

**FIRST AID KIT MANAGEMENT IN SELECTED
TERTIARY INSTITUTIONS IN MALAYSIA**

NURUL FARHANA BINTI HAMDAN FADEL

**FACULTY OF ENGINEERING
UNIVERSITY OF MALAYA
KUALA LUMPUR**

2018

**FIRST KIT MANAGEMENT IN SELECTED
TERTIARY INSTITUTIONS IN MALAYSIA**

NURUL FARHANA BINTI HAMDAN FADEL

**RESEARCH REPORT SUBMITTED IN PARTIAL
FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER SAFETY, HEALTH AND
ENVIRONMENT ENGINEERING**

**FACULTY OF ENGINEERING
UNIVERSITY OF MALAYA
KUALA LUMPUR**

2018

UNIVERSITY OF MALAYA
ORIGINAL LITERARY WORK DECLARATION

Name of Candidate: Nurul Farhana Binti Hamdan Fadel

Matric No: KQD 160023

Name of Degree: Master-Safety, Health and Environment Engineering

Title of Project Paper/Research Report/Dissertation/Thesis (“this Work”): First Aid Kit Management in Selected Tertiary Institutions in Malaysia
Field of Study: Healthcare waste management

I do solemnly and sincerely declare that:

- (1) I am the sole author/writer of this Work;
- (2) This Work is original;
- (3) Any use of any work in which copyright exists was done by way of fair dealing and for permitted purposes and any excerpt or extract from, or reference to or reproduction of any copyright work has been disclosed expressly and sufficiently and the title of the Work and its authorship have been acknowledged in this Work;
- (4) I do not have any actual knowledge nor do I ought reasonably to know that the making of this work constitutes an infringement of any copyright work;
- (5) I hereby assign all and every rights in the copyright to this Work to the University of Malaya (“UM”), who henceforth shall be owner of the copyright in this Work and that any reproduction or use in any form or by any means whatsoever is prohibited without the written consent of UM having been first had and obtained;
- (6) I am fully aware that if in the course of making this Work I have infringed any copyright whether intentionally or otherwise, I may be subject to legal action or any other action as may be determined by UM.

Candidate’s Signature

Date:

Subscribed and solemnly declared before,

Witness’s Signature

Date:

Name:

Designation:

FIRST AID KIT MANAGEMENT IN SELECTED TERTIARY INSTITUTIONS IN MALAYSIA

ABSTRACT

First aid kit provision in the workplace is a common practice by an employer to ensure safety, health and well-being of employees. Mismanagement of first aid items may end up producing a lot of scattered wastes all around the workplace that require the same attention as other healthcare wastes. Considering tertiary institutions as ‘mini cities’ of the workplace which involve a variety of activities, this study aims to ensure proper waste disposal and waste minimization practice of first aid items through holistic management approach. The main objective of this study is to identify the first aid kit management practice among tertiary institutions in Malaysia and to propose an effective first aid kit management system that can be adopted into any working environment. The method applied throughout this study was a random distribution of questionnaires to identify tertiary institutions to take part in this survey. Case studies were conducted in Taylor’s University Lakeside Campus and University of Malaya to understand the practice in more detail and also to validate the first aid management practice reflected through questionnaire results. The questionnaire data were then analyzed and compared to related regulations, guidelines and standards to identify the gap of current first aid kit management practice. From this study, the result demonstrated that the first aid kit management varies among institutions due to the different approaches of health and safety management system. Even though most of the institutions declare they practice waste minimization approach and proper waste disposal throughout first aid kit management, the effectiveness is still uncertain as per findings demonstrated through the case study. Issuance of first aid kit, replenishment control and waste disposal were found to be the main control elements in this study to ensure the effectiveness of first aid kit management in the workplace. Each of the proposed element can be adopted into any first aid kit

management as waste minimization approach and to ensure proper waste disposal of the hazardous substances. This study demonstrated the possibility of managing small and scatter waste through effective and systematic management approach in order to protect adverse effect towards health and environment in the long term.

Keywords: first aid kit, waste disposal, waste minimization, healthcare waste

University of Malaya

PENGURUSAN PETI PERTOLONGAN CEMAS DI INSTITUSI PENGAJIAN TINGGI TERPILIH DI MALAYSIA

ABSTRAK

Pengedaran peti pertolongan cemas di tempat kerja merupakan amalan biasa yang dilakukan oleh syarikat bagi menjamin keselamatan, kesihatan dan kebajikan pekerja. Pengurusan peti pertolongan cemas yang tidak teratur akhirnya akan menghasilkan banyak sisa di merata-rata di persekitaran tempat kerja yang memerlukan perhatian sama seperti sisa penjagaan kesihatan yang lain. Dengan mengambil kira pusat pengajian tinggi sebagai tempat kerja di 'bandar kecil' yang melibatkan pelbagai jenis aktiviti, penyelidikan ini bertujuan untuk memastikan pelupusan sisa dan amalan pengurangan sisa yang teratur bagi barangan peti pertolongan cemas melalui pendekatan pengurusan secara holistik. Objektif utama kajian ini adalah untuk mengenal pasti amalan pengurusan peti pertolongan cemas di kalangan institusi pengajian tinggi di Malaysia dan juga mencadangkan sistem pengurusan peti pertolongan cemas yang berkesan yang boleh diterima pakai dalam mana-mana persekitaran kerja. Kaedah yang digunakan sepanjang kajian penyelidikan ini adalah pengedaran kuesioner rawak kepada institusi pengajian tinggi yang dikenalpasti. Kajian kes telah dilakukan di Kampus Universiti Taylor's Lakeside dan Universiti Malaya untuk memahami amalan secara terperinci dan juga mengesahkan amalan pengurusan pertolongan cemas yang dikenalpasti melalui hasil soal selidik. Data soal selidik kemudiannya dianalisis dan dibandingkan dengan peraturan, garis panduan dan *standard* yang berkaitan untuk mengenal pasti jurang amalan semasa pengurusan peti pertolongan cemas. Melalui kajian ini, hasil menunjukkan bahawa kepelbagaian pengurusan peti pertolongan cemas di kalangan institusi-institusi adalah disebabkan oleh pendekatan sistem pengurusan kesihatan dan keselamatan yang berlainan. Walaupun kebanyakan institusi menyatakan pendekatan amalan pengurangan sisa dan pelupusan sisa yang sewajarnya dilakukan sepanjang pengurusan peti

pertolongan cemas, keberkesanan masih diragui seperti yang dibuktikan oleh penemuan melalui kajian kes. Pengedaran peti pertolongan cemas, pengisian semua barangan dan pelupusan sisa dikenal pasti sebagai kawalan utama dalam kajian ini untuk memastikan keberkesanan pengurusan peti pertolongan cemas di tempat kerja. Setiap unsur yang dicadangkan boleh diterima pakai ke dalam mana-mana pengurusan peti pertolongan cemas sebagai langkah pendekatan pengurangan sisa dan memastikan pelupusan sisa bahan berbahaya yang teratur. Kajian ini menunjukkan kemungkinan pengurusan sisa kecil dan merata-rata boleh dicapai melalui pendekatan pengurusan yang berkesan dan sistematik bagi melindungi kesan buruk terhadap kesihatan dan alam sekitar dalam jangka masa panjang.

Kata kunci: peti pertolongan cemas, pelupusan sisa, pengurangan sisa, sisa barangan penjagaan kesihatan

ACKNOWLEDGEMENTS

It is impossible for me to be a postgraduate student in University Malaya without the cooperation and assistance of people surrounding me who are generous with their time and knowledge. I am deeply honored to carry out this research project and contribute my knowledge to the society. I am sincerely grateful to the generous supervision that I received from Prof. Dr. Nik Meriam Binti Nik Sulaiman throughout all stages of this study.

Special thanks to members of Majlis Bersama Kesihatan dan Keselamatan Pekerjaan Institusi Pengajian Tinggi/ Institusi Pusat Penyelidikan (MBKKP) to contribute to my research study and Office of Safety and Health unit of University Malaya to share some of the required information for my case study. Also, many thanks to Taylor's University Lakeside Campus to allow me to conduct a detailed case study for the benefit of this research.

Finally, my endearing and enduring gratitude to my family: my mom who have always remind me to do goods to others; my dad who have always ensure my well-being; siblings who have always support financially and spiritually.

This study is dedicated to my parents Hamdan Fadel bin Ahmad and Katheeza bte. Mohamed Saleh who always teach me to be a good person in Dunya towards Akhirah, remind me to consistently contribute to society and show me what true love is all about.

TABLE OF CONTENTS

FIRST AID KIT MANAGEMENT IN SELECTED TERTIARY INSTITUTIONS IN MALAYSIA Abstract.....	iii
PENGURUSAN PETI PERTOLONGAN CEMAS DI INSTITUSI PENGAJIAN TINGGI TERPILIH DI MALAYSIA Abstrak.....	v
Acknowledgements.....	vii
Table of Contents.....	ix
List of Figures.....	xii
List of Tables.....	xiv
List of Symbols and Abbreviations	xv
List of Appendices	xvi
CHAPTER 1: INTRODUCTION.....	1
1.1 Background	1
1.2 Problem Statement.....	2
1.3 Aim.....	3
1.4 Objectives.....	4
1.5 Scope.....	4
1.6 Significance of Project	4
CHAPTER 2: LITERATURE REVIEW.....	5
2.1 First Aid as part of Healthcare	5
2.1.1 Definition of Healthcare and First Aid.....	5
2.1.2 First Aid Requirement and Maintenance	5
2.1.3 First Aid Waste Categorization	6
2.2 Healthcare Waste Management	8

2.2.1	Breakdown of Healthcare waste Generation	8
2.2.2	Waste Handling and Segregation.....	10
2.2.3	Healthcare Waste Disposal and Treatment	11
2.3	Contributing Factors to Healthcare Waste Mismanagement.....	14
2.4	Health, Safety and Environmental impact	16
2.5	Recommendation to Improve Healthcare Waste Management	18
CHAPTER 3: METHODOLOGY		21
3.1	Research Process	21
3.2	Data Collection	22
3.2.1	Questionnaire Elements.....	23
3.2.2	Case Study at Taylor’s University Lakeside Campus (TULC)	24
3.2.3	Case Study at University of Malaya (UM).....	24
3.2.4	Limitation for Data Collection.....	25
3.3	Benchmark	25
CHAPTER 4: RESULT AND DISCUSSION		26
4.1	First Phase: Questionnaire Result	26
4.2	Second Phase: Case Study	43
4.2.1	Case Study at TULC	43
4.2.2	Case Study at UM	49
4.3	Overall Practice of First Aid Kit Management	50
4.4	Main Elements in First Aid Kit Management	59
4.4.1	Issuance of First Aid Kit	59
4.4.2	Replenishment Control of First Aid Kit Items	61
4.4.3	Disposal of First Aid items.....	63
4.5	First Aid Kit Management System Proposal.....	65

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS.....	70
5.1 Conclusion.....	70
5.2 Recommendations.....	71
References	72
Appendix A:	75

University of Malaya

LIST OF FIGURES

Figure 2.1: Composition of healthcare waste from different developing Asian countries	9
Figure 2.2: Compliancy of waste management among developing Asian countries with WHO standards.....	10
Figure 2.3: Effects of risk perception on pharmaceutical disposal habits	16
Figure 3.1: Flow chart of research methodology.....	21
Figure 4.1: Institution size based on total number of occupants	27
Figure 4.2: Institutions certification and ‘POPEA’ implementation	28
Figure 4.3: Responsible unit/ department for first kit issuance.....	30
Figure 4.4: First aid kit quantity based on institution size	31
Figure 4.5: Frequency of the first aid kit inspection among institutions.....	33
Figure 4.6: Number of first aiders in institutions	34
Figure 4.7: Frequency of first aid training	35
Figure 4.8: Frequency of first aid items replenishment request	38
Figure 4.9: Replenishment request based on first aid items category	39
Figure 4.10: Estimated yearly expenditure of first aid items	40
Figure 4.11: Availability of unused or expired items in institutions	41
Figure 4.12: Availability of expired or unused first aid items based.....	41
Figure 4.13: Method of disposal of first aid items residue	42
Figure 4.14: Method of disposal of expired or unused first aid items	42
Figure 4.15: First aid kit size and no. of occupants.....	44
Figure 4.16: Headcount of first aiders based on first aid kit location.....	45
Figure 4.17: Percentage of produced first aid waste based on category.....	48
Figure 4.18: Liquid and cream first aid waste type	48
Figure 4.19: Solid first aid waste type	49

Figure 4.20: First aid kit size issued based on number of occupants and risk level in TULC	52
Figure 4.21: First aid kit condition without proper maintenance at TULC (a) and (b) ..	55
Figure 4.22: First aid waste amount relationship between residue and expired items ...	59
Figure 4.23: Main elements to be controlled in first aid kit management	64
Figure 4.24: Example of first aid serial number	66
Figure 4.25: Standard size of first aid kit available	66

University of Malaya

LIST OF TABLES

Table 2.1: First aid waste categorization.....	7
Table 3.1: Elements and information collected from the questionnaire	23
Table 4.1: Range number of occupants.....	27
Table 4.2: Institution details based on institution size	28
Table 4.3: Issuance details based on institution size	30
Table 4.4: Maintenance practice based on institution size.....	32
Table 4.5: Placement of first aid kit based on institution size.....	33
Table 4.6: Responsible person to carry out inspection	34
Table 4.7: Method of first aider selection	35
Table 4.8: First aid treatment practice	36
Table 4.9: Accessibility to first aid kit for treatment.....	36
Table 4.10: First aid items inventory practice	37
Table 4.11: Responsibility to monitor first aid inventory	37
Table 4.12: Purpose for first aid items replenishment	38
Table 4.13: First aid kit size and no. of occupants	43
Table 4.14: Risk level and risk assessment implementation.....	46
Table 4.15: First aid treatment record and monthly inspection practice.....	46
Table 4.16: Amount of expired first aid waste	47
Table 4.17: Expired first aid disposal practice in TULC	49
Table 4.18: Example of recommended first aid kit register.....	65
Table 4.19: Example of first aid treatment register	68

LIST OF SYMBOLS AND ABBREVIATIONS

DOE	:	Department of Environment
DOSH	:	Department of Occupational Safety and Health
EHS	:	Environmental, Health and Safety
FMA	:	Factories and Machinery Act
HOD	:	Head of Department
HSE	:	Health and Safety Executive
MKKP	:	<i>Manual Kesihatan dan Keselamatan Pekerja</i>
NADOPOD	:	Notification of Accidents, Dangerous Occurrence, Occupational Poisoning and Occupational Diseases
NIA	:	No information available
NZ	:	New Zealand
OSHA	:	Occupational Safety and Health Act
OSHMS	:	Occupational Safety and Health Management System
PTj	:	<i>Pusat Tanggungjawab</i>
TULC	:	Taylor's University Lakeside Campus
UK	:	United Kingdom
UM	:	University of Malaya
WHO	:	World Health Organization

LIST OF APPENDICES

Appendix A: Research Questionnaire

.....

75

University of Malaya

CHAPTER 1: INTRODUCTION

1.1 Background

Good practice of healthcare waste management becomes crucial nowadays considering mismanagement of them may lead to potential hazards towards the environment and human health. Healthcare is defined as any medical activities performed to improve or maintain the physical or mental health of individuals or communities. It includes diagnosis, monitoring, treatment, prevention of disease or injuries performed by authorized or qualified personnel. Throughout healthcare activities, a lot of tools, equipment and products will be consumed and generated as healthcare waste.

Healthcare waste is actively produced in many forms by a variety of activities. Many studies have been conducted which emphasize healthcare waste management in bigger premises such as hospital, clinic and production site due to the high generation of waste. Although it is part of healthcare elements, first aid waste management is always overlooked in any premise as first aid waste is always seen as 'minor' or 'scattered' source in any healthcare facilities. First aid items may contain hazardous substances which require attention as with other pharmaceuticals products.

Provision of first aid kit in the workplace is considered mandatory as part of employer responsibility as stated in Section 15 of Occupational Safety and Health Act 1994 and Section 25 of the Factories and Machinery Act 1967. The provision of first aid must be consistent and efficient as part of employee's welfare. The Department of Occupational Safety and Health (DOSH) in collaboration with few other contributors had published Guidelines on First-Aid in the Workplace with Second Edition revised version in 2004. The main objective of the Guidelines is to assist the first-aid facilities planning and implementation in the workplaces by employers, occupiers and health and safety personnel (DOSH, 2004). However, the contents of the Guidelines do not cover a holistic

idea of first aid kit management as it focused on the requirements without expanding the guidance on handling and disposal method.

As part of healthcare products, the need for proper disposal of unused or expired first aid items become important to reduce the burden on domestic waste treatment. The typical components of first aid items vary with the different type of products such as paper, wood, consumable products, solvent-based items and drug contained materials. Some of the contents of first aid items are categorized as hazardous waste. Even though the quantity of first aid wastes produced is in small quantity, there is still some risks and potential dangers to environment related to mishandling of wastes.

Tertiary institutions are referred to as the third level of education or post-secondary education such as universities, colleges, technical institutes and vocational schools. In tertiary institutions, the level of environmentally conscious among society is higher compared to other town and housing areas. A lot of activities take place in the tertiary institutions and it will lead to the generation of the various type of wastes including first aid waste from healthcare activities.

According to the hierarchy of waste minimization strategy, prevention and source reduction it always recommended as the first choice as part of environmental protection. This strategy is relevant to be implemented in first aid kit management to avoid waste scattering which will lead to burden in the domestic waste collection, disposal and treatment.

1.2 Problem Statement

Many studies emphasized on the needs of managing bulk waste by using waste management hierarchy to protect adverse effect towards human health and environment. Prevention and reduction from source are always recommended as preferred waste

minimization strategy. This strategy is actively adopted from many studies as part of environment protection in bigger scope such as public hospitals, clinic, and health center and manufacturing site. However, small and scattered waste such as first aid waste in the workplace is always neglected even though some of the waste elements may consist of hazardous substances. In addition, there is no standards or guidelines used in Malaysia to address the needs of first aid kit management to address waste handling and disposal in the workplace.

