



**A Survey of Nurses' Knowledge and Their Practices Regarding Prevention and
Management of Diabetic Foot Ulcer in Bangladesh**

Sharmistha Shil

**A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Nursing Science (International Program)**

Prince of Songkla University

2013

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Major Program	Nursing Science (International Program)
Academic Year	2013

ABSTRACT

Diabetic foot ulcer is a significant clinical problem leading to morbidity and mortality including amputation of lower extremity. Nurses must have adequate knowledge and practice related to this condition. This descriptive study aimed to examine the level of nurses' knowledge and their practices regarding prevention and management of diabetic foot ulcer in the context of Bangladesh nursing services system. In this study two hundred and eighteen nurses participated. The research instrument was a set of three questionnaires developed for this study: Demographic Data Form, Nurses' Knowledge Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NKPM-DFUQ), and Nurses' Practice Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NPPM-DFUQ).

The content validity was examined by the three experts and back translated into Bangla language. The internal consistency reliability of the NKPM-DFUQ yielded a KR- 20 coefficient of .64. The stability reliability test using

intraclass correlation coefficient (ICC) was applied for both the NKPM-DFUQ and the NPPM-DFUQ yielding the values of .78 and .89, respectively. Both nurses' knowledge and nurses' practice raw scores were transformed into percentages for easy interpretation. The findings indicated that nurses had a very low level of knowledge ($M = 52.60\%$, $SD = 7.86\%$) and a moderate level of practice ($M = 72.30\%$, $SD = 21.28$). There is an urgent need to establish training courses at a post-basic level relevant to nurses working in the healthcare context of Bangladesh. Consequently, quality of care for patients with diabetes could be improved.

Keyword: nurses' knowledge, nurses' practice, diabetic foot ulcer.

ACKNOWLEDGEMENTS

All praises are due to the almighty God for enabling me to carry out the work of this research. My sincere and heartfelt thanks go to my major advisor, Assist Prof. Dr Wongchan Petpichetchian, for her constant support, guidance, valuable suggestions, constructive feedback, and encouragement given throughout my study in Thailand. She had been very patient with me and we had spent hours together to discuss, interpret the findings and refine this thesis. I am equally grateful to my co-advisor, Dr Hathairat Sangchan, for her valuable guidance whenever needed and her valuable suggestions in the research as well as helping me in many other ways.

I wish to express my gratitude to the thesis examining committee who provided valuable comments and suggestions to develop and refine this research. I would like to express my gratitude to Assoc Prof. Dr Aranya Chaowalit, the Dean of the Faculty of Nursing, for providing academic resources at this school to facilitate my learning.

I am also grateful to Prof. Dr Sahidul Hoque Mallik, Director of Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, and Mrs Asia Khatun, Deputy Nursing Superintendent of BIRDEM, for their co-operation and facilitation during the process of data collection. This work would not be completed without the valuable help from every nurse participant. I would like to express my appreciation to all of them.

I am extremely grateful to the Government of Bangladesh and the Directorate of Nursing Services for granting me the scholarship to study abroad.

Finally, great respect to my loving mother, father, and my father-in-law, and appreciation to my younger sisters who give me love and support in taking care of things at home and for helping my two sons during my study in Thailand. Special thanks go to my husband for selflessly encouraging me to take up this study and his sacrifice while I was away from home.

Sharmistha Shil

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1. Conceptual framework of the study delineating the Key Components of Nurses’
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CHAPTER 1

INTRODUCTION

This chapter presents background and significance of the problem, objectives of the study, research questions, conceptual framework, definition of terms, scope of the study and significance of the study.

Background and Significance of the Problem

A huge number of people around the world are suffering from chronic diseases including diabetes mellitus (DM). In 2011, in total, about 350 million people worldwide and more than 55 million in Europe suffered from diabetes mellitus (Lepantalo et al., 2011). Uncontrolled DM results in several devastating complications including diabetic foot ulcer (DFU). The incidence of DFU was 5.3% in type 2 DM and 7.4% in both type 1 and type 2 DM (Jeffcoate & Harding, 2003). The incidence of diabetic foot disease shows increasing trends all over the world (Terashi, Kitano, & Tsuji, 2010). It was projected that 20-40% of diabetes having diabetic foot where the annual incidence of diabetic foot ulcer (DFU) was 6% in each year during 2006, 2007, and 2008 (Margolis et al., 2011).

The incidence of DFU varies from country to country. In the developed countries such as the Netherlands, United Kingdom, and Sweden, the annual incidence was 2.1%, 2.2%, and 3.6%, respectively and a 3-year incidence in the United States was 5.8% (Jeffcoate & Harding, 2003). However, this variation can be due to study designs and characteristics of population under investigation. As part of a review literature in Desalu et al.'s study (2011), they reported a range of this variation

from 1.0% to 4.1% in the US to 20.4% in the Netherlands. In developing countries such as India (Gaur, Varma, & Gupta, 2007) and Kenya (Nyamu, Otieno, Amayo, & Mcligeyo, 2003), the incidence of DFU was reported to be 4.6% and 15%, respectively. This number increased even higher among hospitalized patients to 20% in Iran (Desalu et al., 2011).

In Bangladesh, a study reported that 22 % of patients had previous history of diabetic foot ulcer (Wadud, Samad, Enayet, Rubayat, & Bhowmik, 2006). A retrospective cohort study conducted in a diabetic hospital, the BIRDEM (Bangladesh Institute of Research Rehabilitation in Diabetes, Endocrine and Metabolic Disorders), found that the prevalence of DFU was 2.8% (Paul, Barai, Jahan, & Haq, 2009). Another study conducted in Quader Memorial Foot-Care Hospital showed that rural socioeconomically poor and the lower educated groups of people were at higher risk for the developing of diabetic foot ulcer (Wadud et al., 2006).

About 15% of people with diabetes develop foot ulcers. Foot ulcers are a preceding factor in approximately 85% of lower limb amputations (Reiber et al., as cited in Delmas, 2006). In Bangladesh, Wadud et al.'s study (2006) reported that 6% of patients had DFU before experienced amputation. According to Begum (2010), most of the diabetic patients in Bangladesh lacked knowledge about diet, exercise, foot care and foot wear. As a result, diabetic foot ulcer developed in large number of patients with diabetes and that commonly lead to amputation. It is considered that long-standing diabetes, poor glycemic control, poor socioeconomic condition, lack of proper knowledge about diabetic foot care and inappropriate foot wears are also

important factors for the development of diabetic foot ulcer leading to amputation (Wadud et al., 2006).

