NURSES' KNOWLEDGE AND PRACTICE REGARDING PREVENTION OF SURGICAL SITE INFECTION (SSI) IN HOSPITAL UNIVERSITI SAINS MALAYSIA (USM)

NURUL EIMAN DANISYAH AKTAR APANDI

SCHOOL OF HEALTH SCIENCES
UNIVERSITI SAINS MALAYSIA

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by

NURUL EIMAN DANISYAH AKTAR APANDI

Dissertation submitted in partial fulfilment of the requirements for the Degree of Bachelor of Nursing (Honours)

June 2020

CERTIFICATE

This is to certify that the dissertation entitled "Nurses' Knowledge and Practice Regarding Prevention of Surgical Site Infection (SSI) in Hospital Universiti Sains Malaysia" is the bona fide record of research work done by Nurul Eiman Danisyah bt Aktar Apandi (Matric Number: 134147) during the period from September 2019 to June 2020 under my supervision. I have read this dissertation and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfilment for the degree of Bachelor of Nursing (Honours).

……	……
Signature of Supervisor,	Signature of Co-supervisor,
Cik Norazliah Hj Samsudin	Dr. Nur Syahmina Rasudin
Senior lecturer,	Lecturer,
School of Health Sciences	School of Health Sciences
Universiti Sains Malaysia	Universiti Sains Malaysia
16150 Kubang Kerian	16150 Kubang Kerian
Kelantan, Malaysia	Kelantan, Malaysia
Date: 17th August 2020	Date: 17th August 2020

DECLARATION

I hereby declare that this dissertation is the result of my own investigations except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

……..

NURUL EIMAN DANISYAH BINTI AKTAR APANDI (MATRIC NO: 134147)
Student of Degree of Bachelor of Nursing (Honours)
School of Health Sciences
Universiti Sains Malaysia
Health Campus
16150 Kelantan

Date: 17th August 2020

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LIST OF ABBREVIATIONS

CDC	-	Centre for Disease Control and Prevention
CHD	-	Chlorohexidine
CHG	-	Chlorohexidine Gluconate
HAI	-	Hospital Acquired Infection
HDI	-	Human Development Index
HIV	-	Human Immunodeficiency Virus
NICE	-	National Institute for Health and Clinical Excellence
SLE	-	Systemic Lupus Erythematous
SPSS	-	Statistical Package for Social Science
SSI	-	Surgical Site Infection
WHO	-	World Health Organization

PENGETAHUAN DAN AMALAN JURURAWAT BERKENAAN PENCEGAHAN JANGKITAN TEMPAT PEMBEDAHAN DI HOSPITAL UNIVERSITI SAINS MALAYSIA

ABSTRAK

Jangkitan kawasan pembedahan merupakan jangkitan yang berlaku 30 hari selepas pembedahan dan mengakibatkan banyak kesan seperti meningkatkan kadar kematian dan jangkamasa hospitalisasi serta mendatangkan masalah kewangan bagi pesakit dan sistem kesihatan. Kajian keratan rentas telah dijalankan bertujuan untuk menentukan pengetahuan dan amalan jururawat mengenai pencegahan jangkitan kawasan pembedahan di Hospital USM. Kajian ini juga melihat perbezaan mengenai pengetahuan dan amalan antara jururawat surgeri am dan ortopedik. Pearson Chi Square digunakan untuk menentukan hubungan antara pengalaman kerja klinikal dan pengetahuan dan amalan jururawat mengenai pencegahan jangkitan kawasan pembedahan. Sebanyak 66 jururawat, dengan 34 jururawat wad surgeri am dan 32 jururawat dari wad ortopedik telah direkrut melalui persampelan mengikut kadar. Pengumpulan data telah dijalankan dari Januari 2020 hingga Mac 2020 menggunakan borang soal selidik dan dialisa menggunakan SPSS versi 26.0 untuk Window. Kelulusan etika telah diperolehi daripada Jawatankuasa Etika Penyelidikan Manusia USM (JEPeM). Purata umur bagi peserta ialah 31 tahun. Hasil kajian mendapati jururawat mempunyai tahap pengetahuan yang lemah (M=16.18, SD= 2.745) terhadap pencegahan jangkitan kawasan pembedahan. Manakala bagi tahap amalan, jururawat didapati mempunyai amalan yang bagus (M=67.82, SD=6.44) terhadap pencegahan kawasan pembedahan. Tiada perbezaan yang signifikan mengenai pengetahuan di antara jururawat surgeri am dan ortopedik (p=0.467). Manakala, terdapat perbezaan yang signifikan mengenai amalan di antara jururawat surgeri am dan ortopedik (p=0.013). Tiada perkaitan yang signifikan ditemui antara pengetahuan (p=0.834) dan amalan (p=0.197) dengan pengalaman kerja klinikal. Oleh

itu, jururawat memerlukan lebih banyak pendedahan agar mereka dapat mengenal pasti, menilai dan mengamalkan amalan yang betul. Kesimpulannya, pengetahuan dan amalan dalam pencegahan jangkitan kawasan pembedahan adalah penting dapat dilihat kerana jururawat di Hospital USM mempunyai pengetahuan yang tidak mencukupi. Bengkel atau latihan kursus perlu dilaksanakan untuk meningkatkan pengetahuan mereka.

