Baseline Risk Assessment of Chemical Laboratories and Kitchen Laboratories at the Department of Food Technology and Chemicals, Politeknik Tun Syed Nasir Pagoh

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ABSTRACT

The engineering laboratories at Politeknik Tun Syed Nasir (PTSN) Pagoh involves hazardous processes that might jeopardize personnel and students' health and safety. As a result, methods such as identifying and evaluating major dangers are necessary. However, there is no systematic baseline study of hazard identification and risk assessment in the academic laboratory. Thus, this article provides an overview of the academic laboratory's baseline risk assessment, with an emphasis on the risk assessment technique, kind of hazard, and control methods used to eliminate the hazard. This investigation is focused on two selected laboratories; chemical and kitchen at the Department of Food Technology and Chemical, PTSN. The study is evaluating hazards in operations conducted at both selected laboratories. Hazards include handling laboratory apparatus, storage, disposal of chemicals, samples, or substances that may contain biohazards. The target population was lecturers, lab technicians, and other related people or persons in charge of the laboratories. The methodology of this research uses qualitative assessment and consists of several stages, which are the internal baseline audit ISO 45001 followed by inspection at the workplace. The chemical laboratory and kitchen at PTSN have more opportunities for improvement in safety and health. At inspected labs, safety management should implement an effective risk assessment so as to assist academic laboratories in further strengthening laboratory risk management. Hazard identification, risk assessment, and risk control (HIRARC) should be revised and updated annually during the document review in order to ensure the effectiveness of the occupational health and safety management system (OHSMS). PTSN should maintain a high-quality standard in its operation in order to provide a safe working environment. It is strongly recommended that some preventive actions be taken such as engineering control, administrative controls and personal protective equipment to reduce the risk level in the future.

INTRODUCTION

Current trends in society and work organizations are creating new risks and putting new demands on occupational safety and health research [1]. Organizations which have already carried out risk assessment in their work, have reported positive changes in their working practice, they recognize substandard act and working condition as they develop and take necessary corrective action [2]. Legislation requires that this process should be systematic and be recorded so that the results are reliable and the analyses complete (Department of Occupational Safety and Health, Ministry of Human Resources Malaysia [3]. It is important to quantify hazard at every workplace. Accident and unwanted event can be occurred to higher education institutions [4]. For example, a workshop at a fire or explosion may cause employee

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injuries, harm nearby building or facility and cause environmental damage [5]. For instance, environmental laboratory accommodates a wide variety of chemical burns on fire UMT on January 31, 2012. While at Shah Alam it was reported a single-story building which houses four laboratories of the Faculty of Science at the College Perindu destroyed in a fire at University Technology Mara (UiTM) on Friday evening, July 15, 2013. It was then followed by student classroom block UiTM, Dungun at fire, on Tuesday evening, dated 7 July 2015 [6]. Luckily no life injuries had recorded. While 21 Malaysian students amongst fire victim at Russian National Research Medical University (RNRMU), Moscow [7]. It was reported 7 students were carbon monoxide (CO) poisoning while others 8 outpatient treatment. Unluckily there was one death reported due to respiratory complications and burns 30 % on the face, hands and feet. The fire happened at student's hostel.

The Malaysian government has implemented several technical and vocational education and training (TVET) programs in schools, universities, and training centers. According to the Malaysia Education Blueprint (Higher Education), the demand for TVET personnel would grow by 2020 [1]. To meet this criterion, the government has increased development investment for public TVET institutions, with more than 1,000 TVET institutions in Malaysia to date, 506 of which are public institutions. Malaysia Polytechnic emerged as the largest contributor to workers in the field of education TVET in the country since 2010. TVET refers to a wide range of workplace-relevant learning activities. As a TVET center which hands on practices are common to students, Polytechnic Tun Syed Nasir (PTSN) contains a lot of laboratories, there is a chance that the operators, who include technicians, lecturers, and students, would be engaged in an accident. Some activities in any task can be classed as critical. All operations with hazards that pose considerable risks to employees' health and safety must be recognized [8-9].

Thus, under the occupational, safety and health (OSH) law, employers are responsible for providing a workplace free of serious recognized hazards and for adhering to OSH Act standards, rules, and regulations. Employers are required to check working conditions to ensure that they comply with relevant OSH Act standards. It must include all of the organization's activities, such as staff, equipment, and material selection, work procedures such as workplace risk assessment, working practices, and working environments [3]. The engineering laboratories or workshops at PTSN Pagoh involve hazardous processes that make personnel and others' health and safety vulnerable. As a result, methods such as identifying and evaluating major dangers are necessary. As yet, the completed assessment of the hazard is not properly done; what will the consequences be if the hazard actually causes an injury or harm to the safety and health of the staff, students, and other related people? The law stipulates that this procedure be methodical and recorded in order for the results to be reliable and the analysis to be comprehensive [3].