DFU is a clinical problem leading to morbidity and mortality including amputation of lower extremity. It is not only a great medical problem, but also social, and economical problem globally (Boulton, 2004). DFU also adds to functional disability, mental stress to the patients, and family burden. In some cases disabled condition leads to decreased quality of life and high mortality risk (Ritchie & Prentice, 2011). Many patients with diabetic foot ulcer faced expensive dressing changes and consumed time of family members. In addition, physical effects of pain are recognized by patients as it limits their daily life functions including household maintenance, or earlier enjoyed social activities (Bradbury & Price, 2011). Foot ulcer also increases costs in healthcare and affect employment.

DFU is the major end point of diabetes mellitus. Peripheral neuropathy, peripheral vascular disease, and foot deformity are the predisposing factors for the development of diabetic foot ulcer (Veves, Falanga, Armstrong, & Sabolinski, 2001). Other factors may also contribute. These include biomechanical abnormalities (e.g., plantar callus accumulation, increase in plantar foot pressure, and peripheral edema) and limited joint mobility (Rathur & Boulton, 2007).

As DFU is preventable, it is crucial for all health care providers including nurses to be able to prevent before an ulcer develops. If patients already come with ulcers, nurses must be able to manage DFU to prevent further severe complications, such as wound infection and necrosis that may end up in amputation or hasten death. Nurses must be competent as demonstrated by having accurate and comprehensive knowledge as well as ability to perform necessary measures to screen

patients who are at risk so that preventive measures and risk management can be executed (RNAO, 2005). They also should be able to manage DFU properly and promptly once it develops. Unfortunately, nurses may not be prepared to possess these competencies. The Registered Nurses' Association of Ontario (RNAO)'s six areas of practice recommendations for the assessment and management of foot ulcers for people with diabetes were used as a structure to guide this study. These areas are patient empowerment and education, holistic assessment, foot ulcer assessment, identifying goals of care, management of systemic, local, and extrinsic factors, and evaluation (RNAO, 2005).

Livingston and Dunning (2010) reported that basic nursing education in Australia did not adequately prepare practicing nurses to meet the demands of the expected roles. McIntosh and Ousey (2008) conducted a survey in UK with nurses and podiatrist participants prior to giving a one-day education in wound care. Certain areas of diabetic foot care were assessed. The participants were asked whether they could distinguish and manage the wound differently if this was a diabetic foot ulcer or a pressure ulcer. It was concluded that the variation and inconsistent practices across the participants could impact patient care and could result in patients receiving suboptimal treatments. Shiu and Wong (2011) conducted a small-scale survey specifically on 65 registered nurses (RNs) in Hong Kong. They found that RNs who had received prior training, diabetes foot care knowledge scored higher than those who did not receive.

Recently, a retrospective cohort study of 906 patients with diabetes was conducted in Bangladesh by a group of physicians (Habib, Biswas, Akter, Sahao, & Ali, 2010) to assess the cost effectiveness of medical intervention in patients with

diabetic foot. They found that 2.5% of patients who developed DFU. They also compared cost of treatment between those who underwent amputation and those who did not. The results showed that cost of amputation was 5-6 times higher than the usual treatment. This finding has called for attention to healthcare providers in Bangladesh to provide proper management so that DFU and its complications lead to amputation and cost burden could be reduced.

In Bangladesh, to what extent nurses possess this knowledge and what they practice in prevention and management of DFU is unknown. This study aimed to delve into this area of nursing practice in Bangladesh. In Bangladesh, nurses in government hospitals spent only 5.3% direct patient care and 32.4% of time is spent on indirect patient care and paperwork. Furthermore, 50.1% of time is away from the ward and chatting with other nurses (Hadley &Roques, 2007). Time spent on direct patient care involved administering parenteral and topical medication, administering oxygen and attending to patient immediately before and after death, all intravenous infusions by order of the doctor. The authors also observed that student nurses spent up to 16.7 of their time on direct patient care, were often left to change beds and expected to cover for experienced nurses who were late or being unproductive (Hadley &Roques, 2007).

The majority of nurses in Bangladesh earn diploma in nursing degree and some earn bachelor in nursing degree. In 2011, the registered diploma nurses degree was 26899, and the bachelor in nursing degree was only 1075. (Ministry of Health and Family Welfare, 2011). Both levels of nursing education offer very limited knowledge, especially on foot care of patients having diabetes. There is no any

document in Bangladesh to demonstrate differences between diploma nurses and bachelor nurses in terms of their preparation in DFU care. Nurses gain practical knowledge and skills through their daily work where the ratio of nurses to patients is considered high (Hadley & Roques, 2007; Outlon & Hickey, 2009). Therefore, they actually have little to no time to discuss with doctors for gaining more knowledge (Cockcroft, Milne, Oelofsen, Karim, & Anderson, 2011). Information about standard nursing practice guidelines in the prevention of DFU that can be used as a guide in nursing practice is also lacking in Bangladesh. For this reason, the researcher is interested in surveying nurses' knowledge and their practices regarding prevention and management of diabetic foot ulcer in Bangladesh. The findings of this study would be useful for policy makers at the institutional and national levels to properly prepare nurses and to plan for continuing education programs offered at post-basic levels in the future.

Objectives of the Study

1. To identify the level of nurse's knowledge regarding prevention and management of diabetic foot ulcer in Bangladesh
2. To identify the level of nurse's practices regarding prevention and management of diabetic foot ulcer in Bangladesh

Research Questions

1. What is the level of nurse's knowledge regarding prevention and management of diabetic foot ulcer in Bangladesh?
2. What is the level of nurse's practices regarding prevention and management of diabetic foot ulcer in Bangladesh?

Conceptual Framework

The Registered Nurses' Association of Ontario (RNAO)'s nursing best practice guideline was developed to assess and manage of foot ulcers for people with diabetes. It was chosen to guide conceptualizing the key variables of this study, nurses' knowledge and their practices regarding prevention and management of diabetic foot ulcer because it is targeted for nurse users and that clearly offers areas relevant to nursing contribution to the prevention and management of diabetic foot ulcer.

Nurses' knowledge and their practice are important for educating patients in self-management. Nurses should possess knowledge and perform nursing practice during providing care for patients with diabetes. The Registered Nurses' Association of Ontario (RNAO)'s six areas of practice recommendations for the assessment and management of foot ulcers for people with diabetes were used as a structure to guide this study. These areas included (1) patient empowerment and education, (2) holistic assessment, (3) foot ulcer assessment, (4) identifying goals of care, (5) management of systemic, local, and extrinsic factors, and (6) evaluation (Figure 1). In addition, literature related to prevention and risk management was

integrated under these 6 components. Details of each dimension were conceptualized as follows:

Firstly, patient empowerment and education is a foundation in the care of patients with diabetes as it is helpful in making patients to understand their own conditions and resources available for themselves. Nurses should have knowledge about concept of patient empowerment and be able to empower them. They must also educate patients to perform preventive measures, identify potential risk factors, and manage identified risks.