NURSES' KNOWLEDGE AND PRACTICE REGARDING PREVENTION OF SURGICAL SITE INFECTION (SSI) IN HOSPITAL UNIVERSITI SAINS MALAYSIA (USM)

ABSTRACT

Surgical site infection is an infection that occur 30 days after surgery and cause many effects such as increasing risk of death, increasing hospital stay and financial constraints for patient and health care system. A cross sectional study has been conducted to determine nurses' knowledge and practice regarding prevention of SSI in Hospital USM. This study also examined the difference of knowledge and practice between general surgery and orthopaedic nurses. Pearson Chi-square was used to determine the association between clinical working experience with knowledge and practice towards prevention of SSI. A total of 66 nurses, 34 nurses were from surgical and 32 nurses from orthopaedic wards were recruited through proportional sampling. Data were collected September 2019 until June 2020 using self-administered questionnaires and analysed using SPSS version 26.0 for Window. Ethical approval was obtained from Human Research Ethics Committee (HREC), Universiti Sains Malaysia. The mean age of the participants was 31 years old. The results revealed staff nurses were having poor knowledge level (M=16.18, SD= 2.745) regarding prevention of SSI. Meanwhile for level of practice, nurses were found to be having good practice towards prevention of SSI (M=67.82, SD=6.44). There was no significant difference in knowledge between general surgery and orthopaedic nurses (p=0.467). While, there was significant difference in practice between general surgery and orthopaedic nurses (p=0.013). There was no association to be found between clinical working experience with knowledge (p=0.834) and practice (p=0.197) regarding prevention of SSI. It showed that nurses need more

exposure towards SSI and its prevention for them to identify, assess and implementing the correct practice. As a conclusion, it is shown that knowledge and practice towards SSI is important as the results shows that nurses in Hospital USM had insufficient knowledge. A workshop or course training should be implemented to enhance their knowledge.

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Worldwide, hospital acquired infection (HAI) constitutes a major public health problem striking on millions of people every year (Teshager, Engeda, & Worku, 2015). The Centers for Disease Control (CDC) estimated in 2002 that 1.7 million hospital acquired infection (HAI) occur annually and about 1 in 20 hospitalized patients will develop an HAI, in which, 99,000 will result in deaths (Klevens, et al., 2007). Most literatures indicate that surgical site infections (SSI) were the most common hospital acquired infections (HAI) accounting for more than 30% of cases of HAI (Fasalu, & Rajkumar, 2019).

SSI has been defined in numerous ways as the clinical manifestation of SSI is varied. The infection which penetrate into difference depths of tissues may cause diverse consequences ranging from simple superficial skin infection to severe life-threatening sepsis (Korol, et al., 2013). Thus, to standardise its definition, SSI is classified by CDC into three categories: superficial incisional, deep incisional and organ/space based on the depth of tissues involved (Tan, Shiang, Wong, Azmah & Anil, 2019). The most widely used and accepted definition is the 1992 reclassification and definition by United States of America Centre for Disease Control and Prevention (CDC) in which SSI is defined as "an infection that occurs after surgery in the parts of the body where the surgery took place in between 30 days of an operative procedure or within one year if an implant is being left in place" (Goyal, Sandhu, Kumar, Kosey, & Mehra, 2015). SSI has been

highlighted as one of the most frequent complications of surgical interventions (Olowo-Okere, Ibrahim, Sani, & Olayinka, 2018).

Incidences of SSI varied from hospital to hospital in different countries. According to research published in the Lancet Infectious Diseases in 2018, countries ranking lower on the United Nations Human Development Index (HDI) carry a disproportionately higher burden of SSI where the occurrence of SSI is 9.4% in high-HDI countries, 14.0% in middle-HDI countries, and 23.2% in low-HDI countries (Harrison, 2018). In low and middle-income countries, lack of published had been reported towards SSI risk factors, microbial pathogens and their antibiotic profile have negatively impacted the prevention and management of this infection (Mukagendaneza, et al., 2019). Meanwhile in Malaysia, World Health Organization (WHO) informed that the prevalence of HAI in Malaysia was 14% from 1995 to 2010 where the common type of infection is SSI.

There are various patient-related and process related factors which able to affect patients risk in developing SSI. Throughout the literature, SSI were associated with intrinsic factors such as advanced age, malnutrition, any occurrence of metabolic diseases, tobacco usage, obese people, and individual with immune suppression (Patil, Raval, & Chavan, 2018). Meanwhile, the extrinsic factors which are the most frequently reported risk factors include the pre-operative skin preparation, application of skin antiseptics, inadequate sterilization of instruments and surgical drains, improper surgical hand scrubs and dressing techniques (Teshager, Engeda, & Worku, 2015).

SSI is a preventable surgical complication as most of SSI incidence can be prevented if the care toward SSI has been applied properly. Recently, in 2016 WHO published a global guideline on prevention and SSI. In general, it takes a multi-disciplinary approach to reduce SSI. As frontline caregivers, nurses are the most righteous person to help

surgical patients in avoiding SSI, this can be carry through pre and intraoperative implementation of surgical safety checklists, adequate post-operative wound care and thorough discharge planning (Lübbeke, et al., 2013). However, despite some studies in the developed country are available and easily accessible, evidences regarding level of knowledge and practise towards prevention of SSI are still limited in Malaysia. Therefore, the study aimed to assess nurses' level of knowledge and practice regarding prevention of surgical site infection in Hospital USM, northeast Malaysia.

