hazard awareness, adherence to SWP, and improved emergency response readiness. The modular design enabled focused, repetitive, and task-specific training, incorporating interactive methods such as demonstrations and scenario-based learning to enhance engagement, knowledge retention, and behavioural change. Finally, in the Control phase, sustainability of the intervention was ensured through post-intervention assessment using the same checklist, which demonstrated a marked improvement in compliance to 100% (Good category). Ongoing control measures included periodic quarterly re-training, routine compliance audits, continuous monitoring by the OSH unit, reinforcement of SWP adherence through supervision, and systematic documentation of safety performance indicators. Notably, no recurrence of chemical-related incidents was observed during the three-month follow-up period, indicating sustained improvement in safety practices

4.6. Implications for Practice

The findings of this study have several practical implications:

(a) Modular re-training programmes can be effectively implemented to address specific high-risk tasks in laboratory settings
(b) Structured compliance assessment tools enhance accountability and enable continuous monitoring
(c) Integration of behavioural and human factors approaches is essential for sustaining safety improvements
(d) Periodic reinforcement (e.g., quarterly training) is necessary to prevent regression of unsafe practices
(e) These strategies can be replicated in other laboratory and clinical settings to improve occupational safety and reduce preventable incidents

4.7. Strengths and Limitations

A key strength of this study is the integration of a structured intervention with objective measurement, allowing for clear evaluation of outcomes. The use of a standardized checklist ensured consistency in assessment across multiple domains of safety [24]. However, several limitations should be acknowledged. First, the study was conducted in a single laboratory setting, which may limit generalizability. Second, the sample size was limited to domain-level assessment rather than individual-level data, restricting more advanced statistical analysis. Third, the follow-up period was relatively short, and longer-term sustainability of improvements should be evaluated in future studies. Not only that, another limitation of this study was also the influence of the Hawthorne Effect, whereby participants might modify their behaviours due to awareness of being observed rather than the intervention alone. The use of a structured checklist, direct observation, and continuous monitoring during the post-intervention phase might have contributed to heightened compliance, particularly for visible behaviours such as PPE usage and adherence to safe work procedures. The attainment of 100% compliance across all domains, while encouraging, might therefore reflect a degree of performance reactivity and social desirability bias. Additionally, the relatively short follow-up period limits the ability to determine whether these improvements represent sustained behavioural change or temporary adaptation to observation.

Nevertheless, the significant improvement in compliance, several barriers to sustainability should be considered. The intervention relies heavily on continuous monitoring, periodic retraining, and active supervision, which might not be consistently maintained in resource-constrained healthcare settings. Behavioural improvements observed might diminish over time due to fatigue, competing clinical demands, and reduced reinforcement, particularly in high-workload environments. Additionally, the influence of observation-related behavioural modification, consistent with the Hawthorne Effect, might have contributed to short-term compliance gains. From a resource perspective, although the intervention required minimal financial investment, it incurred substantial time and personnel costs, including staff participation in modular training sessions, OSH personnel involvement in monitoring and audits, and administrative efforts in program development and implementation. These factors suggest that while the intervention is cost-effective, its long-term sustainability depends on integration into organisational systems, including policy reinforcement, leadership engagement, and incorporation into routine safety governance structures. Future studies incorporating longer follow-up durations, unannounced audits, or control groups would be beneficial to differentiate true intervention effects from observation-induced behavioural modifications, in addition to explore strategies to embed such interventions into standard operational workflows to reduce reliance on continuous external monitoring while evaluating the prospects of sustainability.

Overall, this study demonstrates that combining modular re-training with structured assessment and continuous monitoring can significantly improve chemical safety compliance. The integration of safety culture, human factors, and behavior-based safety principles provides a comprehensive framework for addressing occupational hazards in healthcare laboratories. Sustained commitment to these approaches is essential for maintaining a safe and resilient working environment.

5. Conclusions

This quality improvement initiative demonstrates that a structured modular re-training program, guided by the Lean Six Sigma DMAIC framework, can significantly enhance chemical safety compliance in a histopathology laboratory setting. The transition from unsatisfactory to full compliance, coupled with the absence of incident recurrence, emphasizes the effectiveness of targeted, behavior-focused interventions in addressing preventable occupational hazards. Importantly, the findings highlight that gaps in safety practices are often rooted not in the absence of policies, but in human factors, behavioural compliance, and insufficient reinforcement of critical procedures. By integrating systematic training, objective compliance assessment, and continuous monitoring, this study provides a practical and scalable model for strengthening laboratory safety. This initiative is closely aligned with the Sustainable Development Goals (SDG), particularly SDG 8: Decent Work and Economic Growth, which emphasizes the provision of safe and secure working environments for all workers [32]. Ensuring a safe workplace through effective risk management, continuous training, and strong safety governance is fundamental to promoting decent work, protecting workers well-being, and enhancing productivity within healthcare systems. The adoption of such structured and data-driven approaches has the potential to foster a proactive safety culture, improve workforce protection, and reduce the burden of occupational incidents in healthcare settings [29]. Sustained commitment to periodic training, audit mechanisms, and leadership engagement is essential to ensure long-term effectiveness and resilience of safety practices [12,13]. Overall, this initiative reinforces that simple, low-cost, and well-designed interventions can yield substantial improvements in safety outcomes, while simultaneously contributing to global efforts in advancing safe, healthy, and decent working conditions for all.

Author Contributions

A.K.R.: conceptualization, methodology, investigation, formal analysis, project administration, data curation, writing including original draft preparation, visualization, supervision, and correspondence; L.F.Y.: methodology, investigation, data curation, validation, writing which includes review and editing; R.B.I.: methodology, supervision, validation, writing which includes review and editing; A.N.A.: supervision, methodology, formal analysis, writing which includes review and editing; W.K.Y.: investigation, data curation, validation, review and editing; M.D.S.: visualization, investigation, review and editing. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

Ethical review and approval were waived for this study because it was conducted as a Quality Improvement (QI) initiative aimed at evaluating and enhancing routine operational practices and workplace safety preparedness within the hospital setting rather than generating generalizable human subject research findings. The project involved implementation and evaluation of a modular re-training intervention as part of institutional service improvement activities and posed minimal risk to participants. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Informed Consent Statement

Informed consent was attained among the histopathology laboratory technologist who was involved in the study.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. All datasets have been anonymized to maintain participant confidentiality, and access may be restricted due to institutional, ethical, and privacy considerations.

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Conflicts of Interest

The authors declare no conflict of interest.

Use of AI and AI-Assisted Technologies

During the preparation of this work, the authors used ChatGPT to improve the language and correct typos and grammatical errors. After using this tool, the authors reviewed and edited the content as needed and took full responsibility for the content of the published article.

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