# ANALYTICAL HIERARCHY PROCESS (AHP) APPLICATION IN THE DEVELOPMENT OF SAFETY MODULE FOR SHARPS MANAGEMENT

BY

AFIZA ABDULLAH SUHAIMI

A thesis submitted in fulfillment of the requirement for the degree of Doctor of Philosophy in Health Science

Kulliyyah of Allied Health Science
International Islamic University Malaysia

JUNE 2022

# ABSTRACT

The increasing number of healthcare services facilities to accommodate the needs of population growth especially in developing countries including Malaysia has increased the prevalence of sharps injury among the healthcare workers (HCWs). The role of HCWs to ensure the safety standards and practices are implemented is crucial due to the high risk of becoming infected with HBV, HCV, and HIV at 30%, 1.8%, and 0.3%, respectively. However, preliminary study has revealed that until currently, there is no national guidelines on how to handle sharps to avoid injury during various procedures in Healthcare Establishment (HCEs). Therefore, a study was conducted to develop a sharps safety module by considering various factors to ensure that the module is systematic and comprehensive for the basis of national guidelines. The study was conducted through a qualitative study by exploring the current practices and technical methods in managing sharps at selected HCEs in Malaysia, a quantitative study by measuring the prevalence of knowledge, attitude, and practices on sharps management among HCWs in HCEs in Malaysia and an Analytical Hierarchy Process (AHP) method as a multi-criteria decision-making tool to help HCEs stakeholders in making the right decisions. The qualitative study revealed two main themes: organisational factor and employee factors. Seven codes that influenced the cause of sharps injury in these two themes were cost, policy and guideline, training, technology, safety, reporting issues and handling. The quantitative study results revealed that even though most of the participants had a good knowledge level, the attitude, and practices of the participants toward sharps management were only at moderate and poor attitude, and moderate to fair level of practices. All factors identified in qualitative and quantitative study were then included as the criteria in AHP. A three- tier hierarchy structure was established for this study. The first tier stated that the goal of the AHP was to select the best safety module to reduce the risk of sharps. The second tier included the criteria that made up of the six factors: policy, and training, reporting issue, safety, technology, and handling. Finally, the third tier included three alternatives, namely Module A: Basic Integrated Sharps Management Safety Module; Module B: Intermediate Integrated Sharps Management Safety Module and Module; and Module C: Advanced Integrated Sharps Management Safety Module. Once the hierarchy was established, pairwise comparisons were made to formulate the final weights for each criterion and the selection of the alternative. AHP recommended Module C (Integrated Safety Sharps Management Module), with the overall priority at 42.3% as the best safety module to reduce the risk of sharps injury among HCWs in HCEs. Based on the Module C and elements identified in earlier phase of the study, a model of sharps safety management module was established, in conclusion, this study findings provide a comprehensive framework of model for sharps safety management module as the basis for national guidelines on sharps management to ensure the safety of HCWs in HCEs in Malaysia.