1.2 Problem Statement

SSI had been implicated in one-third of postoperative deaths and patients with SSI have a 2-11 times higher risk of death compared with post-operative patients without an SSI (Collaborative, 2017; Spagnolo, Ottria, Amicizia, Perdelli, & Cristina 2013). The mortality rate of SSI is presented as 3% with almost three quarters of SSI-associated deaths are directly caused by SSI (Awad, 2012). Based on the study established in 2002 to estimate HAI and deaths in U.S. Hospitals, the estimated total HAI among adults and children outside of intensive care unit (ICU) were 1,195,142 cases. SSI recorded 244,385 cases while there were 424,600 cases of urinary tract infections, 133,368 cases of bloodstream infections, 129,519 cases of pneumonias and 263,810 were attributable for other infections (Figure 1.1). The estimated death associated with SSI from the total is 8205 deaths (Klevens, et al., 2007). The incidence and mortality rate of SSI varied according to the surgical procedure in which organ-space and deep incisional SSI were associated with a higher mortality and required re-operation more frequently than did superficial incisional SSI (Astagneau, Rioux, Golliot, & Brücker, 2001).

SSI is the most costly type of HAI. SSI caused financial constraints for both patients and health care system (Figure 1.2 & Figure 1.3). The financial burden is increased due

to the direct costs occurred by prolonged hospitalization of the patient (Laloto, Gemeda, & Abdella, 2017). Patient with SSI is expected to extend the length of stay until 9.7 extra days compared to non-SSI patient (Sickder, 2010). SSI negatively impact patient as they loss of earnings during hospitalization and recovery (Badia, et al., 2017). Based on the study by Schmier et al., (2016) SSI would cost on average $20,785 per patient and certain patients may also require re-operation after the occurrence of SSI which is associated with additional costs. Badia et al. (2017) once published that in European hospitals patients who develop an SSI constitute a financial burden approximately double that of patients who do not develop an SSI.

Besides, the development of SSI not only affecting patient but also caused a substantial increase in the clinical and economic burden of surgery. According to Schmier et al., (2016), in United States, the estimated annual cost is $3.3 billion with association of nearly 1 million additional inpatient-days annually (Figure 1.4). The increasing cost of healthcare is attributable to re-operation, extra nursing care and interventions, and drug treatment costs in the occurrence of SSI (Fadnis, Desai, Kagal, & Bharadwaj, 2014).

In addition, SSI negatively impact on patient quality of life (Whitehouse, Friedman, Kirkland, Richardson, & Sexton, 2002). Patient admit of being in pain and discomfort, having a misery feeling, experienced emotional distress and possible deformity (Sickder, 2010). Besides, patients were also more likely to spend more than more days in bed and most likely to miss their regular activities which might cause impairment of and mental health (Perencevich et al, 2003). Furthermore, SSI might put patients at greater risk of secondary infectious complications which attributable to affect patient's quality of life. (Mukagendaneza, et al., 2019)

Based on the journal of infection control and Hospital Epidemiology, SSI is estimated to be preventable up to 60% by using evidence-based guidelines published. Multi-disciplinary teams are involved in the prevention process including physicians, nurses, and hospital to yield ideal results in the process of HAI prevention. Nurses' role in preventing SSI is comprehensive and crucial in executing the implementation of evidence-based practise. However, previous study showed that registered nurses knowledge level regarding evidence based guidelines for the prevention of SSI was low based on their median score and this low level of knowledge could be a potential risk factor for patient's safety (Qasem & Hweidi, 2017). Another research findings investigated nurses' knowledge regarding SSIs prevention which describe the overall knowledge scores as inadequate and their results attributed primarily due to lack of exposure to special training courses regarding to preoperative and postoperative nursing interventions in order to prevent SSI (Teshager, Engeda, and Worku, 2015). A study by Zucco et al., (2019) showed an interesting result where 97.8% of the nurses reported an interest in more education to improve their knowledge about SSI prevention.

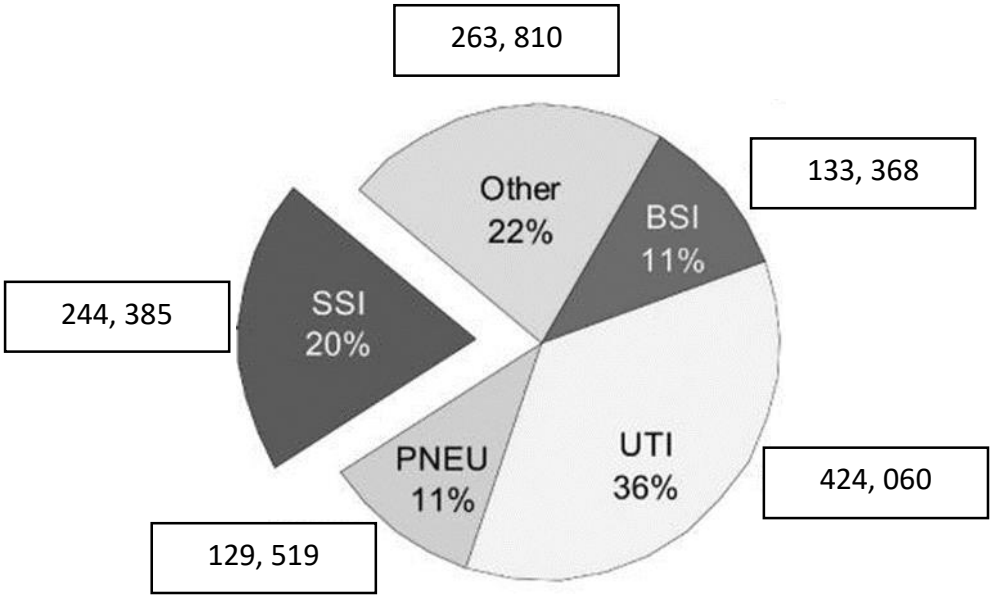

Figure 1. 1 Estimation of health care-associated infections in U.S. Hospitals among adults and children outside of intensive care units, 2002 (Adaptation from Klevens et al., 2007)