Evaluating and understanding of the current state on first aid waste handling, tertiary institutions are selected as a starting case study as nowadays university communities can be considered as 'mini cities' with different degrees of effect on the environment (Adeniran, Nubi, & Adelopo, 2017). Due to this, it is justifiable that proper first aid kit management based on 'cradle to grave' concept be introduced and implemented in any workplace including in tertiary institutions environment. Adopting the overall view from these studies, the negligence issue of handling healthcare waste in large healthcare facilities can represent the same issue in first aid items and facilities waste management. The problem in the first aid kit management can be represented by following research questions:

- (a) What is the current practice of first aid kit management in tertiary institutions in Malaysia?
- (b) What is the best practice to ensure first aid kit can be managed effectively as part of waste minimization strategy?

1.3 Aim

The aim of this research is to ensure proper waste disposal and waste minimization of first aid items through holistic first aid kit management approach.

1.4 Objectives

The first objective of this research is to identify the current first aid kit management in tertiary institutions in Malaysia. Besides, another objective to be achieved in this study is to propose effective and holistic first aid kit management system.

1.5 Scope

The scope of this research covers only for first aid kit management practice in selected tertiary institutions in Malaysia. The study of first aid kit management starts from the issuance of first aid kit until the disposal of first aid waste by the institutions.

1.6 Significance of Project

Since there is no study conducted before to specifically understand the practice of first aid kit management, this research will demonstrate the needs of first aid kit management practice as per case study and questionnaire findings. Through the questionnaire results, the current practice of first aid kit management is determined and the result can be used as a baseline data of first aid kit management among tertiary institutions. A case study is conducted as a close-up and validation of the current first aid kit management practice. From the analysis of questionnaire and case study, the holistic first aid kit management is proposed to adopt waste minimization strategy. This proposal can be used in any workplace environment as part of environment protection.

CHAPTER 2: LITERATURE REVIEW

2.1 First Aid as part of Healthcare

2.1.1 Definition of Healthcare and First Aid

As stated in Guidelines on The Handling and Management of Clinical Wastes by Department of Environment (DOE), healthcare is defined as any medical activities such as diagnosis, monitoring, treatment prevention of disease of handicap in humans or animals performed under the supervision of any person authorized by their professional qualifications (DOE, 2009). While referring to the Guidelines on First Aid in the Workplace by DOSH, first aid is defined as the assessment and interventions performed by a first aider for the injury with minimal equipment until qualified medical or health personnel arrive to provide treatment. First aid provision includes all appropriate facilities, services and personnel required for the immediate treatment of injury or illness at a workplace (DOSH, 2004). First aid emphasizes on early treatment once casualty occurs while healthcare covers all phases of casualty treatment. By comparing both definitions, first aid also can be categorized as a subset of healthcare elements.

2.1.2 First Aid Requirement and Maintenance

First aid provision in any premise includes first-aiders, first-aid box, first-aid room and first-aid equipment. The number of all first aid provision typically is based on the type of industry, number of workers, number of work shifts and location of workplace and status of infrastructure in relation to the nearest medical clinic or hospital (DOSH, 2004). As part of Occupational Safety and Health Act (OSHA) 1994, all injuries in the premises must be recorded and reported to DOSH (OSHA, 1994). This is in parallel with what stated is in Guideline on First Aid in the Workplace as the record of the treatment given by the first-aider should be made and kept for a period of five years by the employer. The main responsibility for maintaining first aid facilities including replenishment and regular inspection belongs to the employers. In this case, employers need to ensure that appointed

first aiders must be able to maintain and perform the responsibility to ensure the services are adequate at all times (DOSH, 2004).

2.1.3 First Aid Waste Categorization

Most of the national or international bodies will describe health or medical treatment waste as healthcare, pharmaceutical, medical or clinical waste. The World Health Organization (WHO) states that all waste generated by healthcare establishment including waste originating from 'minor' or 'scattered' source is defined as healthcare waste. As first aid is part of health and medical services, hence the waste can be categorized based on their components. First aid products potentially end up to produce several categories of waste such as infectious waste, sharps, pharmaceutical waste and chemical waste as stated in WHO. In Guidelines on The Handling and Management of Clinical Wastes in Malaysia, the categorization of first aid is almost similar to WHO categorization on healthcare waste. Table 2.1 shows the list of first aid waste categories:

Table 2.1: First aid waste categorization

Components	First Aid Products	Waste Category
Equipment or materials that have been in contact with blood or any body parts of the injured person suspected to contain pathogens.	Tissues (swabs, gauze pads and dressings) Bandages (triangular, elastic and roller) Eye pads Gloves Adhesive tape Alcohol prep pads Cotton buds Barrier device for CPR such as pocket mask and face shield	Infectious waste, (clinical waste)
Any equipment with sharps or pointed parts that able to cause an injury to the human.	Scissors Safety pin Cervical collar plastic apron Splints	Sharps (clinical waste)
Items contaminated by pharmaceuticals product	Bottles and boxes of pharmaceuticals products.	Pharmaceutical waste (clinical waste)
Waste containing chemical substances that are expired or no longer needed	Disinfectants Antiseptic Burn aid cream Yellow lotion	Chemical waste
Products or items in the solid state that are expired or no longer needed	Cold pack compress gel Unused absorbent paper Unused swabs	Solid waste
Any products or tools that contained high densities of poisonous metal.	Thermometer	Heavy metals

As first aid facilities and items are mainly used for early treatment of casualty, most of the study does not really focus much on the hazardous waste elements in first aid items. There are no previous published studies assessing and categorizing first aid elements particularly for hazardous elements. The assessment and categorization are always conducted for bigger scale healthcare waste focusing in large healthcare services such as hospitals, clinics, pharmacies and university clinics (Ananth, Prashanthini, & Visvanathan, 2010; Hossain, Santhanam, Nik Norulaini, & Omar, 2011).

2.2 Healthcare Waste Management

2.2.1 Breakdown of Healthcare waste Generation

There are many studies conducted previously to discover the healthcare waste management among different type of healthcare facilities. The results demonstrate that public and large healthcare facilities have better waste management practices compared to small private facilities (Mohamed, Ebrahim, & Al-Thukair, 2009). The main sources of healthcare waste identified are hospitals, medical clinics, dispensaries, healthcare camps, medical and biomedical laboratories, medical research centers, mortuary and autopsy centers, animal research and blood banks (Ananth et al., 2010; Bendjoudi, Taleb, Abdelmalek, & Addou, 2009; Blenkarn, 1995; Da Silva, Hoppe, Ravello, & Mello, 2005; Marinkovic, Vitale, Janev Holcer, Dzakula, & Pavic, 2008) demonstrated their finding in Figure 2.1.

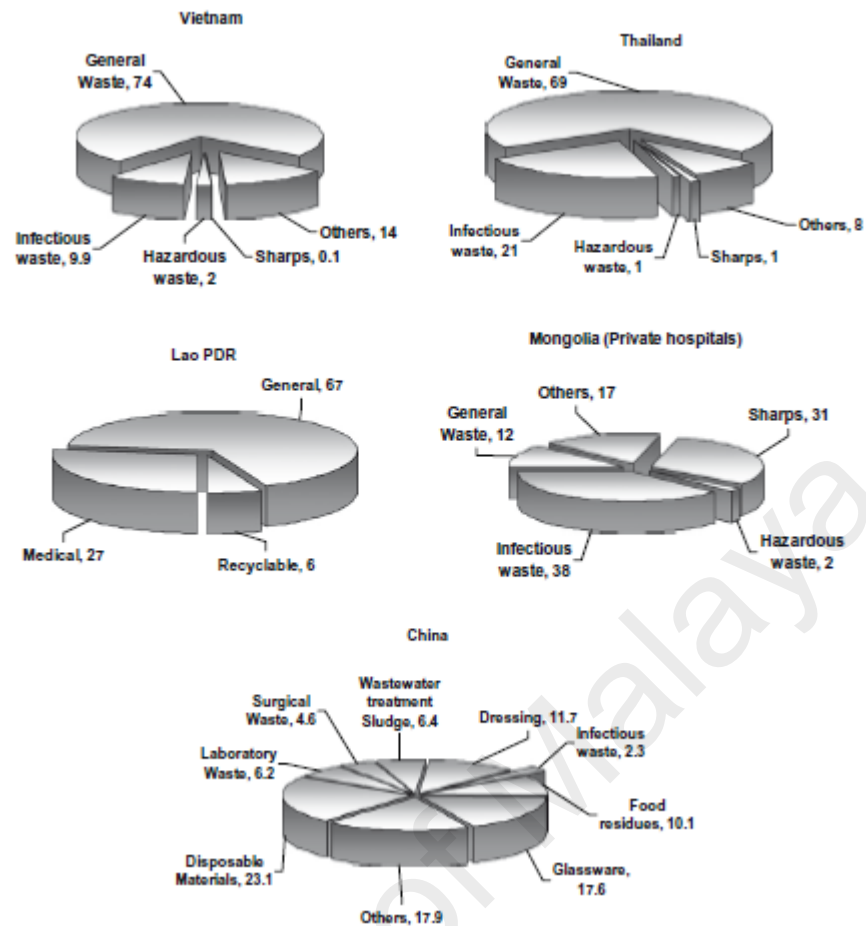


Figure 2.1: Composition of healthcare waste from different developing Asian countries

According to WHO, about 10% to 25% of healthcare waste can be categorized as hazardous waste; while remaining 75% and 90% can be categorized as non-hazardous and it most of the generated waste came administrative and housekeeping activities. Many studies had been conducted to estimate the total amount of healthcare and medical waste generated at facilities and found out to be varied depending on many factors (Ananth et al., 2010; Hossain et al., 2011; Mohamed et al., 2009; Windfeld & Brooks, 2015). Another study concluded that 52% of infectious medical and healthcare waste production comes from rehabilitation service which provides short term treatment to the patients followed by laboratories (23%), surgeries (14%), dialyses (7%) and first aid (4%) (Windfeld & Brooks, 2015). In large healthcare facilities as stated in some studies, the

capacity of healthcare waste can be easily predicted by considering the patient bed capacity of the healthcare facilities (Ananth et al., 2010; Xin, 2015).

2.2.2 Waste Handling and Segregation

A study was conducted in developing countries by the healthcare management plan to understand the staff responsibilities as part of waste handling procedure (Mohamed et al., 2009). The results revealed that waste handling groups including medical staff, administrative staff and infectious control staff do not have a clear scope of responsibilities in implementing the waste handling activities. Another case study also found a similar issue as only a few staffs of the healthcare facilities from developing Asian countries are familiar with appropriate waste management procedure as per Figure 2.2 (Ananth et al., 2010).

Country	Segregation	Storage	Transport	Treatment	Disposal
Cambodia	○	○	⊙	○	⊙
China	⊙	○	○	○	⊙
Indonesia	⊙	⊙	⊙	○	⊙
Japan	○	○	○	○	○
Lao PDR	⊙	⊙	⊙	○	⊙
Malaysia	○	○	○	○	○
Mongolia	○	⊙	○	○	⊙
Myanmar	○	⊙	⊙	○	⊙
Philippines	○	○	○	○	○
Singapore	○	○	○	○	○
Thailand	○	⊙	○	○	○
Vietnam	○	○	○	○	○
○ Followed		⊙ Partial		⊙ Not followed	

Figure 2.2: Compliancy of waste management among developing Asian countries with WHO standards

Waste management procedures also were not completely prepared in the facilities indicating that there is no structured healthcare management and practices related to managing the wastes. Adopting the overall view from these studies, the negligence issue

of handling healthcare waste in large healthcare facilities can represent the same issue in first aid items and facilities waste management.

In most of the department hospitals, yellow plastic bags or bins are always available at all time as the waste quantity of healthcare and clinical items is large and visible to everyone on the premise. However, the need for proper healthcare waste bins is always neglected for small public or private healthcare facilities (Bendjoudi et al., 2009). This situation is alarming as the same situation will be applicable to other premises other than healthcare industries without realizing some elements in first aid items can be categorized as healthcare and clinical waste.

2.2.3 Healthcare Waste Disposal and Treatment

Most of healthcare waste disposal studies emphasized on bulk disposal by industries and health care facilities as the adverse effect to the environment is well known. Based on study conducted in Kabul, disposal practices of unused and expired healthcare among general public is still poor as 77.7% respondents declared that all expired medicines was throw away in household garbage while 12% respondents choose to flush expired medications in toilet or sink (Bashaar, Thawani, Hassali, & Saleem, 2017). Disposal of healthcare products from household still require improvement as many people have a tendency to throw the unused and expired into domestic bin. Study conducted among public in South-East of England discovered that two-thirds of them throw healthcare product that contained pharmaceutical waste in the bin (Bound, Kitsou, & Voulvoulis, 2006). This poor choice of disposal method of healthcare waste demonstrated the lacking of environmental awareness among public.

As other types of waste management, the management practice of healthcare waste also may involve waste minimization, recycle, reuse, recovery and reduction of volume and degree by various treatments (Stoch, Ciecńska, Stoch, Kuterasiński, & Krakowiak,

2018). Since healthcare waste can be categorized into so many types of waste, different approaches and treatments can be selected accordingly. Incineration is the most well-known healthcare disposal method as reported by many studies (Bujak, 2015; Windfeld & Brooks, 2015). Incineration is most likely to be used for the main reasons of converting waste into a safe form, significant waste reduction of total weight and volume and heat recovery from the process (Bujak, 2015; Stoch et al., 2018). However, not all type of healthcare waste can be disposed of through incineration process as there are some possibilities of emitting toxic elements into the environment.

For healthcare solid waste type, recycle-reuse program after sterilization by using supercritical fluid can be implemented at the initial collection of the healthcare solid waste. This main purpose of this techniques is to inactivate the infectious micro-organisms in solid waste generated from healthcare facilities (Hossain et al., 2011). As some hazardous healthcare waste may be accidentally disposed into domestic waste stream, a lot of waste treatment technique studies had been conducted to ensure effective removal of hazardous elements from the healthcare waste. In addition, some of the waste may be released into water flow through domestic wastewater, hospital discharges, sewage treatment plants and water treatment plants (Leung et al., 2012; Ozbek & Sanin, 2004). Hence, many studies have been conducted to improve several advanced treatment systems such as membrane filtration, granular activated carbon and advanced oxidation processes (Yang, Ok, Kim, Kwon, & Tsang, 2017).

Healthcare waste that contain biological waste can be treated using membrane bioreactor and other biological treatment processes. Several studies found that wastewater treatment does not completely eliminate all of healthcare compounds due to their high toxicity (Hopkins & Blaney, 2016; Wang & Wang, 2016; Yang et al., 2017). Active and inactive ingredients of healthcare products are still discharged into wastewater collection

system (Hopkins & Blaney, 2016). Membrane reactor was found to be one of the most effective methods to remove them (Tran, Chen, Reinhard, Mao, & Gin, 2016). Some studies also concluded that in the membrane bioreactor process, biodegradation is the most effective to remove most of healthcare hazardous compounds (Park et al., 2017).

Healthcare waste disposal through incineration might be costly and emits some other nasty elements. Due to this, many researchers put effort to develop alternative waste treatment methods for infectious medical wastes. The current leading alternative method to replace incineration is autoclaving (Windfeld & Brooks, 2015). This process is used to treat infectious waste by using dry heat or steam to raise the temperature to kill microbial contamination. After treatment, the autoclaved waste will be taken to a municipal solid waste landfill site and then will be disposed in the same manner as other non-infectious waste. Compare to incineration, autoclave treatment of infectious healthcare waste is considered environmentally friendly as it does not release and emit the other toxic components such as dioxin and mercury into the atmosphere according to WHO.

2.3 Contributing Factors to Healthcare Waste Mismanagement

In developing countries such as in Africa and Asia, healthcare waste amount generation is lower compared to developed countries. However, the proportion of healthcare waste among total waste is higher than developed countries such as in Europe. The reason behind it is just because advanced legislation and guidelines are followed by developed nations during waste collection by practicing various possible ways during waste handling, storage and transportation. This effort is obviously helpful in minimizing the healthcare waste generation and which is not followed by developing countries (Alagoz & Kocasoy, 2008; Almuneef & Memish, 2003; Tudor, 2007).

Ananth et al. (2010) also revealed that it is likely for economically developed countries such as Japan and Singapore to comply with the WHO requirements as per Figure 2.2. Healthcare waste in developing countries has not yet been fully appreciated as they are still handled and disposed together with domestic and municipal waste (Alagoz & Kocasoy, 2008). At the initial stage of waste disposal, only a small proportion of the total waste may be considered and treated as healthcare waste. Mishandling by mixing the waste together may lead to cross-contamination due to mixing with other non-healthcare waste. This situation may end up to have the entire waste load to be part of healthcare waste which require intense treatment (Blenkharn, 1995; Patwary et al., 2009).

Improper management practice of healthcare waste can be identified from the point of initial collection to the final disposal. Other than lack of appropriate legislation and guidelines, lack of specialized clinical staffs, lack of awareness and effective control also may lead to ineffective healthcare waste management. In addition to this, developing countries may have financial difficulties might, therefore, look for cost-effective disposal methods of healthcare waste. (Hossain et al., 2011). Through the effort to accomplish

cost-effective methods, the mismanagement of waste is likely to occur as there is no other way to secure cost allocation for facilities management.

A survey of personnel behavior towards healthcare waste management in Lybia had been conducted and found that 85% of healthcare facilities (hospital) including managers, cleaning staff, and environmental workers were not trained on waste management and did not provide with the detailed description of waste handling in their job scope. From the same study, 55% of doctors and nurses were also unsure about hospital waste management policies and procedures and showed insufficient knowledge of the potential hazard while 90% of municipal workers who perform the job on transportation of hospital waste to final disposal sites had not been informed and educated on the hazards associated with hospital waste.

Healthcare waste management such as in hospital and clinics required enforcement of regulations. In addition, there is no reference or any declaration in the job description documents of hospital staff on hospital waste management. These phenomena will lead to ineffective healthcare waste handling. (Sawalem, Selic, & Herbell, 2009).

Among householders, the main factor of healthcare waste mismanagement was found to be lack of environmental awareness (Bound et al., 2006). Persons who are not aware of the risk towards the environment may choose poor disposal method of healthcare product especially pharmaceutical products.

