# Nurses' Knowledge and Practice Regarding Prevention of Surgical Site Infection in Bangladesh

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## ABSTRACT

This descriptive, correlational study was to identify the nurses' knowledge and practice at Shere-E-Bangla Medical College Hospital (SBMCH) and examine the relationship between them. One hundred and twenty surgical nurses participated in the study (96% response rate). The instrument used for data collection was a questionnaire which is composed of three parts: Demographic characteristics, Nurses' knowledge questionnaire, and Nurses' practice questionnaire. The latter two questionnaires were tested for content validity from 3 experts in surgical field and were translated into Bangla language using back translation technique. The Cronbach's alpha coefficients determining internal consistency reliability of Knowledge Questionnaire and Practice Questionnaire were .85 and .87, respectively. The data were analyzed by using descriptive statistics and Pearson product-moment correlation.

The results revealed that the nurses had low level of knowledge (M = 69.67%, SD = 8.53) and high level of practice (M = 89.95%, SD = 4.06). There was a weak, significantly negative correlation between knowledge and practice regarding prevention of SSI (r = -.18, $p$ = .04). Some areas of their knowledge were at a very

low level including: identifying best method for pre-operative shaving, recognizing best time for pre-operative hair removal, understanding prevention of infection for patients with immunodeficiency disorder, and recognizing best agent for pre-operative shaving. Some areas of practices were less practiced including: assessing patient's body mass index to monitor nutritional status and advising patients to shower before surgery with antimicrobial agents. These findings suggest that nurses' knowledge and some certain areas of practice regarding prevention of SSI need further improvement.

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# CHAPTER 1

# INTRODUCTION

## *Background and Significance of the Problem*

Surgical Site Infection (SSI) refers to an infection that occurs after operation within 30 days if no implant or within one year if implant (Mangram, Horan, Pearson, Silver, & Jarvis, 1999). SSI is one type of nosocomial infection in which a surgical infection occurs after invasive procedures (Luksamijarulkul, Parikumsil, Varaporn & Konkeaw, 2006). According to the National Nosocomial Infection Surveillance (NNIS) system and the Centers for Disease Control and Prevention (CDC), SSI accounted for 14% to 16% of all nosocomial infections and was the most common health care associated infections among surgical patients in the United States (USA) (Mangram et al.).

Incidence of SSIs may vary from hospital to hospital in different countries. Developed countries, such as the USA, the United Kingdom (UK), and Sweden have the lower incidence of SSIs ranging from 2% to 6.4% (Anderson, Kaye, Classen, Arias, & Podgorny, 2008; Gunningberg, Persson, Akerfeldt, Strdsberg, & Swenne, 2008; Taylor et al., 2004). In developing countries, such as India, Pakistan, Nepal, Turkey, and Iran, the incidence of SSIs is higher ranging from 5.5% to 25% (Desa, Sathe, & Bapat, 2008; Giri, Pant, Shankar, Sreeramareddy, & Sen, 2008; Lohsiriwat, & Lohsiriwat, 2009; Mustafa, Bukhari, Kakru, Tabish, & Qadri, 2004; Razavic, Ibrahimpoor, Kashani, & Jafarian, 2005).

In Bangladesh, a study principally conducted with surgical patients showed that the prevalence of postoperative wound infection in medical college hospitals in

Bangladesh ranged from 6% to 18% (Hadi, 1991). A retrospective study conducted in Shere-E- Bangla Medical College Hospital (SBMCH) showed that the incidence of SSI was 28.49% (Parvin, Mondol, & Gegum, 2002). In addition, another retrospective study conducted in Comilla Medical College Hospital found that the incidence of SSI was 22.05% (Islam, Akhter, & Sickder, 2007). A prospective study conducted in two medical college hospitals found that overall SSI incidence was 11% (Saha & Ashrafuzzaman, 2008).

SSI is a significant clinical problem leading to morbidity and mortality. SSI caused pain, misery, and possible deformity (Fry & Fry, 2007). SSI also added to functional disability and emotional stress to the patients and in some cases disabling condition led to reduce quality of life (Ponce-de-Leon, 1991). Furthermore, SSI might require that the patient undergoes additional surgical procedures or it may result in death (Fry & Fry). Patients with SSI had 2 to11 times higher risk of death compared to patients without SSI (Kirland, Briggs, Trivett, Willson, & Sexton, 1999). The Institute of Medicine reported that SSIs caused death in 44,000 to 98,000 patients per year in the USA (Seltzer, McGrow, Horsman, & Korniewicz, 2002). A study found that mortality rate was 7% in patients diagnosed with SSI (Whitehouse, Friedman, Kiraland, Richarden, & Sexton, 2002).

SSI also causes unnecessary increased health care cost resulting in financial constraints to both patients and health care system as a whole. In the USA, a study revealed that SSI caused prolonged hospitalization 14 extra days and it was estimated that direct cost of hospitalizations per infected patient was US$ 24,344, compared to US$ 6,636 per uninfected patient (Whitehouse et al., 2002). Yet another study conducted in a European university hospital found that patient with SSI spent

additional postoperative length of hospital stay of 16.8 days and additional hospital cost was US$ 11,586 (Weber et al., 2008). SSI has a significant impact on quality of life and economic status. SSI patients spent significantly more time in out-patient department visits, emergency room visits, investigation services, readmission in hospital, and other health care services than patients without SSI. It was found that average estimated total cost of caring patient with SSI was US$ 5,155 compared to US$ 1,773 in patient without SSI (Barnard, 2003).

Intrinsic and extrinsic risk factors were related to the development of SSIs. Intrinsic factors include advanced age, malnutrition, metabolic diseases, smoking, obesity, hypoxia, immunosuppression, and length of pre-operative stay. Extrinsic factors include duration and application of skin antiseptics, preoperative shaving, antibiotic prophylaxis, pre-operative skin preparation, inadequate sterilization of instruments, surgical drains, surgical technique, surgical hand scrub, and dressing technique (Nandi, Rajan, Mak, Chan, & So, 1999; Seibert, 1999; Seltzer et al., 2002).

Among several contributing factors to SSI, nurse's responsible factor seems to be a significant importance, particularly nurses' lack of knowledge and skills. A study found that the malnutrition rate was high in patients before undergoing gastrointestinal surgery due to nurses' lack of knowledge and inability to evaluate nutritional status of the patients (Aydin & Karaoz, 2008). Nurses applied unsterile and inappropriate technique of using glove in surgical wound care and surgical procedures (Hampton, 2003) and 85% of nurses used inappropriate dressing technique in caring for surgical patients (McFadden & Miller, 1994). According to Small (1996), it was found that nurses violated hospital's protocol for pre-operative hair removal due to their negligence. A survey study found that the nurses lacked of potential knowledge

and practice in respect of wound care and also conducted poor management of wounds with inappropriate usage of dressing technique (Hollinworth, Taylor, & Dyble, 2008).

Based on a literature review, approximately 25% of the infections could be prevented by nursing personnel by following proper precautions during nursing care of surgical patients (Parvez, Emmanuel, & Sharma, 2005). Successful nursing care of surgical wounds depended on nurses' evidence-based knowledge and practice in terms of understanding normal wound healing process, type of surgery, methods of wound closure, preventive techniques, risk factors for surgical wound, and management of the surgical wound care. Using these knowledge and practices, nurses can provide a systemic and holistic patient assessment and management to prevent SSI (Vuolo, 2006). In India, a study found that nurses had the mean knowledge score of 73%, but the mean practice score was 63% regarding infection control measures. This study also found that there was a positive relationship between knowledge and practice, but their scores were not consistent regarding infection control measure (Vij, Willliamson, & Gupta, 2001). Another study reveled that nurses had low level of knowledge and high level of practice regarding infection control practice and the weak, negative correlation found between knowledge and practice signified that knowledge did not influence the practice (Najeeb & Taneepanichsakul, 2008).

For the prevention of SSI, nurses should have proper knowledge and they should have skills on this matter during pre-operative, intra-operative, and post-operative period. For this study, the intra-operative prevention of SSI by nurses working at operation theatre will not be assessed because in Bangladesh operating theater mostly is controlled by surgeons. Preoperatively, nurses need to have

knowledge and they should provide care in the following scopes: hygiene and skin preparation, controlling underlying medical conditions, maintaining nutritional status, and antibiotic prophylaxis. Postoperatively, nurses also need to have knowledge and maintain good practice in the following scopes: surgical wound care with aseptic precaution, wound assessment and monitoring of SSI, and nutritional support (Click, 2007; Mangram et al., 1999).

Prevention of SSI is the result of a complex interaction among the patient, wound related factors and nurses' evidence-based knowledge and practice of infection prevention (Hollinworth et al., 2008). Application of current knowledge and practices by nurses can help prevent SSIs, reduce patients' and hospitals' e penditure and improve patients' quality of life. The incidence of SSI is very high in angladesh. Information about standard nursing practice guidelines in prevention of SSI are lacking in Bangladesh. Currently, infection control training program for nurses is existed, but no special training program on prevention of SSI has yet been conducted in Bangladesh. Nurses have a lot of roles to play in prevention of SSI, thus, there is a need to e amine their state of knowledge and practice. The e amination of nurses' knowledge and practices regarding the prevention of SSI has not been conducted in Bangladesh. Therefore, this study was proposed with the following objectives.

*bjectives*

1. To e amine the level of nurses' knowledge regarding prevention of SSI
2. To e amine the level of nurses' practice regarding prevention of SSI
3. To e amine the relationship between nurses' knowledge and practice regarding prevention of SSI.

*Research □uestions*

1. hat is the level of nurses' knowledge regarding prevention of SSI
2. hat is the level of nurses' practice regarding prevention of SSI
3. Is there a relationship between nurses' knowledge and practices regarding prevention of SSI?

*Conceptual Framework*

The conceptual framework of this study (Figure 1) was developed based on loom's Ta onomy ( ). It was selected because the researcher would like to examine whether nurses have been trained to achieve learning outcomes needed to enhance the prevention of SSI. Bloom proposed three learning overlapping domains namely: cognitive, affective, and psychomotor domains. There are interrelationships among these domains. Cognitive domain is an intellectual part of learning process. It is demonstrated by knowledge recalled and the intellectual skills that can be categorized and observed through six levels of behaviors starting from the simplest behavior to the most complex behavior: remembering, comprehension, application, analysis, synthesis, and evaluation. Affective domain relates to emotions, attitudes, appreciations, and values. This domain lists five major categories starting from the simplest behavior to the most complex behavior, namely: receiving, responding, valuing, organization, and characterization (Krathwohl, Bloom, & Bertram, 1973). Psychomotor domain relates to physical movement, coordination, and use of motor-skills. Similar to the previous domains, the simplest behaviors to the most complex behavior of psychomotor domains are: imitation, manipulation, precision, articulation, and naturalization (Bloom, 1956).

Nursing practice is based on nursing knowledge. Certain nursing practices are directly related to the integration and synthesis of nursing knowledge (Evans & Donnely, 2006). Nursing basic courses, training, and experiences are very important foundation for knowledge development of nurses. Nurses' knowledge of SSI is important because it is a foundational component for nurses to perform practice. Practice could be a direct goal-oriented action to build judgments taken by the nurses in order to perform quality care (Ndikon & Onibokun, 2007), that was referred to prevention of SSI in this purposed study. Cognitive domain in this study focused on knowledge regarding prevention of SSI of pre- and post-operative care. Psychomotor domain focused on practice regarding prevention of SSI of pre- and post-operative care. However, affective domain was not included in this study because the prevention of SSI during pre- and post-operative care involves less nurses' judgment and value of this kind of nursing care. The cognitive domain includes knowledge of pre-operative and post-operative care regarding basic level of knowledge (remembering, comprehension, and application). The psychomotor domain includes practice of pre-operative and post-operative care regarding basic level of practice (imitation, manipulation, and precision) (Figure 1).

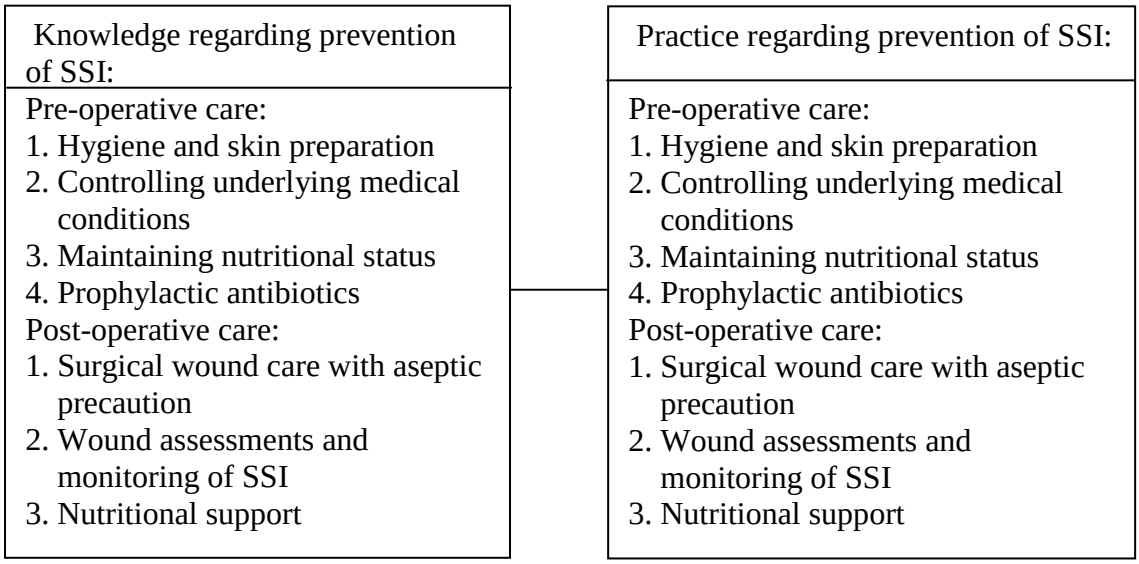


Figure 1

*Framework of Knowledge and Practice Regarding Prevention of SSI*

*Hypothesis*

There is a positive relationship between nurses' knowledge and nurses' practice regarding the prevention of SSI.