Secondly, holistic assessment requires nurses to have knowledge and capability in assessing all aspects of the patient's feet including vascular status, signs and symptoms of infection, diabetic neuropathy (DNP), as well as foot deformity and pressure. Once the ulcer is developed, thirdly, nurses must know how to assess and record the characteristics of the ulcer. Nurses have to identify the location, length, width, depth and classify the ulcers and assess ulcer bed, exudates, odour and peri-ulcer skin.

Fourthly, nurses must know and practice identifying goals of care in mutual agreement with the patient and family. They have to identify how to care for each patient based on clinical findings, expert opinion and patient preference and the potential of the ulcer to heal. Next, in order to successfully achieve the goals once DFU develops, nurses must be able to identify and manage systemic, local, and extrinsic factors that can promote wound healing. Nurses have to modify systemic factors and co-factors that may interfere with or impact on healing and provide local wound cares which include wound debridement, infection control and moist wound environment. Nurses need to have the knowledge and practice of how to provide

pressure redistribution, evaluate and implement treatment options for non-healable wounds.

Finally, nurses must know what to evaluate and perform comprehensive evaluation in order to determine the impact and effectiveness of the treatment plan reassess for additional correctable factors if healing does not occur at the expected rate and consider the use of biological agents, adjunctive therapies and surgery if healing does not occur at the expected rate.

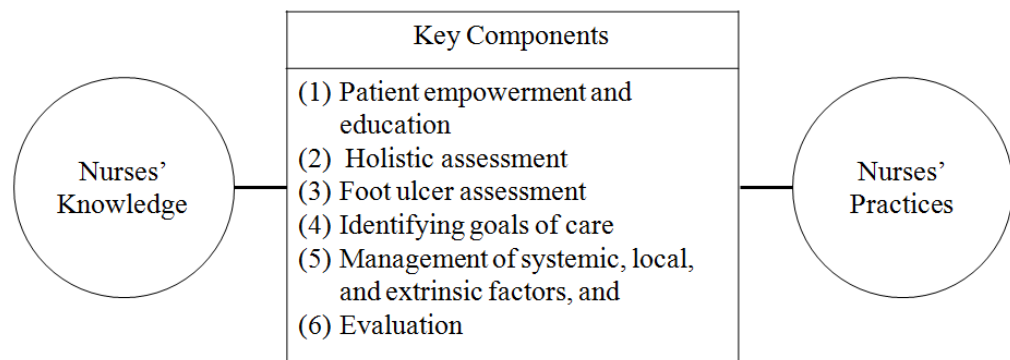


Figure 1

Conceptual Framework of the Study Delineating the Key Components of Nurses' Knowledge and Nurses' Practices for the Prevention and Management of Diabetic Foot Ulcer

Definition of Terms

Nurses' knowledge regarding prevention and management of diabetic foot ulcer refers to nurses' understanding and comprehension regarding the prevention and management of DFU in the following six components: patient empowerment and education as a function of enhancing patient's foot care; holistic assessment of foot care; foot ulcer assessment; identifying goals of care; management of systemic, local, and extrinsic factors; and evaluation. Nurses' knowledge was measured by the Nurses' Knowledge Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NKPM-DFUQ) developed by the researcher. The higher scores indicated the higher level of knowledge.

Nurses' practice regarding prevention and management of diabetic foot ulcer refers to nurse's perception of frequency of their own practice for the prevention and management of DFU. These include six components identical to nurses' knowledge regarding prevention and management of diabetic foot ulcer. Nurses' practice was measured by the Nurses' Practice Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NPPM-DFUQ) developed by the researcher. The higher scores indicated the higher level of practice.

Scope of the Study

This study focused on exploring nurses' knowledge and their level of practices regarding prevention and management of diabetic foot ulcer. The participating nurses were recruited from the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital which is a 2,500-bed multidisciplinary public hospital in Bangladesh. This study was conducted from February 2013 to April 2013.

Significance of the Study

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

1. The findings help develop and organize training programs to increase nurses' skill and awareness to provide nursing care of patients with diabetes, particularly those who are at risk for DFU.
2. The findings serve as the basis to guide the development of nursing curriculum and training courses related to the prevention and management of DFU.
3. The findings can be used as baseline reference for future experimental research, such as the effectiveness of educational program to increase nurses' knowledge and their practices regarding prevention and management of DFU.

CHAPTER 2

LITERATURE REVIEW

This chapter describes the review of literature regarding the development of diabetic foot ulcer, its prevention and management. Existing evidence-based guidelines for prevention and management of diabetic foot ulcer are documented. Current situation regarding DFU care in Bangladesh: Nursing education and practices are recognized. Research evidence related to nurses' knowledge, and their practices regarding prevention and management of diabetic foot ulcer are also presented. The following outline is used to guide the presentation of the key contents.

1. Diabetic foot ulcer
 - 1.1 Overview of DFU
 - 1.2 Pathophysiology of DFU
 - 1.3 Risk factors of DFU
2. Prevention of DFU
3. Management of DFU
4. Existing evidence-based guidelines for prevention and management of DFU
5. Current situation regarding DFU care in Bangladesh: Nursing education and practices
6. Research evidence related to nurses' Knowledge and nurses' practice regarding prevention and management of DFU
7. Summary

Diabetic Foot Ulcer (DFU)

This section covered the following reviews: Overview of DFU, pathophysiology of DFU and risk factors of DFU.

Overview of DFU

Diabetic foot ulcer (DFU) is one of the most common complications of uncontrolled diabetes mellitus (DM) and can result in more harmful consequences than other complications. The incidence of DFU was reported to be 5.3% in type 2 DM and 7.4% in both type 1 and type 2 DM, respectively (Jeffcoate & Harding, 2003). Heitzman (2010) reviewed the literature and reported that once DFU occurs, it causes patients to spend more time in the hospital than those admitted for other reasons. It also leads to morbidity and mortality including amputation of lower extremity. Approximately, 45% of all lower extremity amputations were primarily caused by diabetes, with 60% of non-traumatic amputations being due to long-term complications of diabetes (Heitzman, 2010).

Numerous causative factors and contributing factors or risk factors for DFU development have been recognized in diabetes and wound care literature. It is, therefore, very important for health care providers, especially nurses, to have knowledge about how DFU can develop (pathophysiology including causative factors), of what characteristics of patients that make them more likely to develop DFU (risk factors), and what the early signs and symptoms of DFU are.

Pathophysiology of DFU

The improvement of DFU is established to be the result of “TRIAD” causes. These include diabetic neuropathy, deformity and trauma (Boulton et al., 2008). In addition, the presence of peripheral arterial disease (PAD) has also been acknowledged to be a significant causative factor of DFU (Clayton & Elasy, 2009; RNAO, 2005). Each cause is described in more details.