Keywords: Healthcare workers, Malaysia, NSI, Sharps management

# خلاصة البحث

ن العدد المتزايد من مرافق خدمات الرعاية الصحية لاستيعاب احتياجات النمو السكاني خاصة في البلدان النامية بما فيها ماليزيا، أدى بالتأكيد إلى زيادة انتشار الإصابات الحادة بين العاملين في مجال الرعاية الصحية (HCW). يعد دور العاملين HCW في ضمان تنفيذ معايير وممارسات السلامة المطبقة أمرا حاسما، نظرا لارتفاع مخاطر الإصابة بفيروس HBV، وHCV، وHIV بالنسبة 30%، و1.8%، و 0.3% على التوالي. ومع ذلك، كشفت الدراسة الأولية أنه حتى الآن، لا توجد الإرشادات الوطنية حول كيفية التعامل مع الأدوات الحادة لتجنب الإصابة أثناء الإجراءات المختلفة في مؤسسات الرعاية الصحية HCEs. لذلك، أجريت الدراسة لتطوير وحدة سلامة الأدوات الحادة من خلال النظر في عوامل مختلفة للتأكد من أن الوحدة منهجية وشاملة على أساس الإرشادات الوطنية. أجريت الدراسة من خلال الدراسة النوعية باستكشاف الممارسات الحالية والأساليب التقنية في إدارة الأدوات الحادة في HCEs مختارة في ماليزيا، والدراسة الكمية من خلال قياس انتشار المعرفة، والمواقف، والممارسات بشأن إدارة الأدوات الحادة بين العاملين في مجال الرعاية الصحية في HCEs في ماليزيا، والدراسة التحليلية بطريقة عملية التسلسل الهرمي (AHP) كأداة متعددة المعايير لصنع القرار لمساعدة أصحاب المصلحة في HCE في اتخاذ القرارات الصحيحة. كشفت الدراسة النوعية موضوعين رئيسيين: العامل التنظيمي وعوامل الموظف. سبعة رموز أثرت في سبب إصابات الأدوات الحادة في هذين الموضوعين هي التكلفة، والسياسة والمبادئ التوجيهية، والتدريب، والتكنولوجيا، والسلامة، وقضايا الإبلاغ، والتعامل. أظهرت نتائج الدراسة الكمية أنه على الرغم من أن غالبية المشاركين يتمتعون بمستوى جيد، إلا أن مواقف وممارسات المشاركين تجاه إدارة الأدوات الحادة كانت فقط في موقف معتدل وضعيف، ومستوى معتدل إلى عادل من الممارسات. تم بعد ذلك تضمين جميع العوامل المحددة في الدراسة النوعية والكمية كمعايير في برنامج AHP. أنشئ هيكل هرمي من ثلاثة مستويات لهذه الدراسة. حدد المستوى الأول على هدف AHP لاختيار أفضل وحدة السلامة لتقليل مخاطر إصابات الأدوات الحادة. وشمل المستوى الثاني المعايير التي تتكون من ستة عوامل وهي: السياسة، والتدريب، وإبلاغ القضية، والسلامة، والتكنولوجيا، والتعامل. وأخيرا، تضمن المستوى الثالث ثلاثة بدائل وهي الوحدة A: وحدة السلامة الأساسية المتكاملة لإدارة الأدوات الحادة، والوحدة B: وحدة السلامة المتكاملة المتوسطة لإدارة الأدوات الحادة، والوحدة C: وحدة السلامة المتقدمة المتكاملة لإدارة الأدوات الحادة. بمجرد إنشاء التسلسل الهرمي، تم إجراء المقارنات الزوجية لصياغة الأوزان النهائية لكل معيار واختيار البديل. أوصى AHP بالوحدة C (الوحدة المتكاملة السلامة لإدارة أدوات الحادة)، مع إعطاء الأولوية الإجمالية بنسبة 42.3% كأفضل وحدة السلامة لتقليل مخاطر إصابات الأدوات الحادة بين العاملين HCW في HCEs. بناء على الوحدة C والعناصر المحددة في المرحلة السابقة من الدراسة، تم إنشاء نموذج لوحدة إدارة سلامة الأدوات الحادة. في الختام، توفر نتائج هذه الدراسة إطارا شاملا لنموذج وحدة إدارة سلامة الأدوات الحادة كأساس الإرشادات الوطنية لإدارة الأدوات الحادة لضمان سلامة العاملين HCW في HCEs في ماليزيا.