*Definition of Terms*

*Knowledge regarding prevention of SSI*

Knowledge regarding the prevention of SSI refers to the level of nurses' cognition in terms of remembering, comprehension, and cognitive application of techniques for prevention of SSI in pre-operative care and post-operative care. Pre-operative care involves maintenance of hygiene and preparation of skin, controlling underlying medical conditions, maintenance of nutritional status, and giving antibiotic prophylaxis. Post-operative care includes surgical wound care with aseptic

precautions, wound assessment and monitoring of SSI, and nutritional support. Knowledge regarding prevention of SSI was measured by the structured questionnaire developed by the researcher. The scores were divided into five levels; very low, low, moderate, high and very high. The higher scores indicate higher level of knowledge.

*Practice regarding prevention of SSI*

Practice regarding prevention of SSI refers to the level of nurses' perception of their actions in imitation, manipulation, and precision in prevention of SSI during pre-operative care and post-operative care. Pre-operative care involves maintenance of hygiene and preparation of skin, controlling underlying medical conditions, maintaining nutritional status, and giving antibiotic prophylaxis. Post-operative care includes surgical wound care with aseptic precautions, wound assessment and monitoring of SSI, and nutritional support. Practice regarding prevention of SSI was measured by the structured questionnaire developed by the researcher. The scores were divided into five levels; very low, low, moderate, high and very high. The higher scores indicate higher level of practice.

*Scope of the Study*

This descriptive, correlational study focused on e ploring the nurses' knowledge and practice regarding the prevention of SSI. This study also examined the relationship between nurses' knowledge and their practice regarding the prevention of SSI. The subjects of the study were surgical nurses who worked in the surgical related wards at Shere-E- Bangla Medical College Hospital (SBMCH), a 500-bed teaching hospital in Bangladesh. This study was conducted from November 2009 to January 2010.

*Significance of the Study*

The findings of this study can contribute to nursing practice, nursing education, and development of further research in the nursing profession as follows:

1. For nursing practice, the research findings help develop and organize training programs to increase nurses' knowledge and practice for the prevention of SSI.
2. For nursing education, the research findings provide information to guide the development of nursing curriculum and training courses related to the prevention of SSI.
3. For nursing research, the research findings can be used as baseline reference for future experimental research, such as the effectiveness of educational program to increase knowledge and practice regarding prevention of SSI.

# CHAPTER 2

# LITERATURE REVIEW

This chapter reviews the literature relevant to the present study and related information is described as follows:

1. Surgical Site Infection (SSI)
    1.1 Incidence of SSI
    1.2 Impact of SSI
    1.3 Causes and pathophysiology of SSI
    1.4 Risk factors of SSI
    1.5 Classification of SSI
    1.6 Clinical features of SSI
2. Preventive Strategies of SSI
    2.1 Pre-operative preventive strategies of SSI
    2.2 Post-operative preventive strategies of SSI
3. Development of Nurses' Knowledge and Practice Regarding Prevention of SSI

. Current Nurses' Knowledge and Practice Regarding Prevention of SSI

    4.1 Current nurses' knowledge and practice regarding prevention of SSI in other countries
    4.2 Current nurses' knowledge and practice regarding prevention of SSI in Bangladesh: A situational analysis.

5. Factors Contributing to Nurses' Knowledge and Nurses' practice
6. Summary

*Surgical Site Infection*

Intact skin is the patient's first line of defense against bacterial invasion. A surgical incision is un-intentional breech of this defense mechanism, after which the surgical wound can be contaminated by bacteria from multiple sources (Fry & Fry, 2007). Surgical site infection (SSI) refers to an infection that occurs within 30 days of the operation, if no implant is left in place or within one year of operation, if an implant is left in place and the infection appears to be related to the operation. SSIs are divided into three types, depending on the depth of infection penetrating into the surgical wound: superficial incisional infection, deep incision infection, and organ/space infection (Florman & Nichols, 2007; Gray & Hawn, 2007; Mangram et al., 1999; Pear, 2007).

SSIs are the most common type of nosocomial infection among surgical patients and are commonly caused by the patients' own flora and by health care providers (Florman & Nichols, 2007). According to the National Nasocomial Infection Surveillance (NNIS) system of the Centre for Disease Control and Prevention (CDC), SSI accounted for 14% to 16% of all nosocomial infections and was the most common nosocomial infections among surgical patients, and accounted for 38% of such infection (Mangram et al., 1999).

*Incidence of SSI*

SSI is a world wide clinical problem. In developed countries, approximately 5,000,000 patients developed an SSI during the 44 million inpatients surgical procedures performed annually and rate of SSI was 2% to 5% in the USA (Anderson et al., 2008; Nichols, 2004). In the UK, a study was conducted with caesarean section patients found the incidence of SSI was 2.9% (Ward, Charlett, Fagan, & Crawshaw,

2003). In Sweden, a study reported that the overall SSI rate was 6.4% in orthopedic and thoracic surgical patients (Gunningberg et al., 2008). In 2002, a one-month prospective national multi-cancer surveillance study was conducted in general and gynecology units of 48 Italian hospitals. This study revealed that an incidence of SSI was 5.2% (Petrosillo et al., 2008). Medeiros et al. (2005) conducted a survey study in a tertiary teaching hospital in north-east Brazil. The survey included 5,742 patients of thoracic, urologic, vascular and general surgery. Data analysis revealed that the overall incidence of SSI was 8.8% in 1994 and 3.3% in 2003. In Greece, a prospective study was conducted in 8 surgical wards in patients underwent the surgery during a 9-month period. This study found that the overall incidence of SSI was 5.2% (Roumbelaki, Kritsotakis, Tsioutis, Tzilepi, & Gikas, 2008).

The incidence of SSI is higher in developing countries. In African country (Tanzania), a study showed that SSI incidence was 19.4% (Eriksen, Chugulu, Kondo, & Lingas, 2003). In Peru, a study revealed that incidence of SSI was 26.7% (Hernandez, Romes, Henostroza, & Gotuzzo, 2005). In India, a study showed that overall SSI incidence in a variety of surgical procedures was 18.92% (Desa, Sathe, & Bapat, 2008). In Thailand, a retrospective study of 492 hepato-biliary-pancrease and colon surgical patients was conducted (Kahachindawat et al., 2007). They found that overall incidence of SSI was 7.7% in which most of SSIs were detected within 20 days after operation. Another study that conducted in Thailand with 330 patients undergoing colorectal cancer surgeries found that overall incidence of SSI was 14.5% (Lohsiriwat & Lohsiriwat, 2009). A study carried out at Manipal Teaching Hospital in Nepal reported that an incidence of SSI was 7.3% (Giri et al., 2008).

In Bangladesh, the incidence of SSI from the year 2001 to 2008 ranged from 11% to 30.3%. A one-year retrospective study conducted in 2001 with surgical patients in Shere-E- Bangla Medical College Hospital found that an incidence of SSI was 28.49% (Pervin, Mondol, & Gegum, 2002). Another one-year retrospective study in year 2003 to 2004 with surgical patients in Chittagong Medical College Hospital found that the rate of SSI was 30.3% (Begum, Begum, Roy, & Shil, 2005). Similarly, a one-year retrospective study in year 2005 to 2006 with surgical patients in Comilla Medical College Hospital found that the incidence of SSI was 22.05% (Islam, Akhter, & Sickder, 2007). Therefore, the incidence of SSI in medical college hospitals of Bangladesh trend to be increased during the year 2001 to 2006. Although, the trend of incidence of SSI in the recent year was decreased, the incidence of SSI was still high. It was found that incidence of SSI in two teaching hospitals in Bangladesh was 11% (Saha & Ashrafuzzaman, 2008).

In developing countries, SSI rate was high compared to developed countries. The magnitude of the problem should be determined and many countries remain largely ignored of SSI. Developing countries including Bangladesh need to establish surveillance system to prevent and control of SSI.

*Impact of SSI*

SSI could have devastated impact on the patient's course of treatment and is associated with increased treatment intensity, prolonged hospital stay, and increased the hospital charges by 10% to 20% (Lissovoy et al., 2009; Nandi et at., 1999). In the USA, a study revealed the impact of SSI on the length and costs of hospitalization. SSI prolonged the length of hospitalization by 14 extra days and it was estimated that additional cost per infected hospitalized patient was US$ 24,344, compared to

uninfected patient (Whitehouse et al., 2002). Another prospective study conducted by Weber et al. (2008) found that among 6,283 surgical patients, 187 were diagnosed positive for SSI. They also found that additional length of hospital stay was 16.8 days and additional hospital charge was US$ 11,586. Lissovoy et al. (2009) conducted a survey among 723,490 varieties of surgical patients, out of which 6,891 of SSI patients were identified and they found that in SSI patients, the extended length of hospital stay was 9.7 days and increasing cost of US$ 20,842 per admission. A study revealed that each SSI prolonged length of hospital stay by 7 to 9 days and resulted in an added hospital cost of greater than US$ 3,000 per SSI patient (Barnard, 2003).

SSI created economical and social burden, and increased secondary treatment cost ranging from US$ 7,500 to US$ 10,000 per infection (Seltzer et al, 2002). A study found that the cost of SSI varied depending on the type of operation and the type of infecting pathogen. Estimated cost ranged from US$ 3,000 to US$ 29,000, SSI was accounted for upto US$ 10 billion annually in healthcare expenditures (Kirkland et al., 1999). Patients with SSI spent not only prolonged hospital stay but also increased direct cost due to loss of their work, increased use of drugs, and the use of additional laboratory (WHO, 2002). Patients who acquired SSI required significantly more outpatient visit, re-admission, longer time hospital stay, additional nursing care, excessive laboratory test, more dressing supplies, and in some cases patients needed re-surgery (Perencevich et al., 2003; Urban, 2006). The indirect costs were more difficult to be calculated and included the loss of productivity and job by the patient and family members (Urban, 2006).

SSI is a serious post-operative complication with a significant post-operative morbidity and mortality. SSI caused pain, misery, and possible deformity in the

patients (Fry & Fry, 2007). SSI also added to functional disability and emotional stress and anxiety of the patients and in some cases lead to disabled condition that contributes to reduce quality of life (Ponce-de-Leon, 1991). SSI significantly impaired physical and mental capacity, and decreased patient satisfaction (Perencevich et al., 2003; Urban, 2006). SSI not only increased the patient's suffering but also increased the risk of death (Ponce-de-Leon). A study conducted among 5,369 patients with coronary artery bypass grafting surgery found that 14% patients died due to SSI and multi-organ failure (Loop et al., 1990). In Greece, a study revealed that the mortality rate was higher (7.1%) for patients with SSI compared to those without SSI (2.9%) (Roumbelaki et al., 2008). The above mentioned reports clearly show that SSI has impact on the patients, organization, and nation as a whole.

*Causes and pathophysiology of SSI*

*Causes of SSI*. SSIs are usually caused by bacteria, but fungi and virus can also be causes of SSI, particularly in post-operative wound infection. Most of bacterial infection presented in the patient's endogenous flora-bacteria which are normal residents of the skin or gastrointestinal tract (Howard, 1999). SSI is the consequence of the complex interaction of numerous factors such as host, microbial, and surgical factors. Bacteria are present in the wound after every operative procedure. The number and type of bacteria that contaminates the surgical wound depending upon the magnitude of contamination that is present within the anatomic structures, which are violated by the operation (Fry & Fry, 2009).

The events that potentially result in infection are related to host defense. The host inflammatory responses are the most important component of avoiding infection at the surgical site after surgical procedures. Several acute and chronic medical

conditions adversely affect the inflammatory response and increase the probability of infection (Fry & Fry, 2009).

*Pathophysiology of SSI* Surgical infections are responses to tissue necrosis, leading to the events visible at the surgical areas, which develop swelling, heat, pain, and loss of function. It is characterized by increased blood flow, increased vascular permeability, damage tissue, secretion of preformed mediators, and local or regional accumulation of these biochemical active compound and inflammatory cell. The magnitude of the inflammatory response and its symptoms are dependent on the burden of tissue injury and on the number and pathogenicity of the invading microorganisms. This infection may be locally and systemically involved (Morris & Malt, 1994).

Local infection follows the initial tissue injury. Necrotic tissues are the best nutrient medium for bacterial growth. Bacteria release toxins that destroy additional tissue. Bacteria may invade surrounding tissue slowly or rapidly depending on their production of toxins. Local infection occurs when tissue injury and number of bacteria exceed the capability of the host defense, Signs of local infection include formation of abscess, pus, and exudates at the surgical site (Morris & Malt, 1994).

Systemic infection occurs when micro-organisms invade into the bloodstream and may reach distant organs. The presence of bacteria in the bloodstream causes bacteria to invade into distant organs transiently. Bacteraemia may be progressed as a response to systemic disease with post-operative wound infection. This condition is continued and associated with multiplication of bacteria and then septicemia develops. Septicemia and sepses is manifested by several clinical symptoms. These include high fever, hypercarbia, hypotension, followed by chills,

tachycardia, and then develop auto aggressive multi-system organ failure (Morris & Malt, 1994).

Organ failure is the leading cause of death of surgical patients. Surgical patients following surgery release inflammatory mediators (cytokines) such as tumor necrosis factor- , interleukin-1, and interleukin-6 in the plasma levels. Cytokines may play a role in initiating the cascade of events that can lead to the development of multiple organ dysfunctions following severe hemorrhagic shock. In contrast, surgical patients following trauma and shock also release anti-inflammatory cytokines such as interleukin-10 and transforming growth factor (TGF- ) in the plasma levels. Anti-inflammatory cytokines are additional factor responsible for the prolonged suppression of macrophage function following hemorrhagic shock. Inflammatory cytokines and anti-inflammatory cytokines are important contributing factors to paralysis of cell-mediated immunity response, thereby, leading to subsequent susceptibility infection, sepsis, multi-organ failure (MOF) and death (Figure 2) (Angele & Faist, 2002; Seibert, 1999).