Diabetic neuropathy. Diabetic neuropathy is the most important cause of DFU. It is a disorder that occurs in nearly 50% of patients with diabetes (Aring, Jones, & Falko, 2005), mainly in patients aged above 60 years (Young et al., as cited in Singh, Armstrong, & Lipsky, 2005). More than 60% of diabetic foot ulcers are the result of underlying neuropathy (Clayton & Elasy, 2009). It can occur at any part of the nervous system but the most common one is the chronic sensory motor distal symmetric polyneuropathy (DPN) which involves both the sensory and motor functions of the peripheral nerves. Its onset is less strong, and data suggest that only 13-15% of patients with objective evidence of neuropathy have symptoms (Shaw & Boulton, 1997). Furthermore, the motor component leads to small muscle wasting with a consequent imbalance of flexor and extensor muscles leading to clawing of the toes and prominence of the metatarsal heads (Shaw & Boulton, 1997). Sympathetic dysfunction affecting the lower limbs leads to reduced sweating and results in dry skin that is prone to crack and fissure.

Diabetic peripheral neuropathy is defined by the American Diabetes Association (ADA) as “the presence of symptoms and /or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes” (Boulton,

Vinik, Arezzo, Bril, & Feldman, 2005, p. 956). Simply speaking, DPN is a dysfunction of peripheral nerves found in patients with DM. It must be pointed out, nevertheless, that the neuropathic foot does not ulcerate spontaneously. It is the combination of neuropathy and trauma, whether extrinsic from, for example, ill-fitting footwear, or intrinsic from repetitive pressure on the metatarsal heads during walking that results in tissue breakdown (Shaw & Boulton, 1997).

It has been explained that DPN develops as a result of an accumulation of sugar products. The hyperglycemic state leads to an increase in action of the enzymes aldose reductase and sorbitol dehydrogenase. These enzymes further activate the conversion of intracellular glucose to sorbitol and fructose. These sugar products cause a decrease in the synthesis of nerve cell myoinositol, required for normal neuron conduction. In addition, the chemical conversion of glucose causes a reduction of nicotinamide adenine dinucleotide phosphate stores which is required for the detoxification of reactive oxygen species and for the synthesis of the vasodilator nitric oxide. The net result is an increased oxidative stress on nerve cells and an increase in vasoconstriction leading to ischemia (Clayton & Elasy, 2009).

Diabetic peripheral neuropathy can be a direct causative factor of DFU through the following mechanisms. First, sensory neuropathy causes a loss of protective sensation, resulting in physical trauma. It is reported that nearly 50% of all patients with DM have lost the ability to feel pain, heat or cold, and the sense of touch. Consequently, it makes these patients more vulnerable to physical and thermal trauma, leading to an increasing of 7-fold foot ulceration (Singh et al., 2005). Second, motor neuropathy results in muscle weakness and wasting of the intrinsic muscles of

the foot. Subsequently, there is abnormal weight bearing on the metatarsal heads which leads to ulcerations (Heitzman, 2010). Third, autonomic neuropathy causes decreased perspiration, dry skin, skin breakdown (fissuring), and a loss of microcirculation. Finally, the combination of these neuropathies leads to a cascade of events resulting in the change of the foot itself, including callus formation and Charcot arthropathy, thus predispose the patients to DFU. A callus is a thickened area which develops at sites of high pressure and friction. Allowing excessive pressure can be a forerunner of ulceration (Edmonds, 2006). Charcot arthropathy is a form of neuroarthropathy as a result of the combination of several types of neuropathies. Foot joints are unstable and cause more damage to the foot structure.

Deformity. The foot structural deformity is also a common causative factor to DFU development. This is more prevalent in aging population. A literature review, covering 35 articles, to identify the prevalence of foot health problems among older people was conducted (Stolt, Suhonen, Voutilainen, & Leino-Kilpi, 2010). Stolt et al. found that foot structural deformity was one of four categories of foot health problems in older population. The most common deformities were hallux valgus, a condition in which the first toe turns against the other toes (9-74%), and lesser digital deformities or toe deformities (9-69%) such as hammer toe and claw toe. Other types of deformities were also found in smaller number of older people. These included a high foot arch, pes cavus (5-19%), a low foot arch, and pes planus (6-19%).

Trauma. Direct trauma to the foot of patients with DM is common because of the above two factors. If foot trauma is repetitious, foot ulceration can be easily formed. Macfarlane and Jeffcoate (as cited in Singh et al., 2005) studied factors

contributing to the presentation of DFU among 669 patients. They found that 21% of DFU were attributed to rubbing from foot wear; 11% were linked to injuries, mostly from falls; 4% were due to infections, cellulitis, complicating tenia pedis; and 4% were from cutting toenails. Based on this study, it is noteworthy that improper foot wear contributed to the highest number of DFU development. It may be that use of ill-fitting shoes is instrumental in the development of blisters, callus, and corns.

Peripheral arterial disease (PAD). Peripheral arterial disease is a significant contributing factor to the development of foot ulcer in up to 50% of cases (Clayton & Elasy, 2009). Inadequate blood flow to the lower limbs not only causes skin breakdown but it also delays wound healing and increases the occurrence of amputation (RNAO, 2005). The absence or decreased pulsation of the peripheral pulses, foot tissues can develop ischaemia. Hence, blood circulation cannot pass in the peripheral veins and arteries. Protective sweating is lost and the skin of the ischemic foot is red, dry, thin with dystrophic nails, and susceptible to the pressure from a shoe (Jeffcoate & Harding, 2003).

Furthermore, hyperlipidemia, hypertension, and smoking are other factors that are common in diabetic patients. Consequently, ischemia develops in the lower extremity leading to increased risk of DFU in diabetic patients (Clayton & Elasy, 2009).

Risk Factors of DFU

A large number of authors have pointed the “direct four causes” discussed above in the pathophysiology section as risk factors (e. g., Boulton et al., 2008; Heitzman, 2010; McIntosh et al., 2003). To identify and categorize who are at higher or lower risks; these factors have also been used. Yet, to reduce the uncertainty here, in this review risk factors refer to factors other than the above recognized direct causes (diabetic neuropathy, foot deformity, foot trauma, and peripheral arterial disease). These factors can accelerate the development of DFU. On the other hand, these risk factors alone cannot develop DFU in diabetes patients without the presence of one of the direct causes.

A case control study of 348 people with type 1 and type 2 DM was conducted and published in 1998 (El Shazly et al., as cited in McIntosh et al., 2003) to examine risk factors of major complications of lower extremities, including DFU. Using the multivariate logistic regression, the researchers found that old age (50-70 years old), gender (male), marital status (unmarried), type of diabetes (Type 1) and type of diabetic treatment (insulin treatment in Type 2), having co-morbid diseases (cardio or cerebrovascular disease), poor glycemic control or uncontrolled diabetes (high HbA1c), healthcare facility accessibility (need help to reach a healthcare facility), regularity of follow up visits (no regular visit), and educational intervention (no educational intervention) were significant risk factors for developing lower limb complications. In El Shazly et al.’s study, they did not find the significant contribution of duration of diabetes and smoking, and alcohol consumption. Even though this is outdated and some non-significant factors may be due to other methodological issues,

the results can be used to guide more up-to-date review of the literature to support whether the results are still valid. These factors together with other factors being approved in the literature, including history of foot ulceration and amputation are also included and categorized into 3 groups: demographic risk factors, diabetes and health-related risk factors, and environmental risk factors.