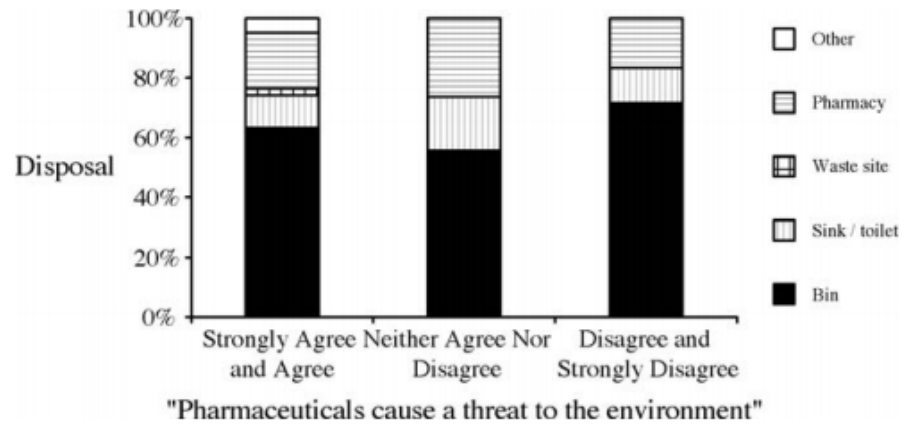


Figure 2.3: Effects of risk perception on pharmaceutical disposal habits

2.4 Health, Safety and Environmental impact

Many studies had been conducted to identify the impact of healthcare waste towards human and environment if the waste is not managed properly. In developing countries, the management of healthcare wastes is still disorganized as most of the wastes are still handled and disposed together with domestic wastes. Thus it creates a great health risk to the public and the environment (Bdour, Altrabsheh, Hadadin, & Al-Shareif, 2007; Coker et al., 2009; Sawalem et al., 2009). The waste generated from healthcare facilities and services ultimately pose danger and risk to health and to the environment even though the percentage of healthcare waste is relatively small compared to the total waste (Bos & Izadpanah, 2002). Due to the infectious nature of healthcare waste, it can also be harmful to human health and environment during handling and disposal of healthcare solid waste (Bokhoree, Beeharry, Makoondlall-Chadee, Doobah, & Soomary, 2014; Hossain et al., 2011).

According to WHO, healthcare waste potentially exposes infection risk, toxic effects and injuries towards the community in the healthcare facilities including workers, waste handlers, patients and the community. It can also lead to the risks of environmental pollution and degradation. Besides, poor management of healthcare waste management can lead to workplace injuries and diseases regardless of infectious and non-

infectious.(Al-Habash & Al-Zu'bi, 2012; Hossain et al., 2011; Nwachukwu, Orji, & Ugbogu, 2013). Some studies emphasizes that anyone who works in the healthcare facilities that potentially in contact with generated healthcare waste are in danger as the waste are likely to have hazardous components. It includes any waste that consists of human tissue, blood or other body fluids, excretions, drugs or other pharmaceutical products, swabs or dressings or syringes, needles or other sharp instruments.

Waste water effluents that contain pharmaceuticals elements even in small quantities from healthcare waste have proven to have a great effect towards wild aquatic animals (Bound et al., 2006; Leung et al., 2012). A study conduct showed that fish exposed to 50% or 100% wastewater effluent had higher tissue concentrated with pharmaceuticals in their brain and plasma. This phenomena indirectly may potentially change the behavior of the affected fish (McCallum et al., 2017). As the effect of the healthcare to wastewater-exposed fish is known, it was obvious that inappropriate healthcare waste management is posing both health hazards and environmental pollution, facing many healthcare centers in the modern world.

Healthcare and pharmaceutical residues containing chemical residues are discharged into the sewerage system. Pharmaceutical residues may include antibiotics and other drugs, heavy metals such as mercury, phenols, and derivatives, and disinfectants and antiseptics. All of these chemical residues can lead to adverse and toxic effects on the operation of biological sewage treatment plants and natural ecosystems of receiving waters.

Mismanagement of healthcare solid waste management practice also can exposed healthcare staffs, patients and hospitals environment with diseases such as cholera, dysentery, skin infection, and infectious hepatitis (Patwary et al., 2009; Tamplin, Davidson, Powis, & O'Leary, 2005). These diseases are able to spread through epidemic

way if the waste is not managed appropriately (Coker et al., 2009). Thus, appropriate methods for the safe management of healthcare waste must be practiced urgently.

2.5 Recommendation to Improve Healthcare Waste Management

While safe disposal of healthcare waste had been promoted, Ananth et al. (2010) in their study had formulated the need for transformation through simple changes in perspectives and practices. High technology is not really required as the main target for the changes is the mindset of all related waste management stakeholders. To close this gap, healthcare waste management practices, capacities and policies must be emphasized especially in developing countries. As mentioned in the study conducted previously, all individuals involved in healthcare waste management must be trained properly to ensure they are familiar with the proper procedures on handling the healthcare waste (Ananth et al., 2010; Mohamed et al., 2009). In order to create effective and successful waste management, the strategy and plan must be established at country level. Mohamed et al. (2009) highlighted the need of adopting best practices from other countries and using international healthcare waste management guidelines as documented by the United Nation Environment Programme (UNEP) and WHO (Mohamed et al., 2009).

The traceability of the generated healthcare waste needs to be managed accordingly to improve healthcare waste management practice. Information such as waste generation source, quantity and quality of waste generation are the key aspects to determine the effectiveness of healthcare waste management practice (Coker et al., 2009; Da Silva et al., 2005). It is important to compile waste information as part of traceability such as the type of collection, details of segregation practices, color-coded containers or bags as identification based on the nature of waste and details on storage facilities of waste. This practice will be useful especially if the waste has to be disposed off-site. Other important details such as information on transportation systems and disposal and

treatment options must be adopted in the healthcare facilities as part of an effort to improve healthcare waste management (Ananth et al., 2010).

As mentioned in healthcare waste disposal and treatment, the recycle-reuse program of healthcare solid waste material after sterilization at the point of the initial collection also can be adopted as part of waste management practices in the facilities. The recycling-reuse program can be carried out successfully and easily as it can be performed by the non-specialized clinical staff (Hossain et al., 2011; Stoch et al., 2018).

Cross-sectional study conducted on healthcare service facilities also found that waste segregation is very poor. The study was conducted in major healthcare facilities and found out that 15% of them is not practicing waste segregation (Oli et al., 2016). Therefore, this portrays that rules and regulations were not properly followed as to ensure proper waste segregation. The study also shows that government hospitals have higher waste generation as well as higher level of compliance to waste segregation. Unlike private hospitals, the control committee is helpful in ensuring the compliance of healthcare waste management practices in healthcare facilities. It shows that there is urgent need to establish the committee in both private and government healthcare facilities to regulate the proper management of healthcare waste generated in the healthcare facilities.

To improve the healthcare waste management among public and householder, the main approach must be come from government and media to do more promotion on the outcome of proper healthcare waste management towards the environment. Through the environment campaign and programs, participants may able to see a positive effect so that the person will aware on the benefits of their disposal actions. Safe and cost effective program approach is required to ease the disposal method among the public. This approach also will able to make public aware on the hazardous effects of expired and unused healthcare products (Bound et al., 2006).

Many parties start to take action to implement proper waste management considering its adverse effect towards environment and health in a long-term run. Some studies emphasized the knowledge and attitude towards healthcare waste management among public and householder. However, there is no direct study conducted to understand the needs of first aid waste management in the workplace. No published studies have been conducted to reveal the possible amount of waste and type of hazardous waste generated from the first aid kit management. Even though first aid waste generated always assumed to be 'minor' and 'scattered', mismanagement of first aid kit increase more burden to domestic waste disposal and treatment. While the provision of first aid kit is not an option as per legal compliance, negligence of managing first aid waste also must be avoided. Thus, it is important to start studying on first aid kit management to ensure proper waste management and disposal.

CHAPTER 3: METHODOLOGY

3.1 Research Process

Figure 3.1 is the overview of research methodology:

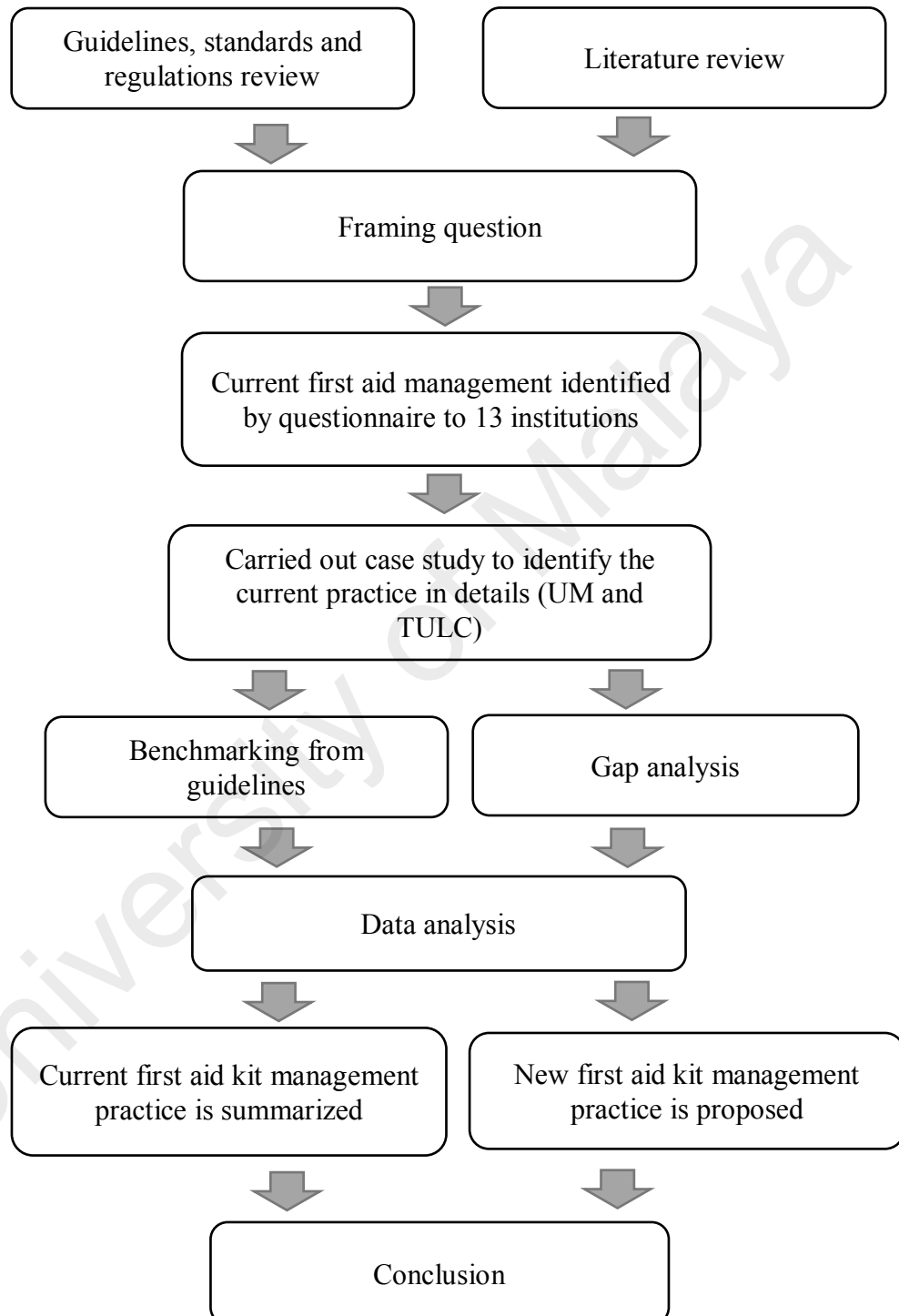


Figure 3.1: Flow chart of research methodology

3.2 Data Collection

This project involved 2 stages of data collection. The first stage was a questionnaire survey involving 13 institutions including public, government linked and private institutions. The institutions were randomly selected to get a baseline data for current first aid kit management practice in Malaysia tertiary institutions. The survey was answered by 1 respondent who represent the number of occupants associated with 1 institution. Sampling method to be used in this research is nonrandom approach of purposive sample as the sample selected (individual to answer the questionnaire) must be the person who has good knowledge on handling the management of first aid provision and maintenance in the selected institutions. Subject completed instruments for the stage 1 of this research will be questionnaires. Second stage will be case study approach at which two institutions are chosen to demonstrate the current practice in depth. For the case study, Taylor's University Lakeside Campus (TULC) and University of Malaya (UM) were selected.

3.2.1 Questionnaire Elements

Table 3.1: Elements and information collected from the questionnaire

Elements	Information collected
a) Institution details	<ul style="list-style-type: none"> i. Certification obtained ii. MS 1722:2011 implementation iii. Total occupants number iv. Healthcare facilities v. References of first aid kit management
b) First aid kit issuance	<ul style="list-style-type: none"> i. Responsible person for issuance ii. Risk assessment prior to issuance iii. Quantity of first aid kit iv. Consideration of first aid kit size and total occupants in respective area v. Traceability of first aid kit
c) First aid kit maintenance	<ul style="list-style-type: none"> i. Location of first aid kit ii. Method of reserving first aid kit iii. Inspection practice iv. Frequency of inspection v. Person to carry out inspection
d) Competency of first aiders	<ul style="list-style-type: none"> i. First aiders headcount ii. Certification and training iii. Frequency of training
e) First aid treatment	<ul style="list-style-type: none"> i. Person to treat first aid injury ii. Treatment record
f) First aid items inventory	<ul style="list-style-type: none"> i. Inventory monitoring system ii. Person to monitor inventory iii. First aid items replenishment trending iv. Preference items to be replenished v. Purpose of replenishment vi. Expenditure for first aid items
g) First aid items disposal	<ul style="list-style-type: none"> i. Disposal method of first aid treatment residue ii. Type of first aid waste generated iii. Disposal method of expired first aid items

3.2.2 Case Study at Taylor's University Lakeside Campus (TULC)

TULC is a private university located in Subang Jaya, Selangor, Malaysia. It was operated on 2010 after university college status was upgraded to university status. Total number of occupants were around 7000 to 8000 including students and staff. First Aid Kit in TULC is managed by Environmental, Health and Safety (EHS) department. It was managed in centralize as the provision of first aid kit was issued by EHS department throughout the years. First aid kit management in TULC was managed as per formulated Safety and Health Policy and First Aid Procedure to ensure the safety and well-being of occupants in the campus area. For the case study, all of first aid kit in TULC was recalled for first aid kit register purpose. The information of current practice of first aid kit management in TULC were collected through the first aid kit register which contained below elements;

- a) Name of department or faculty
- b) Activities type and risk level
- c) Location of first aid kit
- d) First aid kit size
- e) Number of occupants
- f) First aiders headcount
- g) Inspection of first aid kit and consumption records
- h) First aid waste disposal

3.2.3 Case Study at University of Malaya (UM)

UM is a public university located Kuala Lumpur and was established in Malaysia in 1962 after operated in Singapore in 1905. Total number of occupants were about 29000 to 30000. First aid kit management is monitored by Office of Safety and Health (OSH) Unit and the procedure was documented in Occupational Safety and Health Manual. The responsibility of first aid kit provision was decentralized to *Pusat Tanggungjawab* (PTj)

based on 48 identified zone. For this case study, interview with OSH personnel is the main method to identify current first aid kit management in UM.

3.2.4 Limitation for Data Collection

Data collected for questionnaire were displayed as anonymous in the result due to respondent and institution confidential. More than 20 institutions were approached to get a questionnaire response for this research. However only 13 institutions were responding within the timeline. There is no study on first aid management was conducted previously. The questionnaire information as per Table 3.1 is formulated based on first aid regulations and guidelines benchmarking.

TULC institution size is much smaller compared to UM in the estimated ratio of 1:4. The structure and management of occupational safety and health for both institutions are different as most of safety and health practice is decentralized to *PTj* for UM while it is centralized to EHS department for TULC. Thus, data collection from TULC was possible within project timeline through first aid kit register and tally count. However, more time is required for UM to fulfill this method. Due to this limitation, the approach of case study data collection was different for both institutions.

3.3 Benchmark

To introduce new concept of first aid kit management, benchmarking from guidelines, policies and procedures will be conducted to acquire the best approach. The first aid kit management practice will be clustered in few categories to complete the cycle of 'cradle to grave' concept. The holistic management practice to be introduced from the benchmarking will be compared to current practice to understand the gap of current first aid kit management practice in tertiary institutions.

CHAPTER 4: RESULT AND DISCUSSION

The results are presented and discussed in 2 phases. Data obtained through questionnaire is discussed in the first phase while case study findings are discussed in the second phase. From the elements obtained through both findings, the overall practice of first aid kit management in selected tertiary institutions in Malaysia will be discussed.

4.1 First Phase: Questionnaire Result

The questionnaire feedback was successfully received from 13 institutions in Malaysia. The survey results were analyzed based on a few sections; (a) institution details, (b) first aid kit issuance, (c) first aid kit maintenance, (d) competency of first aiders, (e) first aid treatment, (f) first aid items inventory and (g) first aid waste disposal. It is essential to note that the results were established based on the information provided by the respondents through the questionnaire. The overall discussion from the findings of first aid kit management in selected tertiary institution will be discussed in 4.3 section.

(a) Institution details

Each respondent of this research questionnaire represents the total number of occupants in respondent institutions. For this study, the occupant is defined as anyone who can physically access the institution on a daily basis including staff and students. Total number of occupants represents the size of institutions. Each respondent demonstrated the first aid kit management practice in the respective institutions. As per Figure 4.1, 38.46% of the respondents represented more than 10001 to 20000 occupants while 23.08% represented more than 20000 occupants of the institutions. More 61.54% of respondent institutions handled more than 10000 occupants.