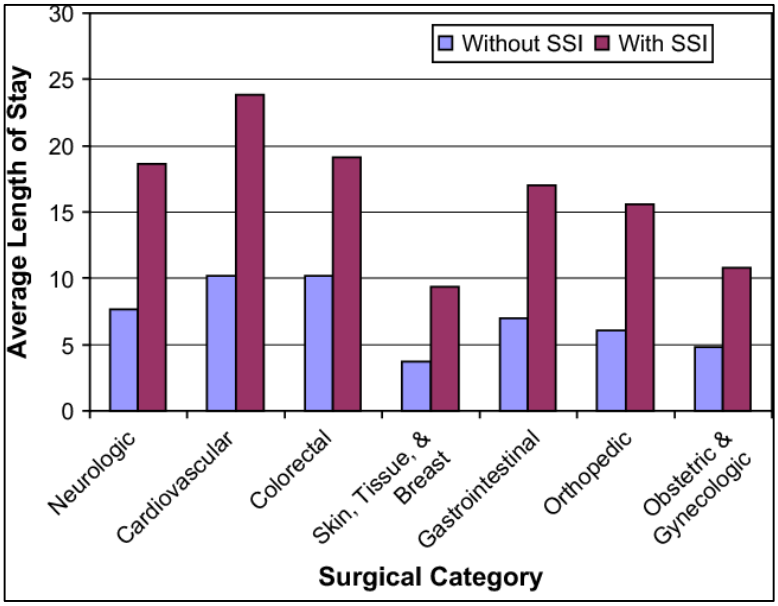

Figure 1. 2 Impact of surgical site infections on length of stay (Source: Lissovoy et. al, 2009)

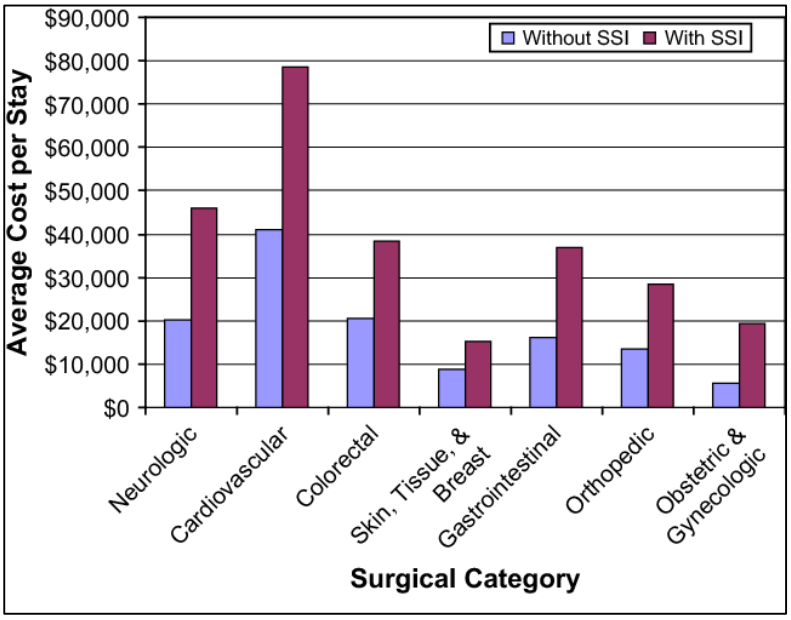

Figure 1. 3: Impact of surgical site infections on cost of hospital stay (Source: Lissovoy et. al, 2009)

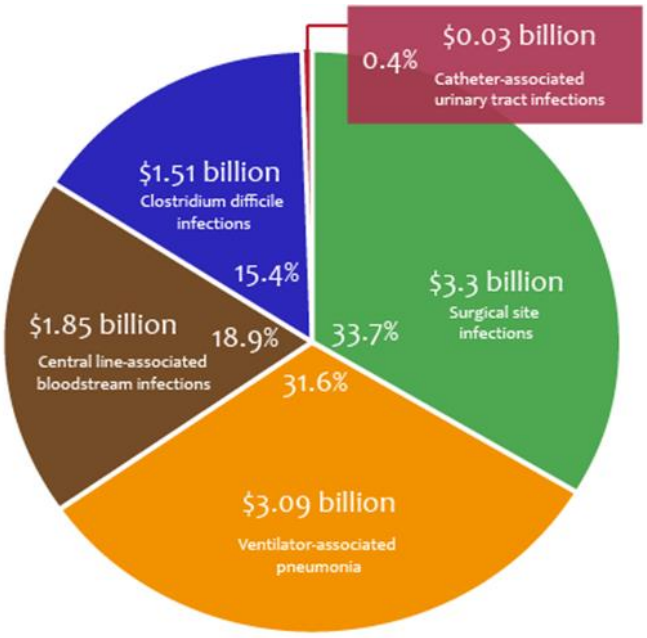

Figure 1. 4 Estimation of cost for each of the five major hospital-acquired infections (HAIs) in the US (Adaptation from Zimlichman et. al, 2013)

1.3 Research Questions

Guiding the research study and to inform the research, the following research questions were formulated:

i. What is the level of knowledge and practice regarding the prevention of SSI among nurses in Hospital USM?

ii. Is there any difference of knowledge and practice regarding prevention of SSI between general surgery and orthopaedic nurses in Hospital USM?

iii. Is there any association between clinical working experience with knowledge and practice regarding prevention of SSI among nurses in Hospital USM?