Therefore, the current study was undertaken to review gap analysis, identify hazard, assess the risk and suggest continual improvement at study engineering workshop at PTSN that described in ISO 45001 (in place of OHSAS 18001 Program). The study is performed to identify hazard based on risk assessment methodology regarding to requirement under OSH ACT 1994. This study is focused on two selected laboratories as in this research in chemical and kitchen laboratories at the Department of Food Technology and Chemical, JTKM PTSN which are located at the Higher Education Hub Pagoh. The respondents involved are lecturers, lab technicians and other related person e.g., support staffs. The research is qualitative risk assessment using audit checklist, and workplace inspection. These findings are useful as guidance in establishing an effective and successful OSH management system, especially for PTSN organization such as the OSH Committee, in Polytechnic Management, as well as DOSH Auditors, with the possibility of generalization to other polytechnics as well.

RESEARCH METHODOLOGY

Research Flow Process

The technique employed in this research procedure was an examination of a range of risk that has been done through the examination of selected laboratories at JTKM, PTSN, Pagoh. The flowchart for the research development and data collection procedure is shown in Figure 1.

Risk Assessment Checklist ISO 45001

On March 12, 2018, ISO 45001, the first International Standard for Occupational Health and Safety Management, was issued [10]. This study advocate using ISO 45001 instead of OHSAS 18001, or transitioning from the present OHSAS 18001 system. OHSAS 18001 is a British Standard for Occupational Health and Safety Management Systems that is widely recognized. Occupational health and safety management's key concepts encompasses identification of hazards, risk assessment, and risk control hierarchies. The standard outlines the fundamental elements for fulfilling the legal responsibility which are to detect, analyze, and manage health and safety hazards. It incorporates the hierarchy of controls principle, which states that workplace organization should try to eliminate the risk first and employ PPE as a last resort to treat the remaining risk. Other legal duties OHSAS 18001, like several other standards, requires every workplace organization to develop a system for identifying and managing the legal and other obligations that apply to their business. The legal compliance auditing and risk briefing information service can assist in managing this aspect of the standard. Health and safety are a culture that workers at all levels of an organization must embrace. The standard calls for methods of involvement and consultation to guarantee that risks from all sections of the organization are managed. This might include Health and Safety Committee meetings, which are mandated under the Safety Representatives and Safety Committees and the Health and Safety (Consultation with Employees).

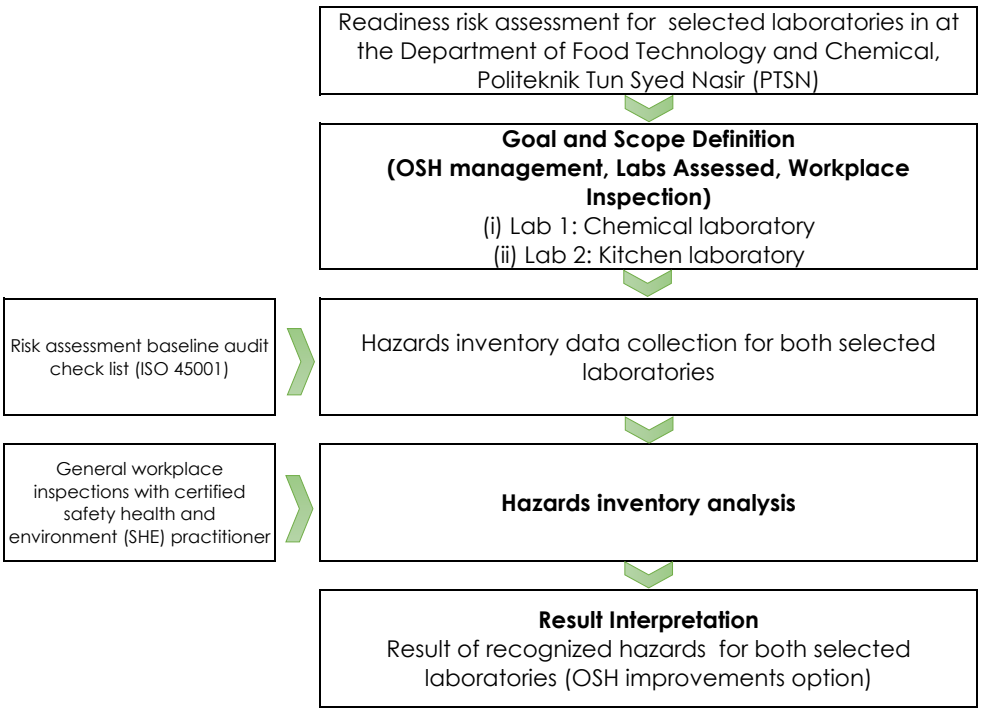

Figure 1 Flowchart for the research procedure.