**الكلمات الرئيسية:** عمال الرعاية الصحية، ماليزيا، NSI، إدارة الأدوات الحادة.

# APPROVAL PAGE

The thesis of Afiza Abdullah Suhaimi has been approved by the following:

_____
Niza Samsudin
Supervisor

_____
Nor Azlina A.Rahman
Co-supervisor

_____
Cheng Jack Kie
Co-supervisor

_____
Mohd. Said Bin Nurumal
Internal Examiner

_____
Rozita Binti Hod
External Examiner

_____
Siti Aesah @ Naznin Muhammad
Chairman

# DECLARATION

I hereby declare that this thesis is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Afiza Abdullah Suhaimi

Signature…… Date……

**INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA**

**DECLARATION OF COPYRIGHT AND AFFIRMATION OF FAIR USE OF UNPUBLISHED RESEARCH**

**ANALYTICAL HIERARCHY PROCESS (AHP) APPLICATION IN THE DEVELOPMENT OF SAFETY MODULE FOR SHARPS MANAGEMENT**

I declare that the copyright holder of this thesis are jointly owned by the student and IIUM.



Affirmed by Afiza Abdullah Suhaimi

…… ……..

Signature Date

# ACKNOWLEDGEMENTS

Praise to ALLAH, His majesty for His uncountable blessings, and best prayers and peace be unto His messenger Mohammed, his pure descendants, and family and his noble companions.

First of all, I wish to address my sincerest gratitude to my supervisor Assoc. Prof. Dr. Niza Samsuddin for her academic guidance, encouragement, support and supervision that lead to the successful completion of this study. I am very grateful to my co-supervisor Assoc. Prof. Dr. Nor Azlina A. Rahman and Dr. Cheng Jack Kie for the knowledge you have shared and the excellent guide throughout my candidature. This work would not have been possible without their assistance.

Many thanks to Kementerian Pelajaran Malaysia and University Malaysia Pahang for the financial support. I am also indebted to all the participants who agreed to take part in this study.

Personally, I have no words to express my gratitude to my beloved husband, Dr. Mohd Armi Abu Samah and my son, Muhammad Adam Ayyad, parents and family, for their unwavering support along all these years and for the several opportunities given to expand both my academic and personal horizons. I deeply thank your practical and emotional support as I added to the roles of wife and mother, the competing demands of study and personal development.

Finally, I wish to record my deep appreciation to my friends and colleagues for giving the right advice at the right time. It was hardly possible for me to thrive in my doctoral work without the precious support of these personalities. Thank you.

# TABLE OF CONTENTS

# LIST OF TABLES

# LIST OF FIGURES

# CHAPTER ONE

# INTRODUCTION

## 1.1 INTRODUCTION

The general concept of the research is mainly highlighted in this chapter. It begins with the explanation of the background of the study and follows with the problem statement. Then, this chapter presents the objective, the scope of the study, the significance of the study and the conceptual framework.

## 1.2 BACKGROUND OF STUDY

The rapid growth of Healthcare Establishments (HCEs) to tackle the increasing healthcare needs in developed and developing countries requires a systematic, safe, and cost-effective management, including the protection of occupational risks among healthcare workers (HCWs). HCWs were reported as a group prone to blood-borne infections (Khraisat and Juni, 2014; Makade et al., 2017). The World Health Organisation (WHO) reported the annual global estimated proportions of HCWs exposed to blood-borne diseases infections were 0.5% for human immunodeficiency virus (HIV), 2.6% for hepatitis B virus (HBV) and 5.95% for hepatitis C virus (HCV) (Pruss-Ustun et al., 2003). In addition, a greater concern should be addressed pertaining to this issue since 90% of the infections attributed to occupational exposure occurred in the developing world as reported by Wilburn et al. (2004).

HCWs who have experienced sharps injury may moreover endure from long-term result of psychiatric morbidity, such as depression, post-traumatic stress disorder (PTSD) and adjustment disorder (AD) (Bhardwaj et al., 2014). Green and Griffiths (2013) further described that the magnitude of depression due to sharps injury was equivalent to the most psychological impact of trauma patients. Sharps injury will also directly affect the health care services and resources through absenteeism (Bhardwaj et al., 2014).

