Applying the HIRADC Method to Occupational Safety Risk Assessment and Control in a Private Higher Education Institution

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Abstract

Occupational health and safety in higher education institutions requires systematic management because academic, laboratory, administrative, and mobility-related activities may generate physical, chemical, biological, and ergonomic hazards. This study aims to identify hazards, assess risk levels, and formulate priority safety controls in a campus environment using the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) method. The research was conducted at a private higher education institution in Tangerang using a mixed-method approach involving field observation, interviews, and questionnaires administered to 50 respondents. Risk assessment was performed by determining likelihood and severity scores, which were then classified into low, moderate, high, and extreme categories. The findings identified 15 potential hazards, 5 high risks, 5 moderate risks, and 5 low risks. Stair areas, pharmaceutical laboratories, and engineering laboratories were identified as the dominant risk locations. Recommended controls include improving lighting, installing safety signs and posters, providing fire extinguishers, ensuring the use of personal protective equipment, conducting safety education, and implementing periodic evaluations. The findings contribute to the development of a systematic occupational safety management framework for higher education institutions and provide practical guidance for prioritizing risk control in campus environments.

Keywords: Campus, HIRADC, Occupational Health and Safety, Risk Assessment, Risk Control.

I. INTRODUCTION

In Indonesia, safety and security in the workplace has not been a major concern in public works and construction, where the rate of work accidents in construction work reaches around 7-8% of all sectors [1]. Based on data from the 2022 national OSH profile report, 21.4% of work accidents occurred in the trade and service business sector, ranking 2nd after various industries [2]. Higher education is one of the service business sectors that has an important role in human resource development [3]. The campus environment is a dynamic space for students, lecturers, staff and visitors [4]. In the midst of their activities, they cannot be separated from facing various risks that can endanger the safety of the existing environment [5]. Therefore, it is important to implement effective methods in the identification and evaluation of risks [6].

This study was conducted at a private university in Tangerang which has a large academic population, and also has a multi-storey building. With the size of the campus area, it is possible that Occupational accidents may occur. Work accidents can occur in classrooms, lecturers' rooms, libraries, laboratories, canteens, parking lots, and other places in the campus area. To increase the productivity of all faculty members, lecturers, and students in the work area, efforts to increase awareness of OSH need to be done [7]. To identify and evaluate potential hazard risks in campus areas, one of the approaches that can be used is HIRADC (Hazard Identification, Risk Assessment, and Determination Control) [8]. HIRADC is a systematic method that helps in identifying hazards, assessing risks, and determining appropriate control measures.

HIRADC is a systematic method that helps in identifying hazards, assessing risks, and determining appropriate control measures [9]. According to previous studies, the implementation of HIRADC can improve safety culture and reduce occupational risks in educational and industrial environments [10]. Several studies have reported that systematic implementation of HIRADC significantly improves hazard control and occupational safety performance [11][12] . This shows that HIRADC is not just a tool, but also an important strategy in risk management in the educational environment.

Previous research has shown that the HIRADC method is effectively used for hazard identification and risk assessment in the industrial and construction sectors, with a focus on factories, construction projects, or manufacturing facilities [13] [12][10]. However, its application in the higher education environment is still very limited. Previous studies tend to be descriptive, do not emphasize risk prioritization based on campus area, or do not integrate risk control hierarchies in a university context. This creates a research gap that shows the need for a systematic evaluation of HIRADC-based campus risks that takes into account the unique characteristics of the academic environment.

The scientific novelty of this research lies in the quantitative mapping of risk priorities in strategic areas of the campus and the preparation of risk control recommendations using a control hierarchy (elimination, substitution, engineering, administrative, and PPE). This study also integrates a mixed-method approach with observations, interviews, and questionnaires to obtain empirical data from the academic community, thus producing findings that can be used as the basis for the development of a structured campus OSH system.