1.4 Research Objectives

1.4.1 General Objectives

The aim of this study was to determine knowledge and practice regarding the prevention of surgical site infection among general surgery and orthopaedic nurses in Hospital USM.

1.4.2 Specific Objectives

i. To determine level of knowledge and practice regarding the prevention of surgical site infection among nurses in Hospital USM.

ii. To determine the difference of knowledge and practice regarding the prevention of surgical site infection among general surgery and orthopaedic nurses in Hospital USM.

iii. To determine the association between clinical working experience with knowledge and practice regarding the prevention of surgical site infection among nurses in Hospital USM.

1.5 Research Hypothesis

The research hypotheses for this study was presented as follow:

H01: There is no significant difference between general surgery and orthopaedic nurses' knowledge and practice regarding the prevention of SSI in Hospital USM.

Ha1: There is a significant difference between general surgery and orthopaedic nurses' knowledge and practice regarding the prevention of SSI in Hospital USM.

H02: There is no significant association between clinical working experience with knowledge and practice regarding the prevention of SSI among nurses in Hospital USM.

Ha2: There is a significant association between clinical working experience with knowledge and practice regarding the prevention of SSI among nurses in Hospital USM.

1.6 Conceptual and Operational Definitions

Table 1. 1 Definitions for the operational terms

Terms	Conceptual	Operational
Knowledge	Information that is organized, summarized and synthesized to increase the comprehension, understanding or awareness (Bergeron, 2003)	In this study, knowledge refer to cognition of nurses regarding the prevention of surgical site infection as elicited using multiple choice questions by choosing one best answer.
Practice	Practice being simply and solely means the protection of the public against the serious dangers that may ensue from incompetence and engaging responsibility in the work of attempting to restore the health to others, repairing their bodily injuries and correcting their bodily deformities, congenital or acquired (Journal of the American Medical Association, 2008)	In this study, practice refers to the level of nurses' perception of their action in preventing surgical site infection. The practice were measured using four point Likert scale, (0) not practicing, (1) seldom practicing, (2) sometimes practicing and (3) always practicing which is adapted from Sickder (2010.)
Surgical Site Infection (SSI)	A surgical site infection is an infection that occurs after surgery in the part of the body where the surgery took place. Surgical site infections can sometimes be superficial infections involving the skin only. Other surgical site infections are more serious and can involve tissues under the skin, organs, or implanted material (CDC, 2010).	In this study, surgical site infections (SSIs) are defined as infections occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site (Spagnolo, Ottria, Amicizia, Perdelli, & Cristina, 2013).

1.7 Significance of the Study

The findings of this study aims to contribute to nursing in its practice, education and research to further the nursing profession as follow:

i. For nursing practice, the research findings able to develop and organize training programs to enhance nurses' knowledge and practice regarding the prevention of SSI.

ii. For nursing education, the research findings serve the information in guiding the development of the nursing curriculum and thorough training courses regarding the prevention of SSI.

iii. For nursing research, the research findings can be used as baseline reference for future experimental research, such as the efficacy of the educational program in producing competence nurses regarding the knowledge and practice regarding the prevention of SSI.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A literature review is a comprehensive summary of the previous research on a topic. The literature review survey scholarly articles, books, and other sources relevant to a particular area of a research. The main objective of literature review is to include the current research within the scientific perspective. In this review, it should describe, summarize, objectively evaluate and clarify the previous research. The theoretical base also should be included as it help to determine the nature of research.

This chapter is going to review the literature related to knowledge of practice in prevention of SSI. It also presents information on nurses' knowledge and practice based on previous study. Lastly, it describes the theoretical framework chosen for this study. Bloom's Taxonomy Model guiding this study.

2.2 Review of Literature

2.2.1 Definition of SSI

Surgical site infection refers to an infection which is related to the surgery and it appears within 30 days after an operation or within one year if an implant was placed (Lubega, Joel, & Justina, 2017). In particular, SSI is presented at skin area but it can involve tissue under the skin, organ or implanted materials once the infection becomes crucial (Spagnolo, Ottria, Amicizia, Perdelli, & Cristina, 2013). Based on the classification ruled by CDC, there are 3 types of SSI which include superficial incisional SSI, deep incisional SSI and organ or space SSI. These infections varies according to the area involve. Most of the SSI cases present within the first 30 days following a procedure

and it commonly occur between the fifth and tenth postoperative day (Norman, et al., 2017). Several studies have identified the main patient-related (endogenous) and procedure-related (external) factors that influence the risk of SSI (Owens, & Stoessel, 2008).

2.2.2 Etiology of SSI

Based on National Institute for Health and Clinical Excellence (NICE) guidelines released in 2008, the occurrence of SSI depends on the contamination at the wound site and it relates specifically to the pathogenicity of the microorganism present to against the host's immune response. The manifestation of SSI is by endogenous or exogenous sources. The patient's skin flora which is *Staphylococcus aureus* being named as the usual cause of infection and it caused approximately 20% to 30% of SSI (Wenzel, 2010). This is because, when the mucous membranes or skin is incised, the exposed tissues are at risk of contamination by endogenous flora (Sickder, 2010). The pathogens that involved in the occurrence of SSI were *Staphylococcus aureus* (28.2%), *Pseudomonas aeruginosa* (25.2%), *Escherichia coli* (7.8%), *Staphylococcus epidermidis* (7.1%), and *Enterococcus faecalis* (5.6%) (Spagnolo, Ottria, Amicizia, Perdelli, & Cristina, 2013). Meanwhile, the pathogenic microorganisms which are acquired from an exogenous sources includes the operating theatre environment, surgical personnel and instruments brought to the sterile field during an operation (Wenzel, 2010).