Workplace Inspections

This inspection concentrated on two selected JTKM PTSN laboratories at the Higher Education Hub Pagoh. The study is assessing hazards associated with operations performed in JTKM's laboratory, which include hazards involved in handling laboratory apparatus, handling/storage/disposal chemicals, samples/substances that may contain biohazards, as well as employing powered equipment, machinery, work environments, energy such as electrical, kinetic, heat, and so on.

Risk Interpretation

A risk interpretation is, in general, the combined effort of risk assessment that involving identification and analyses prospective (future) occurrences that may have a detrimental impact on persons, assets, and/or the environment (i.e., hazard analysis); and making decisions "on the tolerance of the risk based on a risk analysis" while taking influencing elements into consideration (i.e., risk evaluation). A risk assessment, in layperson's words, assesses potential accidents, their likelihood and effects, and the tolerances for such incidents. The results of this procedure might be stated quantitatively or qualitatively. A complete risk management plan for limiting potential threats must include risk assessment

RESULTS AND DISCUSSION

Findings Based on ISO 45001:2018 Audit Check List Evaluation

The gap analysis is carried out with the intention of providing an overview of current risk assessment practice in polytechnics laboratories. The results of the gap analysis were shown in Table 1 as below, which encompasses clauses 8 Operation (8.1 Operational planning and control; 8.1.1 General; 8.2.2 Elimination hazards and reducing OH&S risks; and 8.1.3 Management of change. Clause 8.1.4 Procurement includes 8.1.4.1 General, 8.1.4.2 Contractors, and 8.1.4.3 Outsourcing, as well as Clause 8.2 Emergency preparedness and response. Finally, in clause 9, performance evaluation is related to 9.1 monitoring, measurement, analysis, and performance evaluation [10].

Table 1 Summarization of Findings Based on ISO 45001:2018 Audit Check List Evaluation for Risk Assessment at Selected Laboratories

Item	Area of Concern
The organization use a methodology of documenting risk assessment and control other than that described in ISO 45001 (in place of OHSAS 18001 Program- OHSAS 18001 is a British Standard for Occupational Health and Safety Management Systems that is widely recognized).	Yes Reference in the systems: The organization use a methodology of documenting risk assessment and control other than that described in ISO 45001, however is not completed.
Risk Assessments up-to-date and they do cover current full scope of operations; routine and non-routine activities; all personnel and all facilities	Yes Reference in the systems: Risk assessment for 2022 are not up to date and some are on schedule and will be completed as required.
Changes occurred in the organization's facilities or operations that necessitated a change in the risk assessments, and they	Yes Reference in the systems: No major changes to organization that affects risk assessment.

up-to-dated to cover the scope of the change	
The organization observe the hierarchy of controls (elimination, substitution, engineering control, signage/warning and/or administrative controls, personal protective equipment) when determining controls within risks assessments and other planning documents.	Yes Reference in the systems: Some risk assessment takes into account-work controls, administration & engineering controls however important warning and safety PPE signage were not posted when preparing these documents.
Operational controls in place and working as specified.	Yes Reference in the systems: Moderate, some are in accordance with lab/workshop practices requirement. It was observed that an eye protection, safety attire, electrical shock sign, warning of chemical hazards and biohazards, sharp edge parts, or in short safety signage were not posted at the entrance to the Chemical Laboratory JTKM, and Kitchen JTKM. Besides, the outer door to this kitchen/lab and into working area the safety procedures were not posted. This allows individuals to enter into a work area without being properly informed of the areas required Personal Protective Equipment. This is not a good practice and it is not in accordance with Occupational Safety and Health Management System subject requirement. It was observed security guarding are not installed on the wall for gas piping in line system type in the Chemical Laboratory, because of the danger of gas leakage on the in-line piping system also shall leads to disperse poisonous gaseous may bring harm to users. There were no chemical spillage and bio hazard safety handling and emergency response team posted, then no security labelling for chemical bottles (picto graph), improper procedures upon handling, storage and disposal (scheduled waste) area. Safety barrier must be installed and maintained to ensure that it can prevent contact, remains safe, protect from falling objects, not creating new dangers, does not create any disturbance and enables safe maintenance. At Kitchen labs in JTKM, the oven must also be installed safely and labelled in accordance to legal requirement of safety. Every cutting machine for bread (Kitchen JTKM) must be installed on work bench and must be at the suitable level of height to ensure safety for users to reach. The steel drain cover was observed improper installed since if the user step on the end side of it, the other end side cover will pull out from its socket so these also will lead the user to trip or fall. It was observed there were incorrect colors applied on floor of work, poor workshop management/poor housekeeping, incompetent PIC, contradiction between the duties and power and incorrect SOP for both of laboratory and kitchen at JTKM. Emergency stop button should be installed to all machineries.