This study aims to systematically identify workplace hazards and assess occupational safety risks within the campus environment of a private higher education institution by applying the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) method. Based on the results of the risk assessment, the study seeks to establish risk control priorities in accordance with the hierarchy of controls, ensuring that the most effective preventive and corrective measures are recommended. Furthermore, the research intends to provide strategic, evidence-based recommendations for strengthening occupational safety and health (OSH) management practices, thereby supporting the development of a safer and more sustainable working environment in private universities in Tangerang.

II. METHOD

Occupational safety refers to efforts to prevent workplace accidents and occupational diseases [14]. Occupational safety refers to efforts to prevent work accidents and reduce the risk of illness and disability caused by workers' work and the work environmen [15]. Occupational health is inseparable from occupational safety. This is because occupational safety and occupational health are a system that supports and complements each other [16]. This study uses a mixed method, combining qualitative and quantitative methods to understand the application of HIRADC in the identification and evaluation of risks in the campus area. This approach allows researchers to obtain more comprehensive and in-depth data [17]. The research was conducted in the campus area of the University of a Tangerang Private University, which was selected based on the diversity of facilities and activities that have the potential to pose risks to students and staff.

The population in this study includes students, lecturers, and administrative staff. A purposive sampling technique was employed to select 50 respondents who were directly involved in daily campus activities and possessed sufficient knowledge of occupational hazards within their respective work environments. This approach ensured that the participants could provide relevant and reliable information regarding workplace safety conditions and risk management practices. Data were collected using three complementary techniques. First, in-depth interviews were conducted with key informants, including safety managers and faculty members, to obtain comprehensive insights into the implementation of the Hazard Identification, Risk Assessment, and Determining Control (HIRADC) method within the institution. Second, a structured questionnaire was administered to all 50 respondents, comprising students and staff, to assess their knowledge, awareness, and perceptions of occupational risks across the campus environment. Finally, direct observations were carried out by the researcher in various campus facilities, including laboratories, classrooms, offices, and public areas, to identify potential hazards and verify workplace conditions that could contribute to occupational safety risks.

Qualitative data obtained from interviews were analyzed using thematic analysis, whereas quantitative questionnaire data were analyzed using descriptive statistics to identify patterns related to the implementation of the HIRADC method. Hazard identification, the first stage of HIRADC, was conducted to systematically identify potential hazards within the campus environment through workplace analysis, direct observation, inspections, incident investigations, and the review of occupational accident records [18][19]. The identified hazards were classified into five categories: physical, biological, chemical, ergonomic (physiological), and psychological hazards. This systematic classification provides a comprehensive basis for recognizing and evaluating occupational hazards, thereby supporting effective risk assessment and the development of appropriate control measures to enhance occupational safety and health in the university environment [20][21].

The second stage of the HIRADC method is risk assessment, which aims to evaluate the level of risk associated with each identified hazard in the workplace [13][10] [16][17]. Risk assessment was performed by analyzing two key parameters: likelihood (the probability of a hazard occurring) and severity (the magnitude of its consequences). The combination of these parameters using a risk matrix enabled each hazard to be categorized into low, moderate, high, or extreme risk levels. This classification provides a systematic basis for prioritizing risk management actions and determining appropriate control measures to minimize occupational safety risks. The probability scale applied in this study is presented in Table 1.

Table 1. Likelihood Scale (AS/NZS 4360:2004)

Level	Description	Information
1	Infrequently	An event that is almost never, rare
2	Unlikely	An event that may happen at some point, but is unlikely
3	Keep	An event that may happen at some point
4	May happen	An event that may occur in most circumstances
5	Almost certainly	An event that will definitely happen in every activity carried out

Severity is a level used to determine how severe the impact of a work accident can be. The greater the severity value, the more severe the injury and damage caused [21]. The severity scale reference can be seen in Table 2.