2.2.3 Clinical features of SSI

Clinical features for SSI can exist in local or systemic symptoms including pain, edema, erythema and increase of temperature (Sickder, 2010). Meanwhile, the features that may appear on the surgical wounds are the formation of abscess, purulent drainage from the wound site, friable bleeding of the granulation tissue and delayed wound healing

(Horan et al., 2008). Besides, there are also signs of infection that indicated to obtain a culture and these include: (1) excessive drainage from the wound, (2) changes of colour at the wound area, (3) change in odor and exudates character, (4) any presence of friable granulation tissue, (5) sudden raise of blood glucose in diabetic patient, (6) pain at the surgical wound area, (7) appearance of sign and symptoms of systemic infection (8) delayed wound healing and (9) increased body temperature (Horan et al., 2008)

2.2.4 Classification of SSI

In classifying SSI, CDC defined it depending on the depth of infection penetrated into the wound. It was separated into three types include superficial incisional, deep incisional and organ/space SSI. To be classified as SSI, the infection occurs must be up to 30 days after surgery however if patients are receiving implants it can be up to one year after surgery (Owens, & Stoessel, 2008).

Superficial Incisional SSI. Superficial Incisional SSI occurs within 30 days after the operation. This types of infection involves only skin or subcutaneous tissue that is being incised with the following reference (1) purulent drainage from the superficial incision, (2) the organisms are isolated from an aseptically obtained culture from the superficial incision, (3) at least one of these following signs or symptoms of infection present: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative, (4) diagnosis of superficial incisional SSI by the surgeon or physician.

Deep Incisional SSI. Deep incisional SSI is an infection occurs within 30 days after operation if no implant is left in place or within 1 year if implant is in place. Besides, the infection appears must be related to the operation. It involves deep soft tissues (e.g., fascial and muscle layers) of the incision with at least one of the following manifestation:

(1) purulent drainage from the deep incision but not from the organ/space component of the surgical site, (2) a deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever, localized pain, or tenderness, unless site is culture-negative, (3) an abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathology or radiologic examination, (4) diagnosis of a deep incisional SSI by a surgeon or physician.

Organ/Space SSI. Organ/Space SSI occurs within 30 days after the operation if no implant is left in place or within 1 year if implant is in place and the infection appears to be related to the operation. The infection also must involve any part of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during an operation and at least one of the following criteria happening: (1) purulent drainage from a drain that is placed through a stab wound into the organ/space, (2) organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space, (3) an abscess or other evidence of infection involving the organ/space that is found during examination or reoperation, (4) diagnosis of an organ/space SSI by a surgeon or physician.

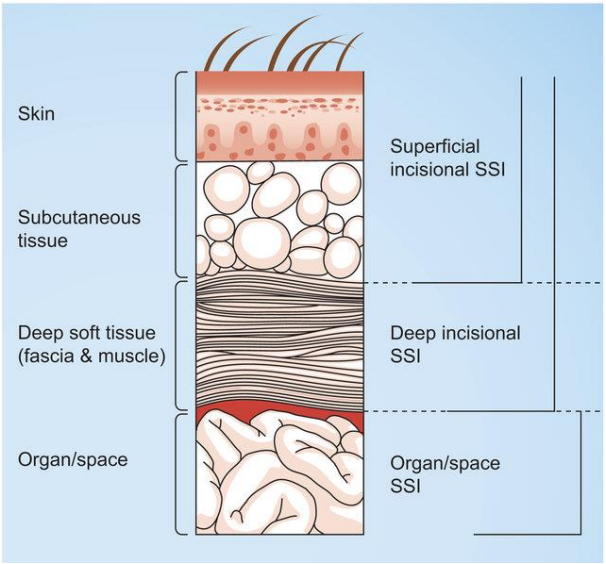

Figure 2. 1 Classification of surgical site infections according to CDC National Nosocomial Surveillance System SSI: Surgical site infection)

2.2.5 Risk Factor of SSI

There are various factors that have the susceptibility to infect any surgical wound, which then classified into intrinsic and extrinsic factor. The combined effects of the intrinsic and extrinsic risk factors have high chances in predisposing patients to SSI (Jasim, et al., 2017).

Intrinsic factors. There are several intrinsic factors that have been identified in the literature. Jasim et al., (2017) published that the intrinsic factors are most likely patient related as compared to extrinsic factor where it is management and care based and even intrinsic factors cannot be changed, the risk they present in terms of infection is identifiable and manageable. The intrinsic factors include underlying medical condition, obesity, age, cigarette smoking, and prolonged hospitalisation.

1. Underlying medical condition- Patient with medical underlying condition are also at risk for the occurrence of SSI. Underlying conditions such as diabetes mellitus, peripheral vascular disease, human immunodeficiency virus (HIV), cancer, and malnourish might contribute to SSI (Sickder, 2010). In general, infectious diseases are more frequent or serious in patients with diabetes mellitus than the non-diabetic population due to homeostasis imbalance (Casqueiro, Casqueiro, & Alves, 2012). High level of sugar in body may causes damage to capillaries, arterioles and venules of subcutaneous tissue which lead to reduce wound healing (Lobley, 2012). On the other side, diabetic may cause impairment in wound healing because of less collagen being produced thus it impact the cell's ability to cross link, and it also cause

deficiency in fibro-blast functions due to tissue ischemia (Dellenbaugh, Dipreta, & Uhl, 2011).