The mechanism to inform contractors/interested parties of relevant operational controls applying to them	Yes Reference in the systems: Work control program

From the above findings (Table 1) it is can be seen that JTKM of PTSN is not fully in ready state to carry out the OSHMS requirement. However, there is lots of opportunity for improvement as found in area of concern data gathered. This finding is very useful in future improvement. The analysis can be made was risk assessment has been carried out through informal program but there is no documentation being recorded. It also had continual improvement but lack of proper documentation. If we can see the operational control was at second problem where there are no Safe Operating Procedures (SOP) posted to almost of inspected laboratories. It also including color code for floor work station which is contradiction to the safety code color spotted at JTKM's kitchen and chemical laboratory.

Workplace Inspection Findings

Meanwhile, from the work place inspections (Table 2), we can conclude that besides risk assessment being weak, the lab management upon JTKM chemical and kitchen laboratory are also needed in more opportunities for improvement in safety and health condition. Figure in Table 2 (a-h) were showing the current practice of the hazard identification and hierarchy of control at inspected labs of JTKM PTSN.

Table 2 Workplace Inspection at Selected Laboratories and Its Findings

Location	Descriptions
Chemical Laboratory (a) 	Chemical storage cabinet - No safety signage at the chemical storage cabinet - No SOPS for chemical handling procedures posted at the chemical storage cabinet
(b) 	Student working area - Poor housekeeping - Have no glassware rack for proper storage - Chemical storage also must be located properly

(c)  	Safety shower - Has been improperly installed and located to electrical isolation devices and outlet gas - Access to safety shower too narrow and too near to the fume hood
(d) 	Chemical preparation room - Lack of materials labelling - Poor housekeeping - Improper scheduled waste bin - Wrong PPE procurement e.g., rubber glove is prohibited, must use chemical resistant glove upon chemical handling activities - No biohazards waste bin provided
Kitchen (e_i) 	Kitchen floor Physical hazard - Physical protruding PVC piping and the socket which can make laboratory user trip and fall

(e_ii) 	- The steel drain cover was observed improper installed, the edge can tip off from the socket-leads to trip or fall to users
(f) 	Kitchen work area - Cutting machine for bread at the unsuitable level of height- too high, overreached - To ensure safety for users to reach, place steps to facilitate users to reach the bread cutting machine
(g) 	Kitchen hot area - The oven has been improper installed and labelled accordance to legal requirement of safety
(h_i) 	Kitchen laboratories in line piping gas system current conditions inspected - Wrong type of connector used from in line piping gas to industrial oven

(h_ii) 	- Wrong type of connector used from in line piping gas to industrial oven

In a chemical laboratory, a chemical hazard has been recognized as the primary threat. The operations include handling chemicals in the fume hood, disposing of acidic waste chemicals, and making solutions. Chemical hazards can manifest as gases, vapors, solids, or liquids [4]. During undertaking experiments within varying experimental circumstances, laboratory users were subjected to chemical dangers from dangerous compounds. The physical, chemical, toxicological, and exposure features of the chemical were reviewed in the chemical hazard to determine the hazard that may occur from the use of hazardous substances. Chemical risks must be identified for control measures to be implemented, as chemical exposure could have immediate or long-term severe health repercussions. Exposure to chemicals is determined based on the route of exposure, frequency of exposure, duration rating, and magnitude rating [4]. Chemical inhalation, chemical ingestion, skin irritation, and other chemical dangers that provide a significant risk should be treated seriously to avoid a serious mishap. Due to maintenance concerns, certain unwanted accidents might occur in academic chemistry laboratories' fume hoods if the situation remains. The frequent maintenance of the fume cupboard is an important aspect of preventing the ventilation's degradation capability, which might minimize the accident [11].

Furthermore, findings in this study revealed that fume hoods were improperly installed and located near electrical isolation devices; that outlet gas was too close to the fume hood, and that access to the safety shower was too narrow. Electrical hazards are typically caused by equipment in which electric shock might emerge during plugging the device's cord to the socket. However, most electrical risks are rated low risk because current control mechanisms successfully reduce the risk [9, 12]. Physical hazards are those that are connected to the work environment were spotted mostly in the kitchen laboratory. It involves being exposed to heat (oven), cold (freezer), noise, radiation, and a protruding object from the floor. The usage of equipment that can produce a fire or explosion, work environment circumstances that can cause a slip or fall, and injuries from sharp objects are the most prevalent physical threats in the kitchen workplace.