Table 2. Severity Scale (AS/NZS 4360:2004)

Level	Description	Information
1	Insignificant	No injuries, material losses are very small
2	Low	There are minor injuries, minor material losses
3	Moderate	Requires P3K or medical treatment and results in loss of working days/loss of organ function for a while, material losses are quite large
4	Major	Injuries that cause disability/total loss of bodily function, large material losses
5	Catastrophic	Causing death, material losses are enormous

After the likelihood and severity values were determined for each identified hazard, the overall risk rating was calculated by multiplying these two parameters using the HIRADC risk matrix. The resulting score represents the level of occupational risk and serves as the basis for prioritizing risk management actions. Risks were classified into four categories: Extreme Risk (E), requiring immediate control measures; High Risk (H), requiring prompt corrective action; Moderate Risk (M), requiring planned corrective measures but not emergency intervention; and Low Risk (L), which can be adequately managed through existing procedures and routine controls. This risk classification provides a systematic framework for prioritizing hazard mitigation efforts and allocating resources effectively to reduce workplace safety risks. The risk rating scale used in this study is presented in Table 3.

Table 3. Risk Rating Matrix (AS/NZS 4360:2004)

	Risk Matrix (S)				
Risk Opportunity (L)	**1**	**2**	**3**	**4**	**5**
5	H	H	E	E	E
4	M	H	E	E	E
3	L	M	H	E	E
2	L	L	M	H	E
1	L	L	M	H	H

The third stage of the HIRADC method is risk control, which aims to eliminate or minimize occupational risks identified during the hazard assessment process [22]. Risk control measures were determined based on the hierarchy of controls, ensuring that the most effective interventions were prioritized according to the level of risk [23]. The hierarchy comprises five levels: elimination, which removes the hazard entirely from the workplace; substitution, which replaces hazardous materials, equipment, or processes with safer alternatives; engineering controls, which reduce exposure through modifications to equipment, facilities, or work processes; administrative controls, which involve the implementation of policies, procedures, training, scheduling, and warning systems to minimize risk; and personal protective equipment (PPE), which serves as the final line of defense by requiring workers to use appropriate protective gear, such as safety shoes, helmets, masks, protective eyewear, and ear protection [24][25][26][27][28][29][30]. Applying this hierarchy enables organizations to implement systematic and effective control strategies, thereby enhancing occupational safety and reducing the likelihood of workplace accidents.

III. Results and Discussion

A. Hazard Identification

Hazard identification was conducted as the initial stage of the HIRADC process to systematically recognize and document potential sources of danger within the campus environment. This process involved a comprehensive survey and direct observation of various campus facilities and operational areas to identify conditions, activities, equipment, and environmental factors that could potentially contribute to occupational accidents or health risks. The assessment focused on identifying existing hazards related to physical, biological, chemical, ergonomic, and psychological factors that may affect students, lecturers, administrative staff, and other campus personnel during daily activities. The results obtained from the field survey were analyzed and categorized based on the type of hazard, location, potential consequences, and possible risk sources. The identified hazards provide an essential foundation for the subsequent stages of the HIRADC method, including risk assessment and the determination of appropriate control measures. The detailed results of the hazard identification process conducted in the selected campus areas are presented in Table 4.

Table 4. July 2024 Survey Results Most Visited Areas/Places

No	Most Visited Areas/Places	Quantity
1	Classroom	20
2	Canteen	11
3	Service Room & 2nd Floor Area	7
4	Library & 4th Floor Area	3
5	Lecturer Room & 3rd Floor Area	2
6	Laboratory of the Faculty of Engineering & Ground Floor Area	1
7	Laboratory of the Faculty of Pharmacy	1
8	A Different Room	5

Table 4 presents the results of the July 2024 survey regarding the most frequently visited areas within the campus environment. The findings indicate that the classroom was the most visited area, with a total of 20 respondents, reflecting its central role as the primary location for academic activities. The canteen ranked second with 11 respondents, followed by the service room and second-floor areas with 7 respondents. Other frequently accessed locations included different rooms with 5 respondents, the library and fourth-floor areas with 3 respondents, and the lecturer room and third-floor areas with 2 respondents. Meanwhile, the Faculty of Engineering Laboratory and ground-floor areas as well as the Faculty of Pharmacy Laboratory were each visited by 1 respondent. These findings demonstrate the distribution of campus activity patterns and provide important information for identifying potential hazard exposure areas, as locations with higher levels of human activity may require greater attention in occupational safety risk assessment and control planning.