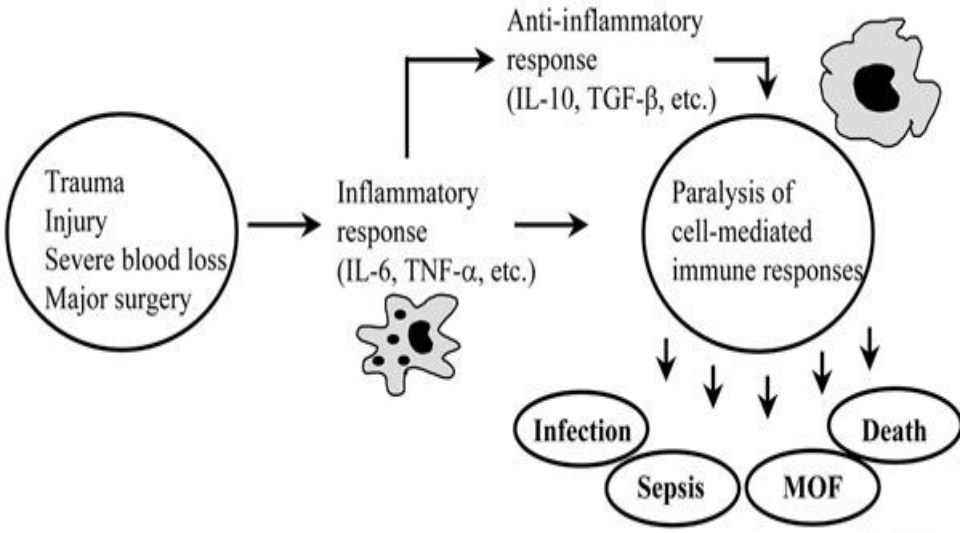


Figure 2

*The Development of Depressed Immune Response and Increased susceptibility Infection, Sepsis, □ □F, Death □From "Clinical Review: Immunodepression in the Surgical Patient and Increased Susceptibility to Infection" by □ □K□Angele □ F□ Faist, □□□□□Critical Care, □, pp□□□□□□□□□□*

*Risk factors of SSI*

There are many factors that affect the susceptibility of any surgical wound to be infected. These are intrinsic and extrinsic risk factors. Both factors may influence potential risk for the development of SSI (Seltzer et al., 2002).

*Intrinsic factors*. Several intrinsic factors are identified in the literature. These include age, nutritional status, cigarette smoking, prolonged hospitalization, hypothermia, and medical underlying conditions.

*Age*□Age was considerable factor that increases the chance for SSI, and aged people and young children are more prone to infection (Gunningberg et al., 2008; Stotts & Wipe-Tevis, 2001). A study found that advanced age (70 years or above) was at risk for SSI (Imai et al., 2008).

*Nutritional status* Malnutrition has long been an increased risk for nosocomial infection including SSI. Patients who are malnourished have been found to possess less competent immune response to infection. Serum albumin level that is below the surrogate marker of 3.4 to 5.4 g/dl is one indicator of risk of SSI (Gunningberg et al., 2008; Hardas & Malangoni, 2008; Pear, 2007). Ascorbic acid is an essential nutrient for hydroxylation amino acid praline and lysine into connective tissue for wound healing (Seibert, 1999). Obesity is considered a potential risk factor for poor outcomes from different kinds of surgical procedures (Choban & Flancbaum, 1997). Obesity (Body Mass Index >40) has been associated with SSI especially after cardiac and orthopedic implant surgery (Bough, Zuelzer, Meador, & Blankkenship, 2007). Imai et al. (2008) found that patients with underweight colon surgery who had BMI of 25 or above had a 1.67-fold risk for SSI compared with patients with BMI less than 25.

*Cigarette smoking* Cigarette smoking is associated with inhibited wound healing and decreased blood circulation to the skin due to microvascular obstruction from platelet aggregation and increased non-functioning of hemoglobin. This factor increased risk of SSI (Florman & Nichols, 2007; Hussey, Leeper, & Hynan, 1998).

*Prolonged hospitalization* Prolonged pre-operative hospitalization has been associated with increased SSI risk because patients may become colonized with resistant bacteria while staying in the hospital (Florman & Nichols, 2007; Gray & Hawn, 2007). Cross-sectional analytic study of 268 surgical patients was conducted to assess the incidence and risk factors for SSI. It was found that pre-operative hospitalization for over 10 days was risk factor for developing SSI (Luksamijarulkul et al., 2006).

*Hypothermia*—Hypothermia is a known problem for patients undergoing surgical procedures. Hypothermia, a reduction in core body temperature below 36°C/96.8°F, was one of the most common patient risk factors for pre-operative complications and SSI (Pear, 2007). It was shown that body temperature of 1.5°C below normal may result in increased risk of SSI, decreased oxygen tension in tissue, cardiac dysfunction, increased blood loss, delay recovery of normothermia, and increased mortality rate (Kurz, Sessler, & Lenhardt, 1996).

*edical underlying conditions*—Medical underlying conditions or diseases were identified as risk factors for developing SSI. Major underlying conditions include peripheral vascular disease, diabetes mellitus, human immunodeficiency virus (HIV), cancer, malnourished, and systemic lupus erythematosus. Patients who were immuno-compromised may be at risk for SSI (Stotts & Wipe-Tevis, 2001). For example, in diabetic patient, pre-operative hyperglycemia was a significant risk factor for developing SSI. Diabetes could result in immunodeficiency disorder because white blood cells do not function well when the blood sugar is high (Florman & Nichols, 2007; Khaodhir, McCowen, & Bistrian, 1999). Seibert (1999) mentioned that dysfunctional healing occurs when there is no enough glucose, oxygen, or proteins supplied to the surgical site tissue in diabetic patients. These ischemic tissues are susceptible to infection, prolonging inflammation. A study revealed that the patients with diabetic history or pre-operative hyperglycemia had a higher SSI rate compared to non-diabetic patients (Liao, Chen, Chen, & Niu, 2005).

*trinsic factors*. Extrinsic factors refer to environmental management factors that may cause SSI. Extrinsic factors of SSI include pre-operative shaving,

transient microorganisms, lengthy operation, prophylaxis antibiotic, and sterilization of instruments.

*Pre-operative shaving*. Pre-operative shaving is considered as an increased risk for developing SSI than using depilatory or clipping agents or hair remover. However, the risk of SSI from either shaving or clipping increased when it was performed at night before surgery (Gray & Hawn, 2007). Any hair removal was associated with increased SSI (Florman & Nichols, 2007; Gray & Hawn, 2007; Leaper, 1995). According to the Center for Disease Control and Prevention (CDC), endogenous skin bacteria including *Staphylococcus aureus* and *Coagulase-negative staphylococci* caused 34% of all SSIs. The risk of SSI was significantly increased if a surgical site was contaminated with a count of more than $10^5$ microorganisms per gram of tissue (Digison, 2007; Florman & Nichols, 2007).

*Transient microorganisms*. A transient microorganisms presented on the hands of health care workers are important extrinsic factor for SSI. Microorganisms on the hands could spread and have the potential to cause harm to clients (Boyce & Pittet, 2002; Leaper, 1995). A study reported that the hands of health care personnel were the primary factor for spread of nosocomial infections (e.g. SSI, urinary tract infection, respiratory tract infection) (Nguyen, Naguyen, & Jones, 2008).

*Lengthy operation*. Lengthy operation is associated with increased risk of SSI. A previous study showed that the longer the length of operative time increased the higher risk of SSI. For example, Imai et al. (2008) found that patients with undergoing colon surgery lasting 8 hours or more had a 4.2-fold risk for SSI compared to operation lasting less than 2 hours. In addition, patients undergoing

gastric surgery lasting 6 hours or longer had a 2.81-fold risk for SSI compared with operations lasting less than 6 hours.

*Prophylaxis antibiotic*—Prophylaxis antibiotic (PA) has decreased the high incidence of wound infection after operations. Administration of PA has decreased post-operative morbidity, and shortened hospitalization. Principles of PA include providing effective levels of antibiotics at the time of wound exposure and effective prophylactic regimens. The regimen should be directed against the most likely infecting organisms. The aim of PA was to augment host defense mechanisms at the time of bacterial invasion; thereby decreasing the transmission of infection. PA attempts to attack organisms before they have a chance to induce infection (Lohsiriwat & Lohsiriwat, 2009; Yoshida, Nabeshima, Gomi, & Lefor, 2007).

*Sterilization of instruments*—Sterilization of instruments is an essential part of aseptic technique and must be performed with validated methods using appropriate quality control, such as boiling point and instruments storage. Sterile gloves minimize transmission of microbes from the hands of the surgical team to patients and prevent contamination of team members with blood and body of the infected patients (Leaper, 1995; Pitter & Ducel, 1994).

*Classification of SSI*

Based on a literature review, there are several systems to classify the SSI. In this review, two systems of SSIs are proposed: (1) based on organic invasive and (2) based on wound characteristics (Horan, Andrus, & Dudeck, 2008; Pear, 2007).

*Classification of SSI based on organic invasive* (Florman & Nichols, 2007; Gray & Hawn, 2007; Horan et al., 2008; Mangram et al., 1999).

*Superficial incisional SSI*□A superficial incisional SSI involves only skin and subcutaneous tissue at the incision. Superficial incisional SSI is diagnosed with the following criteria: (1) purulent drainage from the incisional site, with or without laboratory confirmation, (2) having pain or tenderness, (3) local swelling, redness or heat, (4) incisional deliberately opened by surgeon unless incision culture is negative, and (5) being diagnosed by the surgeon.

*Deep incisional SSI*. A deep incisional SSI involves deep tissue including muscle and fascia. Deep incisional SSI is diagnosed with the following criteria: (1) purulent drainage from the deep incision but not from the organ/space component of the surgical site, (2) incision deliberately opened by a surgeon when the patient had one of the followings: a fever >38 $^{0}$C, localized pain or tenderness (unless the infection site is culture negative), (3) an abscess or other evidence of infection found on examination during re-operation, by histopathologic, or by radiological examination, and (4) being diagnosed by a surgeon.

□*rgan□space SSI*□An organ/space SSI involves organs or body cavities that are manipulated during surgery. Organ/space SSI is diagnosed with the following criteria: (1) purulent drainage, (2) positive wound culture, (3) abscess or other evidence of infection found on direct examination, during re-operation, by histopathologic or by radiologic examination and (4) being diagnosed by a surgeon.

*Classification of SSI based on wound characteristics*

The risk of infection is based on wound characteristics. The traditional surgical wound classification system designed by the CDC divided the increased

likelihood and extent of bacterial contamination during the surgical procedure into four separated classes of procedures (Pear, 2007).

*Class I clean wound*: The wound is considered to be clean when the operative procedure does not enter into a normally colonized viscus or lumen of the body. Incidence of SSI in this class of procedures is less than 2% depending upon clinical variables and contamination in the operative room environment, from the surgical team or most commonly from patient'skin. (Florman & Nichols, 2007; Fry & Fry, 2007; Gottrup, Melling, & Hollander, 2005; Vuolo, 2006).

*Class II clean contaminated wound*: A site is considered to be clean-contaminated, when the operative procedure enters into a colonized viscus or cavity of the body, but under elective and controlled circumstances. SSI rates in this class ranged from 4% to 10% (Florman & Nichols, 2007; Fry & Fry, 2007; Gottrup et al., 2005; Vuolo, 2006).

*Class III contaminated wound*: When gross contamination is present but no infection is obvious, a surgical site is considered to be contaminated wound. Bacteria introduced by spoilage of the surgical field were important cause of contamination. SSI rates in this class exceeded 20% (Fry & Fry, 2007; Gottrup et al., 2005; Vuolo, 2006).

*Class I dirty*: If active infection is already present in the surgical site, it is considered to be a dirty wound. Pathogens of the active infection site as well as unusual pathogens will likely be encountered. SSI rates in this class of procedures exceeded 40% (Fry & Fry, 2007; Gottrup et al., 2005).

*Clinical feature of SSI*

Clinical feature of SSI consists of local and systemic signs and symptoms of surgical wound infection including erythema, pain, edema, and temperature. Surgical wounds may include abscess formation, purulent drainage from the wound site, delayed wound healing, and friable bleeding of granulation tissue (Celik, 2007). Sign of infection that indicated the need to obtain a culture includes: (1) excessive drainage from the surgical wound, (2) a change in the color of the surgical wound area, (3) a change in the odor and character of exudates, (4) a presence of friable granulation tissue, (5) a sudden raise in the blood glucose in the diabetic patient (6) increased pain at the surgical wound site, (7) delayed surgical wound healing, (8) appearance of sign and symptoms of systemic infection, and (9) increased body temperature (Celik, 2007; Horan et al., 2008). In addition, SSI feature detected with laboratory finding includes leukocytosis and a decrease in the thrombocyte count. A specific diagnosis of the presence of infection is made with gram stain and culture of microorganisms from the opened surgical wound (Celik, 2007).

*Preventive Strategies of SSI*

The general health and well-being of surgical patients play a major role in the risk for developing an SSI. Although, some risk factors of SSI cannot be modified, some risk factors can also be minimized, controlled, or managed by health care personnel especially nurses (Floman & Nichols, 2007). Nurses in pre-operative care and post-operative care must deal with important infection control responsibilities. Nurses are responsible for providing evidence-based practice to prevent infection of SSI during pre-operative and post-operative period (Fry & Fry, 2007).