Demographic risk factors. Demographic risk factors are non-modifiable factors. These include age, gender and marital status.

Age. Age is a significant factor that increases the chance for DFU and aged people are at greater risk for development of DFU than young people. It is believed that foot health problems are considerable independent predictors of falls in older people, thus increasing the risk for falls too (Stolt et al., 2010). In addition, older people may also have impaired balance and performance in limited foot care and mobility. Usually, aged people blood glucose concentrations are higher than younger people. Sometimes, foot infection, can lead to fracture resulting in DFU (Stockslager & Schaeffer, 2003). Diminished ability for self care, including personal daily foot examinations, and poor vision pose a risk in the older aged people (Nwabudike & Ionescu-Tirgoviste, 2008).

Gender. Generally, DFU is more frequently found in male than female. A study in Romania that included male patients with an average age of 62.6 years, 62% of them had DFU which was related to neuropathy (Nwabudike & Ionescu-Tirgoviste, 2008). They also found that 75.9% of ulcers were placed in the toe area, 80.1% of patients presented only one lesion, and Wagner category was in 63.9% of them. Hence, males and those with neuropathy were at most risk of having foot

ulcers. Another study of 398 diabetic populations was conducted to analyze the foot type, foot deformity and ulcer occurrence in the high-risk diabetic foot (Ledoux et al., 2005). It was found that 74% of the study populations were male and the average age was 62 years. Foot-type distributions were 19.5% pescavus, 51.5% neutrally aligned and 29.0% pesplanus. They also found 23.9% hallux valgus, 46.7% hammer/claw toes and 24.4% hallux limitus. So, this study revealed that foot type and foot deformity were significantly related to DFU development.

Marital status. A case-control study of 375 people with type 1 and type 2 diabetes mellitus was conducted in Malaysia to identify specific socio-demographic and lifestyle factors which are associated with foot ulcer in type 1 and type 2 diabetes patients (Misliza & Mas, 2009). Using the multivariate logistic regression, the socio demographic variables were age (44-65 years old), gender (male, female), ethnic (Chinese, Malay, Indian), marital status (married, unmarried), living status (living with spouse/ relative/others, alone), educational level (tertiary, secondary, primary, never schooling), household income per month and occupation type. Lifestyle factors included body mass index, smoking status, duration of smoking, number of cigarette per day, status of alcohol consumption, duration of alcohol intake, number of drinks per week, exercise practice, type of exercise, and type of foot wear used during exercise. The researchers found that age, gender, ethnic, occupation type and smoking were significant risk factors for developing diabetic foot ulcer.

Diabetes and health-related risk factors. Diabetes and health-related risk factors are type of diabetes, type of diabetic treatment, duration of diabetes, glycemic control, co-morbid diseases, and history of foot ulceration and amputation.

Type of diabetes mellitus. There are two types of diabetes, Type 1 diabetes mellitus and type 2 diabetes mellitus.

Type 1 diabetes mellitus. Type 1 diabetes mellitus is characterized by destruction of the pancreatic beta cells. It is subdivided into two types: type 1A immune-mediated diabetes, and type 1B idiopathic diabetes. In Canada, the United States and Europe, approximately 90% to 95% of people with type 1 diabetes mellitus have 1A immune-mediated diabetes (Güven, Matfin, & Kuenzi, 2010).

Type 2 diabetes mellitus. Type 2 diabetes mellitus is a heterogeneous condition that describes the presence of hyperglycemia in association with relative insulin deficiency. Most people with type 2 diabetes are overweight adults. Recently, however, type 2 diabetes has become a more common occurrence in obese adolescents and children. Although type 1 diabetes remains the main form of diabetes in children worldwide, type 2 diabetes has become the predominant form and is expected to increase within 10 years (Güven et al., 2010).

A study of 609 patients with type 2 diabetes mellitus was conducted in the Netherlands to assess the prevalence of foot ulcers and their determinants in a primary health care setting (de Sonnaville, Colly, Wijkkel, & Heine, 1997). At first visit all patients were examined by a podiatrist. Amputations, active foot ulcers (Wagner stage 1 or 2) and pre-ulcers (Wagner stage 0, hard skin with or without

maceration changes) were recorded in 0 (0%), 11 (1.8%), and 79 (12.9%) patients, respectively. Using the multivariate logistic regression, the researchers found that after adjustment for age and gender, duration of diabetes, cigarette smoking, peripheral vascular disease (assessed by calculating ankle/brachial index), sensory neuropathy (by Semmes-Weinstein monofilament 5.07), dry feet and severe hammer toes were independently and significantly linked with development of diabetic foot ulcer (pre-ulceration). They concluded that a foot pre-ulcer can be found in one of every seven patients with type 2 diabetes.

Type of treatment for diabetes. The desired outcome of glycemic control in both type 1 and type 2 diabetes is normalization of blood glucose as a means of preventing short and long-term complications. Treatment plans involve medical nutrition therapy, exercise and anti diabetic agents. Weight loss and dietary management may be sufficient to control blood glucose levels in people with type 2 diabetes. Optimal control of both type 1 and type 2 diabetes is associated with prevention or delay of chronic diabetes complications (Guyen et al., 2010).

Insulin. Type 1 diabetes mellitus always requires treatment with insulin and many people with type 2 diabetes eventually require insulin therapy. Insulin is destroyed in the gastrointestinal tract and must be administered by injection or inhalation. All insulin preparations are measured in international units. Most types of insulin are available in U-100 strength (i.e., 100 units of insulin/1ml). Insulin preparations are categorized according to onset, peak, and duration of action.

Insulin types are classified by length and peaking of action. There are four principal types of insulin: rapid-acting, short-acting, intermediate-acting and long

acting. Short-acting insulin is soluble crystalline insulin whose effects begin within 30 minutes after subcutaneous injection and generally last for 5 to 8 hours. The rapid-acting insulin preparations are produced by recombinant technology with an amino acid substitution. They have a more rapid onset, peak, and duration of action than short-acting regular insulin. The rapid-acting insulin, which is used in combination with intermediate or long acting insulin, is usually administered immediately before a meal. Intermediate to long acting insulin preparations include NPH, glargine, and detemir. These have slower onsets and a longer duration of action. They require several hours to reach therapeutic levels, so their use in type 1 diabetes requires supplementation with rapid or short acting insulin. Glargine and detemir have slower, more prolonged absorption than NPH insulin and provide a relatively constant concentration over 12 to 24 hours.