Furthermore, figure 1 shows that classrooms and canteens represent the most frequently visited campus locations, indicating higher potential exposure to occupational hazards compared with other areas. The July 2024 Survey Results of the 5 Areas/Places with the most hazard potential are as shown in Figure 1 of the pareto chart below:

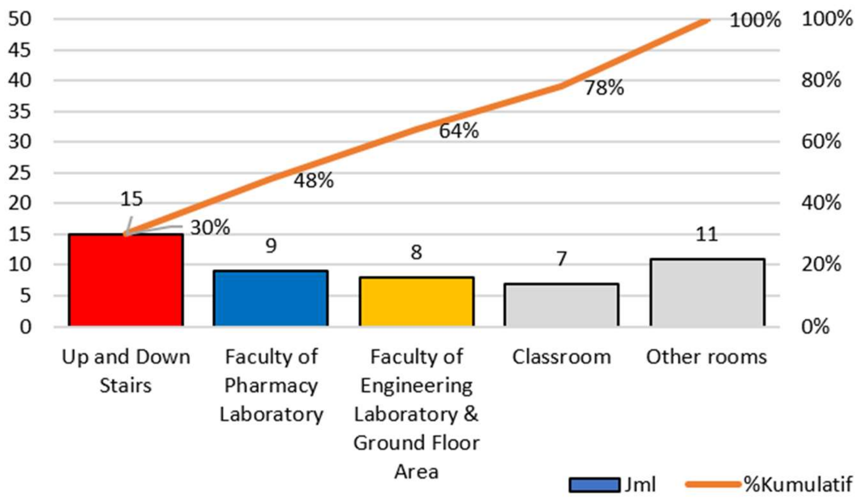

Figure 1. Pareto Points a Potential Hazard Area

Hazard identification is carried out by analyzing any or any point areas of potential hazards that are observed or assessed. The sources of the hazards identified will later be classified into 5 types, namely physical hazards, chemical hazards, biological hazards, chemical hazards, physiological/ergonomic hazards and psychological hazards. Not all places in the campus area have these five types of hazards, because of the difference in conditions in each place in the campus area. An example of the results of hazard identification on the steps between floors can be seen in Table 5.

Table 5. Identify Potential Hazards in the Steps Area

No	Types of Hazards	Potential Hazards
1	Physical	Falling from a height
2	Physical	Sprains or injuries to the legs
3	Ergonomics/Physiology	Lack of Lighting
4	Ergonomics/Physiology	Fatigue and gout
5	Ergonomics/Physiology	Turn Stairs too steep

Table 5 presents the results of hazard identification in the stairway area, where several potential hazards were identified based on physical and ergonomic factors. The physical hazards identified include the risk of falling from a height and leg sprains or injuries, which may occur due to unsafe stair conditions, improper use, or inadequate attention while moving between floors. In addition, several ergonomic/physiological hazards were identified, including insufficient lighting, which may reduce visibility and increase the likelihood of accidents, as well as fatigue and gout-related discomfort that may affect mobility and safety during stair use. Another significant ergonomic concern is the presence of stairs with excessive steepness, which can increase physical strain and the risk of slips or falls, particularly for individuals with limited mobility. These identified hazards highlight the importance of implementing appropriate control measures, such as improving lighting conditions, ensuring proper stair design and maintenance, and providing safety awareness to minimize potential accidents. The subsequent hazard identification results for the Pharmaceutical Laboratory are presented in Table 6.