*Pre-operative preventive strategies of SSI*

*Hygiene and skin preparation*- The Association of Operating Room Nurses (2002) recommends pre-operative cleaning, hair removal, and antimicrobial skin preparation to reduce bacterial colony count of the incision site. The pre-operative skin preparation is essential part in the prevention of SSI. The mainstays of the pre-operative skin preparation recommendations are pre-operative showering and skin antisepsis, shaving or hair removal from surgical site (Floman & Nichols, 2007). Alcohol-based antiseptic is used during pre-operative skin preparation. It is safe, and effective for prevention of SSIs (Seal & Paul-Cheadle, 2004). Many agents are also available to be used as skin antiseptic agents. The ingredient combinations are iodophors, chlorhexidine gluconate, parachlorometaxylenol, iodine, and alcohol (Mulberry et al., 2001). The use of an antiseptic agent for pre-operative bathing or showering is widely practiced with the belief that it will help to prevent surgical site infection. Showering with an antiseptics or detergent agents significantly decreases skin microbial counts. The incidence of *Staphylococcus aureus* infection in clean procedures was reduced by 50% in patients who were showered with chlorhexidine compared with the bar soap (Anderson et al., 2008; Floman & Nichols, 2007).

The practice of shaving to remove the hair from the surgical site the night before an operation was associated with a significantly higher risk for SSI compared with the use of depilatory agents, clippers agents or no hair removal (Mangram et al., 1999). If hair removal was necessary, the use of clippers or depilatory agents was preferable than shaving to reduce the risk of surgical contamination (Florman & Nichols, 2007). Shaving the skin before surgery is no longer recommended because it creates microscopic cuts that increase the risk of SSI. If hair removing is necessary, it

should be removed with electric clippers immediately before surgery and a depilatory is not recommended to use because it could cause a hypersensitivity reaction in some patients (Forren, 2006). Celik and Kara (2007) conducted a study with 789 patients undergoing spinal surgery and found that patient with shaved group (n = 371) had higher rate (25%) of SSI compared to group without shaving before surgery (n = 418).

*Controlling underlying medical condition* Surgical procedures routinely challenge the surgical patients' host defense mechanisms. Several types of immune system malfunction may make a patient vulnerable during the surgical procedures (Castro, 2008). The immuno-compromised or immuno-suppression is the disordered immune system in which the ability to resist or fight infections is subnormal or not functioning normally (Neil, 2007). Immuno-suppression can arise in patients with conditions such as systemic lupus erythematosus, leukemia and lymphoma. In addition, immuno-suppression can be caused by infections such as the human immunodeficiency virus (HIV) or by the administration of drug, including chemotherapy agents and steroids, or as a result of metabolic diseases such as renal failure and diabetes (O'Doherty, Barrington, & Klein, 2009). Many diseases, disorders, and medications could impair the immune system, leaving the patient vulnerable during the pre-operative period. Nurses, therefore, must have a basic knowledge of the immune system and must actively use the nursing process to protect their patients throughout the pre-operative and post-operative care (Neil, 2007).

Strategies for preventing and treating infections depend on the type of immuno-suppression disorder. For example, blood glucose level should be kept below or equal to 110 mg/dl which could help white blood cells (WBC) to function normally and thus prevents SSI (Forren, 2006). Patient who has an immunodeficiency disorder

has more chance at risk of infection. The following cares could help to reduce the risk of infection: (1) patient being treated periodically with immunoglobulin intravenously, (2) practicing good personal hygiene, (3) not eating undercooked food, (4) drinking safe water, and (5) avoiding contact with people who have infections (Desai & Kuo, 2005). Nurses should also consider the following pre-operative nursing care including avoid opportunistic infection, maintain thermoregulation, maintain the balance of fluid volume, and avoid latex allergy or chemical hazards (Neil, 2007).

□*aintaining nutritional status*□ Pre-operative nutritional status had a significant impact on surgical outcomes. The major nutritional problems in the pre-operative period were under nutrition and over nutrition. Under nutrition and weight loss continues to be prevalent among hospitalized and long term care patients (Gunningberg et al., 2008). Because of lack of the major nutrients necessary for recovery, patients were at a higher risk than a patient of normal weight. Protein deficiency is most common among these patients. Low protein storage predisposes the patient to shock, increased edema, and decreased antibody production. The last factor increases the risk of infection. Giving appropriate diets with carbohydrates, protein, fat, vitamin, and minerals for malnourished patients could be helpful to prevent SSI (Pear, 2007; Ward et al., 2003). A prospective randomized control trail study revealed that patients who received pre-operative supplemented diet, showed a significantly decreased incidence of SSI compared to the control group (Senkal et al., 1999). Another study found that patients with cancer, who received pre-operative supplemented diet, showed a significantly reduced rate of SSI and also reduced length of hospital stay compared to the control group (Braga et al., 1999).

Obese patients are at higher risk of SSI in surgery than the patients having normal weight. Excess fat could cause several complications during surgery including increased working load of heart, increased risk of SSI, respiratory problems, increased the risk of infection, and delay in healing. Pre-existing conditions such as hypertension and diabetes which are prevalent in obese persons also increases the risk (Bough et al., 2007). There is no quick way for an obese patient to safely lose the weight prior to surgery. If time permits, a low calorie diet, high in essential nutrients should be provided. Starvation or fat diets are not recommended (Pear, 2007). Dietary considerations before surgery for an adequately nourished patient are also important. The pre-operative diet for these persons should contain less carbohydrates but rich in protein, minerals, vitamins, and fluids. These nutrients assist in a rapid recovery as they promote wound healing and decrease the risk of infections and other complications (Ward et al., 2003; Yoshida et al., 2007).

Nurses need to have enough knowledge about continuous nutritional assessment and correction for surgical patients as an important surgical team member. Routine evaluation of patients' nutritional status should be done by nurses to early detect malnourished conditions (Aydin & Karaoz, 2008).

*Prophyla□is antibiotics*□Timing of the antibiotic administration is considered critical for effective antibiotic prophylaxis. Prophylaxis antibiotics reduce the incidence of SSI (Lohsiriwat & Lohsiriwat, 2009). According to the Centers for Disease Control and Prevention (CDC) 1999 Guidelines, prophylaxis antibiotics should have a bactericidal activity during intra-operative contamination and should be given intravenously 30-60 minutes before surgery (Mangram et al., 1999; Weber et al., 2008). The consistent and correct administration of antimicrobial prophylaxis is

the most effective method to reduce the risk of SSI. Optimal administration of the prophylaxis antibiotic required that the correct agent should be administered prior to incision of surgery to maintain an effective antibiotic serum concentration throughout the course of surgery (Floman & Nichols, 2007; Forren, 2006). An estimated 40% to 60% of SSIs were preventable with properly administered prophylactic antibiotics (Mangram et al.). Nurses need to have knowledge regarding an important prophylaxis antibiotic for patients undergoing surgery and should maintain the appropriate timing for administration of antibiotic prior to incision.

*Post□operative preventive strategies of SSI*

*Surgical wound care with aseptic technique*□Successful nursing care of surgical wound care depends on the nurses' knowledge and understanding about the normal wound healing physiology, cleansing solution, aseptic technique, and equipment. Using this knowledge nurses can provide quality wound care and thus prevent wound infection. The main purposes of wound care are (1) to protect the wound from trauma or bacterial contamination, (2) to promote wound healing, and (3) to prevent the spread of organisms from an infected wound to other sites (Blunt, 2001; Vuolo, 2006).

Appropriate dressing materials should be selected according to the nature of the wound such as size, site depth of the wound, and the presence of slough or infection. Usually, dressing absorbs excess exudates, but maintains warm and moist condition at the wound surface to improve healing and should allow gaseous exchange. The primarily closed incision (i.e. the skin edges are re-approximated at the end of the operation), should be covered with a sterile dressing for 24-48 hours, until the incision edges are scaled (Mangram et al., 1999). When a surgical incision is

opened to heal by secondary intention, it should be covered with sterile moist gauze and a dressing should be applied with aseptic technique (Vuolo, 2006).

Wound dressing procedures are as follows: (1) whenever a wound is inspected or the dressing is touched, fully aseptic precautions must be taken and the condition of the wound should be recorded by the nurses, (2) equipment and dressing materials must be sterile (3) antiseptic solutions must be freshly prepared (4) The room should be free of visitors, cleaning activities and bed making should cease 30-60 minutes, and (5) separate infected from non-infected cases (National Institute for Health and Clinical Excellence [NICE], 2008); Vuolo, 2006).

Wound dressing steps are as the followings: (Mangram et al., 1999; NICE, 2008):

1. Wash and dry the hands
2. Clean and disinfect the surfaces of the dressing trolley by using paper towel and 70% ethyl alcohol with 0.5% chlorohexidine solution
3. Attach disposable bag with trolley for soiled dressing disposal
4. Wear face mask if required
5. Disinfect the hands and use sterile gloves
6. Open the corner of the sterile inner dressing bag carefully and place the sterile drape to form a sterile filed
7. Pour the antiseptic solution in the dressing set to make it ready for use
8. Remove the wounds'outer dressing with sterile forceps and discard them
9. Clean the wound using sterile forceps and cotton swabs from the site of incision to the outer edge, and clean the more contaminated (dirty area), each in a single stroke and discard the cotton swabs

10. Wipe the wound site as dry as possible
11. Inspect the wound, e.g. healing process, signs of infection such as pus, redness, swelling and tenderness
12. Cover the wound if needed, with dry sterile dressing preferably transparent
13. Clean and disinfect the surfaces of trolley and dry it well
14. Discard the soiled material in the proper place
15. Wash and dry the hands

□*ound assessment and monitoring of SSI*□An accurate and detailed SSI assessment is vital to take care of patient with wound. Care plan, treatment intervention, and ongoing management are based on initial and subsequent SSI assessment. Assessment provides the key elements about current status of wound and was essential to the developments of nursing care interventions (Baranoski & Ayello, 2004). Surgical wound assessment is needed for the following nine purposes: (1) identify causes of the wound, (2) recognize clear picture of what the wound looks like, (3) understand comprehensive picture of the patient, (4) identify contributing risk factors of wound healing, (5) be able to communicate to other health care providers, (6) provide continuity of care, (7) determine centralized location for wound care information, (8) propose components of the wound care plan, and (9) prevent complications of the wound care (Baranoski & Ayello).

Exudates, purulent discharge, size, and characteristics of SSI measurement are essential components of wound assessment within clinical practice. Such measurement provided the objective data that assisted nurses to identify wound healing progress, alerted nurses to evidence of deterioration, enhanced

communication between healthcare providers, aided in the selection of advanced treatment modalities (Romanelli et al., 2008). Any assessment of SSI should begin with the time of incisional site opened. Repeated systematic timely assessment is required because the extent of SSI is a dynamic process.

A structured wound assessment tool (ASEPSIS) helps to identify the assessment of SSI. ASEPSIS is an acronym for seven wound parameters to examine SSI. These parameters include additional therapy, serous exudates, erythema, purulent exudates, separation of deep tissue, isolation of bacteria, and stay (hospital) greater than 14 days. Summed score over wound assessment performed each day for the first 5 post-operative days indicates a severity of infection or complication (Wilson, Webster, Treasure, & Sturridge, 1986).

*Nutritional support* The goal of post-operative diet therapy is to retain body weight losses as soon as possible. Energy, protein, and ascorbic acid are major factors in achieving rapid wound healing (Black, 2005). Major surgical procedures greatly increase energy and protein requirements. Minerals and other vitamins also play a vital role in recovery from wound. Adequate energy and protein intakes are essential to limit protein and fat losses. The post-operative diet may be liquid, semisolid, soft diet or of regular consistency, but it must be high in calories, protein, vitamins, minerals, and fluids (Appelboam & Sair, 2006). Immunonutrients, such as arginine, glutamine, nucleotides and omega 3 fatty acids, reduce complications in surgical patients. Immune-enhancing feeds reduce the risk of infectious complications, and reduce hospital stay. Inadequate nutritional supports increase morbidity and mortality, delay the return of normal body functions, and retard the process of tissue rebuilding (Gianotti, 2006). Inadequate nutrition prevents wounds from healing at a normal pace

and causes edema and muscular weakness. At the stage of post-operative recovery, nurses should work closely to give maximum support to patients (Mequid, Compos, & Hammond, 1990).

The dietitians should prepare appropriate diets schedule and give dietary advice for surgical patients from pre-surgery to post-surgery which will result in improved immune function and reduce incidence of SSI. A study found that malnourished patients who received post-operative supplemented diet had a significantly reduced incidence of SSI and length of hospital stay compared to the control group (Braga, Gantti, Nespoli, Radaelli, & Carlo, 2002). Another study found a significantly reduced incidence of SSI and also treatment cost of the patients who received post-operative supplemented diet compared to those who received non-supplemented diet (Metin et al., 1997).

*Development of Nurses' Knowledge and Practice Regarding Prevention of SSI*

Human behaviors are influenced by many factors. Nurses' practice on prevention of SSI is considered to be one of nurses' behaviors in caring for surgical patients. According to Bloom (1956), the educationalist who proposed a classical conception of learning domains, three learning domains are classified. These include cognitive, affective and psychomotor (practical skills) domains. His conceptualization was used to guide this study. Each domain is described below.

Cognitive domain is demonstrated by knowledge recalled and the intellectual skills, comprehending information, organizing ideas, analyzing and synthesizing data, applying knowledge, choosing the alternatives in problem-solving and evaluating the ideas or actions (Bloom, 1956). This domain on the acquisition and

use of knowledge is predominant in the majority of courses. Bloom (1956) identified six levels within the cognitive domain, from the simplest level through the most complex level. These six levels are remembering, comprehension, application, analysis, synthesis, and evaluation. These six levels further can be categorized into two levels as lower and higher level of cognition. The lower level consists of subscales of remembering, comprehensive, and application whereas higher level comprises of analysis, synthesis, and evolution. Knowledge of the cognitive domain may be justified as an important outcome of learning in many ways. loom's taxonomy and knowledge is used in terms of intellectual ability. These abilities indicate that the individual can find information and techniques which lead to perform some behaviors and develop skills (Bloom, 1956).