Table 4.1: Range number of occupants

Range number of occupants	Number of institutions (n_i)	Percentage, % ($\sum n_i/N$)
0-5000	1	7.69%
5001-10000	4	30.77%
10001-20000	5	38.46%
More than 20000	3	23.08%
Total	13	100.00%

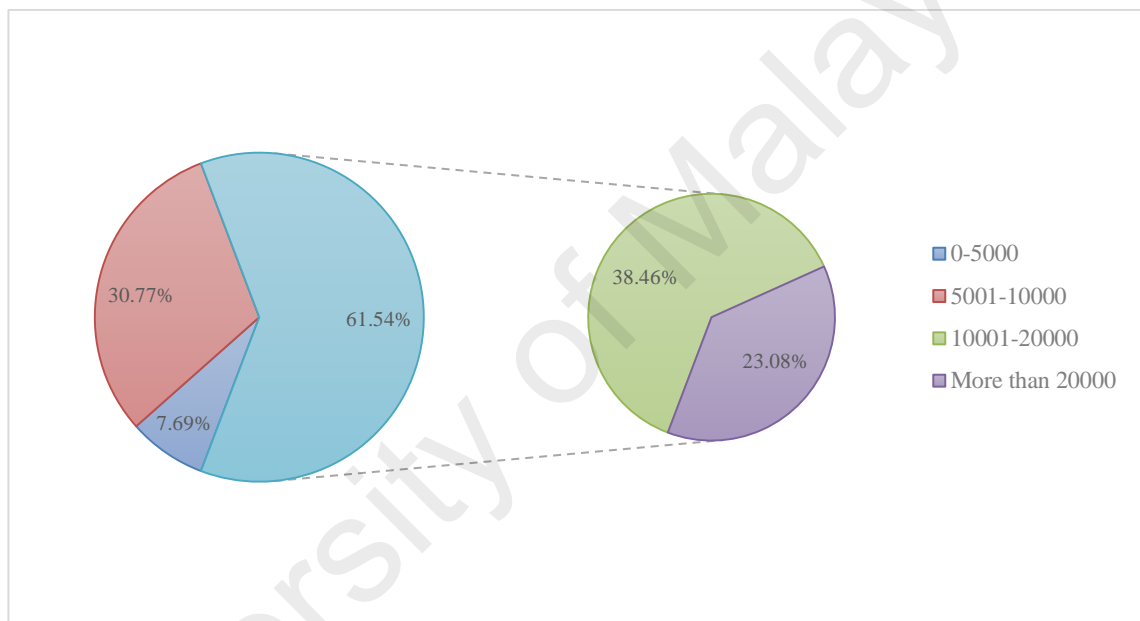


Figure 4.1: Institution size based on total number of occupants

To compare the institutions details, the results were categorized and presented as tally counts based on given range number of occupants. The percentages of institution details are tabulated as per Table 4.2.

Table 4.2: Institution details based on institution size

Institution Details	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N^1$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
OHSAS 18001 Certification	0	0	1	2	3	23.08%
ISO 9001 Certification	0	2	2	3	7	53.85%
ISO 14001 Certification	0	0	1	1	2	15.38%
Others Related Certification	1	1	1	0	3	23.08%
'POPEA' Element Implementation	1	3	3	3	10	76.92%
In House Clinic Facilities	1	4	5	3	13	100.00%
Internal Policy and Procedure	1	4	5	3	13	100.00%
DOSH Guidelines as Reference	1	4	4	3	12	92.31%

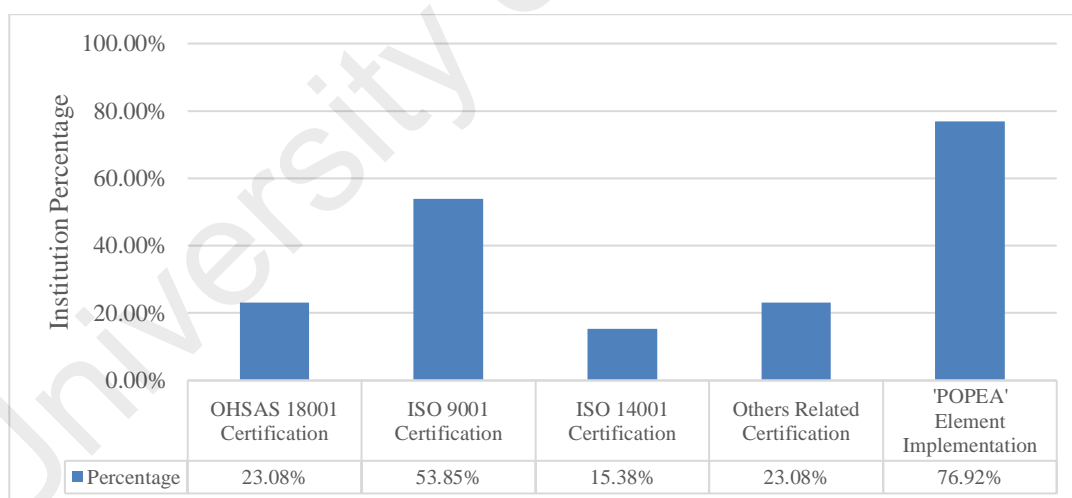


Figure 4.2: Institutions certification and 'POPEA' implementation

As per Figure 4.2, some of the institutions are certified with more than 1 type of certification. In Table 4.2, 23.8% institutions that host more than 20000 occupants (3 out

¹ N is the total number of institutions that contributed to this questionnaire (N=13).

of 12 institutions) performed better in certification to run overall health and safety management in their areas. Overall, the certification obtained demonstrated that the health, safety and environmental management in the institution is still under-performing as an overall percentage of holding related certification is below 50%. ISO 9001 certification is the only type of certificate that reaches 53.85% based on the response.

For research purposes, it is essential to understand institutions occupational safety and health management system implementation as per 'P-Policy, O-Organising, P-Planning and Implementing, E-Evaluation, A-Action for Improvement (POPEA) as a basic principle of MS1722: 2011 implementation. This element is introduced through Guidelines on Occupational Safety and Health Management Systems by DOSH as a conceptual framework to make appropriate arrangements for the establishment of an OSHMS in any premise. In this questionnaire section, 79.62% (10 out of 13) institutions demonstrated their commitment to meet the basic principle of MS1722:2011.

As per Table 4.2, all of the respondent institutions were facilitated by the in-house clinic. Based on Guidelines on First-Aid in the Workplace by DOSH, in-house clinic with the registered nurse or medical assistant is required if the number of occupants is more than 400 (DOSHS, 2004). All institutions were also equipped with an internal policy and procedure to assist the first aid kit management in their institutions. However, 1 out of 13 institutions did not use Guidelines on First-Aid in the Workplace by DOSH as the main reference to managing first aid kit in the respondent institution.

(b) First aid kit issuance

For this section, the issuance details for all institutions is tabulated in Table 4.3. The first aid kit issuance responsibility was analyzed as per Figure 4.3. The total numbers of first aid kit issued in the institutions were analyzed as per Figure 4.4.

Table 4.3: Issuance details based on institution size

Issuance Details	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
Risk Assessment as requirement	1	2	3	3	9	69.23%
Consideration of First Aid Kit Size ²	1	2	1	2	6	46.15%
First Aid Kit Traceability	0	2	4	0	6	46.15%

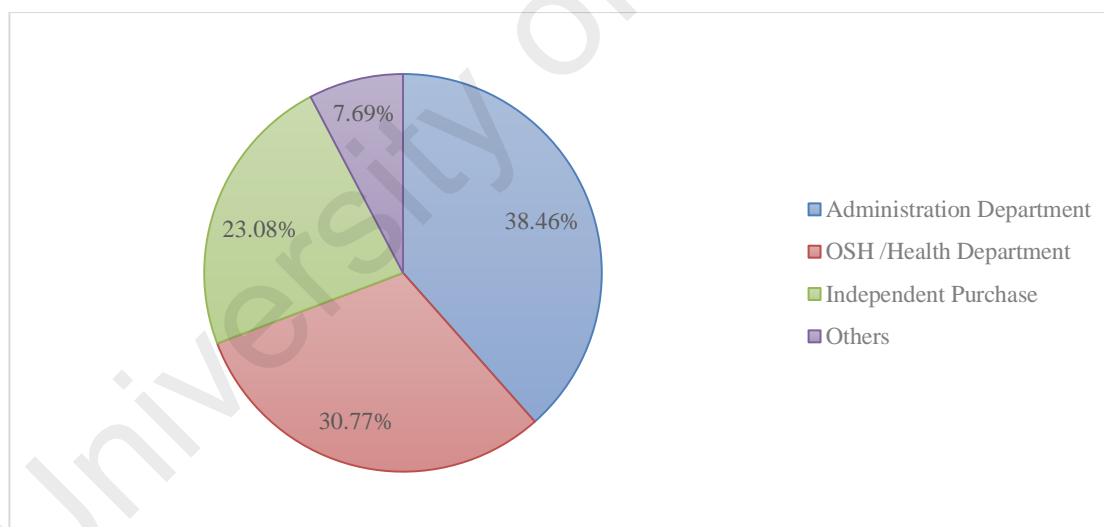


Figure 4.3: Responsible unit/ department for first kit issuance

² Kit size based on Box A, B or C as per Fourth Schedule Regulation 38, Safety, Health and Welfare Regulation 1970, FMA 1967

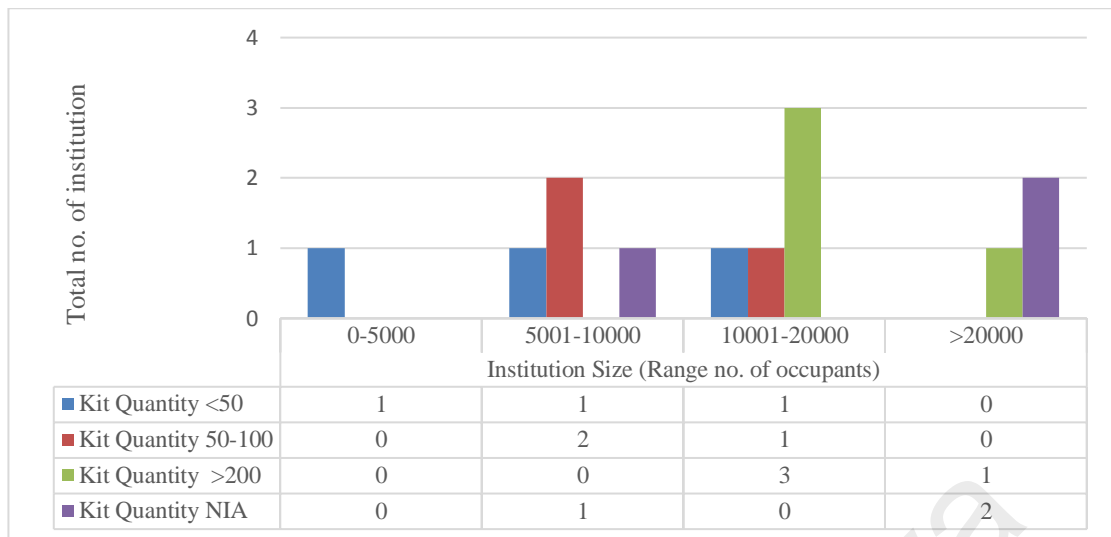


Figure 4.4: First aid kit quantity based on institution size

From Figure 4.3, 38.46% institutions demonstrated the issuance of first aid kit was managed by administration unit while 30.77% institutions demonstrated this responsibility is handled by OSH or Health Services department. For independent purchase, 23.08% respondents demonstrated that there is no dedicated department or unit to be responsible for first aid kit issuance as it was accomplished by independent purchase among institutions occupants.

The result demonstrated that 69.23% institutions (9 out of 13) as shown in Table 4.3 conducted the risk assessment as part of first aid kit issuance requirement. The purpose of risk assessment is to identify the possible risk and injury that may occur in the affected institution's area. First aid kit traceability system is defined as any tracking system such as serial number, barcode and any form to trace first aid kit as to verify first aid information such as location, responsible person, date of issuance and others. From the questionnaire responses, 53.85% was not equip with any tracking system to trace the presence of first aid kit in the institutions.

Figure 4.4 shows the total number of first aid kit in the institution. 3 out of 13 institutions were not able to determine the total number of first aid kit in their institutions as there is no information and record to estimate the number.

Overall, only 46.15% institutions (6 out of 13) fully consider the total number of occupants at the affected area before first aid kit is issued. The size of first aid kit issued in the institutions is usually based on recommended size identified as Box A (small), Box B (medium) and Box C (large) as per FMA 1967.

(c) First aid kit maintenance

Overall, 92.31% institutions (12 out of 13) as shown in Table 4.4 performed the inspection of first aid kit practice. However, the frequency of inspection varied as per Figure 4.5. Only 61.54% institutions conducted monthly inspection to maintain their first aid kit while the remaining conducted yearly inspection. The purpose of the inspection is to ensure that the contents of the box are regularly replenished as per Guidelines on First-Aid in the Workplace by DOSH.

Table 4.4: Maintenance practice based on institution size

Maintenance Practice	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
Locking of first aid kit	0	1	1	0	2	15.38%
First aid kit inspection	1	4	4	3	12	92.31%

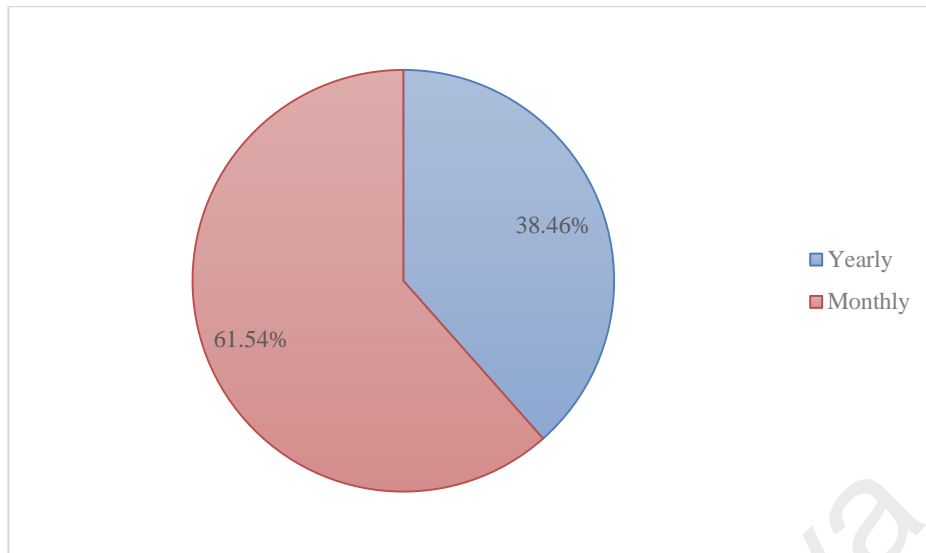


Figure 4.5: Frequency of the first aid kit inspection among institutions

As per Table 4.5, some institutions demonstrated that first aid kit may be located at different location and method based on the type of activities in the affected area. Some of the respondent institutions is not define a specific location to reserve first aid kit among institutions. 10 out of 13 institutions do not locate first aid kit in the open area for the public use.

The inspection of first aid kit in the institutions may be performed by the various department. Most of the institutions (69.23%) practiced self-inspection for first aid kit inspection. Self-inspection in this context defined as the person responsible for first aid activities in their working area.

Table 4.5: Placement of first aid kit based on institution size

Placement of First Aid Kit	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
In the open area	1	1	0	1	3	23.08%
In the dedicated area at which permission required	1	4	1	2	8	61.54%
Kept by first aiders	1	3	5	1	10	76.92%

Table 4.6: Responsible person to carry out inspection

Responsible person to carry out inspection	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
Self-inspection	0	3	3	3	9	69.23%
OSH personnel	1	1	0	1	3	23.08%
Health Services Staff	0	0	2	0	2	15.38%

(d) Competency of first aiders

For this section, first aider is defined by a person who has successfully completed a first-aid course and able to perform first aid kit treatment when necessary. If the range of total occupants in respondent institutions is higher, the numbers of the first aiders required is higher. However, there is no proper trend as per tabulated data in Figure 4.6.

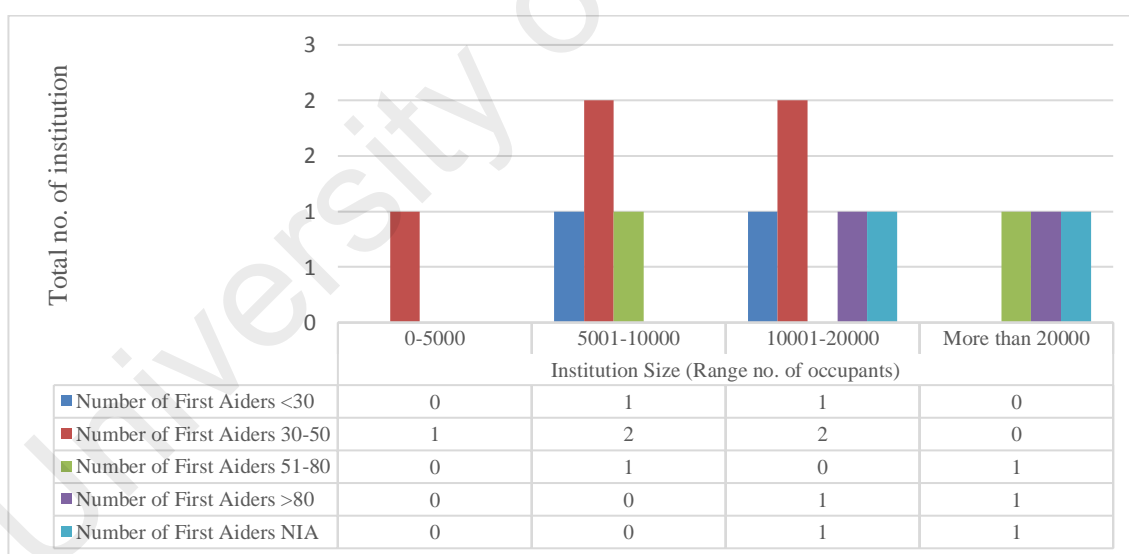


Figure 4.6: Number of first aiders in institutions

The selection method to appoint first aiders among institutions varied and the most common practice is appointed by Head of Department (HOD) as shown in Table 4.7. It is essential to determine how first aiders appointed in the institutions to understand the control of first aiders adequacy and competency.

Table 4.7: Method of first aider selection

Method of First Aider Selection	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
Volunteer basis	1	3	2	0	6	46.15%
Appointed by HOD	1	4	1	3	9	69.23%
Selected through competency test	0	0	2	0	2	15.38%

Most of the respondent institutions (12 out of 13) are practicing first aid training based on recommended frequency as per guidelines by DOSH. Refresher training is required every 3 years to maintain the competency of first aiders in the institution. The training must be conducted by any approved organization that certified by DOSH as per guidelines.