Intensive insulin treatment regimens. There are two intensive treatment regimens: multiple daily injections and continuous subcutaneous infusion of insulin. Multiple daily injections (MDI), the basal insulin requirements are met by intermediate or long-acting insulin administered once or twice daily. Boluses of rapid or short-acting insulin are used before meals. The continuous subcutaneous insulin infusion (CSII) method uses an insulin pump. With this method, the basal insulin requirements are met by continuous infusion of subcutaneous insulin, the rate of which can be varied to accommodate diurnal variations.

An observational study of 678 diabetic patients was conducted in a hospital of North India (Shahi et al., 2012) to prospectively determine risk factors for foot ulceration in diabetic cases. Using the multivariate logistic regression, the

researchers found that family /social history; age (47-55 years of old); sex (male, female); routine habits like tobacco, chewing, smoking and alcohol intake; duration of diabetes and diabetic foot; and treatment were significantly risk factors for diabetic foot ulcer. In Shahi et al.'s study, however, they found that the important risk factors for diabetic foot ulcers included age > 50 years (OR= 6.97, p = 0.00), duration of diabetes 4 to 8 years (OR= 2.47, p = 0.00), and > 8years (OR = 3.03, p = 0.00), rural location (OR = 0.44, p = 0.00), oral hypoglycemic treatment (OR= 2.90, p= 0.00), insulin treatment (OR= 9.58, p = 0.00) and tobacco use (OR= 0.57, p = 0.00).

Duration of diabetes. Long duration of diabetes mellitus is a strong risk factor for DFU. It is associated with a higher incidence of DFU (Merza & Tesfaye, 2003). Clients with diabetes mellitus are living longer, with an increased risk for development of chronic complications. Chronic macrovascular complications including coronary artery disease, cerebrovascular disease, hypertension, peripheral vascular disease, and infection are the common complications. Chronic microvascular complications including retinopathy, nephropathy, leg and foot ulcers, sensorimotor neuropathy, autonomic neuropathy (like pupillary, cardiovascular, gastrointestinal and genitourinary) are also common. Among them evidence showed that neuropathy, peripheral vascular disease, and infection are the most common risk factors for DFU (Frykberg et al., 2006; RNAO, 2005). A systematic review and meta-analysis by Crawford, Inkster, Klenijnen, and Fahey (2007), showed that patients who developed foot ulcers had diabetes for longer than those who did not, but this effect was not statistically significant (95% CI -0.75 to 5.99). A cross-sectional study at Kenyatta National Hospital in Nairobi found that, generally, patients who had diabetes for a long duration, developed diabetic foot ulcer. The types of ulcers were

neuropathic 47.5%, neuroischaemic 30.5%, and ischaemic 18% (Nyamu et al., 2003). In addition, 1,788 patients with diabetes mellitus were screened and among them 82 (4.6%) were found to have DFU.

Glycemic control. Poor glycemic control can speed up the development of DFU. High blood glucose levels can increase the risk of complications. It is well-established that high glucose levels increase the risk of vascular disease (UK Prospective Diabetes Study, 1998) but it also gives rise to neuropathy and increase infection. Literature has shown a trend toward the positive relationship between the level of HbA1c and the development of DFU. A large scale survey with 1,285 diabetic veterans who did not have DFU at baseline was conducted (Boyko, Ahroni, Cohen, Nelson, & Heagerty, 2006). Subjects were followed up at 12 months to 18 months to assess whether the DFU had developed. Seven factors were included in a backward stepwise regression analysis and subsequently, using the COX regression model. Boyko et al. revealed that subjects who had higher level of HbA1c were at higher risk to develop DFU. Those who have HbA1c of 10% would be at the highest risk (would place in the top quartile) and those with an acceptable level of HbA1c of 7.0% would still be at risk but lower than those with higher HbA1c level.

A systematic review and meta-analysis study conducted by Crawford et al. (2007) revealed non-significant findings. They pooled the results from four case-control studies to compare between patients with diabetes who developed DFU and those who did not. The researchers found that subjects with DFU had higher level of HbA1c than those who did not have ulcers but this finding was not reached a statistical significant (Weighted Mean Difference: WMD = 0.95%,

95 % CI -0.33 to 2.33). The findings from these two studies are promising to support that good control of diabetes should reduce the risk of DFU development.

Co-morbid diseases. Most of the patients with DFU had co-morbid diseases such as chronic renal disease and visual impairment.

Chronic renal disease. Chronic renal disease is the major co-morbid disease of patients with DFU. High blood sugar from diabetes can destroy renal blood vessels. A consequence of microangiopathy, nephropathy involves damage to and eventual obliteration of the capillaries that supply the glomeruli of the kidney. Over time, the kidney is not able to do its jobs as well. Later it may stop working completely. When kidney cannot work, blood pressure increases. Cholesterol and triglyceride levels rise too. As a result, oedema develops specially in the feet. Sometimes neuropathy, deformity, repetitive stress develops and the combined effect lead to DFU (Hanberg, 2009).

Visual impairment. Visual impairment is another co-morbid disease of patients with DFU, which may reflect the severity of micro vascular disease (Merza & Tesfaye, 2003). In diabetes, the retinal capillary becomes diseased; it loses the ability to transport red blood cells and thus oxygen and nourishment to the retina, with consequent tissue hypoxia and ischemia leading to visual impairment (Nelsen-Marsh, 2005). A large study of 1,229 people was conducted in Europe to investigate the characteristics of diabetic patients with foot ulcer in 14 European hospitals in 10 countries (Prompers et al., 2007). Using baseline and follow up visits, the researchers found that 27% of all patients were admitted to the hospital. Sixty-three percent of the patients were either previously managed in primary care or did not receive any treatment before inclusion. Disabling co-morbidity was present in 32% of the patients.

Severe visual impairment in 15%, end-stage renal disease in 6%, heart failure and angina pectoris in 11% and the inability to stand or walk without help in 10% of all patients were significant risk factors for developing DFU.

History of foot ulceration and amputation. A study found that about 60% of previous healed ulcers occurred in foot ulcer recurrence (Ghanassia et al., 2008). Patients who had previous diabetic neuropathy history mostly developed diabetic foot ulcer and the rate of amputation was 6.5 to 10 times higher in association to the general diabetic population (Akha, Kashi, & Makhrough, 2010). Numerous studies have established that foot ulceration is more common in those patients with a past history of ulceration or amputation and in patients with a poor social background (Shaw & Boulton, 1997).

A review of the literature in four cohort studies investigated the risk associated with history of foot ulceration (Crawford et al., 2007). These studies found that, patients who had previous ulceration were more likely to develop diabetic foot ulcer. One case-control study and one cohort study found history of amputation to be a risk factor for foot ulceration. These two studies also found that a history of lower limb bypass operation predicted future foot ulcer.