According to Evenns and Donnelly (2006), cognitive domain is a critical component of nurses' decision making which is one of the principle characteristics of professional nursing. The performance of the skill can not stand alone; it is always supported by the knowledge and judgment. A dressing change can serve as an example. Before performing dressing change, the nurse should use his/her knowledge of wound healing process, sign, and symptoms of SSI to determine whether the particular wound should require appropriate dressing solution and dressing material which are commonly used. Clinical competence of nurses requires knowledge and skill inherent in the practice of the nursing profession. Nursing knowledge is essential factor for nursing practice. Having adequate knowledge is essential for nurses' decision making that occurs before, during, and after the actual tasks being performed.

Affective domain is demonstrated by behaviors indicating attitudes of awareness, interest, attention, concern, and responsibility, ability to listen and respond in interactions with others, and ability to demonstrate those attitudinal characteristics or values which are appropriate to the test situation and the field of study. This domain relates to emotions, attitudes, appreciations, and values, such as enjoying, conserving, respecting, and supporting. The five major categories listed the simplest behavior to the most complex behavior are receiving, responding, valuing, organizing, and characterizing (Krathwohl, Bloom, & Bertram, 1973).

Psychomotor domain includes physical movement, coordination, and use of the motor-skill areas. Development of these skills requires practice and is measured in terms of speed, precision, distance, procedures, or techniques in execution. The five major categories listed in the simplest behavior to the most complex behavior are imitation, manipulation, precision, articulation, and naturalization (Bloom, 1956).

Cognitive domain in this study focused on knowledge regarding prevention of SSI during pre and post-operative care. Psychomotor domain focused on practice regarding prevention of SSI during pre and post-operative care. However, affective domain was not included in this study because the prevention of SSI during pre and post-operative care involves less nurses' judgment or less nurses' value of doing nursing care. The cognitive domain focused in this study included knowledge of pre-operative and post-operative care and this domain included only low level of knowledge i.e., remembering, comprehensiveness, and application. The psychomotor domain focused in this study included knowledge of pre-operative and post-operative care and this domain included only low level of practice i.e., imitation, manipulation, and precision.

In this study, the lower level of cognitive and psychomotor domains were used because it was considered relevant to the nursing educational context in Bangladesh where nurses have been trained to develop their cognitive and psychomotor ability up to application of knowledge and to precision of practice, but not to analyze, synthesis, or evaluate such knowledge and practice that they perform to the patients. It was assumed that if nurses possessed the lower level of cognition and practice in the area of prevention of SSI adequately, they would be able to further develop themselves to possess the high level of cognition and practice.

*Current Nurses' Knowledge and Practice regarding Prevention of SSI*

*Current nurses' knowledge and practice regarding prevention of SSI in other countries*

Prevention of SSI is a complex interaction among the patient related factors, wound related factors, and the evidence-based practice performed by nurses (Hollinworth et al., 2008). In UK, a study reported that the nurses poorly performed aseptic technique particularly gloving and hand-hygienic practice (Prester, 2005). Small ( ) reported that the nurses violated hospital's protocol for pre-operative hair removal due to their negligence and also lack of current knowledge. In Turky, a survey conducted at a Faculty of Medicine with 129 clinical nurses. This study revealed that the nurses had a poor general quality of hand washing. It was also found that the subjects did feel the necessity of washing their hands but they were not able to wash their hands due to dense working conditions, insufficient necessary materials, and drying and sore hands after frequent washing (Akyol, 2007).

A study revealed that nurses lack the potential knowledge and practice in respect of wound care and also found poor management of wounds with inappropriate use of dressing conducted by nurses (Hollinworth et al., 2008). In addition, a study showed that 85% of nurses used inappropriate dressing technique in caring for surgical patients because they had difficulty in applying the theory and knowledge into their practices (McFadden & Miller, 1994). In addition, a study found that the malnutrition rate was high in patient before having gastrointestinal surgery. This same study also found that the nurses were not able to evaluate nutritional status due to their lack of knowledge (Aydin & Karoz, 2008).

Nurses' well-researched knowledge and good practice can contribute to infection control and reduce hospital acquired infection (Hawker, 1999). In India, a study found that the mean knowledge and practice of nurses regarding the infection control measure was 73% and 63%, respectively. This study also found the positive relationship between knowledge and practice. This same study indicated inconsistent level of knowledge and practices of nurses however, nurses' knowledge and practice were related (Vij et al., 2001). Another study in Maldives revealed that nurses had high knowledge score, but low practice score. The same study also found negative relationship between knowledge and practices of nurses (Najeeb & Taneepanichsakul, 2008).

*Current nurses' knowledge and practice in prevention of SSI in Bangladesh: A situational analysis*

Current situation in Bangladesh, surgical patients and patients with accidents are increasing day by day in hospitals and the incidence of SSI is present among them. Nurses provide both pre and post-operative care for surgical patients. Based on

researcher's e perience, nurses are responsible for providing appropriate pre-operative care, such as administering shaving, prophylactic antibiotics. In addition, nurses provide post-operative care, such as wound assessment, wound dressing, as ordered by surgeons, nutritional support. However, standard nursing guidelines in prevention of SSI are not available now a day. In addition, the nurse-patient ratio is 1: 15 that is against international standard for 1: 4. Therefore, the inadequate proportion of nurses and patients would affect quality of nursing.

It is accepted that nurses' knowledge and skills based on evidence-based practice are essential to prevent SSI. Most of nurses in Bangladesh graduated in the Diploma degree followed by Bachelor degree in which contents of prevention of SSI has not been specifically included in those curriculums. Most of nurses learned how to prevent infection in general terms for those curriculums. Although, now a day infection control training programs organized by the government are available, the contents of those training programs do not specify on prevention of SSI. Currently, there is no such kind of research in Bangladesh to examine the nurses' knowledge and practice regarding the prevention of SSI. Hence, researcher is aware that there is a need to e amine the e isting nurses' knowledge and practice regarding prevention of SSI in Bangladesh.

*Factors Contributing to Nurses' Knowledge and Nurses' Practice*

Several factors contributing to nurses' knowledge and their practice have been identified in nursing literature. Very few studies explored such factors in an area of SSI. Thus in this section, the researcher presents the literature demonstrating empirical evidence of contributing factors from various topics, not limited to only

surgical site infections. Literature has shown that nurses' age, gender, areas of practice, years of working experience, and education and training play roles in nurses' knowledge and practice.

*Age*□Difference age is related to nurses' knowledge and their practice. In pain literature, it was found that nurses whose age were over 30 years old tend to overestimate burn pain. Whereas, nurses who were less than 25 years old tended to underestimate burn pain (Iafrati, as cited in Allock, 1996). In nutrition literature, one study found that younger nurses were more knowledgeable than older ones (Endevelt, Worner, Goldman, & Karpati, 2009).

□*ender*□ ender difference in nurses' knowledge and practice has also been addressed in the literature. A cross-sectional survey was conducted with 650 European ICU nurses (Labeau et al., ). They evaluated ICU nurses' knowledge of the SSI prevention guideline. The researchers found that male nurses had better knowledge scores than female nurses. Another survey study was conducted with 216 Italian operating theater nurses regarding infection control. This study found that the level of knowledge was higher in male nurses compared to female nurses (Angelillo, Mazziotta, & Nicotera, 1999).

*Areas of practice*□ Areas of practice are influential factor on nurses' knowledge and practice. A comparative study was conducted with 45 qualified nurses at three hospitals in Ireland. It was found that nurses who had more practice experience in caring AIDS patients appeared to have more knowledge than those who did not practice in AIDS area (Steele & Melby, 1995). Another study found that nurses who practiced in nutritional area showed significantly higher nutritional knowledge than those with less clinical practices (Lindseth, 1997).

*ears of working e perience* There were inconclusive findings in terms of years of working e perience on nurses' knowledge and practice. In Spain, a survey study found that nurses who had more years of working experience of nurses had the higher level of knowledge than those who had less years of working experiences. However, years of working experience did not influence clinical practice (Pancorbo-Hidalgo, Garcia-Fernandez, Lopez-Medina & Lopez-Ortega, 2007). Another study found that nurses who had more than 10 years of working experience showed a decline of their knowledge and practice regarding infection control than novice recruited nurses (Vij, Williamson, & Gupta, 2001).

*ducation and training* The factor of education and training on nurses' knowledge and practice are inconclusive. Nurses who received higher education had high level of knowledge than those did not receive (Steel & Melby, 1995). A study reveled that the graduate nurses possessed more knowledge and practice than diploma nurses (Vij, Williamson, & Gupta, 2001). Another study found that the nurses who trained on infection control training had more likely to perform better practice than untrained nurses (Najeeb & Taneepanichsakul, 2008). However, a study revealed that training program did not make any significant difference in the knowledge level between control and experimental groups (Benneth & Weale, 1997).

*Summary*

Surgical site infections (SSIs) are the most common post-operative complications and cause substantial morbidity, mortality, and increases expense for treatments. SSI was also the second most common nosocomial infection among surgical patients. Multiple risk factors influence the development of SSI. In the

prevention of SSI, nurses require good enough knowledge and practice for proper caring for the surgical patients during pre-operative and post-operative periods. Pre-operative care involves maintenance of hygiene and preparation of skin, controlling underlying medical conditions, maintenance of nutritional status, and giving antibiotic prophylaxis. Post-operative care includes surgical wound care with aseptic precautions, wound assessment and monitoring of SSI, and nutritional support.

Cognitive, affective, and psychomotor domains are components that help to guide nurses' knowledge and practice. Many factors influence nurses' knowledge and practice, such as age, gender, areas of practice, years of working experience, and education and training. Based on a literature review, it was found that level of nurses' knowledge and practices regarding prevention of SSI were not congruent and also its relationship was still inconsistent. Currently, nursing practice regarding prevention of SSI in angladesh is based on nurses' e periences and their clinical judgments. Standard nursing guidelines in prevention of SSI are lacking in Bangladesh. Evidence-based nursing practice regarding prevention of SSI in Bangladesh has not been known as well as nurses' knowledge regarding prevention of SSI has not been explored.

# CHAPTER 3

# RESEARCH METHODOLOGY

This chapter discusses on the research design, setting, population, sample size, instruments, procedures for data collection, ethical considerations and data analysis.

*Research Design*

The descriptive and correlational study was conducted to obtain information on knowledge and practices of nurses regarding prevention of SSI at Shere-E-Bangla Medical Hospital (SBMCH) in Barisal and also to examine the relationship between these variables.

*Population and Setting*

One of the largest government acute care centre and teaching hospital in Barisal, Bangladesh was conveniently selected to be a target setting for the study. Barisal is located in the south geographical zone of Bangladesh. The SBMCH is located in the town of Barisal. There are more than one thousand patients getting admitted per day in this hospital. The total number of nurses is 300 nurses, out of which 138 nurses are working in the surgical wards. There were 13 surgical wards covering general surgery, orthopedics, ENT (ear, nose, and throat), eye, gynecology, and labour (postpartum and caesarian section). Nurses who were working in these wards were recruited, if they held a minimum of diploma degree in nursing and had at least six months of experience in surgical related wards.

*Sample Si□e*

The sample size of the study was calculated by using power analysis (Cohen, 1988). In this study, the sample size was estimated for an acceptable level of significance ( ) . , an e pected power of . ( - ) and estimated population effect size of .24 (P) that was calculated from the previous study (Vij et al., 2001). This previous study examined the relationship between knowledge and practice of nurses regarding infection control measure. Correlation of these two variables was *r* □.24. The maximum number of subjects was 132 to achieve a significant level of .05 and power .80. However, a total of 125 surgical nurses were working in surgical wards and they met the inclusion criteria. Thus, in this study all 125 nurses were approached. Only 120 surgical nurses willingly participated to comprise the sample.

*Instrumentation*

*Instruments*

A set of structured questionnaires developed by the researcher was used in this study. The questionnaires were divided into three parts.

*Part A*: *Demographic Characteristics*

There were nine items: i.e. age, sex, marital status, religion, educational level, working experience in surgical units, length of services, in-service training, and name of duty ward (Appendix B).

*Part B: Knowledge Regarding Prevention of SSI □uestionnaire*

This questionnaire was used to e amine the level of nurses' knowledge regarding prevention of SSI. It was designed to measure three cognitive levels: remembering, comprehension, and cognitive application. The contents include

knowledge needed for prevention of SSI during pre-operative and post-operative period. For pre-operative period, the scopes of contents are hygiene and skin preparation, controlling underlying medical conditions, maintaining nutritional status, and antibiotic prophylaxis. For post-operative period, it includes surgical wound care with aseptic precaution, wound assessment and monitoring of SSI, and nutritional support.

There are twenty five multiple choice questions. The correct response for each item receives a score of “ ” and “ ” for incorrect response (Appendix B). The scores ranged from 0-25 and were transformed into percentage. The higher scores indicated the higher level of knowledge. For interpretation, the researcher divided the transformed scores into five levels (McDonald, 2002) as follows:

| Scores (%) | Level of knowledge / Practice |
|---|---|
| <60.00 | Very low |
| 60.00 - 69.99 | Low |
| 70.00 - 79.99 | Moderate |
| 80.00- 89.99 | High |
| 90.00 -100.00 | Very high |

*Part C: Practice Regarding Prevention of SSI □uestionnaire*

This questionnaire was used to e amine the level of nurses’ practice regarding the prevention of SSI. It was designed to measure three levels of practice: imitation, manipulation and precision. The contents include practice needed for the prevention of SSI during pre-operative and post-operative period. For pre-operative period, the scopes of contents are hygiene and skin preparation, controlling underlying medical conditions, maintaining nutritional status, and antibiotic

prophylaxis. For post-operative period, it includes surgical wound care with aseptic precaution, wound assessment and monitoring of SSI, and nutritional support.

There are twenty five items. A 4-point rating scale was used covering information of pre-operative and post-operative care. Each item score ranged from “ ” no practice, “ ” seldom practice, “ ” sometimes practice, and “ ” always practice (Appendix B). The total scores ranged from 0-75 and were transformed into percentage. The higher scores indicated the higher level of practice. For interpretation, the researcher divided the transformed scores into five levels using the criteria as indicated in Part B.