Statistics from Occupational Health Unit, Ministry of Health Malaysia (MOH) from 1998 to 2005 has reported that the incidence rate of sharps injury was 74.9% of all injuries and the needle stick injury was the major cause of sharps injuries among the HCWs (Ministry of Health Malaysia, 2007). Malaysia has legislative requirements and guidelines on managing sharps injury including Environmental Quality (Scheduled Wastes) Regulations, 2005, Sharp Injury Surveillance Manual, 2007 and Guideline of Management of Healthcare Workers infected with HIV, HBV, and HCV, 2007. Nevertheless, several studies in Malaysia reported that prevalence of Needle Stick Injury (NSI) were still high. A study by Rampal et al. (2010) stated that the prevalence of NSI among HCWs in a Malaysian hospital was 23.5% and considered as high. The same study showed that there were gaps between knowledge and practice related to sharps injury. Hasnaa et al. (2017) showed that 1405 cases of NSI were reported in MOH Malaysia facilities in 2011. This alarming figure prompts further exploration of the root cause and plan for future improvement.

Until currently, there is no standardized national guideline on how to handle sharps to avoid injury during various procedures in HCEs. Most HCEs have their own initiatives to give trainings on sharps handling at the workplaces. Situational analysis revealed that the content of the training, sharps handling practices, and waste management varied among individuals and HCEs. Hence, it is crucial to have a standardized and comprehensive sharps management that can reduce the risks of sharps injury among the HCWs.

However, making a decision to reduce the risk of sharps among HCWs while maintaining the safe practices of sharps handling is very complicated since it normally involves items that are not easily comparable under the same units of measurement. Due to the items that sometimes more subjective to be considered. Thus, an established multi-criteria decision-making tool called Analytical Hierarchy Process (AHP) was applied in this study to select the best safety module for sharps management since AHP offered the simplicity, power, and minimal data dependence (Kao et al., 2016, 2020).

## 1.3 PROBLEM STATEMENT

Today, Malaysia is one of the chosen countries for medical tourism. The Malaysian government has identified medical tourism as a growth sector during the 1997-1998 Asian financial crises, when significant numbers of Indonesians began to turn to Malaysian private hospitals for affordable and quality healthcare. With the 2010 launch of the Economic Transformation Program (ETP), which intended to transform Malaysia into an upper middle-income country with a knowledge-based economy, interests in harnessing medical tourism's economic potential grew. The ETP earmarked healthcare as one of the country's 12 National Key Economic Areas (NKEAs) deemed to have the potential to spur growth (Pemandu, 2010; Meghann Ormond et al., 2014). According to the National Transformation Programme (NTP) Annual Report 2015, Malaysia generated RM588.6 million in healthcare travel revenue between January and September 2015, with the target for the full year being set at RM854 million. This shows a great growth of health tourism in Malaysia. This scenario has promoted the increased of HCE in Malaysia.

In conjunction with the growing of healthcare tourism (HCT) industry, another aspect that needs serious attention by the government, policy makers and workers in healthcare establishments (HCEs) is safety issues among the HCWs. Needle stick injury (NSI) is considered the second commonest cause of occupational injury within the National Health Service (NHS) (Elmiyeh et al., 2004). The definition of needle stick injury by the Occupational Safety and Health, is injuries caused by needles such as hypodermic needle, blood collection needles, intravenous styles and needles used to connect parts of intravenous delivery system (MOH, Malaysia 1998).

Centres for Disease Control and Prevention (CDC) estimated that each year 385,000 needle sticks and sharps injuries (NSSI) are experienced by HCWs, with an average of 1000 sharps injuries per day (Zafar et al., 2009). The WHO states that among the 35 million HCWs worldwide, about 3 million receive percutaneous exposures to blood-borne pathogens each year; 2 million of those to hepatitis B virus (HBV), 0.9 million to hepatitis C virus (HCV) and 170,000 to human immunodeficiency virus (HIV) (Choi et al., 2017).