Table 6. Hazard Identification in the Pharmaceutical Laboratory

No	Types of Hazards	Potential Hazards
1	Physical	Damage from sharp tools
2	Chemistry	Unexpected Chemical Reactions
3	Biology	Biological Contamination
4	Biology	Exposure to fine particle dust
5	Chemistry	Exposure to toxic chemicals

Table 6 presents the results of hazard identification conducted in the Pharmaceutical Laboratory, where several potential hazards were identified across physical, chemical, and biological categories. The identified physical hazard involves the potential for injuries caused by sharp tools, which may result in cuts or puncture wounds during laboratory activities if equipment is not handled properly. Chemical hazards include the risk of unexpected chemical reactions and exposure to toxic chemicals, which may occur due to improper handling, storage, or mixing of laboratory substances, potentially causing health impacts or safety incidents. Meanwhile, biological hazards were identified in the form of biological contamination and exposure to fine particle dust, which may pose risks to laboratory users through inhalation, contact, or contamination of the working environment. These findings indicate that pharmaceutical laboratory activities involve multiple risk sources requiring appropriate preventive measures, including proper laboratory procedures, safety training, chemical management, contamination control, and the use of appropriate personal protective equipment (PPE). The subsequent hazard identification results for the Engineering Laboratory are presented in Table 7.

Table 7. Hazard Identification in the Engineering Laboratory

No	Types of Hazards	Potential Hazards
1	Physical	Electrical Hazards
2	Chemistry	Exposure to Corrosive Chemicals
3	Chemistry	Fire
4	Ergonomics/Physiology	Noise Exposure
5	Physical	Injury Mechanism

Table 7 presents the results of hazard identification in the Engineering Laboratory, where several potential hazards were identified, including physical, chemical, and ergonomic risks. Physical hazards include electrical hazards and injury mechanisms that may result from unsafe equipment use or improper laboratory practices. Chemical hazards involve exposure to corrosive chemicals and the risk of fire due to improper handling or storage of hazardous materials. In addition, noise exposure was identified as an ergonomic hazard that may affect the health and comfort of laboratory users. These findings highlight the need for appropriate control measures, such as safety procedures, equipment maintenance, chemical management, and the use of PPE to reduce occupational risks.

B. Risk Assessment

Risk assessments are carried out to determine the level of risk that may occur in each place in the campus area. In risk assessment, there are parameters used, namely likelihood and severity which are determined by assessment based on survey results and or data owned by agencies/institutions/companies. Likelihood is the level of likelihood of a workplace accident, while severity is how severe the impact of a workplace accident can be. After determining the value based on likelihood and severity in the real conditions that exist in the campus area, the next step that can be taken is to multiply the likelihood and severity values. The purpose of multiplying the likelihood and severity values is to determine the level of risk at observation sites in the campus area. The risk level is an assessment that will show the risk that is at low, medium, high, and extreme levels. An example of the results of the risk assessment in the campus area can be seen in Table 8.

Table 8. Risk Assessment in the Campus Area

No	Potential Hazards	Consequence	L	S	Risk Rating	Risk Level
1	Falling from a height	Pain or bruising on any part of the body	1	3	3	M
2	Sprains or injuries to the legs	Leg injuries	2	2	4	L
3	Lack of Lighting	Sprained leg	2	3	6	M
4	Fatigue and gout	Shortness of breath	4	2	8	H
5	Turn Stairs too steep	Dizziness/Fainting	3	3	9	H
6	Damage from sharp tools	Hand injuries	2	2	4	L
7	Unexpected Chemical Reactions	Burns or fires	3	3	9	H
8	Biological Contamination	Poisoning	2	2	4	L
9	Exposure to fine particle dust	Shortness of breath	4	2	8	H
10	Exposure to toxic chemicals	Shortness of breath, dizziness, headache	4	2	8	H
11	Electrical Hazards	Fire	2	3	6	M
12	Exposure to Corrosive Chemicals	Skin wounds, tool damage	2	3	6	M
13	Fire	Equipment and buildings burned	2	3	6	M
14	Noise Exposure	Hearing loss	2	2	4	L
15	Injury Mechanism	Injuries	2	2	4	L

After a risk assessment was carried out on the 3 areas with the most potential danger on campus, it was found: 5 potential high risk (H); 5 medium potential risk level (M), and 5 low risk potential (L). The next stage that will be carried out after the risk assessment is to carry out risk control, namely making follow-up efforts to prevent and minimize the occurrence of accidents that endanger campus residents.