*Translation of the questionnaires*

Translation of the questionnaires in this study was conducted with back translation technique (Sperder & Devellis, 1994). This technique was preceded in three phases. Phase 1, original English version (developed by the researcher) of the questionnaires was translated into Bangla version by a bilingual Bangladeshi translator. Phase 2, the Bangla version was back translated into English by a bilingual Bangladeshi second translator. Phase 3, an English expert evaluated both original questionnaires and the back translated English versions to ensure the equivalence of the two versions. Two-time revision of Bengali version was performed until the equivalence of the two versions was met.

*alidity and reliability of the instruments*

The content validity of the original English version questionnaires was assessed by a panel of three experts in surgical field; one surgeon in Bangladesh, one nurse educator in Bangladesh, and one expert nurse educator in Thailand. For reliability, the knowledge and practice Bangla version questionnaires were tested with

20 nurses, who had the same characteristics as subjects in the actual study but working in the general hospital. Internal consistency reliability was analyzed. Kuder-Richardson (KR-20) and Cronbach's alpha coefficient was used for the knowledge regarding prevention of SSI Questionnaire and the practice regarding prevention of SSI Questionnaire, respectively. The KR-20 coefficient was .85 for the knowledge questionnaire and Cronbach's alpha coefficient was .87 for the practice questionnaire regarding prevention of SSI.

*thical Consideration*

Permission for data collection was obtained from Institutional Review Board (IRB), Faculty of Nursing, Prince of Songkla University (PSU), Thailand, and from Director of Shere-E- Bangla Medical College Hospital (SBMCH), Bangladesh. The subjects voluntarily participated in this study were approached by the researcher. They gave written or oral consent to the researcher. The researcher explained to the subjects that they had right to participate or not to participate and their wish was respected. The researcher also explained to the subjects that their information and identity would be kept confidential. The researcher used the coding system to identity the subjects.

*Data Collection Procedures*

The procedures for data collection were as follows:

1. After the approval from Institutional Review Board (IRB) of the Faculty of Nursing, Prince of Songkla University, the researcher met and submitted application to the director and to the nursing superintendent of

SBMCH for gaining permission and explaining the objectives and procedure of the study.

2. The researcher met and explained the purpose of study to the ward in-charge at surgical related wards.
3. The subjects who met the inclusion criteria were approached to participate in the study.
4. The researcher explained and provided informed consent form (Appendix A) to every selected subject before distributing the questionnaires to ensure subject's rights were strictly maintained.
5. The selected subjects received the questionnaires after they signed the informed consent form.
6. The researcher requested the subject to complete the questionnaire two or three days, and then the researcher checked the answered questionnaires.

. The researcher used coding to maintain subject's anonymity. Subject's name and other information was not disclosed and then all the data would be destroyed at the completion of the study.

*Data Analysis*

Data were analyzed using computer software. The analysis included descriptive and inferential statistics to answer the research questions. Demographic characteristics, the knowledge transformed scores regarding prevention of SSI, and the practices transformed scores regarding prevention of SSI were analyzed using frequency, mean, standard deviation (SD), and range. The levels of knowledge and practice regarding prevention of SSI was categorized and described. The relationship

between knowledge and practice regarding the prevention of SSI was analyzed by using Pearson product-moment correlation. The assumptions of normality and linearity of these two variables were tested. It was found that the knowledge and practice scores had normal distribution and the linearity relationship between the knowledge and practice scores was verified.

# CHAPTER 4

# RESULTS AND DISCUSSION

This study aims to e amine nurses' knowledge and practice regarding prevention of surgical site infection (SSI) at SBMCH and to examine the relationship between nurses' knowledge and practice. A descriptive, correlational design was used in this study. One hundred and twenty out of 125 surgical nurses at SBMCH had completed the questionnaires, yielding a response rate of 96%. The results of this study are presented as follows:

. Subjects' demographic characteristics

2. Knowledge regarding prevention of SSI

3. Practice regarding prevention of SSI

4. Relationship between nurses' knowledge and practice regarding prevention of SSI

## Results

*Subjects' Demographic Characteristics*

The demographic data of the subjects are presented in Table 1. The majority of the subjects were female (90.8%). The average age was 40.86 years old (SD = 6.47), ranging from 28 to 55 years old. The majority of the subjects (95.8%) were married. More than one-fourth (27.5%) worked in the male (17.5%) and female (10%) surgical wards. The average years of working experiences in the surgical wards was 3.77 years (SD =1.29), ranging from 1 to 16 years. Most of them (93.3%) completed

diploma in nursing. More than half of the subjects (54.2%) were trained in the infectious control program.

Table 1

*Subjects' Demographic Characteristics N*

| Demographic characteristics | n | % |
|---|---|---|
| Age (years old): (M = 40.86, SD = 6.47, Min-Max =28-55) | | |
| 25-35 | 34 | 28.30 |
| 36-46 | 57 | 47.50 |
| 47-57 | 29 | 24.20 |
| Sex | | |
| Male | 11 | 9.20 |
| Female | 109 | 90.80 |
| Marital status | | |
| Single | 4 | 3.40 |
| Married | 115 | 95.80 |
| Divorced | 1 | 0.80 |
| Educational level | | |
| Diploma in nursing | 112 | 93.30 |
| B.Sc in nursing | 8 | 6.70 |

Table 1 (Continued)

| Demographic characteristics | n | % |
|---|---|---|
| Name of duty ward | | |
| Male surgical | 21 | 17.50 |
| Female surgical | 12 | 10.00 |
| Male Orthopedic | 12 | 10.00 |
| Female Orthopedic | 12 | 10.00 |
| Postoperative | 10 | 8.30 |
| Gynecological and labour | 20 | 16.70 |
| Cabin | 12 | 10.00 |
| Eye | 10 | 8.30 |
| ENT | 11 | 9.20 |
| Working experience in surgical wards (years) | | |
| (M = 3.77, SD = 1.29, Min-Max = 1-16) | | |
| 1-5 | 99 | 82.50 |
| 6-10 | 17 | 14.20 |
| 11-16 | 4 | 3.30 |

Table 1 (Continued)

| Demographic characteristics | n | % |
|---|---|---|
| Service experience (years) | | |
| (M = 3.69, SD = 1.19, Min-Max = 1-20) | | |
| 0-5 | 1 | 0.80 |
| 6-10 | 22 | 18.30 |
| 11-15 | 37 | 30.80 |
| 16-20 | 13 | 10.80 |
| >20 | 47 | 39.30 |
| Infection control training program | | |
| Yes | 65 | 54.20 |
| No | 55 | 45.80 |

*Knowledge Regarding Prevention of SSI*

The results have shown that the level of total knowledge regarding SSI prevention in this group of subjects was at the low level (marginal to moderate level) (M = 69.67%, SD = 8.53%) with the minimal scores of 48% and the maximum scores of 92% (Table 2). Fifty three subjects (44.2%) had knowledge of SSI prevention at the low level and forty three subjects (35.8%) had knowledge of SSI prevention at the moderate level followed by a very low and high level (Table 3). Considering each sub-dimension of the knowledge of SSI, the pre-operative knowledge of SSI was at the low level with the mean of 66.66% and the post-operative knowledge of SSI was at the moderate level with the mean of 74.16% (Table 2).

Table 2

*□inimum, □a□imum, □ean, Standard Deviation, and Level of Total Knowledge and Sub□Dimensions of Pre and Post Knowledge Regarding Prevention of SSI □N□□□□*

| Variable | Min-Max (%) | M (%) | SD | Level |
|---|---|---|---|---|
| Total knowledge | 48.00-92.00 | 69.67 | 8.53 | Low |
| Pre-operative knowledge | 46.67-93.33 | 66.66 | 10.40 | Low |
| Post-operative knowledge | 40.00-100.00 | 74.16 | 12.47 | Moderate |

Table 3

*Frequency and Percentage of Nurses' knowledge According to Level of the Knowledge Regarding Prevention of SSI □N□□□□*

| Level of knowledge | n | % |
|---|---|---|
| Very low | 7 | 5.80 |
| Low | 53 | 44.20 |
| Moderate | 43 | 35.80 |
| High | 16 | 13.40 |
| Very high | 1 | 0.80 |

In reference to Table 4, the results revealed five items of knowledge questionnaire that the highest number of nurses correctly answered. They were as follows: identifying a sign of no surgical site infection, comprehending a purpose of surgical hand washing, recognizing the laboratory investigation used to ensure SSI, identifying that surgical patients with compromised immune system were more at

high risk for SSI, and comprehending that maintenance of normal nutritional status for surgical patients could prevent risk for post operative complication.

Table 4

*Five Items of Nurses' Knowledge that the Highest Percentage of Nurses Correctly Answered (N=113)*

| Items | n | % |
|---|---|---|
| 1. Signs of no surgical site infection | 113 | 94.80 |
| 2. Purpose of surgical hand washing | 109 | 90.80 |
| 3. Laboratory investigation used to ensure SSI | 109 | 90.80 |
| 4. High risk for SSI in surgical patients with compromised immune system | 107 | 89.20 |
| 5. Maintenance of normal nutritional status for surgical patients to prevent SSI | 106 | 88.30 |

According to Table 5, the results revealed that there were four items of knowledge questionnaire that the lowest percentage of nurses' correctly answered. None of them answered correctly for the best method of pre-operative shaving. The rest three items were: recognizing the best time for pre-operative hair removal, comprehending that eating well-cooked food is beneficial for preventing infection in patients with immunodeficiency disorders, and recognizing the best agent for pre-operative skin preparation.

Table 5

*Four Items of Nurses' Knowledge that the Lowest Percentage Correctly Answered* □*N*□□□□□

| Items | n | % |
|---|---|---|
| 1. Best method for pre-operative shaving | 0 | 0.00 |
| 2. Best time for pre-operative hair removal | 29 | 24.20 |
| 3. Eating well-cooked food for prevention of infection in patients with immunodeficiency disorders | 37 | 30.80 |
| 4. Best agent for pre-operative skin preparation | 39 | 32.50 |

*Practice Regarding Prevention of SSI*

The results revealed that nurses' practice of SSI was at high level (M = 89.95%, SD = 4.06) with the minimum scores of 80% and the maximum scores of 96 % (Table 6). More than half of the subjects (51.70%) reported that their practices regarding prevention of SSI were at a very high level (Table 7). Considering each sub-dimension of the practice of SSI, the pre-operative practice of SSI was at a high level with the mean score of 85.92% and post-operative practice of SSI was at a very high level with the mean score of 96 % (Table 6).

Table 6

*□inimum, □a□imum, □ean, Standard Deviation of Nurses' Practice, and Its Sub□ Dimensions Regarding Prevention of SSI □N□□□□*

| Variables | Min-Max (%) | Mean (%) | SD | Level |
|---|---|---|---|---|
| Total practice | 80.00-96.00 | 89.95 | 4.06 | High |
| Pre-operative practice | 73.33-93.33 | 85.92 | 4.87 | High |
| Post-operative practice | 76.67-100.00 | 96.00 | 5.01 | Very high |

Table 7

*Frequency and Percentage of Nurses' Practice According to Level of Practice Regarding Prevention of SSI □N□□□□*

| Level of practice | n | % |
|---|---|---|
| Very high | 62 | 51.70 |
| High | 58 | 48.30 |

Table 8 shows five items of practice questionnaire that highest percentages of nurses "always practice". These five items were: (1) discarding dressing materials after performing dressing, (2) performing hand washing after changing dressing, (3) cleansing and disinfecting dressing trolley with antiseptic solution, (4) advising the surgical patients to take vegetables and fruits, and (5) using sterile dressing materials for performing wound dressing. However, one item of nurses' practices that none of them never practice was assessing surgical patients' body mass inde for identifying the nutritional status (Appendix C, Table 11).

Table 8

*Five Items of Nurses' Practice that Highest Percentage of Nurses "Always Practice"* □*N*□□□□

| Items | n | % |
|---|---|---|
| 1. Discard the dressing material after performing wound dressing | 116 | 96.70 |
| 2. Wash hands before and after changing wound dressing | 114 | 93.30 |
| 3. Cleanse and disinfect the dressing trolley with antiseptic solution | 113 | 94.20 |
| 4. Advise surgical patients to take vegetables and fruits before and after surgery | 113 | 94.20 |
| 5. Use sterile dressing materials for cleansing surgical wound dressing | 112 | 93.30 |

*Relationship Between Knowledge and Practice Regarding Prevention of SSI*

Correlation analysis was conducted to determine the relationship between knowledge and practice variables and their sub-dimensions using Pearson product-moment correlation coefficient. The results were reported that there was a weak, significant negative correlation between total knowledge and total practice regarding prevention of SSI (r = -.18, $p$ = .04). However, there was no significant relationship between pre-operative knowledge and pre-operative practice, also between post-operative knowledge and post-operative practice ($p$>.05).

# Discussion

The study was aimed to e amine the nurses' knowledge and their practice regarding prevention of SSI in SBMCH, Barisal, Bangladesh. This section discusses the results in relation to the research questions and the hypothesis.

## *Nurses' Knowledge Regarding Prevention of SSI*

In this study, the average scores of knowledge regarding prevention of SSI of the subjects were at a low level (marginal to moderate level), with pre-operative knowledge was at a low level and post-operative knowledge was at a moderate level. Many factors might contribute to the low level of knowledge regarding prevention of SSI among nurses in this study. Firstly, most of the subjects (93.3%) completed diploma in nursing and only eight subjects (6.7%) completed bachelor degree in nursing. For nursing education in Bangladesh, curriculum in both diploma and bachelor degree in nursing included general principal of infection control. The focus on evidence-based practice and knowledge regarding prevention of SSI has not been implemented. Therefore, no specific contents of prevention of SSI included in the nursing program would be one factor for lower level of knowledge in this area.