Laboratory employees are also vulnerable to psychological risks as a result of work stress, which can lead to weariness. Workplace stress may be caused by a heavy workload, an inflexible work schedule, insufficient equipment, poor communication, and a lack of company support. Musculoskeletal disorders and muscular strain are caused by ergonomic dangers such as an inconvenient working position. Aside from that, laboratory users may be susceptible to biological dangers when working with biological material, which can result in bacterial infection, transmission of infection, and skin inflammation. Mechanical dangers were mostly noticed in engineering laboratories, where users work with dangerous machinery that can cause accidents such as arm in machines, fractures, entrapment, crushing, and cutting. All of these threats must be properly addressed in order to establish a safe working environment in academic laboratories [9, 13].

Future Activities and Research Direction

It is highly urged that certain preventive measures be implemented to decrease the danger level in the future [3]. The key strategies for controlling a hazard include engineering controls such as plant designs and alterations, equipment ventilation systems, and procedures that reduce the source of exposure. Following that, administrative controls include changes to how work is done, such as work schedules, rules and other regulations, operational procedures such as standards and operating procedures (including training, housekeeping, and equipment maintenance), and, finally, personal hygiene practices. Individuals also use personal protective equipment (PPE) to decrease exposure, which includes chemical contact or noise exposure [3]. Because of a lack of exposure to such expertise and experience, most of the educational institutes lacks understanding concerning workplace safety and health risks [1]. Employee training and education on how to perform their duties safely reduces the risk of vulnerability and is an important factor of any complete workplace health and safety strategy (Table 3). Training should include not just how to do the activity safely, but also how to understand the hazards and risks associated with the job [14]. It must also educate them on how to safeguard themselves and their colleagues. Suggested safety program has been described as below.

Table 3 Future Activities Suggested

Hazard Identification, Risk Assessment and Risk Control (HIRARC) Program	Contents	Suggested Duration
HIRARC Induction	a) HIRARC Definition, Hazard Classification b) The Important of HIRARC c) Legal Requirement d) HIRARC Instrument: -BASELINE AUDIT CHECKLIST, Hazard Identification Checklist, HIRARC Form, Risk Matrix	3 Days
HIRARC Development	a) HIRARC Personnel or Teamwork b) HIRARC Planning c) HIRARC Element d) Hazard Identification e) Risk Evaluation f) Risk Control g) HIRARC Process h) Description of Work/Activities i) Risk Prioritization j) Risk Control k) Implementation of Control l) Continual Review	11 Days

PTSN also are recommended to have continuous improvement in accordance with OSH Act 1994 for example to develop Master Plan containing future OSHMS enhancement program, well documented safe operating procedures (SOPs) and hazard identification, risk assessment and risk control (HIRARC) and many others [14]. It is suggested that PTSN to work closely with industry workplaces or with establish agencies such as national institute of occupational safety and health (NIOSH), DOSH, and department of environment (DOE). HLIs like PTSN can act as a forum for discussion and sharing OSH information also spearhead research into relevant OSH areas, in partnership with the national council of occupational safety and health (NCOSH) and DOE.

CONCLUSION

This study assessed the baseline risk evaluation of two laboratories for JTKM PTSN safety management - chemical and kitchen laboratories - using qualitative methodology. In conclusion, marked chemical and kitchen laboratories at PTSN is having more of opportunity for improvement towards safety and health such as to ensure constant improvement in line with the OSH Act of 1994, that involves developing a Master Plan that includes future OSHMS enhancement programs, well-documented safe operating procedures (SOPs), and hazard identification, risk analysis, and risk control (HIRARC). Even though there is certified namely MS ISO 9001:2000, with this accreditation the management at JTKM laboratories as well as JKPK PTSN is hoping to move forward to achieved others accreditation such as MS 1722, ISO 45001 (in place of OHSAS 18001), MS ISO 14001 etc. To provide a safe working environment, PTSN must maintain a high quality of operation. At inspected labs, safety management should implement the scheduled waste regulation 2005 under Environmental Quality Act (EQA) 1974 for hazardous waste and waste water. Besides, the HIRARC should be revised and updated annually during the document review in order to ensure the effectiveness of the OHSMS. The authors wish to acknowledge the Polytechnic Tun Syed Nasir, Pagoh for their technical support in this research.

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