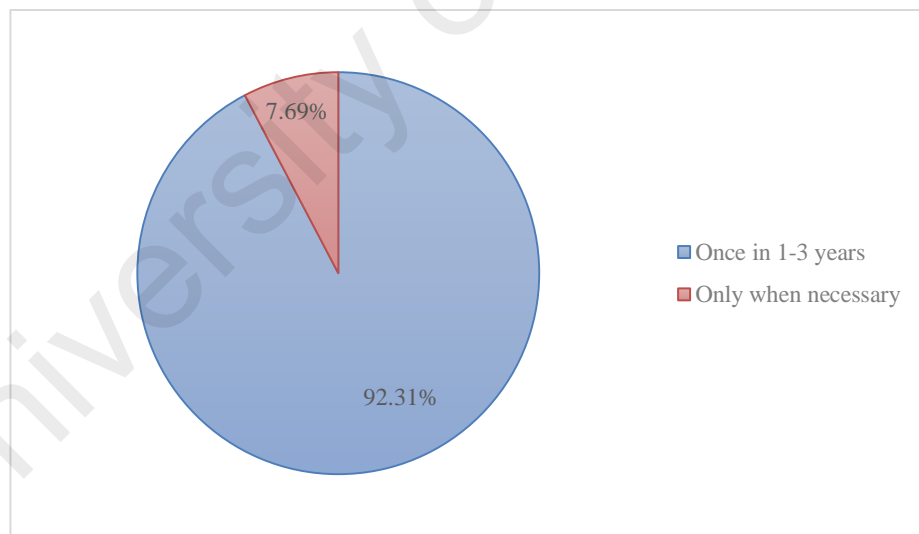


Figure 4.7: Frequency of first aid training

(e) First aid treatment

From the data collected, 76.92% institutions (10 out of 13) implemented first aid treatment practice in their institutions. However, not all first aid records registered as per NADOPOD Regulations as only 53.85% institutions (7 out of 13) demonstrated the practice as shown in Table 4.8.

Table 4.8: First aid treatment practice

First Aid Treatment Practice	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
First Aid Treatment Record	1	3	4	2	10	76.92%
First aid injuries as part of NADOPOD registration	0	2	2	3	7	53.85%

As per Table 4.9, result shown that the accessibility to first aid kit for first aid treatment is not limited to only first aiders. While 69.23% institutions (9 out of 13) restricted first aid kit access to first aiders, some flexibility is still allowed by the institution based on the location of first aid kit and nature of the activity for the affected area.

Table 4.9: Accessibility to first aid kit for treatment

Person to Access to First Aid Kit for Treatment	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
Anyone	1	1	2	1	5	38.46%
Appointed by HOD	0	1	1	0	2	15.38%
Restricted to only First Aiders	1	4	2	2	9	69.23%

(f) First aid items inventory

In this section, first aid items inventory is defined as a complete list of all first aid items in stock. From the response shown in Table 4.10, 76.92% institutions (10 out of 13) were found to have inventory monitoring system for all first aid items in their institutions. All replenishment first aid items activities recorded by 76.92% institutions (10 out of 13 institutions). The objective of replenishment record is to ensure the purpose

of replenishment is acknowledged by first aid items provided, in this case, is a person who monitors inventory control as per Table 4.11.

Table 4.10: First aid items inventory practice

First Aid Items Inventory Practice	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 ($n_1=1$)	5001-10000 ($n_2=4$)	10001-20000 ($n_3=5$)	> 20000 ($n_4=3$)		
Inventory Monitoring System	1	3	4	2	10	76.92%
First Aid Items Replenishment Record	0	4	4	2	10	76.92%

Among the affected 10 institutions, some of the institutions demonstrated that the responsibility to monitor first aid items inventory is shared by a few responsible persons based on affected unit or department as per Table 4.11.

Table 4.11: Responsibility to monitor first aid inventory

Person to monitor First Aid Inventory	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 ($n_1=1$)	5001-10000 ($n_2=4$)	10001-20000 ($n_3=5$)	> 20000 ($n_4=3$)		
OSH Unit	1	1	0	1	3	23.08%
Health Care Facility	0	0	2	1	3	23.08%
Administration	0	1	1	1	3	23.08%
Others	0	1	0	0	1	7.69%

Through this question, it was unlikely to get replenishment request trending data as most of the respondent demonstrated that there is no information available to estimate the frequency. Only 5 respondents were able to demonstrate the frequency of first aid items replenishment request in the affected institutions. The frequency can be once per week or once per month from the entire institution as shown in Figure 4.8.

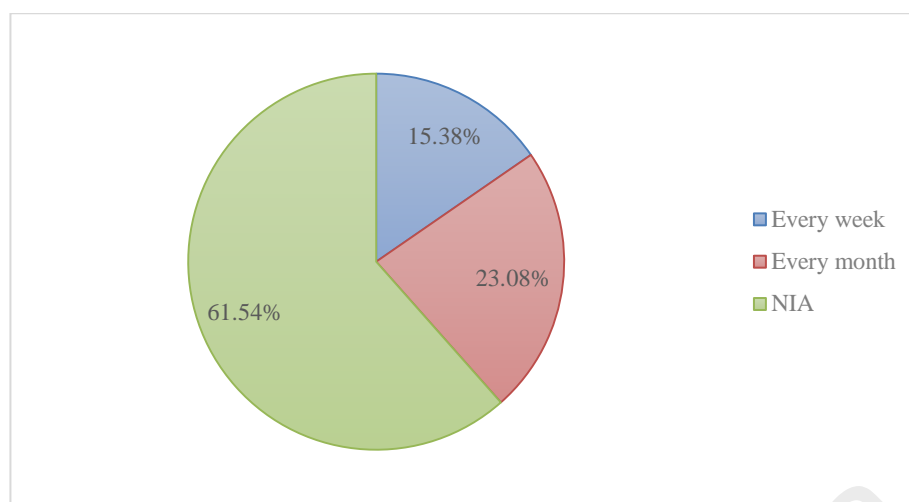


Figure 4.8: Frequency of first aid items replenishment request

The most common purpose of first aid item replenishment is due to expired or unused products as result tabulated in Table 4.12. Other purposes identified are due to new request of first aid kit and injuries incident in the institutions.

Table 4.12: Purpose for first aid items replenishment

Purpose for first aid items replenishment	Institution size (Range number of occupants)				Total no. of institution = $\sum n$	Institution percentage = $\sum n/N$
	0-5000 (n ₁ =1)	5001-10000 (n ₂ =4)	10001-20000 (n ₃ =5)	> 20000 (n ₄ =3)		
New Request	0	4	2	1	7	53.85%
Expired/Unused	1	4	3	2	10	76.92%
Injuries	0	3	2	0	5	38.46%
Others	0	0	1	0	1	7.69%

As per Figure 4.9, the trending of replenishment request of first aid items based on category was categorized as a consumable product; liquid, cream or solvent base; solid material. Based on the response, the highest replenishment request for first aid items is shared for both category; solid material and liquid, cream or solvent base. The

consumable product such as paracetamol and painkiller were having the lowest demand for the replenishment.

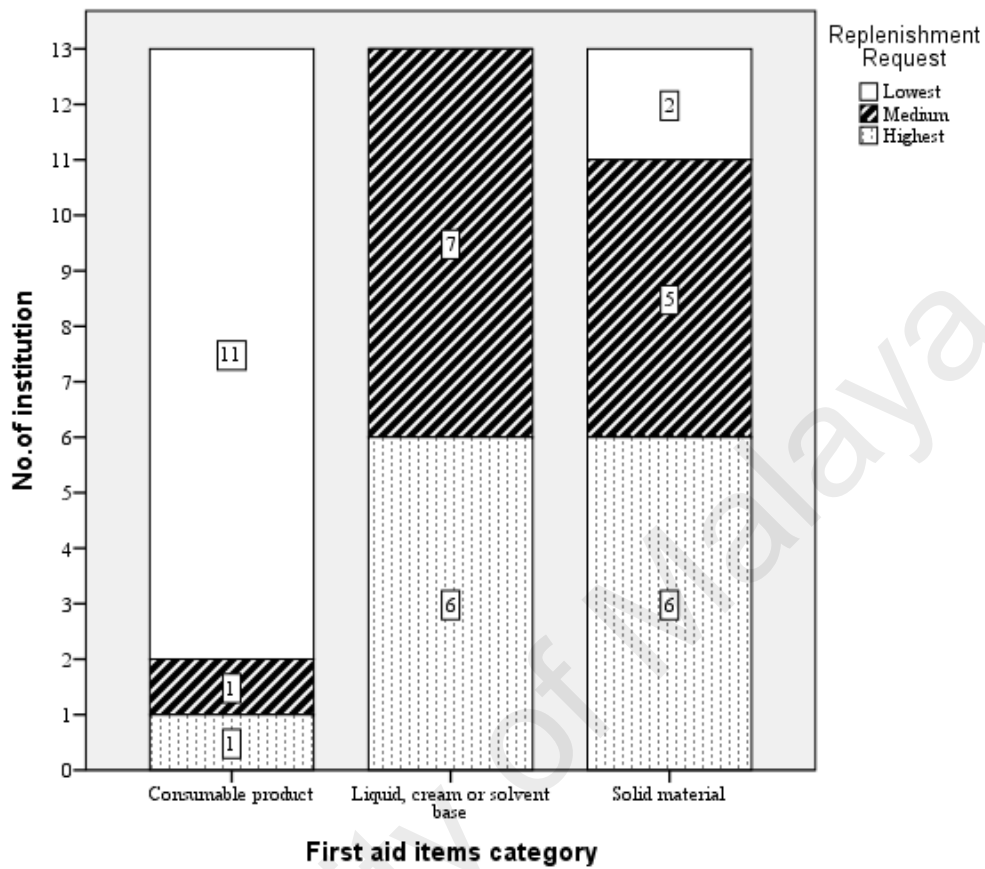


Figure 4.9: Replenishment request based on first aid items category

For first aid items estimated yearly expenditure, 23.08% institutions (3 out of 13) were unable to provide information. The estimated yearly expenditure of first aid items among institutions can be referred to Figure 4.10.

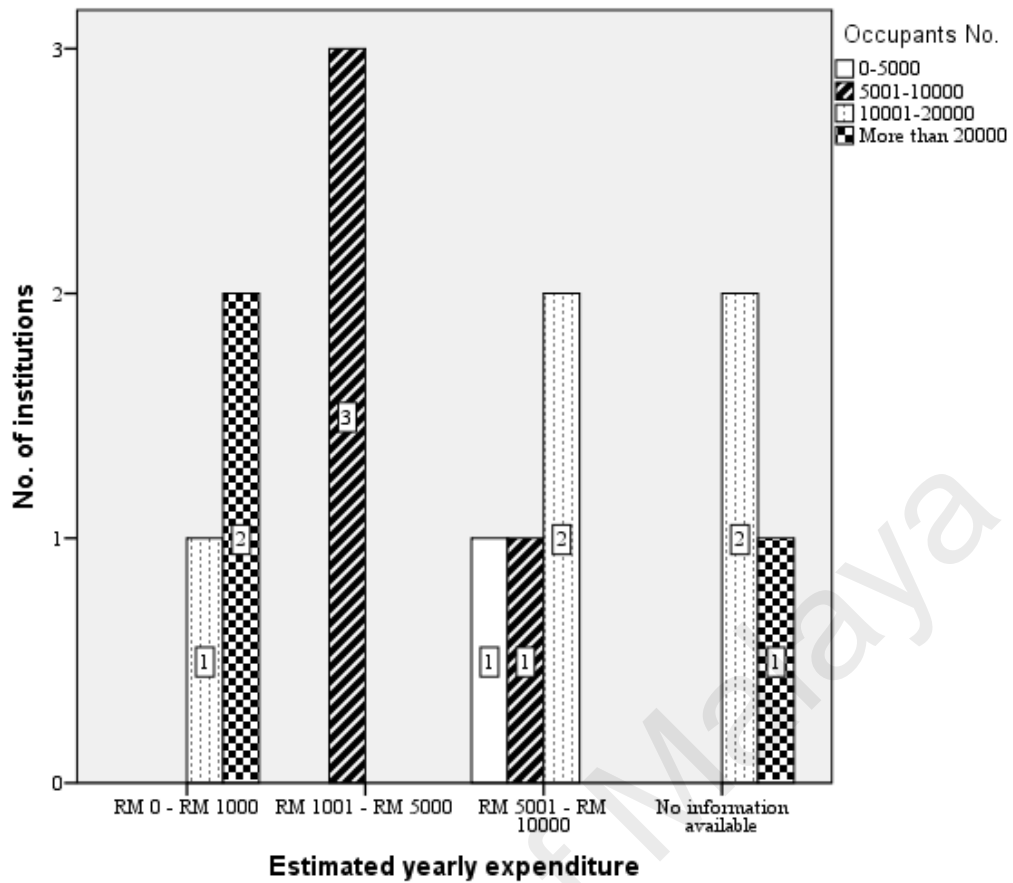


Figure 4.10: Estimated yearly expenditure of first aid items

(g) First aid waste disposal

As per Figure 4.11, 53.85% institutions (7 out of 13) demonstrated that the expired and unused of first aid items are generated at their institutions while 23.08% institutions (3 out of 13) are uncertain on the first aid kit yearly expenditure due to no information available in the affected institutions.

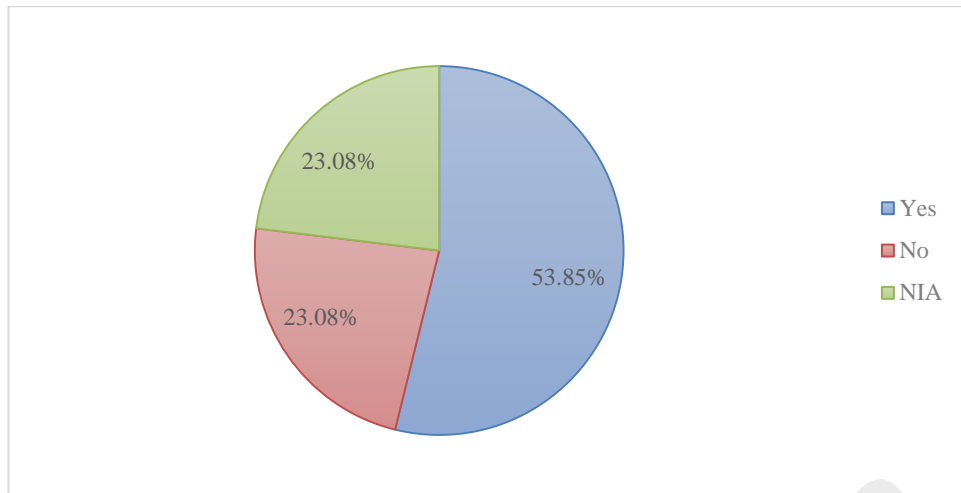


Figure 4.11: Availability of unused or expired items in institutions

As per respondent estimation, the highest production of expired or unused first aid items are liquid, cream and solvent base category.

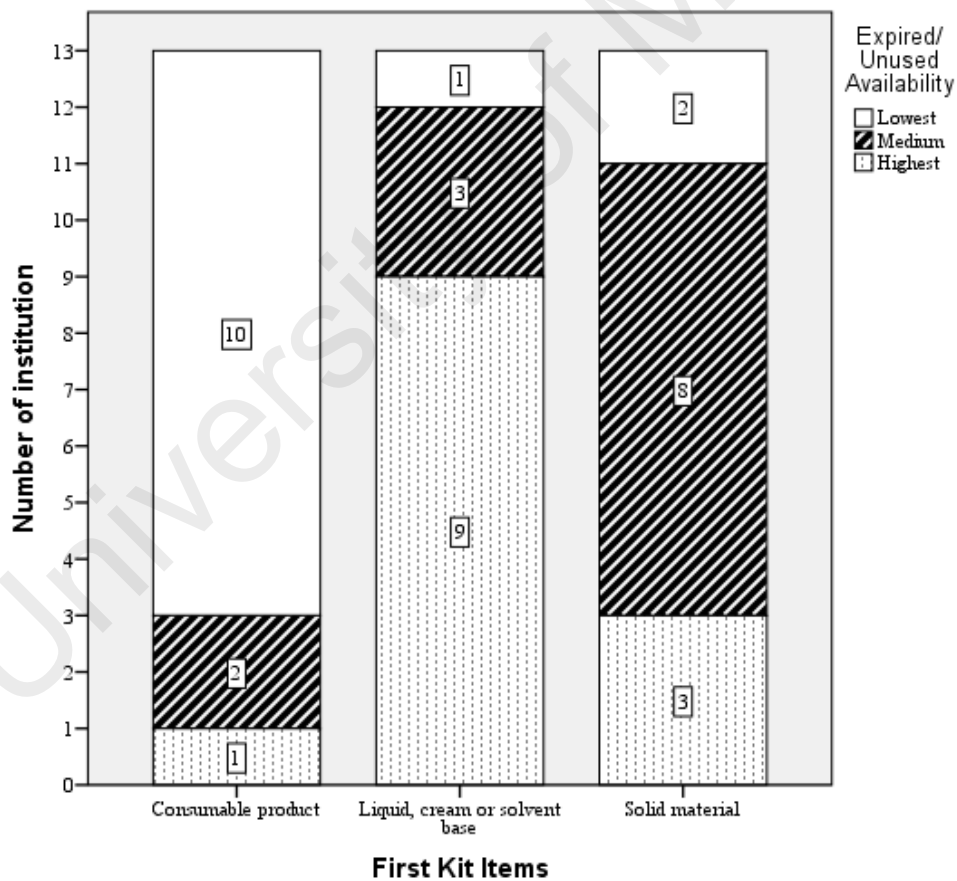


Figure 4.12: Availability of expired or unused first aid items based

Residue is defined by any remaining first aid items after first aid treatment applied that already in contact with patient's body or contaminated with any first aid kit products.