2. Obesity- Obese patient are the another group which are at significant risk in developing SSI. A literature review by Noobs and Crozier (2011) highlighted that in obese people, their adipose tissue is not vascularised well and this might contribute to be poorly oxygenated. On the site note, oxidative killing by neutrophils is the primary defence against surgical pathogens and the risk of infection is inversely related to tissue oxygen partial pressure (Kabon, et.al, 2004). Obesity has become one of the major risk factor for surgical site infection and contributes to a high morbidity and mortality in the obese population (Alexander, Rahn, & Goodman, 2009).

3. Age- Another intrinsic factor that increase the risk for infection to occur is old age. As people ages, immune system ability to respond to infection is reduced and this might cause the elderly prone to develop wound infection (Lobley, 2012). Guo & Dipietro (2010) suggested that in aging people, the subcutaneous tissue are reduced, less capillaries are present and cell proliferation decreases causes delay in wound healing.

4. Cigarette smoking- Cigarette smoking has been associated with delaying of wound healing. Based on the literature by McDaniel and Browning (2014), cigarette smoking disrupts the wound healing by causing tissue hypoxia in which actually normal tissue oxygen pressures are necessary for the entire reparative process. Most frequently studied revealed that the content of cigarette, nicotine has been a part of relation to tissue hypoxia. Nicotine is harmful to skin and subcutaneous tissue because it stimulates the sympathetic nervous system to release catecholamine, which then trigger peripheral vasoconstriction and diminish tissue perfusion rates (Mc Daniel, &

Browning, 2014). Besides, wound healing also negatively affect by carbon monoxide and hydrogen cyanide, where both leads to tissue hypoxia as they bind to the haemoglobin and reduce the oxygen content in the blood. As a result of a shift to the left in the oxygen dissociation curve, oxygenated haemoglobin in the bloodstream is reduced resulting in impaired tissue profusion and cellular hypoxia (Nolan, Jenkins, Kurihara, & Schultz, 1985).

5. Prolonged hospitalisation- Prolonged hospitalization has been associated with increasing the SSI risk is due to patient can become colonized with resistant bacteria during the hospital staying (Sickder, 2010). In a cross-sectional analytic study where 268 patients were being studied to assess the incidence and risk factor of SSI and the results were that pre-operative hospitalisation for over 10 days have high risk to develop SSI (Guo, & Dipietro, 2010).

Extrinsic factor. Extrinsic factors are the sources of infection which those are from environmental and sits management that may cause SSI. These includes staff, hospital environment and sterilization of instruments.

1. Staff factors- It is estimated that 20-40% of HAI has been attributed to cross infection through the direct or indirect contact with the healthcare personnel (Weber, Rutala, Miller, Huslage, & Sickbert-Bennett, 2010). Hands are the easiest transmission of microbes as they are colonized by two categories of microbionta which are resident flora and transient flora. Resident flora are found on the skin surface such as *Stapylococcus epidermidis*, ,meanwhile transient flora are composed of microorganisms acquired by contact with contaminated surfaces such as the environment, patients or other people. It is easily transferred to the next patient or environment touched. These include antimicrobial-resistant pathogens such as

MRSA, *Acinetobacter* or other multi-resistant Gram-negative bacteria, and viruses such as Norovirus. All of these micorbes have a high susceptibility to being transferred to patient if hand hygiene was not oerform well by the healthcare personal when in contact with patient (Thomas, 2019).

2. Hospital environment- There are various studies that strongly suggest contamination from the environment and more likely from the hospital might cause the transmission of organisms. This is due to hospital environment has become a source of infection such as MRSA, VRE, *C. difficile* and resistant Gram-negative bacteria such as Acinetobacter spp (Weber, Rutala, Miller, Huslage, & Sickbert-Bennett, 2010). The environment of the operating theatre also has the impact on the risk of SSI (Thomas, 2019).

3. Sterilization of instruments-Sterilization of instruments had become one of the crucial part of aseptic technique and it must be performed with validated method by using appropriate quality control which includes boiling point and instruments storage (Sickder, 2010). Based on Sickder (2010) sterile glove will minimize the transmission of microbes towards patient and prevent the contamination of team members with blood or any discharge of the infected patients.

2.2.6 Prevention of SSI

The general health being of surgical patients play an important role in the risk for developing SSI and although some risk cannot be modified, some of it can still be controlled, minimized and managed by the health care personnel (Sickder, 2010). Based on Sickder (2010) nurses are the most right person in providing the evidence-based practice to prevent the infection of SSI. In 2018, WHO released a new edition of global guidelines for SSI prevention and they include more recommendations in the pre-, intra

and postoperative periods to prevent SSI. A recommended as WHO, the preventative strategies are as follow.

Preoperative preventative strategies of SSI

1. Hygiene and skin preparation

The preoperative phase is an important period in which to prevent surgical site infections (Purba, Setiawan, Bathoorn, Postma, Dik, & Friedrich, 2018). As a practice of hygiene, preoperative whole-body bathing or showering has been recommended in clinical practice to make the skin as clean as possible and at the same time reducing the bacterial load at the site of infection (WHO, 2018). Guidelines developmental group suggests that plain or anti-microbial soap can be used for this purpose. The preoperative showering is usually done with an antimicrobial soap in which chlorhexidine gluconate (CHG) 4% is combined with detergent or in a triclosan preparation as it is more affordable and easily accessible (Derde, Dautzenberg, & Bonten, 2012). Meanwhile, for surgical site skin preparation in patients undergoing surgical procedures, WHO released a guideline where strong recommendations have been given in using alcohol based antiseptic solution in particular those based on chlorhexidine gluconate (CHG). According to systematic review by Hemani and Lepor (2009), alcohol-based solutions that contain CHG have sustained and durable antimicrobial activity that lasts long after alcohol evaporation. In addition to that, these solution are efficacious as it is quick, sustained, and durable with broader spectrum antimicrobial activity. This statement also has been in line with the Health Technology Assessment Report by Ministry of Health Malaysia, where 2 % CHG in 70% alcohol is potentially superior to 4% chlorhexidine and povidone iodine solution and may be the antiseptic of choice for skin preparation prior to surgery. Using a 2% chlorhexidine solution has been found to be effective in reducing microbial skin