Environmental risk-factors. Environmental risk-factors are including healthcare facility and follow up visits.

Healthcare facility. A quasi-experimental study of 150 diabetes patients was conducted in Hong Kong to determine the effectiveness of a diabetes nurse clinic intervention in controlling the poor glycemia of older patients with type 2 diabetes (Chan, Yee, Leung, & Day, 2006). Using the pre and follow-up tests, the researchers found that age, sex, years of diabetes, family history of diabetes mellitus,

living partner, smoking and drinking status, activity of daily living, social allowance and the treatment group were associated with DFU. Biomedical variables: HbA1c, systolic blood pressure, diastolic blood pressure, and weight and episode of health care use like admission or accident and emergency department attendance also linked with DFU. Further, comparisons were made between the two groups for all these demographic variables and showed no significant difference. Chan et al.'s study also found an effective intervention of diabetes nurse clinic in giving consultation and education to the type 2 diabetic patients. The diabetes nurse provided follow-up and routine care such as maintaining glycaemic control by engaging the consumers into quality of care. Both the follow-up group and the control group had an improvement in the HbA1c and systolic blood pressure and reduction on healthcare utilization.

Follow up visits. A prospective study of 1,285 people with diabetes without foot ulcer was conducted to examine outcome with annual clinical evaluations and quarterly mailed questionnaires to identify foot problems (Boyko et al., 2006). Boyko et al. also found that in 12 to 18 month-intervals patients with diabetic foot ulcer needed reexamination to assess the outcome. Moreover, patients were encouraged to call study staffs by the research clinic if they assumed that they had a foot ulcer. They were also contacted monthly by mail. However, orange labels were affixed to the medical record problem list, reminding providers to check their patients' feet. Yet, in order to report, study staff offered to advance triage of patients with foot lesions, thereby reducing provider workload. Boulton et al. (2008) reviewed the literature and reported that patient should be thoroughly assessed about foot risk and assigned a foot risk category. These categories are used in a referral system and for following up by the specialized clinician or team on a regular basis. Patients in

risk category 0 usually do not need referral and must accept general foot care education and undergo comprehensive foot examination yearly. Similarly, patients in foot risk category 1 may be managed by a specialist or generalist every 3-6 months. They need referral to specialist to assess the need for specialized treatment and follow up. Those in categories 2 and 3 should be referred to a foot care specialist or specialty clinic and seen every 1-3 months (Boulton et al., 2008). Hence, regular follow up visits can reduce the risk of DFU development.

Prevention of DFU

Prevention of DFU ought to be the primary goal for all involved in diabetic foot care. The prevention of diabetic foot ulcer requires a positive approach involving the person with diabetes, family/caregivers and an interdisciplinary team of healthcare providers (Canadian Diabetes Association [CDA], 2008; Frykberg et al., 2006). According to available practice guidelines and standard care, prevention of diabetic foot ulcer consists of optimal diabetes management, patient and family education, annual examination of the foot, screening for peripheral vascular disease, interdisciplinary team approach, daily foot care, assessment of history of previous ulceration and formation, assessment of high risk conditions, and management of high risk conditions (ADA, 2004; Armstrong & Lavery, 1998; CDA, 2008; Frykberg et al., 2006; Singh et al., 2005).

Optimal Diabetes Management

Preventive education and care needs overall diabetes management as well as the optimal glycemic control, control of hyperlipidemia, control of hypertension, treatment of renal disease, treatment of peripheral vascular disease, optimal nutritional status, smoking cessation, identification and management of neuropathy and retinopathy (CDA, 2008). A prospective study conducted in the UK stated that 1% mean reduction in hemoglobin A1C was associated with a 25% reduction in micro-vascular complications, including neuropathy (Singh et al., 2005). Jeffcoate and Harding (2003) reported that enhanced blood glucose control will reduce microvascular complications, and reduction in cardiovascular risk factors will render the foot less susceptible to ischemia from macrovascular disease. Furthermore, to reduce the risk of vascular disease complications smoking cessation should be encouraged (ADA, 2004).

Patient and Family Education

Education is very useful component of people with diabetes to prevent DFU. Diabetic patients and those with high risk foot conditions should be educated about their risk factors and proper management (ADA, 2004). All diabetic patients and patients at risk must know the implications of the loss of protective sensation, the importance of foot monitoring on a daily basis, the proper care of the foot, including nail and skin care, and the selection of appropriate footwear (ADA, 2004; McIntosh, 2008). Inappropriate footwear is a major cause of diabetic foot ulcer (International working group on the diabetic foot, as cited in McIntosh, 2008). One study assessing the impact of poorly fitting footwear found that those who had developed a diabetic

foot ulcer were 5.1 times more likely to have been wearing poorly fitting shoes than those who were ulcer free (Nixon et al., as cited in McIntosh, 2008). Patients should be instructed to contact nurses if the patient identified any abnormalities (Lavery et al., 2007).

The patient's acceptance of these issues and their physical ability to do appropriate foot surveillance and care must be assessed. Patients should be instructed never to wear hosiery that is too tight and avoid elastic tops as these can reduce circulation into the foot (McIntosh, 2008). Patients with physical constraints, visual difficulties preventing movement or cognitive problems that impair their ability to assess the condition of the foot and to establish appropriate responses will need other people such as family members, to assist in their care. Patients at low risk may derive help from education on foot care and foot wear (ADA, 2004).

Annual Examination of the Foot

A physical examination of the feet must be performed by a health care professional at least annually in all people with diabetes. The physical examination of the feet includes neurological, vascular, dermatological, musculoskeletal and wound examination like assessment of the blood circulation and the sensation in the foot, examination for any skin changes and structural deformities of the foot (CDA, 2008; Frykberg et al., 2006). To identify high risk foot conditions, all patients with diabetes should accept an annual foot examination. A diabetes foot screening must be completed in order to assess the diabetic foot and assign a risk category. Vascular examination should be performed including palpation of pulses e.g., dorsalis pedis, posterior tibial, popliteal and femoral pulses, capillary refill time, venous refill time,

colour changes like cyanosis, and erythema, presence of edema, temperature gradient, dermal thermometry and presence of edema such as skin atrophy, nail atrophy, abnormal wrinkling and diminished pedal hair (CDA, 2008; Frykberg et al., 2006).