According to Arafa et al. (2012), few efforts have been undertaken in developing countries to raise awareness about sharps injury among HCWs. As a developing country, Malaysia also has put several efforts on sharps management including the establishment of legislative requirements and guidelines on managing sharps injury in Environmental Quality (Scheduled Wastes) Regulations, (2005), Sharp Injury Surveillance Manual (2007) and Guideline of Management of Health care workers infected with HIV, HBV, and HCV (2007). Nevertheless, several studies in Malaysia reported that the prevalence of Needle Stick Injury (NSI) was still high (Rampal et al., 2010). A study from Malaysia revealed that the prevalence of sharps injury among HCWs was 23.5% (Rampal et al., 2010) and 19.9% among medical students during their Clinical Training in Malaysia (Swe et al., 2014).

Prior to this study, a preliminary survey was conducted, including from the literature review, to gain an overview of the sharps management problems, particularly in Malaysia. A preliminary survey has revealed that until currently, there is no national guideline on how to handle sharps to avoid injury during various procedures in HCEs; and the content of the training, sharps handling practices and waste management vary among individuals and HCEs. It is crucial to have a standardized and comprehensive sharps management module that focuses on safety and health aspects to reduce the risks of sharps injury among HCWs.

The preliminary survey also shows that Malaysia has:

i. A lot of requirements and procedures to be followed in managing sharps since several businesses are concerned; therefore, many distinct procedures from various organisations are given.
ii. Significant potential health issues arising due to improper sharps management, such as Hep B, Hep C and HIV.
iii. No structured sharps management.
iv. Poor understanding of sharps regulations and standards.
v. Lack of control, supervision, and monitoring on sharps management.
vi. Low education and training on sharps management among the hospital staff.

These situations should be addressed by the occupational health, infection prevention team, service managers and national decision-makers to improve the current sharps management and practices among HCWs for the safe workplace and environment. However, making decisions on the complex problems are always complicated. Decision making is often done through the perception and judgement of individual, leading to ambiguous results of decision making. It also normally involves several factors, including items that are purely technical while others are subjective and derived from social, political, and environmental factors, and are difficult to be considered in determining the best result to solve the problems. Thus, the AHP that was introduced by Saaty in 1977 to help the decision-makers make the final decision was applied in this study. AHP is recognised as an established multi-criteria decision tool, and widely used in several fields, such as economics, environment, politics, and engineering due its powerful technique to solve complicated and unstructured problems that may have interactions and correlations among different objectives and goals (Talib et al., 2011; Damjan et al., 2016).

## 1.4 RESEARCH OBJECTIVES

### 1.4.1 General Objective:

To develop the best safety module for sharps management in healthcare establishments.

### 1.4.2 Specific Objectives:

i. To explore how sharps are managed at selected HCEs in Malaysia through qualitative study.
ii. To measure the prevalence of knowledge, attitude and practices of sharps management among HCWs in HCEs in Malaysia through quantitative study.
iii. To develop the safety module for sharps management in HCEs by using AHP.

## 1.5 RESEARCH QUESTIONS

This study was conducted to answer the following research questions:

vii. How are sharps managed in the selected HCEs?

viii. What are the problems faced by HCWs in the current sharps management?

ix. What are the elements of sharps safety module for sharps management in HCEs?

## 1.6 SIGNIFICANCE OF STUDY

Preliminary survey and literature reviews revealed the need for an improvement in sharps management strategy to reduce the occupational accident among the HCWs in Malaysia. Consequently, this study provides a development of comprehensive sharps safety training module for HCWs in Malaysia. The sharps safety training module is specifically intended to improve the practices, awareness, and attitudes of sharps management among the HCWs. These positive elements can result in the betterment of safety culture in HCEs in order to reduce the risks of sharps injury and prevent the occupational infectious diseases among HCWs at HCEs in Malaysia.

The sharps safety training module also offers the basis for the sharps management guidelines to employers who are obligated to ensure the safety, health, and welfare of the employees under the provision of section 15 of Occupational Safety and Health Act 1994 (Act 514). The employers are responsible to provide information, instructions, trainings, and supervision to reduce as far as practicable the hazards and risks related to the job tasks or activities of the workers. The development of standardized and comprehensive sharps safety training modules will help the authorities to educate and enforce the employers to adhere to the legislative requirements among HCEs.