Secondly, it has been proposed that education and training prepare nurses to gain better/more knowledge (Najeeb & Taneepanichsakul, 2008; Pancorbo-Hidalgo et al., 2007; Suchitra & Devi, 2007). However, this claim could not be applied in this study. An additional analysis showed that there was no significant difference in nurses' knowledge between nurses who were trained in infection control program and those who were not, this might be because of the fact that the infection control

training program offered to nurses in Bangladesh might not particularly focused on the prevention of SSI. This is necessary for further improvement of this training course. In addition, a study revealed that Bangladeshi nurses have been trained to perform task-oriented nursing care rather than problem oriented nursing care (Hadley & Roques, 2007). This factor may limit nurses' willingness and ability to search new knowledge.

Thirdly, less years of working experience in surgical ward might affect the low level of knowledge among nurses. In this study, an average year of working experience was approximately 4 years. A study found that nurses who had more years of working experience showed their knowledge level of infection control at a higher level than those with less years of experience (Vij et al., 2001). Another study revealed that nurses who had more working experience had better pain management performance compared to those who had less year of experience (Lui, So, & Fong, 2008).

Finally, nurses might have a confusion of roles in their providing care regarding prevention of SSI. Usually, most preventive activities for prevention of SSI are responsible by surgeons. Therefore, nurses might be confused at how to integrate the prevention of SSI into their daily practice. This factor might relate to their low level of knowledge.

Consideration was given to each item of nurses' knowledge regarding prevention of SSI. The data showed that nurses had high level of knowledge regarding prevention of SSI in the areas of recognizing signs of SSI, performing hand washing for reducing the risk of SSI, comprehending swab culture for investigation to assess SSI, concerning high risk of SSI in immunodeficiency patients, and understanding

important maintenance of normal nutritional status in surgical patients (Appendix C, Table 10). These data indicate that nurses had knowledge of SSI prevention in areas of general infection control. Nurses gained this general knowledge from their SSI prevention information from diploma or bachelor nursing program and/or service experiences.

However, this group of subjects still lacked knowledge in some areas of SSI prevention. These areas were related to the best time for pre-operative hair removal, and the method of using clipping shaving method for pre-operative shaving. These data indicated that nurses could not access to evidence-based nursing practice of SSI prevention. The limitation of this SSI evidence-based of practice of SSI has not been included in Diploma and bachelor program in nursing. The lack of nurses' knowledge in this study indicated the urgent need to evaluate and revise the education and training program in prevention of SSI because the knowledge acquired through basic and continuing education and in-service training could enhance nursing practice (Even & Donnelly, 2006).

*Nurses' Practice Regarding Prevention of SSI*

It was revealed that the average practicing scores of the nurses were at a high level. The present study also revealed that pre-operative practice was identified at a high level and post-operative practice was identified at a very high level. This finding indicates that nurses had provided good nursing practices for prevention of SSI. There are several individual and organizational factors that influence high level of practice. The first factor is sufficient supplies of water, gloves, disposal boxes, antiseptic solutions, and surgical instruments. These supplies can help nurses to

perform good practice. A study had found that surgical infection control was related to sufficient resources of caring for surgical patients (Nguyen, Nguyen, & Jones, 2008). The second factor, hospital administrator in SBMCH increased tight supervision and monitoring system from supervisors to staff nurses. These tight supervision and monitoring system could increase the hours that nurses in government hospital spend their working time in direct contact with their patients compared to previous study that nurses spent only 5.3% of their working time in direct patient care (Hadley & Roques, 2007).

The third factor is related to the policy of implementing code of conduct of nurses for patient care endorsed by Bangladesh Nursing Council. This policy may lead the nurses to increase their awareness to perform practice regarding prevention of SSI. The forth factor may be due to the low sensitivity of the questionnaire of prevention of SSI practice in this study. Considering each item of the practice questionnaire, most of the items were related to the information of general practice of infection control rather than the prevention of SSI. Hence, revision of the practice questionnaire is needed for further study.

The fifth factor may be due to the social desirability that the subjects responded to the self-report practice questionnaire. They might tend to respond in order to get higher scores even though they might not have performed those activities (Adams et al., 2005). Finally, the Bangladeshi nurses have been trained to perform task oriented nursing care rather than problem-solving oriented nursing care. This reflects that nurses may perform nursing care without knowing the reason why they need to do that task.

Consideration was given to each item analysis of practice regarding prevention of SSI. It revealed significant findings (Appendix C, Table 11). Nurses reported that they had very highly performed SSI prevention practice in some areas because those items are common nursing activities that nurses could perform easily, such as disposing dressing materials after performing surgical site dressing for preventing spread of infection, washing hands before and after surgical wound dressing and caring patients, cleaning and disinfecting dressing trolley with antiseptic solution, advising surgical patients to take fresh vegetables and fruits before and after surgery and using sterilizing dressing materials during dressing. This indicated that nurses had performed good practices in these areas. However, it was also shown that no nurses assessed body mass index (BMI) in surgical patients for identifying nutritional status. A possible explanation was that Bangladeshi nurses had never been trained to assess body mass index (BMI) in surgical patients for identifying nutritional status. In addition, in some areas of practice, nurses lacked performances, such as learning shaving method from others, advising surgical patients for performing pre-operating showering, and advising surgical patients for performing pre-operating showering with antimicrobial agents. This indicated that nurses had limited resources to assess evidence-based practice; therefore, it is needed to provide update information to the nurses in these areas.

*The Relationship Between Nurses' Knowledge and Practice Regarding Prevention of SSI*

A weak, significant negative correlation found between knowledge and practice regarding prevention of SSI signified that knowledge is still related to

practice, but in the different direction. It revealed that low knowledge level was related to high practice level. This phenomenon was surprising. According to Bloom's taxonomy, the positive relationship was expected. However, a previous study had also found that there was a weak, negative correlation between knowledge and practice regarding infection control among doctors and nurses (Najeeb & Taneepanichsakul, 2008). Another study had found no relation between knowledge and practice regarding universal precaution of infection control (El-Shafle, Mokabel, & Helmy, 1995). Whereas, one study had found positive relationship between knowledge and practice in infection control measure (Vij et al., 2001). Therefore, the relationship between knowledge and practice is inconclusive. In addition, factors related to nurses' practice may not be linear correlation only by nurses' knowledge. In reality, there are many factors influencing nurses' practice including, hospital policy, sufficiency of staff nurses, sufficiency of nurse-patient ratio or availability of practice guideline.

The method of data collection may explain the negative relationship between nurses' knowledge and their practice. oth self-report data collection and social desirability could preclude the true performances of nurses in SSI prevention; whereas the low level of knowledge could be a representative of true cognitive ability; therefore, this phenomenon could explain the negative relationship between knowledge and practice regarding prevention of SSI.

# CHAPTER 5

# CONCLUSIONS AND RECOMMENDATIONS

A descriptive, correlational design was used to e amine the nurses' knowledge and practice regarding prevention of SSI at SBMCH and to examine the relationship between their knowledge and practice. The study was conducted from November, 2009 to January, 2010 at SBMCH. The instrument for data collection was a questionnaire which composed of three parts: Demographic characteristics of the subjects, Knowledge regarding prevention of SSI questionnaire and Practice regarding prevention of SSI. Summary of the findings, implications and recommendations based on the findings of the study are discussed in this chapter.

## *Summary of the Findings*

This study revealed that nurses reported a low level of knowledge and high level of practice regarding prevention of SSI. This study also revealed that nurses lacked knowledge and practice regarding prevention of SSI in some areas. Lacking of knowledge areas were: identifying the method of pre-operative shaving, recognizing the time of pre-operative hair removal, comprehending the prevention of infection for patients with immunodeficiency disorders, and recognizing the agent of pre-operative skin preparation. Lacking of practice area was assessing body mass index (BMI) in surgical patients for identifying nutritional status. In addition, there was a weak, significant negative correlation between knowledge and practice.

*Limitations of the Study*

Several limitations were inherent in the methodology used in this study. Firstly, certain other factors, such as hospital policy or nurse patient-ratio, that might affect the relationship of knowledge and practice regarding prevention of SSI did not include in this study. Secondly, the convenience sample recruited from surgical wards and only in one hospital in SBMCH limited the generalizability of the results to other hospitals in Bangladesh. Thirdly, this study used a self-report questionnaire to e amine nurses' practice regarding prevention of SSI that may not reflect the actual nursing practice. Finally, using the reference of educational cut off point for nurses' practice level similar to the knowledge level may overestimate the practice level. These two questionnaires should be further explored on their sensitivity and specificity.

*Implications and Recommendations*

Based on the results of this study, it is indicated that problem of lacked knowledge regarding prevention of SSI among nurses is alarming. To improve the quality of care and the quality of life of patients suffering from surgical infection, the following implications and recommendations are offered.

*Nursing practice*

The results of the study display information of nurses' knowledge and practice regarding prevention of SSI in the SBMCH. This information should be transferred to stakeholders, such as Secretary of Bangladesh Ministry of Health and Family Welfare, the Director of nursing services, and hospital administrators. Education and training program using current evidence-based knowledge and practice

would help improving the quality of nursing care. Hospital administrator should provide effective prevention of SSI policy as an institutional goal by developing standard guidelines for prevention of SSI for staffs in surgical units.

*Nursing education*

The results of the study indicated that nurses lacked knowledge regarding prevention of SSI. Inadequate education in the previous Bangladesh nursing curriculum and previous, outdated in-service training program may be the cause. Thus, it is recommended that the syllabus in Bangladesh Nursing Curriculum should be reviewed and added comprehensive program regarding prevention of SSI, so that nursing students would be well-prepared before graduation. More up-to-date in-service training program should be organized to enhance nurses' competency regarding prevention of SSI and eliminate knowledge deficit.

*Nursing research*

The findings from this study will provide a reference criterion for further studies in the field of SSI in Bangladesh. This study can be improved by increasing the sample size and medical hospitals to enhance the generalizability. A replication of this study using observation method is recommended to e amine the level of nurses' practice regarding prevention of SSI. Predictive study of factors related to nurses' practice for prevention of SSI is recommended for future study.

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# APPENDICES

# APPENDIX A

## Invitation Letter and Informed Consent

Dear Nurse

ou are invited to participate in a research project entitled "Nurses' Knowledge and Practice Regarding Prevention of Surgical Site Infection" at Sere-E-Bangla Medical College Hospital (SBMCH), Barisal. Please read this form carefully, and feel free to contact the researcher prior to the beginning of the study, if you have any questions.

Date of Ethics Committee Approval: September 04, 2009. Institutional Review Board (IRB), Faculty of Nursing, Prince of Songkla University, Thailand.

Identity of Researcher: My name is Md. Humaun Kabir Sickder and I am a student of Master in Nursing Science (International Program) at Faculty of Nursing, Prince of Songkla University, Thailand. I am also a senior staff nurse at Shere E-Bangla Medical College Hospital, Barisal, Bangladesh.

Purpose: As a master student, I have to conduct research and submit the research thesis. As such, I have designed a research project entitled "Nurses' Knowledge and Practice Regarding Prevention of Surgical Site Infection" for fulfilling this requirement.

Description: During this study, you will be asked to complete a set of questionnaires concerning your knowledge and practice related to pre-operative and post-operative care to prevent the surgical site infection as well as your personal information. I shall also request for some demographic information. Your participation will take approximately 45 minutes to 1 hour of your precious time.

Potential Benefit: By participating in the study, the research finding will be of immense help to develop training program to improve the knowledge and practice regarding prevention of surgical site infection. From such a research vantage, you will be helping to increase the understanding of prevention of surgical site infection.

Potential harm: There is no known harm associated with your participation in this research.

Confidentiality: All records of participation will be kept strictly confidential, such that only I myself and my advisors will be accessing the information. Data will be stored in a locked cabinet. Data will be destroyed at the end of the project. The result from this study will be reported in a written research report and presented as an oral report during an academic conference. Information about the study will be presented in an overview without identifying individual data.

Participation: Participation is completely on voluntary basis. It may be discontinued at any time without any reason, explanation and penalty.

Consent: I have read the above from, understand the information mentioned, also I can ask questions or withdraw at any time. I consent to participate in today's research study.

(Signature of Participant…….) (Signature of Researcher……)

Date…… Date……

(Name:……) (Name:……)

If you have any inquiries, please contact

Md.Humaun Kabir Sickder, Master of Nursing Science, Faculty of Nursing, Prince of Songkla university, Thailand Mobile-0846317615

Senior Staff Nurse SBMCH, Barisal Mobile-01716548733

## APPENDIX B

## Questionnaire

Subject No:……. Date:…….

The questionnaire is composed of three parts: part A, part B, and part C.

**Part A: Demographic Data Profile**

Please answer the following questions and give the mark (x) on the parenthesis and fill in the blank area.

. Age:……years

2. Sex:

Male ( )

Female ( )

3. Religion:

Muslim ( )

Buddhist ( )

Hindu ( )

Christian ( )

4. Marital status:

Single ( )

Married ( )

Separated ( )

Widowed ( )

Divorced ( )

5. Educational level:

Diploma in nursing ( )

B.Sc in Nursing ( )

Masters of Nursing ( )

6. Name of duty ward:

Male surgical ward ( )
Female surgical ward ( )
Postoperative ward ( )
Orthopedics ward ( )
Gyn. and labour ward ( )
Eye, ENT ward ( )

7. Service experience:

0-5 years ( )
6-10 years ( )
11-15 years ( )
16 -20 years ( )
Above 20 years ( )

8. Working experience in this surgical ward……years

9. Have you ever taken any training regarding infection control?

No ( )

Yes ( )

If yes, mention the number of infection control training program attend…….

**Part B: Knowledge of Prevention of Surgical Site Infection (SSI) Questionnaire.**

Please read the following sentences and then give the mark (x) of multiple choice questions to the best answer for the each question according to your understanding.