C. Risk Control

Risk control is a preventive measure for the risk of work accident hazards in every place that has been observed on the campus area. Risk control that can be carried out in the campus area is elimination, substitution, engineering, administration, and the use of PPE. Risk control recommendations were developed according to the hierarchy of controls recommended by ISO 45001 and OSHA, prioritizing engineering controls over administrative controls and personal protective equipment whenever feasible.

1. High Level of Risk Control (H)

Based on the results of the risk assessment, five categories of high-level risks (H) were identified within the campus environment. These risks require immediate attention and appropriate control measures because they have a significant potential to cause workplace accidents, injuries, or operational disruptions. The risk control strategies were determined based on the hierarchy of controls, considering the characteristics of each hazard and the level of risk identified. The detailed results of the high-level risk assessment and the recommended control measures are presented in Table 9.

Table 9. High Level of Risk Control (H)

No	Area	Type of Hazard	Potential Hazard	Causes	Recommended Control Measures
1	Steps	Ergonomic / Physiological	Fatigue and gout	Prolonged walking, repetitive stair climbing, inadequate rest periods, and workers with pre-existing musculoskeletal or metabolic disorders.	Install handrails on both sides of the stairs, provide adequate rest intervals, implement job rotation, conduct ergonomic awareness training, and encourage periodic health assessments for workers at risk.
2	Steps	Ergonomic / Physiological	Stair inclination is too steep	Staircase design does not comply with ergonomic standards, excessive stair angle, narrow treads, and absence of anti-slip surfaces.	Redesign stairs according to occupational safety standards, install anti-slip stair nosing, provide sturdy handrails, improve lighting, and place warning signage at stair entrances.
3	Pharmacy Laboratory	Chemical	Unexpected chemical reactions	Improper segregation of incompatible chemicals, incorrect labeling, inadequate storage conditions, and insufficient knowledge of chemical compatibility.	Segregate incompatible chemicals, implement Chemical Compatibility Charts, ensure proper labeling based on GHS standards, provide chemical handling training, and establish Standard Operating Procedures (SOPs) for laboratory activities.
4	Pharmacy Laboratory	Biological	Exposure to fine particulate dust	Poor ventilation, improper handling of powdered substances, lack of local exhaust ventilation, and inadequate use of respiratory protection.	Install Local Exhaust Ventilation (LEV), conduct laboratory work inside a fume hood when appropriate, require suitable respiratory protective equipment (e.g., N95 respirators), perform regular housekeeping, and monitor indoor air quality periodically.

No	Area	Type of Hazard	Potential Hazard	Causes	Recommended Control Measures
5	Pharmacy Laboratory	Chemical	Exposure to toxic chemicals	Direct handling of hazardous substances, accidental spills, inadequate use of Personal Protective Equipment (PPE), and insufficient ventilation.	Substitute hazardous chemicals where feasible, utilize engineering controls such as chemical fume hoods, enforce the mandatory use of appropriate PPE, prepare emergency spill response procedures, install emergency eyewash stations and safety showers, and conduct routine occupational exposure monitoring.