## 1.7 SCOPE OF STUDY

This study focused on developing the best safety module for sharps management. The primary concern of this study was to reduce the occupational risks among the healthcare workers through the best module of sharps management. To achieve the objective, this study was conducted in three phases: phase 1: Qualitative Study; phase 2: Quantitative Study; and phase 3: AHP application.

Firstly, in phase 1, this study was carried out to explore the manner in which the sharps were treated at selected HCEs in Malaysia through a qualitative study. This phase was conducted at three selected HCEs in Kuantan, Pahang. The data gathering techniques included focus group discussions and in-depth interviews. The participants involved were among doctors, nurses and waste pickers who were believed to have knowledge and experience on how sharps were managed and to be able to give the best information about the subject being studied.

In phase 2, this study was carried out via questionnaires to measure the prevalence of knowledge, attitude, and practices of sharps management among HCWs in HCEs in Malaysia. This survey contributed to the identification of the problems facing HCWs in the current sharps managements. The questionnaire was distributed to the relevant respondents who had experience handling sharps directly or indirectly during their daily work routine within Peninsular Malaysia.

Then, in phase 3, AHP was applied to develop the safety module for sharps management in HCE. At this phase, the elements of sharps safety module for sharps management in HCEs was identified. Only the relevant and appropriate elements were chosen to be used in the AHP application. AHP was used in this study to estimate and rank all these factors to develop a module and guide the HCEs in sharps management.

In addition, this study is not applicable to all industries. It is only limited to healthcare industries. The study also only applicable to three groups of healthcare workers, which are doctors, nurses, and waste pickers. Furthermore, it might not be true under all circumstances.

## 1.8 CONCEPTUAL DEFINITIONS HEALTHCARE WORKERS (HCWs)

HCW are persons whose activities involve contact with patients, blood, or other body fluids from patients in healthcare, laboratory, or public safety settings.

### Healthcare Facility

Any premises in which one or more members of the public receive healthcare services (Private Healthcare Facilities and Services Act 1998).

### Medical Waste

All waste materials generated at healthcare facilities, such as hospitals, clinics, physician's offices, dental practices, blood banks, and veterinary hospitals/clinics, as well as medical research facilities and laboratories (U.S. EPA, 2013).

### Sharp Waste

Used or unused sharps (e.g., hypodermic, intravenous or other needles; auto-disable syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass) (WHO, 2014).

## 1.9 OPERATIONAL DEFINITIONS

### Healthcare Workers (HCWs)

HCWs are employees of the selected healthcare facilities who are directly or indirectly involved in sharp materials during working with diverse backgrounds but only limited to managers, doctors, nurses, and waste pickers.

**Healthcare Facility**

Three selected premises in which one or more members of the public and private receive healthcare services.

**Medical Waste**

All waste materials generated at healthcare facilities excepts the general waste.

**Sharp Waste**

All used or unused sharps (e.g., hypodermic, intravenous or other needles; auto-disable syringes; syringes with attached needles; infusion sets; scalpels; pipettes; knives; blades; broken glass) used by HCWs.

## 1.10 CONCEPTUAL FRAMEWORKS

The conceptual framework of this study is outlined in Figure 1.1. It presented the central theme, the focus, and the main thrust of the study. It served as a guide to the conduct of this research. The current study was mainly related to development of sharps safety modules. The main aim of this research was to reduce the risks of sharps among HCWs by proposing the best safety modules.

The conceptual frameworks were divided into three main parts namely, setting up the process, managing up the process and outcomes of the process. In first parts, setting up the process of safety models was designed as a basic guide on the contents on the development sharps safety modules. Thus, several risks factors of sharps injury that contribute to the magnitude of the sharps management problems were critically identified includes type of exposure, type of device used, the mechanism of exposure and the department of injury happen.