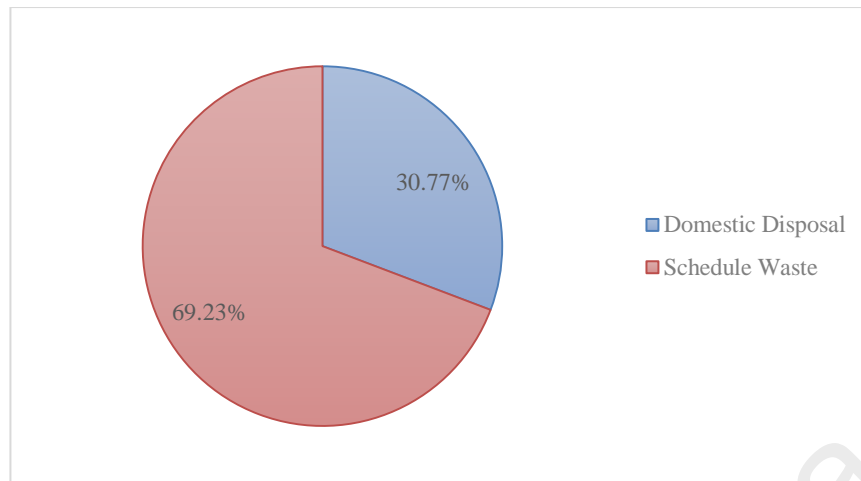


Figure 4.13: Method of disposal of first aid items residue

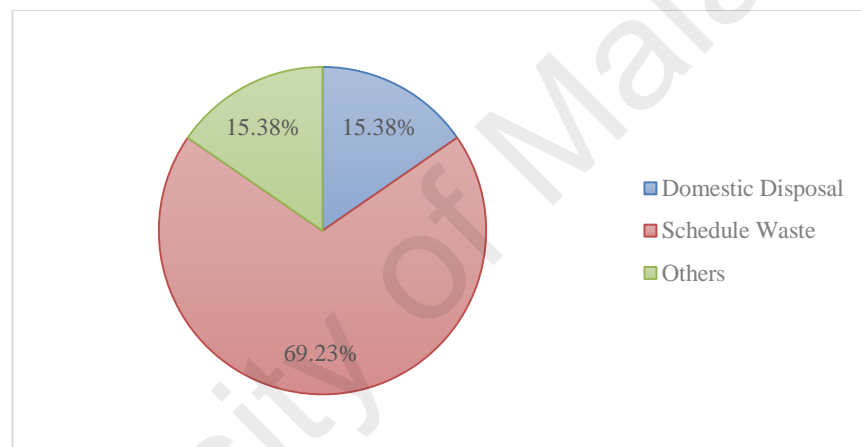


Figure 4.14: Method of disposal of expired or unused first aid items

As per Figure 4.13 and, Figure 4.14, 69.23% institutions (9 out of 13) demonstrated that all type of first aid waste generated from expired or unused product and treatment residues are disposed according to schedule waste requirement.

4.2 Second Phase: Case Study

Case study performed in TULC and UM to understand the practice of first aid kit management among institutions in close up and details. The findings from questionnaire will be validated through the case study. This case study also identified the variation of management approach towards first aid kit management in the institutions.

4.2.1 Case Study at TULC

(a) Number of Occupants and First Aid Kit Size

The total number of First Aid kit counted in TULC was 71 boxes. Table 4.13 is the summary of the size of First Aid Kit based on the range of occupants in the first aid kit location. From the data collected, 62 out of 71 First Aid Kit issued was in Size B even though the number of occupants found to be less than 25 people.

Table 4.13: First aid kit size and no. of occupants

First Aid Kit Size	No. of Occupants				Total
	1-25	26-50	51-100	More than 100	
Box A (small)	4	1	0	0	5
Box B (medium)	30	22	5	5	62
Box C (large)	0	0	0	2	2
Others ³	2	0	0	0	2
Total	36	23	5	7	71

³ Pouch type of first aid kit

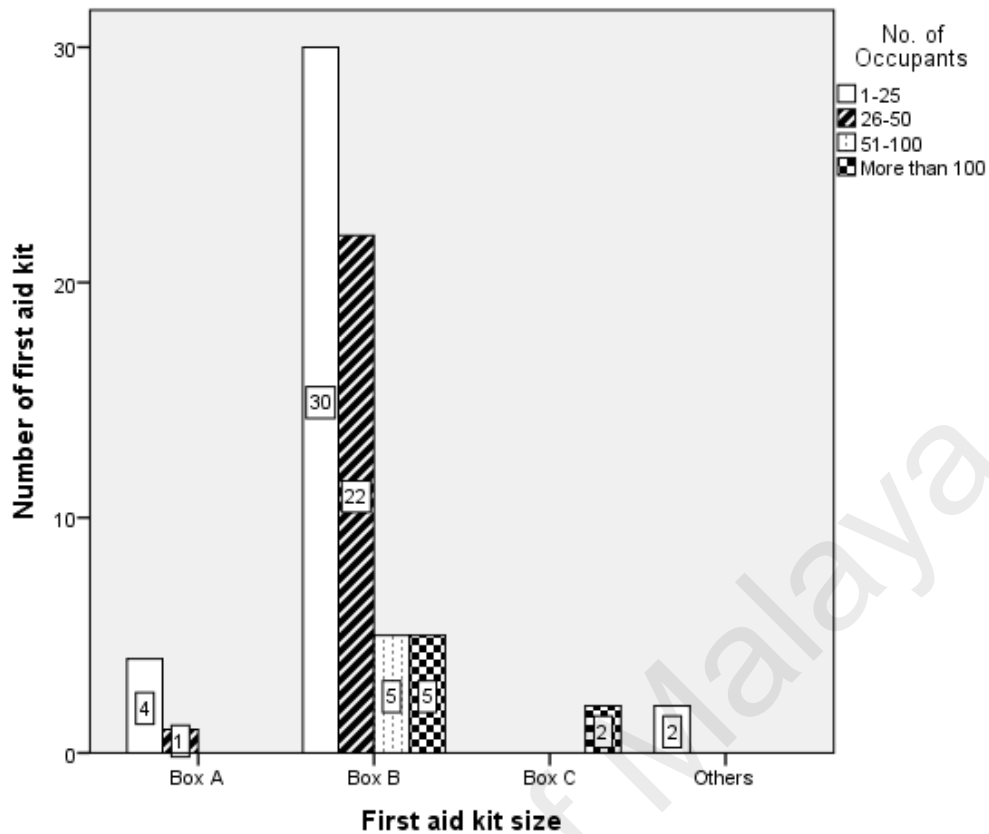


Figure 4.15: First aid kit size and no. of occupants

(b) Number of First Aiders

As per Figure 4.15, the bar chart displays the number of first aider based on the department which was provided with First Aid Kit in the dedicated location. From the findings, 11 out of 17 departments found to own first aid kit without competent and trained personnel to access to first aid kit⁴.

⁴ For this data analysis, number of occupants in the affected area is not considered

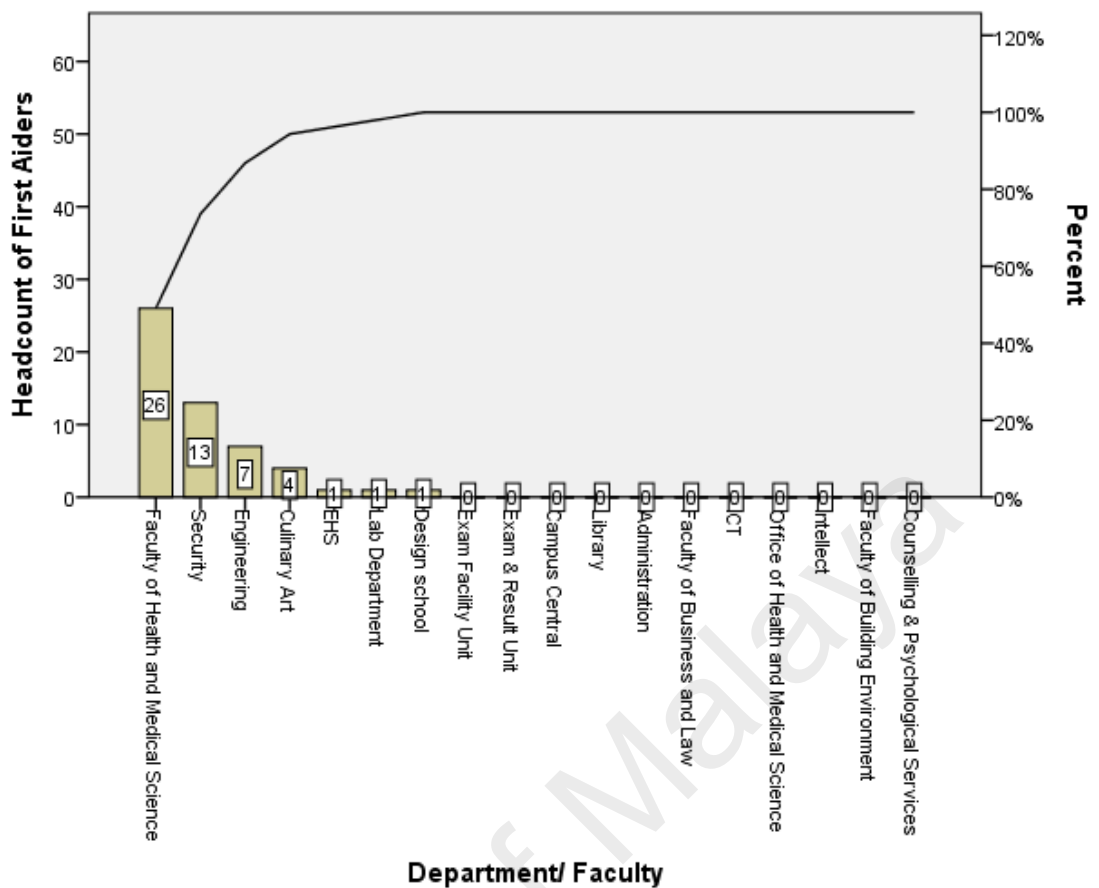


Figure 4.16: Headcount of first aiders based on first aid kit location

(c) Risk Assessment

To understand the risk level and risk assessment practice in TULC, short assessment performed in all affected area at which first aid kit was located to identify the possible level risk as. From the assessment, 28 areas found to have low risk, 42 with medium risk and only 1 identified as high-risk area as per Table 4.14. The responsible person in all affected area who manages first aid kit was questioned on the implementation of risk assessment and result demonstrate only 51 out of 71 affected areas found to be assessed previously.

Table 4.14: Risk level and risk assessment implementation

Risk Level of Activity in the area ⁵	Risk Assessment Implementation		Total
	Yes	No	
Low (can cause minor injuries)	10	18	28
Medium (can cause medical leave more than 4 days)	40	2	42
High (can cause fatal or serious injuries)	1	0	1
Total	51	20	71

(d) Maintenance of First Aid Kit

Table 4.15 presented the maintenance of first aid kit practice from TULC case study. In TULC, 44 out of 71 affected area demonstrated first aid treatment recording practice to trace the injuries and first aid items consumption. 42 out of 71 affected area performed the monthly inspection as part of their practice to ensure all first aid items are in good condition and replenishment per minimum stock required.

Table 4.15: First aid treatment record and monthly inspection practice

Maintenance Practice	Yes	No	Total	Percentage of 'Yes' %
First Aid Treatment Record	44	27	71	61.97
Monthly Inspection	42	29	71	59.15

⁵ Risk was determined by EHS Department as per observed activities in the affected area

(e) First Aid Waste Disposal Method

There was no first aid waste disposal procedure documented by TULC. For this research purpose, all of the first aid coordinators were encouraged to return all of the expired first aid items to EHS Department as an exchange for first aid items replenishment. During the case study, the inspection also was carried out to collect all of the expired first aid items. From November 2017 to March 2018, all expired first aid items were successfully collected and weighed to estimate the possible amount of expired first aid waste generated in TULC.

Table 4.16: Amount of expired first aid waste

Waste Category	Items	Active ingredients (w/v)	Weight (kg)
Liquid and Cream	Antiseptic- Yellow lotion	Acriflavine 0.10% to 0.50% Sodium benzoate	7.31
	Analgesic- Flanil Cream	Methyl salicylate 10.20% - 12.70% Menthol 5.44%- 5.80% Eugenol 1.36%	0.31
	Liniment Methyl Salicylate	Methyl salicylate 25.00%	1.02
	Normal Saline	Sodium chloride	0.28
	Antiseptic Germicide	Chloroxylenol 4.80%	0.42
	Antiseptic Cream	Chlorhexidine Gluconate 1.00% Parabens 0.23% Chloroxylenol B.P. 0.30% Triclosan 0.30%	0.07
	Others	Others	0.15
Solid	Sterile Dressings	-	0.90
	Adhesive Plaster	-	0.32
	Surgical Paper Tape	-	0.10
	Eye pad	-	0.04
	Others	-	0.07
Consumable ⁶	Pain killer	Paracetamol	0.09
Total			11.08

⁶ Any oral intake medicines such as painkiller

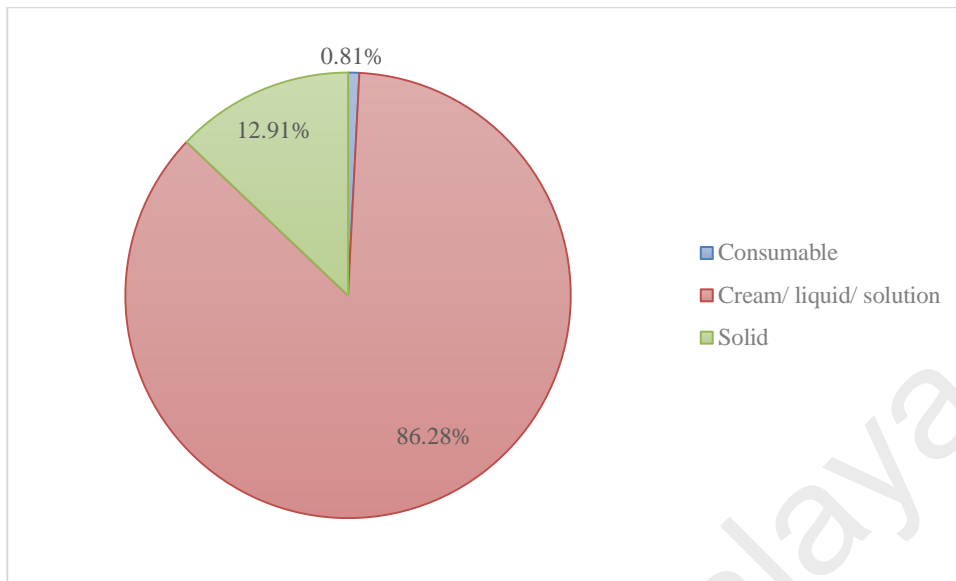


Figure 4.17: Percentage of produced first aid waste based on category



Figure 4.18: Liquid and cream first aid waste type



Figure 4.19: Solid first aid waste type

The amount of first aid waste collected is 11.08 kg including all waste categories as per Table 4.16. The total amount captured during the collection period was able to represent 70.4% of the possible amount as the remaining items were disposed through the domestic dustbin.

Table 4.17: Expired first aid disposal practice in TULC

Disposal practice in TULC	Frequency	Percentage (%)
Return to EHS Department	50	70.42
Throw into domestic dustbin	21	29.58

4.2.2 Case Study at UM

First aid kit management is performed by zone decentralizing in UM. Some limitations identified to obtain accurate data due to no traceability of first aid kit information. Longer time is required to do tally count on available first aid kit in the campus as the size of institutions is at least four times bigger than TULC.

The main approach to get information was interviewing OSH unit to understand the background of first aid kit management. From the interview, safety and health implementation were established through *Manual Kesihatan dan Keselamatan Pekerja* (MKKP) manual which contained all related procedure including the first aid kit management in UM. Similar to other respondent universities, first aid guidelines by DOSH is the main reference for the first aid implementation in UM. However, OSH unit agreed the implementation of first aid kit management in UM is not effective as there is still some gaps to reach to guidelines recommendation. In written MKKP, it was stated that *Pusat Tanggungjawab* (PTj) is responsible to conduct first aid needs assessment to identify the additional first aid items required in the affected area. In addition, it also mentioned in MKKP to monitor first aid items consumption date and expiry date as part of first aid kit maintenance (UM, 2017)

Unlike TULC, first aid kit management in UM was managed by the responsible person appointed to represent each divided zone. UM consist of 48 zones where a minimum of 3 first aiders are required for each zone. All first aiders are trained in first aid treatment in collaboration with Training Department and hospital of *Kolej Pembantu Perubatan Seremban*. Total numbers of certified first aiders are unknown as there is no traceability of first aiders' status. As the first aid kit management was decentralized to individual zone, PTj will be responsible for all of first aid kit activities including first time provision, replenishment and inventory control. A total number of first aid kit in UM is undetermined as there is no traceability system implemented in a previous year.

4.3 Overall Practice of First Aid Kit Management

Overall, the implementation of first aid kit management in tertiary institutions are varied and not standardized from the issuance phase to waste disposal phase as it is depending on health and safety institution management approach. From Table 4.2, all of

the institutions are established with internal policy and procedure to administrate first aid management. This data indicate that all institutions are committed to the first aid management to comply with OSH Act 1994. While TULC is managing first aid kit in centralizing by health and safety unit, UM decentralized the first aid kit management by dedicating the task to individual 'zone'. This variation of management system approach is not a main concern as the most critical part is all elements of first aid waste minimization can be identified and controlled in all operational phases of first aid management.

Starting from the issuance of first aid kit, 3 out of 13 institutions demonstrated that the first aid provision is controlled independently through individual purchase. For the provision purpose, the main consideration is about the specification of first aid kit including contents of first aid kit, size of first aid kit and identification of competent first aider in the affected area. As long as all said elements are understood by the first aid kit provider regardless of their background, the effectiveness of first aid kit management in the institution can be achieved. The effectiveness of first aid kit provision can be measured but not limit to the suitability of first aid contents toward possible injuries, necessary amount to avoid excessive products and appropriate first aid treatment to avoid seriousness of the injuries.

From the questionnaire results, only 6 out of 13 institutions carefully considered first aid kit size to provide to the affected occupants as shown in Table 4.3. The bigger size of first aid kit will contain the higher quantity of first aid items. Cost control will be another concern for the bigger size of institutions. Thus, institutions with more than 20000 of occupants are likely to carefully consider first aid kit size in order to prevent overspending on first aid items. The questionnaire result demonstrated that institutions with more than 20000 occupants are likely to have certification at least ISO 9001 to validate their

management operation. This will be one of the factors to reflect their control in managing first aid kit in the institution.

As per case study conducted in TULC, the consideration of first aid size is not part of the consideration as per Figure 4.15. Even though the number of occupants found to be less than 25 people, 30 affected area was issued with first aid kit Size B. Data was re-analyzed based on risk level as per Figure 4.20 to understand the first aid kit provision pattern. However, occupants number with less than 25 persons are still being provided with Size B of first aid kit instead of Size A.