bacteria without causing irritation at the site of use (Edmiston et al., 2008). For removal of hair from the intended site of surgical incision has traditionally been part of the routine preoperative preparation of patients undergoing surgery and the hair itself has been associated with a lack of cleanliness and the potential to cause SSI (WHO SSI Prevention Guidelines, 2018). However, according to NICE Quality Standard, preoperative shaving of areas is no longer recommended as it increases SSI (Thomas, 2019). A literature review by Maqbali (2016) reveals that postoperative infection developed in four patients in the shaved group and in one patient in the non-shaved group. Thus, if any hair removal is necessary, remove hair outside the operating room using clippers or a depilatory agent (Sickder, 2010).

2. Controlling underlying medical condition

Patient's host defence mechanism is usually challenged by surgical procedure. Several types of immune system malfunction may also cause patient vulnerable during surgical procedure. Immunosuppression can arise in patients with condition such as systemic lupus erythematous (SLE), leukaemia, lymphoma and human immunodeficiency virus (HIV). Based on Zhang et. al (2012) HIV-infected patients are increased in possibility of developing SSI after surgery however a suitable perioperative management can decrease the SSI incidence rate of HIV-infected patients. Thus, the nurses must be equipped with knowledge of immune system in order to carry out a comprehensive nursing care during pre and post-operative period. Based on Desai and Kuo (2005), the preventative strategies that can be carried out are to ensure patient is being treated with immunoglobulin intravenously, practising good personal hygiene, eating well-cooked food, drinking safe water, avoiding contact form infectious patient and also to maintain the thermoregulation.

3. Maintaining nutritional status

Maintaining nutritional status during pre-operative period is very important as it has significant impact towards surgical outcomes. This is due to ignoring nutritional status may compromise the patient's ability to heal and subsequently prolong the stages of wound healing (Rusell, 2001). The major nutritional problem during the pre-operative period are under nutrition or over nutrition (Sickder, 2010). Based on Ahmed & Haboubi (2010) older people often have reduced appetite and energy expenditure, which, coupled with a decline in biological and physiological functions such as reduced lean body mass, changes in cytokine and hormonal level, and changes in fluid electrolyte regulation, delay gastric emptying and diminish senses of smell and taste. Micronutrient deficiencies are often common in elderly people especially protein. Thus, it is important to give an appropriate diet with carbohydrates, protein, vitamins, fat and minerals to prevent SSI (Sickder, 2010). Besides, obese patients are also at higher risk for SSI due to excess fat in body which may cause complications (Guo & Dipietro, 2010). There is no quick way for an obese patient to lose weight before surgery, thus dietary consideration is vital in preparing adequate nutrition. The pre-operative diet should contain less carbohydrates but rich in protein, minerals, vitamin and fluids (Sickder, 2010).

4. Prophylactic antibiotic

For the past 20 years, the efficacy of antibiotic prophylaxis in surgery has been well established and the guiding principle is the belief that antibiotics in the host tissues can augment natural immune defence mechanisms and help to kill bacteria that are inoculated into the wound (Borade, & Syed, 2017). The prophylaxis antibiotic is given to patient before; clean surgery (involving the placement of prosthesis or implant), clean-contaminated surgery, and contaminated surgery. Based on NICE guidelines, the timing and pharmacokinetics must be taken into account before

prescribing antibiotic prophylaxis, for example the serum half-life and necessary infusion time of the antibiotic. Also, a repeat dose of antibiotic prophylaxis should be given when the operation is longer than the half-life of the antibiotic. However, the timing for the antibiotic administration is considered to be crucial for an effective antibiotic prophylaxis. Based on the recommendations from previous study, prophylactic antibiotics can be administered within 30 minutes prior to incision and have a desired safety from surgical site infection (Borade, & Syed, 2017).

Post-Operative Measure in Preventing SSI

1. Wound Dressing

   The main purposes of a surgical dressing when used are to cover a wound are to control any postoperative bleeding, absorb exudate if anticipated, ease pain and provide protection for newly formed tissue (Dumville, et., al, 2016). Appropriate dressing materials must be selected according to the wound condition such as wound size, depth of wound, presence of slough or infection (Sickder, 2010). Based on NICE clinical guideline of SSI Prevention, all dressing materials used should ensure that the wound remains; (1) moist with exudate but does not get macerated, (2) free from clinical infection and excessive slough or devitalised/necrotic tissue, (3) free from toxic chemicals, particles or fibres released from the dressing, (4) at an optimum temperature for healing to take place, (5) undisturbed by frequent or unnecessary dressing changes and (6) at an optimum pH value.

2. Wound assessment and monitoring of SSI

   Patient with wound must be considered into an accurate and detailed wound assessment in preventing SSI (Sickder, 2010). Assessment of the wound is vitally important as the guideline to provide the most appropriate intervention to improve patient outcomes and reducing the cost of care (Brennan, 2019). Generally, the