Table 9 presents the identified high-level risks (H) and their recommended control measures in the campus environment. The main high-risk areas were the stairway area and the Pharmacy Laboratory. In the stairway area, ergonomic hazards such as fatigue, gout, and excessive stair inclination were identified due to repetitive use, inadequate rest, and improper stair design. The recommended controls include installing handrails, improving lighting, applying anti-slip surfaces, redesigning stairs according to safety standards, and providing ergonomic awareness training. In the Pharmacy Laboratory, high risks were associated with chemical and biological hazards, including unexpected chemical reactions, exposure to fine particulate dust, and toxic chemicals due to improper chemical handling, inadequate ventilation, and insufficient PPE use. Control measures include proper chemical management, improved ventilation, mandatory PPE use, safety procedures, and regular exposure monitoring. These findings highlight the need for systematic risk control strategies to minimize occupational hazards in the campus environment.

2. Moderate Risk Control (M)

Based on the results of the risk assessment, five categories of moderate-level risks (M) were identified within the campus environment. Although these risks do not require immediate emergency actions, they still require appropriate corrective measures and continuous monitoring to prevent escalation and reduce the possibility of workplace accidents. The recommended control measures were determined based on the hierarchy of controls, considering the characteristics of each hazard and its potential impact on campus users. The detailed findings of the moderate risk assessment and the proposed risk control strategies are presented in Table 10.

Table 10. Moderate Risk Management (M)

No	Area	Type of Hazard	Potential Hazard	Causes	Recommended Control Measures
1	Steps	Physical	Falling from height	Slippery stair surfaces, absence of anti-slip materials, inadequate handrails, poor housekeeping, and failure to maintain three-point contact while using stairs.	Install anti-slip stair treads and handrails, conduct routine inspections and maintenance, improve housekeeping practices, install warning signage, and provide safety awareness training regarding safe stair use.

No	Area	Type of Hazard	Potential Hazard	Causes	Recommended Control Measures
2	Steps	Ergonomic / Physiological	Inadequate lighting	Insufficient illumination levels, malfunctioning lighting fixtures, poor lighting distribution, and lack of periodic maintenance.	Upgrade lighting systems to comply with occupational lighting standards, perform regular inspection and maintenance, install emergency lighting where necessary, and ensure adequate illumination for all stairways.
3	Engineering Laboratory	Physical	Electrical hazard	Damaged electrical cables, overloaded electrical circuits, improper grounding, exposed wiring, and inadequate preventive maintenance.	Perform routine electrical inspections, install Ground Fault Circuit Interrupters (GFCIs), ensure proper grounding of electrical equipment, replace damaged cables immediately, implement Lockout/Tagout (LOTO) procedures, and provide electrical safety training.
4	Engineering Laboratory	Chemical	Exposure to corrosive chemicals	Improper handling of corrosive substances, chemical splashes during laboratory activities, inadequate PPE usage, and improper chemical storage.	Store corrosive chemicals according to GHS requirements, provide chemical-resistant gloves, face shields, laboratory coats, and safety goggles, utilize chemical fume hoods, install emergency eyewash stations and safety showers, and conduct laboratory safety training regularly.
5	Engineering Laboratory	Chemical	Fire	Presence of flammable chemicals, ignition sources near combustible materials, poor chemical storage practices, electrical faults, and inadequate emergency preparedness.	Store flammable chemicals in approved safety cabinets, eliminate ignition sources, install fire detection and suppression systems, provide suitable fire extinguishers (ABC/CO_2), conduct periodic fire drills, develop emergency response procedures, and ensure personnel receive fire safety training.

3. Low Level Risk Control (L)

Based on the results of the risk assessment, five categories of low-level risks (L) were identified across several locations within the campus environment. Although these risks have a relatively low potential impact compared to moderate and high-level risks, they still require proper management and routine monitoring to ensure that existing safety conditions are maintained. Low-level risks can generally be controlled through the implementation of standard operating procedures, regular maintenance, safety awareness, and compliance with established workplace safety practices. The identification of these risks is important to prevent their escalation into more serious hazards and to support a continuous improvement approach in occupational safety management. Examples of risk identification and control measures for low-level risks within the campus area as in Table 11.