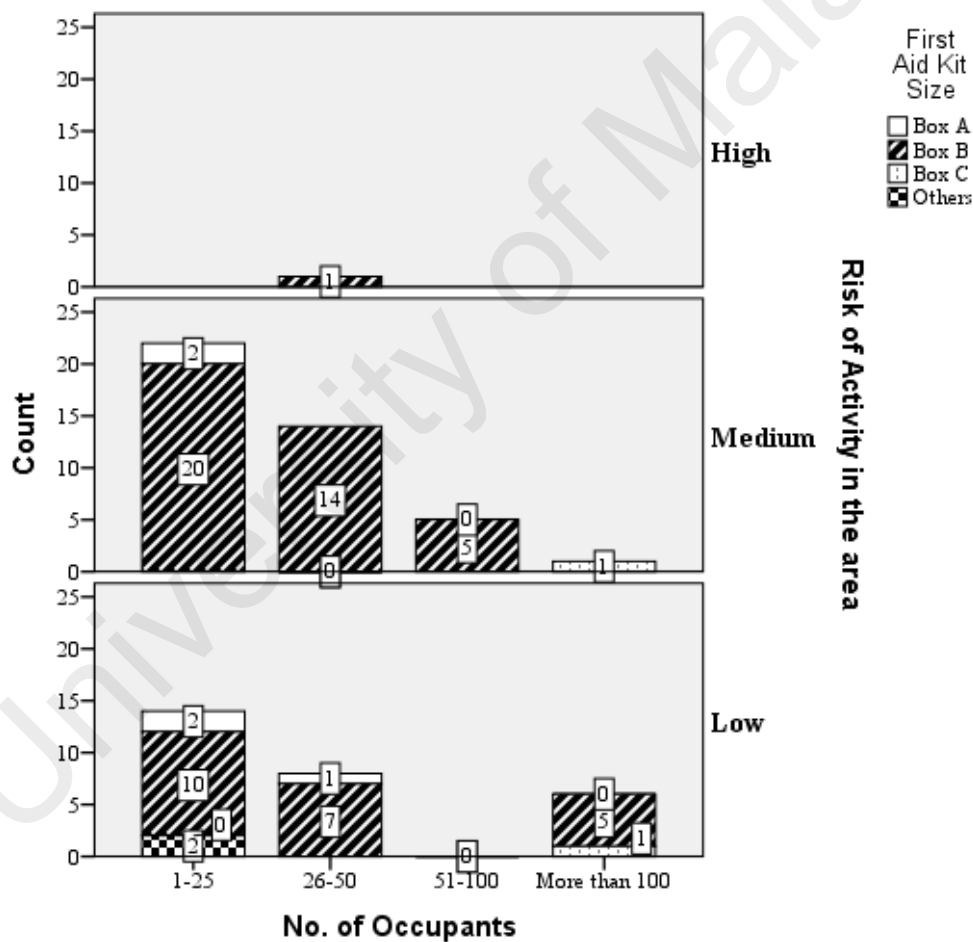


Figure 4.20: First aid kit size issued based on number of occupants and risk level in TULC

Another important element to be considered for first aid kit provision besides first aid kit size is the first aid kit quantity. Both of the elements are correlated to each other depends on the nature of activities. Through the questionnaire, data tabulated as per Figure 4.4 to

understand the consideration of first aid quantity to the number of occupants in the affected institution. Identifying quantity of first aid kit in the institution is not only useful in ensuring adequacy of first aid kit provision, it also can assist in first aid items inventory control.

From the questioners result, 69.23% institutions demonstrated the implementation of risk assessment as part of the requirement before first aid kit is provided. This approach must be essentially considered as the benefit towards safety and health management in institutions is extensive. While early detection of risk can be controlled in the early stage, it can reduce the likelihood of injuries or accident in the affected area. Thus the consumption of first aid can be reduced through reduction of first aid injuries. Through risk assessment, the need for additional contents for first aid kit also can be determined earlier where particular hazards exist (HSE Gov. UK, 2013).

As per guidelines provided by DOSH, it is advisable to appoint 2 first aiders for 150 occupants (DOSHS, 2004). However, the numbers can be reduced or increased based on the distance of medical service center, the number of employees at work at any given time and the risk level at affected area (Department of Labour NZ, 2011; HSE Gov. UK, 2013). As most of the activities in the institutions can be identified as low risk, this recommended ratio is considered as sufficient in addition to in house clinic facility. From the questionnaire results, the ratio of first aiders to occupant numbers among respondent institutions is not standardized even though most of the institutions referred to guidelines and internal policy and procedure. This finding was validated through TULC case study as per Figure 4.16 and 11 out of 17 departments found to own first aid kit without competent and trained personnel. Even though some of the affected department occupied by less than 25 people, it is essential to appoint first aider once first aid kit was issued to

prevent misuse of first aid items and to reduce injuries severity through effective treatment.

The need of the first aider in the affected area was overlooked due to the low number of occupants and low risk level. It is recommended to appoint first aider to be trained accordingly if the numbers of occupants are more than 25, even in low hazard environments (HSE Gov. UK, 2013). This competency and adequacy of first aiders are very important to ensure the effectiveness of first aid treatment and to control the consumption of first aid items. Selection method to choose first aiders can be adopted in any way as far as practicable and as long as first aiders able to attend to unforeseen casualty efficiently. As per guidelines by DOSH, it is recommended to practice refresher training at least once in three years to maintain the competency of first aiders. Based on questionnaire result, 12 out of 13 institutions found to practice this effectively. Traceability of active first aiders in the institution also can be one of the indicator of effective management of health and safety.

First aid kit traceability system is defined as any tracking system such as serial number, barcode and any form to trace first aid kit as to verify first aid information such as location, responsible person, date of issuance and others. From the questionnaire response, only 46.15% institutions (6 out of 13) demonstrated this practice. There is no standard or guidelines to emphasize specifically on this practice. However, this method is recommended as it can assist towards effective first aid management system as all of the required information can be obtained through the tracking system.

Another important element to effectively manage first aid kit is periodically maintenance including inspection and consumption monitoring. As per Table 4.4, 92.31% institutions (12 out 13) are practicing periodical inspection while 38.46% institutions (5 out of 13) revealed that inspection of first aid kit is performed once per year. It is also

validated in TULC case study at which 29 out of 71 first aid kits were not well inspected per monthly basis.



Figure 4.21: First aid kit condition without proper maintenance at TULC (a) and (b)

It is advisable to inspect at least once per month to monitor the preparedness of first aid products when casualty occurred. First aid kits must be checked regularly and replenished as soon as possible after use, so there's always an adequate supply of equipment available (DOSHS, 2004). First aid kit inspector not necessary must be the same person as the first aider. The only important element to be considered is inspector must be someone who is trained to observe the abnormality of physical condition first aid items, aware on the minimum quantity of items required and caution on items expiry date. Self-inspection based on first aid kit location is the best approach to ensure the effective maintenance and easy access to the first aid kit. As per Table 4.6, self-inspection approach is the most preferred method among institutions. Maintenance of first aid kit is not only beneficial to ensure the readiness of the kit, expired product also can be determined earlier in order to acknowledge purchaser to plan of purchase earlier.

Another special consideration to be emphasized in first aid kit maintenance is the public access. Some of the institutions provide some flexibility to allow anyone or any

first aid kit care taker to access to first aid kit when necessary as per Table 4.5. Even though there is no restriction for this flexibility, this approach needs to be reconsidered as it may be exposed to misuse and inappropriate first aid treatment.

As per NADOPOD Regulation 2004, all accidents and dangerous occurrence in the workplace must be recorded and maintained in an approved form. First aid injuries may occur from workplace accidents or due to the dangerous occurrence of the unsafe working condition. To ease the legal register, it is advisable to have first aid treatment record as part of accidents or injuries traceability in the institution. As per Table 4.8, 76.92% institutions (10 out of 13) practice first aid treatment record while only 53.85% institutions (7 out of 13) associated this record into NADOPOD register. Data obtained from TULC case study demonstrated 27 out of 71 affected unit was not practicing treatment record. First aid treatment can identify accident trends and possible areas for improvement in the control of health and safety risks. It also can be used for future reference of first aid 'need assessments'. These records may also be useful for insurance and investigative purposes (HSE Gov. UK, 2013). The practice of first aid treatment record should be emphasized in the institution as it is not only partially beneficial to comply with OSHA 1994, it is also useful to control and monitor consumption trending of first aid items.

Inventory monitoring is another part of first aid kit management practice to ensure the readiness of first aid items prior to replenishment demand. 76.92% institutions (10 out of 13) demonstrated this practice as per Table 4.10. It is essential to manage the inventory through effective approach such as 'Just in Time', 'First in First out' and keep the minimum amount in stock. The major advantage of this approach is the likelihood to produce unused or expired items can be reduced significantly and excessive purchase can

be prevented. Effective cost control is another advantage that can be obtained through proper inventory monitoring system.

To foresee the consumption rate of first aid kit among institutions, the replenishment frequency was determined through the questionnaire and found that 61.54% institutions (8 out of 13) as per Figure 4.8 where uncertain on the consumption rate. The consumption rate of other remaining institutions can be weekly and monthly. As per findings, this data indicate that there is a lacking in first aid items inventory and replenishment control among institutions even though 10 out of 13 claimed to be notified on replenishment purpose of first aid items.

The main replenishment purpose identified from the questionnaire is to replenish expired and unused of first aid items followed by new first aid items request as per Figure 4.9. This result may demonstrate the likelihood of expired and unused waste of first aid items to be generated in affected institutions. Liquid, cream or solvent based category such as antiseptic and analgesic are the highest demand for replenishment followed by solid material category (e.g. bandages and swabs). Oral intake product such as a painkiller is the lowest demand as some of the institutions are not practicing oral intake provision as part of first aid practice. This data also can be used to predict the most favorable category of first aid items to be expired and generated as first aid waste in the institutions.

The estimated yearly expenditure found to be inconsistent to the size of institutions as per Figure 4.10. While 3 out of 13 institutions stated that there is no information available to estimate yearly expenditure of first aid items, 4 of institutions spent around RM 5001 to RM10000 yearly on first aid items. The aim of this questionnaire section is to understand the spending trending of first aid items among tertiary institutions. The expectation for this section is the bigger size of institutions will result in higher expenditure. There are no proper correlation between institution size and expenditure

amount. However, some factors may affect the first aid expenditure trending such as the type of purchased items, quality of products and quantity of first aid kit. As a relation to inventory control, expenditure rate can be reduced accordingly if the effective inventory control system is practiced.

TULC case study demonstrated that 43 out of 71 affected areas throw away all first aid items residue into domestic waste dustbin while as per institutions questionnaire, 4 out of 13 institutions are performing this practice. TULC case study demonstrated that proper waste disposal from treatment residue can be reached if the required facilities such as yellow bins are provided. As the first aid injuries were considered too seldom to happen for the low-risk environment, this practice cannot be ignored. Therefore, compatible type of waste bag or bin is recommended to be provided and stored in first aid kit.

Unused and expired first aid items are the bigger concern as it can be generated throughout the operation of the institution. Less consumption of first aid kit for the treatment will lead to more generation of unused and expired first aid items. This hypothesis presented as per Figure 4.22. From TULC case study, 11.08 kg of a waste amount collected within five months as per Table 4.16. The amount is predicted to be more if all affected departments are able to return the expired or unused items as part of replenishment requirement. While a number of TULC occupants is within 7000 to 8000 range, 71 boxes of first aid kit were found. From case study conducted in UM, the occupants are at least four times bigger than TULC. Thus, the waste generated from unused and expired items predicted to be four times within the same timeline. This estimation may be considered valid as the total quantity of first aid kit will be higher if the number of occupants is higher as per Figure 4.4. It is important to start to determine first aid waste information such as source, type and generated amount to plan for proper disposal waste management.

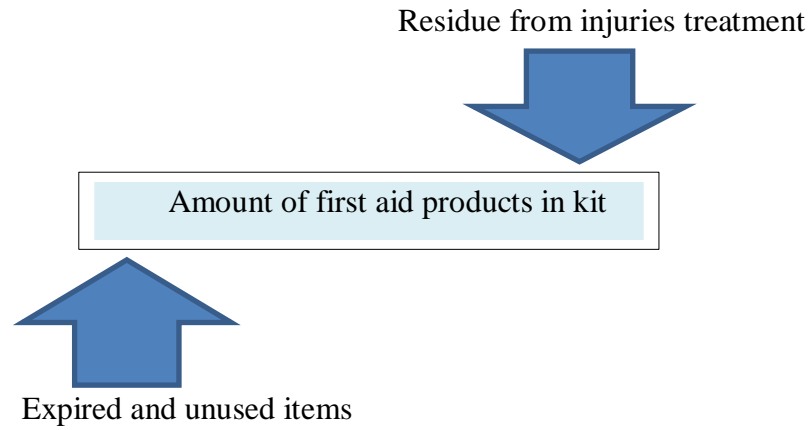


Figure 4.22: First aid waste amount relationship between residue and expired items

Disposal method of particular first aid items may be considered as some of the contents collectively may bring harm to the environment. Domestic waste disposal may be suitable for only selected items that not contained any hazardous substance. To understand the proper method of disposal, all related guidelines and regulation must be considered to categorize first aid waste as per Table 2.1. If the generated amount of first aid items are low, there must be an effective waste collection, waste transportation and waste disposal system as to centralize the waste management process within the institution. The similar waste category in the institution can be managed together to reduce the cost of waste handling.

4.4 Main Elements in First Aid Kit Management

This main elements obtained throughout the benchmarking of guidelines, standard and regulations of first aid kit management.

4.4.1 Issuance of First Aid Kit

(a) Assessment to identify the risk and hazards.

An assessment is needed to understand the appropriate first aid required for the risk and hazards circumstances. As per case study, 21 out of 71 department unit at TULC did not perform any risk assessment to identify the type of risk and possible injuries that may occur among occupants. In order to perform first aid assessment, a few items should be

considered such as nature and pattern of occupant's activities, organization's accident or injuries history, number of occupants and needs of mobilizing or traveling (HSE Gov. UK, 2013). In Guidelines on First-Aid in the Workplace by DOSH, there is no emphasize on the needs of risk assessment to identify the suitability of the first aid items and facilities issuance. An assessment must be an essential part of first aid kit management in any organization as it does not only identify the risk and hazards circumstances, it may also assist the employer to control the risk earlier as per hierarchy of control so that likelihood of the accident and injuries can be prevented.

(b) Number of occupants and first aid kit size

First aid kit size and number of occupants need to be essentially considered prior to issuance. This element is necessary as in the long-term run, most of the items in the first aid kit may remain unused and expired if there is no consumption. By considering the number of occupants at one time as part of first aid kit issuance requirement, it will able to control excessively supply thus waste minimization method can be applied at the early stage. As per response obtained through the questionnaire, 46.15% institutions claimed that the total number of occupants is part of their consideration to issuing first aid while 41.67% claimed that it is only partially effective. Besides the benefit of cost-effective control, numbers of first aiders required in respective location can be determined through this consideration.

(c) First aiders competency

As per Guidelines on First-Aid in the Workplace, the ideal numbers of first aiders for tertiary institutions (considering as the workplace with low-risk hazards and more than 400 workers) is 2 for every 150 workers. In this interpretation, students' presence in one time at one location must be considered to satisfy legal provision of Section 15 of the OSHA 1994 (Act 514) and Section 25 of the FMA 1967 (Act 139). As per Figure 4.16,

even though first aid kit was issued for few responsible unit locations, 10 from 17 unit location were discovered to have none of certified First Aider. For this research purpose, the certified first aider is defined by the person who undergoes First Aid course conducted by institutions recognized by the DOSH. Even though some of the occupants were knowledgeable on basic first aid skill, their first aid treatment knowledge and competency was not validated. The presence of competent first aider is required to attend to any injury or casualty to ensure the treatment is applied effectively. Effective treatment will not only prevent the seriousness of the injuries, it also can reduce the excessive consumption of first aid items during the treatment.

4.4.2 Replenishment Control of First Aid Kit Items

(a) Inspection of first aid condition

For the purpose of first aid kit maintenance, at least monthly inspection must be performed per unit of first aid kit. For the inspection, few items must be considered such as expiry date, physical condition and quantity of first aid kit items. The best person to perform the inspection must be someone who is able to access to first aid kit efficiently. First aider may act as first aid kit inspector when necessary or employer shall appoint the right person to act as 'first aid kit coordinator' for each of unit department. Monthly inspected should be performed by using effective inspection checklist as a reference. The contents of first aid kit should be examined frequently and restocked soon after use. Therefore, first aid kit coordinator may able to identify any first aid items that heavily consumed, nearly expired and physically damaged. This approach will be beneficial for organization inventory control as per 4.4.2(c).

(b) First aid items consumption and injury recording

To make sure the first aid kit is restocked or replenished in a timely manner, monitoring the trending of the first aid items consumption will be the best approach

(Department of Labour NZ, 2011). It is advisable to practice it every time a First Aider attend to injuries treatment. In addition, consumption trending of first aid items for injuries treatment is essential to determine the level of safety in the workplace. By proper recording of first aid treatment, it will be beneficial for an employer to provide necessary welfare and improve the risk control approach so that overall trending of workplace accidents can be reduced effectively. Student welfare is a primary concern for most of the institutions. Even though risk level is low in overall, re-occurrence of minor injuries that happened from student activities may reflect workplace safety threats and unsafe condition in the institution. To ease the execution of first aid treatment record, it is recommended that required writing materials are kept in or near the kit so First Aider able to record what has been consumed per injury treatment. By recording type of first aid items consumed and injuries type, it is also fulfilling the legal requirement as per Notification of Accidents, Dangerous Occurrence, Occupational Poisoning and Occupational Diseases (NADOPOD) Regulations 2004 in OSHA 1994.

(c) Inventory control

‘Reduce’ is one of the basic methods for waste minimization. By reducing the number of first aid items in inventory stock, the likelihood of producing expired first aid items can be reduced significantly. It is recommended to purchase required first aid items when it is necessary rather than purchase in bulk. The purchaser can be notified in a timely manner or ‘Just in Time’ if the inspection of first aid kit is managed as per (a). The practice of bulk purchase required more space to store all of the new first aid stock. First aid items replenishment trending is uncontrolled if there is no forecasted consumption is performed by the purchaser. For purchase estimation purpose, the purchaser may refer to first aid items consumption trending or injuries record.

