ADMINISTRATIVE OVERSIGHT OF CHEMICAL AND BIOSAFETY COMPLIANCE IN ZAMBOANGA CITY HIGHER EDUCATION INSTITUTIONS

*** Maisora T. Tahil**
Zamboanga Peninsula Polytechnic State University
R.T. Lim Boulevard, Baliwasan, Zamboanga City Philippines
Contact number: +639166069676 email: aimhightahil@gmail.com

***ABSTRACT**: This study examined the role of administrative oversight in the implementation of chemical and biosafety practices in Higher Education Institutions (HEIs), with particular emphasis on chemical waste management and laboratory biosafety. Using a convergent mixed-methods design, quantitative findings identified CB1 as the lowest-rated indicator (M = 2.63, SD = 1.680), indicating only slight awareness among respondents. Qualitative findings revealed inconsistencies in chemical waste management, including improper disposal practices, limited institutional policies, and delays in hazardous waste certification and transport. In contrast, biosafety practices were generally implemented consistently through established disinfection procedures for microorganisms prior to disposal. The findings indicate that effective administrative oversight is critical in strengthening policy implementation, ensuring regulatory compliance, and promoting safe laboratory practices. The study underscores the need for stronger institutional governance, regular training, and adherence to Republic Act No. 6969 to safeguard human health and the environment within HEI laboratories.*

Keywords: Chemical waste management, biosafety, HEIs, hazardous chemicals, laboratory safety

INTRODUCTION

Background of the Study

In recent decades, rapid advancements in scientific research and laboratory-based instruction have significantly increased the use, storage, and disposal of chemical and biological substances in higher education institutions (HEIs). While these developments have enhanced academic instruction and research productivity, they have also heightened the potential risks to laboratory personnel, students, and the surrounding community. One of the most critical concerns arising from these activities is the proper management of chemical and biohazardous waste, which includes infectious, toxic, and environmentally harmful materials derived from laboratory operations [1]. Inadequate oversight and improper disposal of such waste can result in serious health hazards, environmental contamination, and long-term ecological disruption. Chemical safety is a vital component of laboratory management, requiring the systematic application of policies and procedures to minimize risks associated with hazardous substances. Effective chemical safety depends not only on technical knowledge of chemical properties and hazards but also on institutional enforcement of safety standards, training programs, and compliance monitoring [2].

Similarly, biosafety focuses on preventing exposure to biological agents such as bacteria, viruses, fungi, and parasites through the implementation of containment strategies, safety protocols, and appropriate laboratory infrastructure. The Occupational Safety and Health Administration [3] classifies workplaces that handle such agents as hazardous, underscoring the need for strong administrative controls and regulatory compliance. The primary objective of biosafety is the containment of potentially dangerous biological agents to protect laboratory workers, the public, and the environment [4].

To achieve this, national and international biosafety frameworks require laboratories to adhere to established standards for facility design, waste disposal, equipment use, and personnel training. In the Philippines, programs such as the Laboratory Biosafety and Biosecurity Program mandate both public and private laboratories to comply with internationally recognized biosafety and biosecurity standard [5]. However, the effectiveness of these mandates largely depends on the extent of administrative oversight, institutional leadership, and enforcement mechanisms within HEIs.

Proper management of chemical and biological waste is a shared responsibility, but institutional administrators play a central role in ensuring compliance through policy development, allocation of resources, and continuous monitoring. Failure in administrative oversight can lead to lapses in safety practices, increased risk of laboratory accidents, and potential violations of regulatory standards [6]. Given the inherently hazardous nature of laboratory activities, institutions are expected to foster a culture of safety supported by Environment, Health, and Safety (EHS) offices, regular training programs, standard operating procedures (SOPs), and systematic incident investigations such as root cause analysis (RCA) [7].

Despite the presence of government policies and institutional safety frameworks, the degree to which administrative oversight ensures effective chemical safety and biosafety compliance in HEIs remains insufficiently examined. This concern is particularly relevant in Zamboanga City, where higher education institutions routinely conduct laboratory-based instruction and research. This study therefore sought to evaluate the role of administrative oversight in enforcing chemical and biosafety compliance in Zamboanga City HEIs, identify existing gaps in implementation, and propose strategies to strengthen institutional governance and promote a safer laboratory environment.

Research Questions

This study aims to assess the extent of administrative oversight in the implementation of government policies and guidelines on chemical safety and biosafety in higher education institutions (HEIs) in Zamboanga City, Philippines. Specifically, it seeks to answer the following questions:

1. What is the status of implementation of government policies and guidelines on chemical and biosafety among HEIs in Region IX?
2. What barriers hinder the effective implementation of chemical and biosafety guidelines in higher education institutions?