1. Which one is the best method for pre-operative shaving?
   a. Razor shaving method
   b. Depilatory shaving method
   c. Clipping shaving method (x)

2. When is the best time for pre-operative hair removal?
   a. On night preoperatively
   b. In the morning on the day of surgery
   c. Immediately before operation (x)

3. Which one is the best agent for pre-operative skin preparation?
   a. Alcohol-based products (x)
   b. Clorhexidine gluconate
   c. Betadine scrub

4. What is the purpose for pre-operative skin preparation?
   a. To prevent or inhibit bacterial growth (x)
   b. To prevent or inhibit viral growth
   c. To prevent or inhibit fungal growth only

5. How would you disinfect surgical site before surgery?
   a. Applying a broad spectrum antiseptic (x)
   b. Applying soap
   c. Applying savlon solution

6. Which one is true answer for prophylaxis antibiotic?
   a. Prophylaxis antibiotic is an important medication for preventing surgical site infection (x)
   b. Prophylaxis antibiotic is less important medication for preventing surgical site infection
   c. Prophylaxis antibiotic is not important medication for preventing surgical site infection

7. When should you administer prophylaxis antibiotic to surgical patients?
   a. Prophylaxis antibiotic is applied 30 to 60 minutes before operation. (x)
   b. Prophylaxis antibiotic is applied 2 hours before operation.
   c. Prophylaxis antibiotic is applied 15 minutes before operation

8. What is the purpose of pre-operative showering?
   a. To reduce the skin's microbial infection ( )
   b. To promote comfort
   c. To prevent the bacterial growth

9. What is the best skin agent for pre-operative showering to prevent surgical site infection?
   a. Tab-water
   b. Anti-bacterial soap (x)
   c. Herbal- Soap

10. Which one is correct for the malnourished surgical patients?
   a. Have more immune response to prevent infection
   b. Have less immune response to prevent infection (x)
   c. Have normal immune response to prevent infection

. hat are laboratories in assessing patient's nutritional status

a. Serum albumin and CBC (complete blood count) (x)

b. Serum albumin and urine analysis

c. Serum albumin and stool examination

12. What is the correct level of blood sugar which enhances function of white blood cell adequate to prevent SSI?

a. Lower than or equal to 110 mg/dl (x)

b. Lower or equal to 200 mg/dl

c. Higher than 200 mg/dl

13. What is the best antiseptic solution to disinfect the surface of dressing trolley?

a.70% ethyl alcohol with 0.5% chlorohexidine solution (x)

b.0.5% chlorohexidine solution

c.70% ethyl alcohol

14. Which is the correct purpose for surgical hand washing?

a. Reduce the risk of surgical site infection (x)

b. Increase the risk of surgical site infection

c. Reduce the risk of dryness of nurses' hands

15. Which are the correct steps of hand washing?

a. Wet your hands, rinse, and dry

b. Wet your hands, apply antiseptic agent, rinse, dry with a paper towel (x)

c. Wet your hands, apply soap, and rinse

16. Which one is the correct answer for the benefit of wound dressing?

a. Dressing absorbs exudates (x)

b. Dressing does not absorb exudates

c. Dressing decreases wound pain

17. When do you change the surgical wound dressing?

a. Within 24 hours after surgery

b. When a dressing material (gauze) presents with a lot of exudate (x)

c. When a surgeon orders

18. How do you select dressing solution?

a. Based on wound-based characteristics (x)

b. Based on size of the wound

c. Based on depth of the wound

19. What is the purpose of maintenance of normal nutritional status for surgical patients?

a. To prevent risk of post-operative complication (x)

b. To reduce immune function

c. To reduce healing process

20. What kinds of diet should be provided for the post-operative patients?

a. Protein rich diet and vitamin C containing fruits (x)

b. Carbohydrate rich diet and vitamin C containing fruits

c. Fat rich diet and vitamin C containing fruits

21. Which one is the correct answer for surgical patients with compromised immune system?

a. More vulnerable for risk of surgical site infection (x)

b. Have normal immune function

c. Have no risk to develop surgical site infection

22. How do you prevent infection of patients with immunodeficiency disorder?
    a. Eat fresh fruits and fresh vegetables
    b. Eat well-cooked food (x)
    c. Drink tab water

23. Which statement is correct for diagnosis of surgical site infection?
    a. Surgical site infection occurs within 30 days after operation (x)
    b. Incision culture is negative
    c. Patient has fever within the first 3 days after operation

24. Which answer is a good sign of no surgical site infection?
    a. No discharge, no fever (X)
    b. No discharge, edema of the skin around the wound
    c. No discharge, open suture line

25. Which laboratory is used to ensure SSI?
    a. Swab culture investigation(x)
    b. Blood culture investigation
    c. Urine culture investigation

**Part C:**

Table 9

*Practices Regarding Prevention of Surgical Site Infection □uestionnaire*

Please answer the following questions by giving the mark (x) on the column that best fit to your current practice.

| SL. No | Items | Never practice (0) | Seldom practice (1) | Sometimes practice (2) | Always practice (3) |
|---|---|---|---|---|---|
| 01 | Alcohol and chlorohexidine gluconate (CHG) is the most common antimicrobials used for patient's skin preparation in my ward | | | | |
| 02 | I wash my hands before and after changing wound dressing and touching the surgical site | | | | |
| 03 | I wash my hand before wearing sterile gloves | | | | |
| 04 | I perform pre-operative shaving right before surgery | | | | |
| 05 | I administer pre-operative prophylactic antibiotic within one hour before surgery | | | | |

| SL. No | Items | Never practice (0) | Seldom practice (1) | Sometimes practice (2) | Always practice (3) |
|---|---|---|---|---|---|
| 06 | I advise my patient to take pre-operative showering 6 to 12 hours before surgery | | | | |
| 07 | I advise my patient to take pre-operative showering or bathing with antimicrobial agents | | | | |
| 08 | I perform prescribed glucose test before and after surgery in a diabetic patient | | | | |
| 09 | I administer injection insulin or give oral medication as ordered in a diabetic patient | | | | |
| 10 | I assess my patient's body mass index (BMI) before and after surgery | | | | |
| 11 | I advise a malnourished patient to intake nutritious (especially protein) diet | | | | |
| 12 | I advise my patient to take vegetables and fruits before and after surgery | | | | |

| SL. No | Items | Never practice (0) | Seldom practice (1) | Sometimes practice (2) | Always practice (3) |
|---|---|---|---|---|---|
| 13 | I advise my patient with compromised immune system avoiding contact with people who have infections | | | | |
| 14 | I advise and obese patient to less intake of carbohydrate | | | | |
| 15 | I use sterilized dressing materials for cleansing surgical wound dressing | | | | |
| 16 | I use povidone-iodine and normal saline for cleansing surgical wound dressing | | | | |
| 17 | I use an aseptic technique during surgical wound dressing | | | | |
| 18 | I learn shaving method from others and apply to pre-operative patients | | | | |
| 19 | I used aseptic technique during obtaining swab culture | | | | |
| 20 | I advise an immunodeficiency disorder patient to maintain personal hygiene | | | | |

| SL. No | Items | Never practice (0) | Seldom practice (1) | Sometimes practice (2) | Always practice (3) |
|---|---|---|---|---|---|
| 21 | I assess and monitor surgical site condition | | | | |
| 22 | I separate infected from non-infected cases during dressing | | | | |
| 23 | I use face mask during cleansing surgical wound dressing | | | | |
| 24 | I clean and disinfect the surface of the dressing trolley with antiseptic solution | | | | |
| 25 | I discard the soiled material in the proper place after performing wound dressing | | | | |

## APPENDIX C

Table 10

*Frequency and Percentage of Correct Responses to □ach Item of Knowledge Regarding Prevention of SSI Prevention □N□□□□*

| No. | Items | n | % |
|---|---|---|---|
| 1 | Which one is the best method for pre-operative shaving? | 0 | 0 |
| 2 | When is the best time for pre-operative hair removal? | 29 | 24.20 |
| 3 | Which one is the best agent for pre-operative skin preparation? | 39 | 32.5 |
| 4 | What is the purpose for pre-operative skin preparation? | 109 | 85.8 |
| 5 | How would you disinfect surgical site before surgery? | 97 | 80.8 |
| 6 | Which one is true for prophylaxis antibiotic? | 101 | 84.20 |
| 7 | When should you administer prophylaxis antibiotic to surgical patients? | 84 | 70.00 |
| 8 | What is the purpose of pre-operative showering? | 74 | 61.70 |
| 9 | What is the best skin agent for pre-operative showering to prevent SSI? | 97 | 80.80 |
| 10 | Which one is correct for the malnourished surgical patients? | 93 | 77.5 |
| 11 | hat are laboratories in assessing patient's nutritional status | 109 | 90.80 |
| 12 | What is the correct level of blood sugar which enhances function of white blood cell adequate to prevent SSI? | 103 | 85.80 |
| 13 | What is the best antiseptic solution to disinfect the surface of dressing trolley? | 74 | 61.7 |
| 14 | Which is the correct purpose for surgical hand washing? | 109 | 90.80 |

| No. | Items | n | % |
|---|---|---|---|
| 15 | Which are the correct steps of hand washing? | 88 | 73.3 |
| 16 | Which one is the correct answer for the benefit of wound dressing? | 111 | 92.50 |
| 17 | When do you change the surgical wound dressing? | 53 | 44.20 |
| 18 | How do you select dressing solution? | 99 | 82.50 |
| 19 | What is the purpose of maintenance of normal nutritional status for surgical patients? | 106 | 88.30 |
| 20 | What kinds of diet should be provided for the post-operative patients? | 102 | 85.00 |
| 21 | Which one is the correct answer for surgical patients with compromised immune system? | 107 | 89.20 |
| 22 | How do you prevent infection of patients with immunodeficiency disorder? | 37 | 30.80 |
| 23 | Which statement is correct for diagnosis of surgical site infection? | 53 | 44.20 |
| 24 | Which answer is a good sign of no surgical site infection? | 113 | 94.20 |
| 25 | Which laboratory is used to ensure SSI? | 109 | 90.80 |

Table 11

*Frequency and Percentage of Responses to □ach Item of Practice Regarding Prevention of SSI □N□□□□*

| No | Items | Never practice n (%) | Seldom practice n (%) | Sometimes practice n (%) | Always practice n (%) |
|---|---|---|---|---|---|
| 01 | Alcohol and chlorohexidine gluconate (CHG) is the most common antimicrobials used for patient's skin preparation in my ward | 1(.80) | 1(.80) | 26(21.70) | 92(76.20) |
| 02 | I wash my hands before and after changing wound dressing and touching the surgical site | | | 6(5) | 114(95.00) |
| 03 | I wash my hand before wearing sterile gloves | | | 8(6.70) | 112(93.30) |
| 04 | I perform pre-operative shaving right before surgery | | 1(.80) | 23(19.20) | 96(80.00) |
| 05 | I administer pre-operative prophylactic antibiotic within one hour before surgery | | 1(.80) | 41(34.20) | 78(65.00) |
| 06 | I advise my patients to take pre-operative showering 6 to 12 hours before surgery | 3(2.50) | 4(3.30) | 41(34.20) | 72(60.00) |

| No | Items | Never practice n (%) | Seldom practice n (%) | Sometimes practice n (%) | Always practice n (%) |
|---|---|---|---|---|---|
| 07 | I advise my patients to take pre-operative showering or bathing with antimicrobial agents | 3(2.50) | 4(3.30) | 41(34.20) | 72(60.00) |
| 08 | I perform prescribed glucose test before and after surgery in a diabetic patient | | 1(.80) | 19(15.80) | 100(83.30) |
| 09 | I administer injection insulin or give oral medication as ordered in a diabetic patient | | 1(.80) | 16(13.30) | 103(85.80) |
| 10 | I assess my patient's body mass index (BMI) before and after surgery | 120(00) | | | |
| 11 | I advise a malnourished patient to intake nutritious (especially protein) diet | | | 9(7.50) | 111(92.50) |
| 12 | I advise my patient to take vegetables and fruits before and after surgery | 1(.80) | 1(.80) | 5(4.20) | 113(94.20) |

| No | Items | Never practice n (%) | Seldom practice n (%) | Sometimes practice n (%) | Always practice n (%) |
|---|---|---|---|---|---|
| 13 | I advise my patient with compromised immune system avoiding contact with people who have infections | | | 13(10.80) | 107(89.20) |
| 14 | I advise my obese patients to less intake carbohydrate | | | 10(5.80) | 110(91.70) |
| 15 | I use sterilized dressing materials for cleansing surgical wound dressing | 1(.80) | | 7(5.80) | 112(93.30) |
| 16 | I use povidone-iodine and normal saline for cleansing surgical wound dressing | | | 10(8.30) | 110(91.70) |
| 17 | I use an aseptic technique during surgical wound dressing | 2(1.70) | | 13(10.800 | 105(87.50) |
| 18 | I learn shaving method from medical personnel and perform to pre-operative patients | 24(20.00) | 5(4.20) | 22(18.30) | 69(57.30) |
| 19 | I use aseptic technique during obtaining swab culture | | 1(.80) | 8(6.70) | 111(92.3) |
| 20 | I advise an immunodeficiency disorder patients to maintain personal hygiene | | | 15(12.50) | 105(87.50) |

| No | Items | Never practice n (%) | Seldom practice n (%) | Sometimes practice n (%) | Always practice n (%) |
|---|---|---|---|---|---|
| 21 | I assess and monitor surgical site condition | | | 29(24.20) | 91(75.80) |
| 22 | I separate infected from non-infected cases during dressing | 1(.80) | 1(.80) | 13(10.30) | 105(87.50) |
| 23 | I use face mask during cleansing surgical wound dressing | | 1(.80) | 20(16.70) | 99(82.50) |
| 24 | I perform clean and disinfect to surface of the dressing trolley with antiseptic solution | | | 7(5.60) | 113(94.20) |
| 25 | I discard the soiled material in the proper place after performing wound dressing | | | 4(3.30) | 116(96.70) |

# VITAE

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