4.4.3 Disposal of First Aid items

(a) Identification of waste source

As per case study conducted in TULC, expired first aid items were produced all the time from the identified first aid kit. It is similar to the survey result conducted to other institutions as 53.8% of institutions claimed that there is expired first aid items produced in their compound. Practically, the likelihood to produce expired first aid items in the institution is high if the activities risk level at the affected area is low. Thus, the quantity of first aid items to be used for the treatment will be less as the injury is seldom to occur. As per Table 2.1 in the literature review, first aid items may end up to become any type of waste category. It may be generated as a residue from first aid treatment such as used the swab, pieces of cottons and used glove. It also can be generated as expired items if there is less or no first aid items consume for treatment or replenishment purpose.

(b) Segregation and collection of unused and expired first aid items

As per case study conducted at TULC, 11.08 kg of first aid items including all first aid categories were generated. The total amount of expired first aid items expected to be more if all affected department is able to return expired items within the collection timeline from November 2017 to March 2018. There is no practice of collecting all unused and expired items to be disposed accordingly in previous years. As the amount may roughly represent first aid waste generation in TULC within 5 months, the total amount assumed to be more if the practice is implemented in other bigger scale of universities. Expired and unused first aid items collection will be recommended approach to overcome waste to be scattered around. To ease waste handler for waste collection and waste disposal, segregation will be the best method as the effect of waste substances on health and environment may be different.

(c) Proper method of first aid waste disposal

Any first aid items which already in contact with patients' blood must be treated as infectious waste to control the risk of health effects. While managing first aid kits, care also should be taken to dispose of all first aid items safely once they reach their expiry date (HSE Gov. UK, 2013). As per case study conducted in TULC, laboratories and health service center are able to practice proper disposal as per schedule waste regulation. The main reason is some of the areas are prepared with biohazard or clinical yellow bin for daily activity purpose. It is not possible to implement biohazard disposal practice in other areas as the clinical yellow bin is not provided. Meanwhile, all of the expired first aid items once segregated must be disposed as per recommendation in Guidelines on The Handling and Management of Clinical Wastes in Malaysia. If the items can be categorized as non-hazardous, it may be managed jointly with municipal wastes.

<u>Main Control Elements</u>	<u>Requirement</u>	<u>Outcome</u>
Issuance	Risk assessment.	→ Early identification of risk
	Number of occupants and first aid kit size	→ Effective cost control
	First Aider competency	→ Prevent the seriousness of the injuries
Replenishment	Inspection of first aid condition	→ Maintain first aid condition
	Consumption and injury recording	→ On time replenishment and detection of the unsafe working condition
	Inventory control	→ Prevent over purchase by 'Just in Time'
Disposal	Identification of waste source	→ Waste reduction strategy can be planned
	Segregation and collection	→ Prevent waste scattering
	Proper disposal method	→ Prevent adverse effect on health and environment

Figure 4.23: Main elements to be controlled in first aid kit management

4.5 First Aid Kit Management System Proposal

(a) First aid policy and procedure

In order to standardize the practice of first aid management system in the workplace, policy and procedure are required to set the standard. While the policy is emphasizing on basic principle to manage first aid in institutions, the procedure must clearly mention stage by stage of first aid activities from issuance to disposal stage.

(b) First aid kit register

For monitoring purpose, first aid kit register is recommended to trace all information required but not limited to date of issuance, first aid items consumption and the total quantity of first aid kit in the institution. More information is better to monitor all aspects of first aid kit management. To ease the monitoring process, traceability through serial number or barcode is the common and easy method to be established.

Table 4.18: Example of recommended first aid kit register

<i>Serial No.</i>	<i>Date of issuance</i>	<i>Location of first aid kit</i>	<i>No. of occupants</i>	<i>Size of first aid box</i>	<i>Name of first aider</i>
<i>FA001</i>	<i>13-08-17</i>	<i>Engineering Workshop</i>	<i>1-25</i>	<i>A</i>	<i>Mohd</i>
<i>FA002</i>	<i>14-09-17</i>	<i>Culinary Art Classroom</i>	<i>26-50</i>	<i>B</i>	<i>Nurul</i>
<i>FA003</i>	<i>16-12-17</i>	<i>Administration Office</i>	<i>51-100</i>	<i>C</i>	<i>Siva</i>
<i>FA004</i>	<i>21-01-18</i>	<i>Examination Office</i>	<i>More than 100</i>	<i>C</i>	<i>Leong</i>



Figure 4.24: Example of first aid serial number

(c) ‘Need assessment’ as part of first aid issuance requirement

It is highly recommended to conduct ‘need assessment’ to determine first aid provision in the workplace. Through ‘need assessment’, specific hazards such as potentially hazardous substances, tools or machinery will be identified to understand the risk and possible injuries (Department of Labour NZ, 2011). While the hierarchy of hazard control such as elimination, isolation or minimization is applied, possible injuries can be reduced significantly thus first aid treatment required will be less. ‘Need assessment’ also can determine required size and number of first aid kit after all aspects are considered before first issuance of kit.



Figure 4.25: Standard size of first aid kit available

(d) Minimize first aid items inside kit

To minimize possible expired and unused first aid items generated, the best approach is to control pharmaceutical items quantity reserved inside first aid kit. It is recommended to avoid oral intake product for pain relief medicines, such as paracetamol or aspirin to be stored in first aid kit. Normal first aiders may not be certified to do so as oral intake product is only can be given by a person that is medically qualified to do (Department of Labour NZ, 2011). The quantity of other first aid items also can be controlled based on treatment and consumption history supported by first aid injuries record.

(e) Monthly inspection with a checklist

This approach is one of the most effective methods to monitor and maintain first aid kit condition. The main purpose of this inspection is to observe physical condition of items, expiry dates and minimum quantity to be on standby in each of first aid kit. First aid treatment register

First aid treatment record is recommended to monitor the usage of first aid kit items mainly to treat injuries in the workplace. This approach also will prevent misuse of first aid items as part of the control. Nothing other than first aid items, pen and first aid treatment register should be reserved in the kits.

Table 4.19: Example of first aid treatment register

<i>Employee's Name</i>	<i>Ahmad</i>
<i>Department/Working Area</i>	<i>Engineering workshop</i>
<i>Date & Time of Treatment</i>	<i>10-02-208, 3.30 pm</i>
<i>First Aider Name</i>	<i>Mohd</i>
<i>Description of Injury</i>	<i>Open wound at the right elbow</i>
<i>Cause of Injury</i>	<i>Hit the sharp edge of metal on the table accidentally while cutting wood plate</i>
<i>Treatment Provided</i>	<i>Stop bleeding, clean wound, apply antibiotic and protect the wound</i>
<i>First aid items used:</i> <i>(Reminder: replenish the first aid kit with disposed of items)</i>	<i>Gauze, antibiotic cream, sterile bandage</i>

(Department of Labour NZ, 2011)

(f) Returning unused or expired items policy

To gather all scattered first aid waste, returning unused or expired items policy is highly recommended to ensure all waste can be managed accordingly. This policy needs to be emphasized to any of first aid items that contained poisonings chemical and drugs such as antiseptic and paracetamol. The possible approach that can be implemented in institutions is returning unused or expired items as an exchange for the replenished item. While all expired and unused first aid items can be collected efficiently, this policy also able to minimize misuse of first aid items issue.

(g) Inventory monitoring system

Monitor the trending of first aid items replenishment is required as to estimate the best time to buy first aid items stock. 'Just in Time', 'First in First Out' and minimum in stock approach is recommended to reduce the likelihood of expired and unused items in the workplace.

(h) Waste disposal management

Waste disposal needs to be considered for the residue of first aid treatment and expired or unused items. It is recommended to supply plastic bag or biohazard bag for each of first aid kit to dispose residue of first aid treatment as clinical waste (Department of Labour NZ, 2011). All expired and unused first aid items that required schedule waste regulation need to be segregated and dispose accordingly.

University of Malaya

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The first aid kit management may indicate the implementation of occupational safety and health management as a whole in any premise including risk assessment and control, injuries treatment and waste management. The first aid kit management practice among institutions is varied based on nature of implementation of occupational health and safety management system in an institution. Even though most of the institutions were referring to guidelines, standards, policies and procedure, the consideration of first aid waste management needs to be improved as part of the controlled element in first aid kit management. This control is essential as part of waste reduction strategy to protect the adverse effect on the environment and health.

From the case study, the major source of first aid waste is likely to be generated from inventory items, first aid kit products and residue produced from first aid treatment. Therefore, a lot of consideration is required to ensure the effectiveness of first aid kit management so that generation of waste can be overcome from the point of the first issuance of first aid kit. The guidelines and standard may need to emphasize the need of managing first aid kit from the first issuance until disposal so that small and scattered first aid waste generation can be controlled properly.

The most significant main elements to be controlled as per findings are the issuance of first aid kit, replenishment control and waste disposal. It is including but not limited to risk assessment before first aid kit issuance, first aid treatment record, unused or expired items returning policy and effective inventory control. Each of proposed element able to integrate with waste minimization approach and ensuring proper waste disposal of hazardous elements from first aid kit activities.

While a lot of studies emphasized on the bigger scale of healthcare waste management, the hazards associated with scattered, small sources of health-care waste should not be neglected. Thus, this study proved that those associated waste such as first aid items is possible to manage through effective management system in order to protect adverse effect towards health and environment.

5.2 Recommendations

Since there is no study conducted specifically on the first aid kit management previously, there is no baseline study to properly define the target area of this research. While this study already demonstrated first aid kit management practice among tertiary institutions, it is recommended to extend this study to other premises such as other working environment and industries to compare the current general practice. Also, some studies required to suggest proper effective control on first aid kit waste management in bigger boundaries such as district, town or state.

The details of categorization of waste that can be produced from first aid activities need to be studied in details so that accurate health and environmental impact can be identified. For this research purpose, the impact towards health and environment is determined through literature review without any further evaluation. The generation rate of first aid waste yearly or monthly basis needs to be determined to forecast the impact and the burden towards domestic waste disposal and treatment.

It is also recommended to further study on the need of technology to ease the management system through digital approach. Digital first aid kit management system will be the smart tool to integrate the purchasing activity, first aid treatment, inventory and other activities to minimize the likelihood of waste generation. This will be aligned to the current target of promoting modern electronic administration management.

REFERENCES

- Al-Habash, M., & Al-Zu'bi, A. (2012). Efficiency and Effectiveness of Medical Waste Management Performance, Health Sector and its Impact on Environment in Jordan Applied Study. *World Applied Science Journal* 19, 6, 880-893.
- Alagoz, A. Z., & Kocasoy, G. (2008). Determination of the best appropriate management methods for the health-care wastes in Istanbul. *Waste Management*, 28(7), 1227-1235.
- Almuneef, M., & Memish, Z. A. (2003). Effective medical waste management: It can be done. *American Journal of Infection Control*, 31(3), 188-192.
- Ananth, A. P., Prashanthini, V., & Visvanathan, C. (2010). Healthcare waste management in Asia. *Waste Manag*, 30(1), 154-161.
- Bashaar, M., Thawani, V., Hassali, M. A., & Saleem, F. (2017). Disposal practices of unused and expired pharmaceuticals among general public in Kabul. *BMC Public Health*, 17(1), 45.
- Bdour, A., Altrabsheh, B., Hadadin, N., & Al-Sharif, M. (2007). Assessment of medical wastes management practice: a case study of the northern part of Jordan. *Waste Manag*, 27(6), 746-759.
- Bendjoudi, Z., Taleb, F., Abdelmalek, F., & Addou, A. (2009). Healthcare waste management in Algeria and Mostaganem department. *Waste Manag*, 29(4), 1383-1387.
- Blenkharn, J. I. (1995). Waste Disposal-What Rubbish. The disposal of clinical waste. *Journal of Hospital Infection*, 30(Supplement), 514-520.
- Bokhoree, C., Beeharry, Y., Makoondlall-Chadee, T., Doobah, T., & Soomary, N. (2014). Assessment of Environmental and Health Risks Associated with the Management of Medical Waste in Mauritius. *APCBEE Procedia*, 9, 36-41.
- Bos, A. V. D., & Izadpanah, A. (2002). Building Capacity for Comprehensive Medical Waste Management in Asia. *EM The Urban Environment*, 18-20.
- Bound, J. P., Kitsou, K., & Voulvoulis, N. (2006). Household disposal of pharmaceuticals and perception of risk to the environment. *Environ Toxicol Pharmacol*, 21(3), 301-307.
- Bujak, J. (2015). Thermal treatment of medical waste in a rotary kiln. *Journal of Environmental Management*, 162, 139-147.
- Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P., & Hammond, F. (2009). Medical waste management in Ibadan, Nigeria: obstacles and prospects. *Waste Manag*, 29(2), 804-811.
- Da Silva, C. E., Hoppe, A. E., Ravello, M. M., & Mello, N. (2005). Medical wastes management in the south of Brazil. *Waste Management*, 25, 600-605.

- Department of Environment (2009). *Guidelines on The Handling and Management of Clinical Wastes in Malaysia (3rd Edition)*. Malaysia: Ministry of Natural Resources and Environment.
- Department of Labour, New Zealand (2011). *First Aid For Workplace- A Good Practice Guide*. (ISBN 978-0-478-33383-1).
- Department of Occupational Safety and Health (2004). *Guidelines on First-Aid In The Workplace (2nd Edition)*. Malaysia: Ministry of Human Resource.
- Health and Safety Executive Gov. United Kingdom (2013). *First aid at work-The Health and Safety (First-Aid) Regulations 1981*. (ISBN 97- 0-7176-6560-0)
- Hopkins, Z. R., & Blaney, L. (2016). An aggregate analysis of personal care products in the environment: Identifying the distribution of environmentally-relevant concentrations. *Environmental International*, 92-93, 301-306.
- Hossain, M. S., Santhanam, A., Nik Norulaini, N. A., & Omar, A. K. (2011). Clinical solid waste management practices and its impact on human health and environment-A review. *Waste Management*, 31(4), 754-766.
- Leung, H. W., Minh, T. B., Murphy, M. B., Lam, J. C., So, M. K., Martin, M., . . . Richardson, B. J. (2012). Distribution, fate and risk assessment of antibiotics in sewage treatment plants in Hong Kong, South China. *Environmental International*, 42, 1-9.
- Marinkovic, N., Vitale, K., Janev Holcer, N., Dzakula, A., & Pavic, T. (2008). Management of hazardous medical waste in Croatia. *Waste Management*, 28(6), 1049-1056.
- McCallum, E. S., Krutzelmann, E., Brodin, T., Fick, J., Sundelin, A., & Balshine, S. (2017). Exposure to wastewater effluent affects fish behaviour and tissue-specific uptake of pharmaceuticals. *Science of the Total Environment*, 605-606, 578-588.
- Mohamed, L. F., Ebrahim, S. A., & Al-Thukair, A. A. (2009). Hazardous healthcare waste management in the Kingdom of Bahrain. *Waste Management*, 29(8), 2404-2409.
- Nwachukwu, N. K., Orji, F. A., & Ugbogu, O. C. (2013). Health Care Waste Management – Public Health Benefits, and the Need for Effective Environmental Regulatory Surveillance in Federal Republic of Nigeria.
- Occupational Safety and Health Act* (1994). Malaysia: Laws of Malaysia.
- Oli, A. N., Ekejindu, C. C., Adje, D. U., Ezeobi, I., Ejiofor, O. S., Ibeh, C. C., & Ubajaka, C. F. (2016). Healthcare waste management in selected government and private hospitals in Southeast Nigeria. *Asian Pacific Journal of Tropical Biomedicine*, 6(1), 84-89.
- Ozbek, M., & Sanin, F. D. (2004). A study of the dental solid waste produced in a school of dentistry in Turkey. *Waste Management*, 24(4), 339-345.

- Park, J., Yamashita, N., Park, C., Shimono, T., Takeuchi, D. M., & Tanaka, H. (2017). Removal characteristics of pharmaceuticals and personal care products: Comparison between membrane bioreactor and various biological treatment processes. *Chemosphere*, *179*, 347-358.
- Patwary, M. A., O'Hare, W. T., Street, G., Maudood Elahi, K., Hossain, S. S., & Sarker, M. H. (2009). Quantitative assessment of medical waste generation in the capital city of Bangladesh. *Waste Manag*, *29*(8), 2392-2397.
- Sawalem, M., Selic, E., & Herbell, J. D. (2009). Hospital waste management in Libya: a case study. *Waste Manag*, *29*(4), 1370-1375.
- Stoch, P., Ciecńska, M., Stoch, A., Kuterasiński, Ł., & Krakowiak, I. (2018). Immobilization of hospital waste incineration ashes in glass-ceramic composites. *Ceramics International*, *44*(1), 728-734.
- Tamplin, S. A., Davidson, D., Powis, B., & O'Leary, Z. (2005). Issues and options for the safe destruction and disposal of used injection materials. *Waste Manag*, *25*(6), 655-665.
- Tran, N. H., Chen, H., Reinhard, M., Mao, F., & Gin, K. Y. H. (2016). Occurrence and removal of multiple classes of antibiotics and antimicrobial agents in biological wastewater treatment processes. *Water Research*, *104*, 461-472.
- Tudor, T. L. (2007). Towards the development of a standardised measurement unit for healthcare waste generation. *Resources, Conservation and Recycling*, *50*(3), 319-333.
- University of Malaya (2017), *Manual Kesihatan dan Keselamatan Pekerjaan*.
- Wang, J., & Wang, S. (2016). Removal of pharmaceuticals and personal care products (PPCPs) from wastewater: A review. *Journal of Environmental Management*, *182*, 620-640.
- Windfeld, S. T., & Brooks, M. S. (2015). Medical Waste Management 2015 - A Review. *Journal of Environmental Management*, *163*, 98-108.
- World Health Organization, Definition and characterization of health-care waste. Retrieved from http://www.who.int/water_sanitation_health/medicalwaste/002to019.pdf
- World Health Organization, Treatment and disposal technologies for health-care waste. Retrieved from http://www.who.int/water_sanitation_health/medicalwaste/077to112.pdf
- Xin, Y. (2015). Comparison of hospital medical waste generation rate based on diagnosis-related groups. *Journal of Cleaner Production*, *100*, 202-207.
- Yang, Y., Ok, Y. S., Kim, K. H., Kwon, E. E., & Tsang, Y. F. (2017). Occurrences and removal of pharmaceuticals and personal care products (PPCPs) in drinking water and water/sewage treatment plants: A review. *Science of Total Environment*, *596-597*, 303-320.