Review of Related Literature

Chemical waste generated through scientific research and laboratory activities has become a growing concern among universities and colleges. Proper disposal of these wastes is the responsibility of researchers, faculty members, and laboratory personnel, as the improper disposal of hazardous chemicals through regular waste systems, drains, or the atmosphere is prohibited under environmental regulations [8]. Hazardous substances may produce acute toxicity following a single exposure or chronic toxicity after prolonged exposure, thereby posing significant threats to human health and the environment [9]. In Zamboanga City, concerns regarding chemical waste management have been raised by members of the Chemistry Society during chemical safety conferences, citing the lack of agencies and institutional mechanisms dedicated to the management of hazardous chemical waste.

Republic Act No. 6969, otherwise known as the Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990 [10], mandates institutions handling hazardous substances to coordinate with the Department of Environment and Natural Resources–Environmental Management Bureau (DENR-EMB). Waste generators are required to register with the EMB, submit inventories of hazardous waste, establish contingency plans, and coordinate with accredited transporters and treatment facilities for the proper disposal of hazardous materials.

Media reports have likewise documented incidents associated with inadequate chemical safety practices. One notable example is the mercury spill at the Philippine Science High School in 2017, which resulted in the temporary suspension of classes and highlighted the consequences of delayed reporting and inadequate emergency response procedures [11]. Such incidents emphasize the need for comprehensive emergency preparedness plans and trained personnel within educational institutions.

A study by Gonzales and Bronce (2019) reported that chemistry laboratories generated approximately 1–10 liters of liquid hazardous waste annually, in addition to smaller quantities of plating wastes and hazardous solid materials [12]. Similarly, biohazardous waste including infectious chemical, medical, animal, and plant wastes poses risks to living organisms and may adversely affect ecological systems if improperly managed [1].

Chemical safety has been defined as the application of best practices in handling chemicals and conducting laboratory procedures to minimize risks to individuals and the surrounding community [2]. OSHA Rule 1013(e) identifies hazardous workplaces as environments in which workers are exposed to biological agents such as bacteria, fungi, viruses, protozoa, nematodes, and other parasites [3].

Furthermore, biosafety programs aim to contain potentially harmful biological agents through the use of appropriate facilities, equipment, and laboratory practices [4]. The National Program on Laboratory Biosafety and Biosecurity requires laboratories handling pathogens and toxins to comply with international standards to maintain a safe and secure environment [5].

Laboratory environments inherently involve physical, chemical, and biological hazards that necessitate strict adherence to established safety procedures and risk management practice [13]. Likewise, consistent compliance with laboratory protocols is essential to minimizing occupational injuries, preventing accidents, and safeguarding the health and well-being of laboratory personnel and the surrounding community[14]. Consequently, many colleges and universities have established Environment, Health, and Safety (EHS) offices to oversee institutional safety programs, ensure regulatory compliance, and promote a culture of safety within their campuses.

Theoretical Framework

This study was anchored on Systems Theory, Compliance Theory, and Safety Culture Theory, which collectively explain the role of administrative oversight in promoting chemical and biosafety compliance in higher education institutions (HEIs). Systems Theory posits that organizations operate as interconnected and interdependent systems in which policies and resources serve as inputs, administrative oversight functions as the process, and compliance outcomes represent the system's outputs [15].

Compliance Theory asserts that adherence to laws, regulations, and institutional policies is influenced by effective monitoring, enforcement mechanisms, and accountability structures within organizations [16]. Meanwhile, Safety Culture Theory emphasizes that leadership plays a critical role in shaping the shared values, attitudes, and behaviors that foster safe practices and sustained organizational commitment to safety [17].

Collectively, these theoretical perspectives suggest that strong administrative oversight enhances institutional compliance, strengthens safety culture, and supports the effective implementation of chemical and biosafety practices within HEIs.

Methodology

Research Design

This study employed a Convergent Parallel Mixed-Methods Design to examine administrative oversight in the implementation of chemical safety and biosafety policies among higher education institutions (HEIs) in Zamboanga City. The quantitative component utilized a researcher-developed questionnaire to assess the status of implementation of government policies and guidelines on chemical safety and biosafety, particularly in relation to chemical waste management and laboratory biosafety practices. Conversely, the qualitative component involved Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) to explore the challenges encountered by stakeholders in implementing these policies and to provide a deeper understanding of institutional practices. A convergent mixed-methods approach was deemed appropriate because it enables the integration of quantitative and qualitative findings, thereby providing a more comprehensive perspective on the research problem [18].

Research Locale

The study was conducted among selected higher education institutions (HEIs) in Region IX, Philippines. The participating institutions represented both private higher education institutions and State Universities and Colleges (SUCs). Selection of the study sites considered accessibility

and prevailing peace and security conditions to ensure the safe conduct of the research.