Table 11. Low-Risk Handling

No	Area	Type of Hazard	Potential Hazard	Causes	Recommended Control Measures
1	Steps Area	Physical	Sprains or injuries to the legs	Uneven or slippery stair surfaces, improper stair design, absence of handrails, poor housekeeping, and inappropriate footwear.	Install anti-slip stair surfaces and secure handrails, maintain good housekeeping, conduct regular stair inspections, improve lighting conditions, provide safety signage, and require the use of slip-resistant safety footwear.
2	Pharmaceutical Laboratory	Physical	Damage from sharp tools	Improper handling of scalpels, needles, broken glassware, and other sharp instruments; inadequate training; improper disposal of sharps.	Provide comprehensive training on safe handling of sharp instruments, use puncture-resistant sharps disposal containers, inspect tools regularly, establish Standard Operating Procedures (SOPs), and require cut-resistant gloves where appropriate.
3	Pharmaceutical Laboratory	Biological	Biological contamination	Improper handling of biological samples, inadequate sterilization procedures, cross-contamination, poor laboratory hygiene, and failure to use appropriate biosafety practices.	Implement Biosafety Level (BSL) procedures appropriate to laboratory activities, enforce strict hand hygiene, sterilize laboratory equipment routinely, use biological safety cabinets when necessary, segregate infectious waste, and require laboratory coats, gloves, masks, and eye protection.
4	Engineering Laboratory	Ergonomics / Physiology	Noise exposure	Operation of noisy laboratory equipment, prolonged exposure to	Install noise-dampening materials and engineering noise controls, perform routine noise monitoring, limit exposure duration through job rotation,

No	Area	Type of Hazard	Potential Hazard	Causes	Recommended Control Measures
				high sound levels, inadequate acoustic insulation, and absence of hearing conservation measures.	implement a hearing conservation program, and require hearing protection when exposure exceeds permissible limits.
5	Engineering Laboratory	Physical	Injury mechanism	Contact with moving machinery, rotating equipment, falling objects, pinch points, improper machine guarding, and unsafe operating practices.	Install machine guards and emergency stop systems, implement Lockout/Tagout (LOTO) procedures during maintenance, conduct operator competency training, establish preventive maintenance schedules, display safety warning signs, and require appropriate PPE including safety shoes, helmets, gloves, and safety glasses.

Based on the table, it is clear that it provides recommendations for controlling the risk of danger by providing OSH education both through forums and posters to be aware of potential accidents in the stair area as well as the availability of fire extinguishers in the laboratory room. The consistent use of appropriate personal protective equipment (PPE) should be mandatory before conducting laboratory activities to minimize residual occupational risks. Thus, an analysis has been carried out with the results of the assessment showing that there are 15 potential hazard risks, 5 high risk, 5 medium risk and 5 low risk.

IV. CONCLUSION

This study demonstrates that the HIRADC method is an effective approach for identifying occupational hazards, assessing risk levels, and prioritizing risk control measures in a higher education campus environment. A total of fifteen potential hazards were identified, comprising five high-risk, five moderate-risk, and five low-risk hazards. The highest-risk areas were the stairways, pharmaceutical laboratory, and engineering laboratory, indicating that these locations require priority attention in campus occupational safety management.

The findings emphasize that implementing the hierarchy of controls—including engineering controls, administrative measures, and appropriate use of personal protective equipment (PPE)—can effectively reduce occupational risks and strengthen campus safety performance. The proposed recommendations provide practical guidance for university management in developing a structured Occupational Health and Safety (OHS) management system based on periodic risk assessment and continuous safety improvement.

Although this study was conducted at a single private university, the proposed HIRADC framework can serve as a reference for similar higher education institutions. Future studies should involve multiple universities and evaluate the effectiveness of implemented control measures to further strengthen evidence-based campus safety management. Overall, this study contributes to the development of a safer, healthier, and more sustainable campus environment.

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