The study was conducted among selected higher education institutions (HEIs) in Region IX, Philippines. The participating institutions represented both private higher education institutions and State Universities and Colleges (SUCs). Selection of the study sites considered accessibility and prevailing peace and security conditions to ensure the safe conduct of the research.

Population and Sampling Procedure

The study participants consisted of selected employees and students from participating higher education institutions (HEIs) in Zamboanga City who were directly involved in the implementation of chemical safety and biosafety policies. These included faculty members, laboratory personnel, health and safety representatives, and selected student leaders enrolled in laboratory-based programs. Participants were purposively selected based on their roles and experiences related to administrative oversight, policy implementation, and compliance with chemical and biosafety standards.

Research Instruments

The study utilized a researcher-developed questionnaire to assess the implementation of chemical safety and biosafety policies among selected higher education institutions (HEIs) in Zamboanga City. The instrument, developed based on relevant national and international standards, consisted of ten (10) items measured on a six-point Likert scale ranging from 1 (Not at All Aware) to 6 (Extremely Aware). To supplement the quantitative data, Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) were conducted to explore stakeholders' challenges and administrative practices related to chemical and biosafety compliance.

Data Gathering Procedure

Data were collected in accordance with established ethical and institutional protocols. Formal approval was obtained from the participating higher education institutions (HEIs), and informed consent was secured from all participants prior to data collection. Quantitative data were gathered using a researcher-developed questionnaire consisting of ten (10) items measured on a six-point Likert scale, while qualitative data were obtained through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) to explore stakeholders' challenges and administrative practices related to chemical and biosafety compliance.

Data Analysis Procedure

This study assessed the role of administrative oversight in the implementation of chemical and biosafety guidelines among selected higher education institutions (HEIs) in Zamboanga City. Quantitative data were used to determine the level of awareness and implementation of chemical and biosafety practices, while qualitative data explored the challenges encountered by stakeholders in complying with relevant laws, policies, and institutional regulations.

Legend: 1.0-1.82 not all aware 1.83-2.65 Slightly aware 2.66 – 3.48 Mildly aware 3.49-4.31 aware 4.32-5.14 Very aware 5.15-6.00 Extremely aware

RESULTS AND DISCUSSION

Table 1 Awareness on Chemical and Biosafety

Questions	Mean	SD	Interpretation
CB1	2.63	1.680	Slightly aware
CB2	4.80	1.558	Very aware
CB3	4.80	1.524	Very aware
CB4	4.59	1.504	Very aware
CB5	3.51	1.820	Aware
CB6	4.25	1.758	Aware
CB7	4.42	1.745	Very aware
CB8	4.66	1.655	very aware
CB9	4.95	1.553	Very aware
CB10	2.98	1.780	Mildly aware
CB	4.16	0.834	Aware

As shown in Table 1, the lowest-rated indicator of Chemical and Biosafety was CB1 (M = 2.63, SD = 1.680), which was interpreted as "Slightly Aware." The response distribution exhibited moderate positive skewness (0.6573) and negative kurtosis (-0.8896), suggesting generally low awareness with some variation among respondents.

Qualitative findings from the Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) revealed inconsistencies in chemical waste management across participating higher education institutions (HEIs). While some institutions demonstrated appropriate practices such as proper labeling, storage, and temporary containment of hazardous chemicals, others reported disposing of chemical waste through burial or drainage systems. These findings indicate gaps in institutional compliance and awareness regarding the proper handling and disposal of hazardous substances.

Chemical waste management remains a significant concern in academic laboratories because hazardous chemicals pose risks to human health and the environment when improperly handled. Several institutions reported that untreated chemical waste is temporarily stored in designated stockrooms while undergoing registration as hazardous waste generators with the Environmental Management Bureau (EMB). One laboratory personnel stated:

“The head has already prepared it, and the first step we are currently taking with the EMB is that they have conducted an inventory in our laboratory. They provided some recommendations that we still need to comply with before they can issue the certification. As of now, it is still classified as low risk.” (KII #5)

Although some institutions had initiated compliance procedures with the EMB, certification and arrangements for the transport and treatment of hazardous waste remained pending. Similarly, FGD participants acknowledged the existence of waste disposal mechanisms but emphasized the need for greater consistency and institutional support:

“There are existing mechanisms, but there is a need to strengthen them, establish proper designated areas, and ensure consistency in their implementation.” (FGD Participant #1)

Additional findings revealed the absence of formalized waste management policies in some institutions. One informant noted:

"For example, if there is any, it is buried in the ground… or thrown into a pit." (KII)

Another participant highlighted the lack of established disposal arrangements:

"There is no established policy. We were only informed that once the volume reaches a certain level, it can be included with their waste." (KII #6)

Laboratory waste such as gloves and sharps was occasionally disposed of with general non-biodegradable waste, while chemical residues were often neutralized and stored until enough accumulated for disposal. In several cases, laboratory personnel simultaneously managed multiple laboratory facilities that also functioned as storage and office spaces, potentially increasing exposure to hazardous substances. Consequently, laboratory safety practices were largely dependent on the initiative and vigilance of personnel responsible for enforcing safety procedures.

These findings underscore the importance of complying with Republic Act No. 6969, which mandates the proper handling, storage, transport, and disposal of hazardous wastes. Registration with the EMB as a hazardous waste generator is therefore essential to strengthen institutional compliance and promote safer laboratory environments.

In contrast, biosafety practices were consistently observed across participating institutions. Microorganisms used in laboratory activities were routinely disinfected prior to disposal through established methods such as autoclaving, chlorination, and the use of approved disinfectants, reflecting a generally higher level of compliance with biosafety protocols than with chemical waste management practices.

Conclusion

The study revealed gaps in the implementation of chemical and biosafety practices among participating higher education institutions (HEIs), particularly in chemical waste management. Findings indicated low levels of awareness and inconsistencies in waste disposal, segregation, and compliance procedures. Although some institutions had initiated measures such as Environmental Management Bureau (EMB) registration and temporary storage of hazardous waste, the absence of formal institutional policies and incomplete certification processes continued to pose potential health and environmental risks. In contrast, biosafety practices were generally well implemented, particularly in the proper disinfection of microorganisms prior to disposal. Overall, the findings underscore the critical role of administrative oversight in strengthening institutional policies, enhancing regulatory compliance, and promoting safe and sustainable laboratory practices.

Recommendations

Higher education institutions (HEIs) should strengthen administrative oversight by establishing formal policies and standard operating procedures (SOPs) for the management of chemical and biological waste in accordance with national laws and safety guidelines. Institutions should provide regular training to laboratory personnel, ensure the proper handling, storage, transport, and treatment of hazardous waste, and sustain effective biosafety practices. Furthermore, collaboration with the Environmental Management Bureau (EMB) should be prioritized to facilitate timely certification and compliance, thereby promoting safer and more sustainable laboratory environments for students and personnel.

REFERENCES

1. Mecklem, R. L., & Neumann, C. (2005). Defining and managing biohazardous waste in U.S. research- oriented universities: A survey of environmental health and safety professionals. *Journal of Environmental Health, 68*(4), 9–13.
2. Kemsley, J. (2013). Chemical safety. *Chemical & Engineering News, 91*(22), 27–29.
3. Occupational Safety and Health Administration. (2017). *Occupational safety and health standards.* U.S. Department of Labor.
4. Siegel, J. D. (2022). Biosafety and biosecurity in laboratory settings. In *StatPearls*. StatPearls Publishing.
5. Asia-Pacific Biosafety Association. (2016). *National laboratory biosafety and biosecurity program manual.* Asia-Pacific Biosafety Association.
6. Rioux, J., & Zuman, P. (2018). Laboratory safety and compliance: The role of institutional oversight in higher education. *Journal of Chemical Health and Safety, 25*(4), 18–24.
7. Shih, Y. C., Lee, C. H., & Wang, M. J. (2016). Establishing a culture of safety in academic laboratories through environment, health, and safety management systems. *Safety Science, 84*, 215–223.
8. Shively, J. (2020). Chemical waste disposal guidelines for academic laboratories. *Environmental Health and Safety Journal, 15*(2), 45–50.
9. U.S. Environmental Protection Agency. (2023). *Learn about hazardous waste.* U.S. Environmental Protection Agency.
10. Republic Act No. 6969. (1990). *Toxic Substances and Hazardous and Nuclear Wastes Control Act of 1990*. Republic of the Philippines.
11. Philippine Daily Inquirer. (2017, March). Mercury spill prompts temporary closure of Philippine Science High School laboratory. *Philippine Daily Inquirer*.
12. Gonzales, A., & Bronce, R. (2019). Hazardous waste generation and management practices in chemistry laboratories. *Philippine Journal of Science and Technology, 12*(1), 55–63.
13. Phifer, B. (2024). Laboratory risk management and safety practices in higher education institutions.*Journal of Laboratory Safety, 29*(1), 12–21.
14. National Research Council. (2011). *Prudent practices in the laboratory: Handling and management of chemical hazards* (Updated ed.). National Academies Press.
15. von Bertalanffy, L. (1968). *General system theory: Foundations, development, applications.* George Braziller.
16. Tyler, T. R. (1990). *Why people obey the law.* Yale University Press.
17. Reason, J. (1997). *Managing the risks of organizational accidents.* Ashgate Publishing.
18. DeFranzo, S. E. (2011). Convergent parallel mixed ethods design. *Snap Surveys Research Blog*.