Patients must be checked by neurologic examination including measurement of vibration perception threshold, Semmes-Weinstein 10-gram monofilament to test light pressure, temperature perception, pain, and deep tendon reflexes. Also this includes dermatologic examination such as skin appearance e.g. color, texture, turgor, quality, dry skin. Moreover, patients with diabetes should be examined for calluses such as discoloration, sub callus hemorrhage, fissures, nail appearance e.g. dystrophic, atrophic, presence of hair, ulceration, gangrene, and infection and markers of diabetes e.g. skin spots, diabetic dermopathy. In addition, they have to be inspected for musculoskeletal deformities like hammer toes, charcot deformities, iatrogenic deformities, limited joint mobility and gait evaluation (CDA, 2008; Frykberg et al., 2006). If the wound develops, wound descriptions should cover wound location, wound dimensions including depth, edema, exudates, type, amount, odor, colour, signs of inspection and in duration. There are different methods commonly used to screen and assess diabetic peripheral neuropathy. The Canadian Diabetes Association (2008) suggests using 10-gram Semmes-Weinstein monofilament or 128-HZ for assessing neuropathy. Another study by Cornblath (2004) recommended that reflex testing, superficial pain testing, light touch perception, vibration testing, sympathetic skin response, quantitative sensory testing and nerve conduction studies should be used to assess diabetic neuropathy.

Screening for Peripheral Arterial Disease

Peripheral arterial disease is most easily detected by the ankle brachial index (ABI), which is the ratio of systolic blood pressure in the ankle divided by the systolic blood pressure at the arm (Singh et al., 2005). ABI of 0.90 or less suggests peripheral arterial disease, while higher than 1.1 may represent a falsely elevated pressure caused by medial arterial calcinosis (ADA, 2003; Reekers & Lammer, 2012). Moreover, palpation of peripheral pulses should be a routine component of the physical exam and should include assessment of the femoral, popliteal and pedal pulses like dorsalis pedal pulses and posterior tibial pulses. The diagnostic criteria for peripheral arterial disease based on the ABI are interpreted as follows: normal if 0.90-1.30; mild obstruction if 0.70-0.90; moderate obstruction if 0.40-0.69; severe obstruction if < 0.40 ; poorly compressible if > 1.30 (ADA, 2003). One large study found that the ABI was strongly related to the risk of foot ulceration (Boyko et al., 1999).

Interdisciplinary Team Approach

The maintenance of foot health in the person with diabetes is best achieved by a reliable, preventative strategy that is implemented with an interdisciplinary approach involving a team of specialists and personnel who provide a coordinated process of care (CDA, 2008). A few studies have assessed the role of foot expert as the main intervention in preventing diabetic foot ulcers. Among 91 diabetic persons with a healed pool ulcer, there were 20 ulcer recurrences in those randomized to podiatric care 32 in the control group after a median follow up of 386 days (Singh et al., 2005). In another trial of diabetic persons with neuropathy, 235

were randomized to receive podiatric care at least twice a year 263 to receive no podiatric treatment. During the study period, there was no difference in the incidence of foot ulcers, but the podiatric care group had fewer deep ulcers, infected ulcers and hospital admission days (Singh et al., 2005).

Daily Foot Care

Education about foot care must be provided to all people with diabetes and their families/caregivers. Daily foot care is necessary for preventing complications of diabetic neuropathy. Patients must be encouraged to inspect their feet daily for dry or cracking skin, fissures, plantar callus formation and signs of inspection between the toes and about the toenails. Application of topical ointments must be avoided between toes (Aring, Jones, &Falko, 2005). Diabetic person must be presented with information about routine self-care and monitoring of diabetes such as blood glucose control or meal planning. Patients with diabetes should be informed about daily examination of foot problems and when to ask for advice from a healthcare professional e. g. if any color change, swelling, breaks in the skin, pain, numbness and if self-care and monitoring is difficult (CDA, 2008). Patient also must avoid sources of possible trauma such as walking barefoot, cutting nails incorrectly, avoiding hot objects or chemicals such as hydrogen peroxide and iodine (McIntosh, 2008). Patients should be informed about the assessment of protective sensation and bony deformities to prevent DFU. Protective sensation is assessed by the 5.07 Semmes-Weinstein 10 gram nylon filament test and 10gram monofilament test (Aring et al., 2005). Prevention of inappropriate footwear is a major goal for all diabetes patients. Without loss of protective sensation individuals can select appropriate shelf

footwear. When foot deformities are present persons who have neuropathy or ischemia, should take extra care with the fitting of footwear (CDA, 2008) like type of shoes, light socks, patterns of wear on the lining and sole of the shoes, presence of foreign bodies in shoes and insoles (Frykberg et al., 2006).

Assessment of History of Previous Ulceration and Amputation

A diabetic patient with a history of previous ulceration or amputation is at increased risk for further ulceration, infection and subsequent amputation (Armstrong & Lavery, 1998). Patients must provide this information as a guide to the frequency of foot care visits (Frykberg et al., 2006). In other words, if they have a history of foot ulceration and amputation, they should pay more attention and receive more foot care visits. Patients must be asked that they have to do a daily foot inspection either by themselves or by a caretaker. They should also be asked whether they perform gentle cleansing with soap and water, followed by the application of topical moisturizers to help maintain healthy skin that can better resist breakdown and injury (Armstrong & Lavery, 1998). Educating patients about proper foot care and periodic foot examinations are effective interventions to prevent ulceration (Singh et al., 2005). Patient education regarding nail care and proper foot wear is crucial to reducing the risk of an injury that can lead to ulcer formation (Armstrong & Lavery, 1998). Other probably successful interventions include optimizing glycemic control, smoking cessation, intensive podiatric care and debridement of calluses (Singh et al., 2005).

Assessment of High Risk Conditions

Persons with diabetes must be educated concerning high risk foot conditions and proper management. Patients should be instructed that the hyperglycemia, impaired immunological responses, neuropathy and peripheral vascular disease are the main predisposing factors leading to limb threatening diabetic foot infections (Frykberg et al., 2006). Educating patients about the detection of the loss of protective sensation, daily foot check such as monitor the injury problems, the proper care of the foot as well as nail and skin care, feet should be looked at every day after a bath or shower and before putting on shoes and socks (ADA, 2004). A hand mirror is the most important way to check all areas of the foot. Good lighting and with eyeglasses on (if needed) must be performed in foot checks. Feel and look are two steps in foot checks (ADA, 2004).

Elevated foot pressure is an important risk conditions for foot complications (Lavery et al., as cited in RNAO, 2005). The plantar surface of the forefoot is found to be the most common location for the development of an ulcer (ADA, 1999). Pressure over bony prominences can lead to callus formation and in the absence of protective sensation may predispose the area of breakdown (Boyko et al., 1999; Hutchinson et al., 2000). Callus can act as a foreign body elevating plantar pressures and there is considerable reduction in pressure when the callus is removed Boulton et al., 1999; Muray, Young, Hollis, & Boulton, 1996 (as cited in RNAO, 2005). Patient must be encouraged about smoking cessation to reduce the risk of vascular disease complications (ADA, 2004).

Management of High Risk Conditions

Evidence of increased plantar pressure or people with neuropathy may be adequately managed with well-fitted walking shoes or athletic shoes. Patients should be well-informed on the implications of sensory loss and the ways to substitute other sensory modalities like hand palpation, visual inspection for surveillance of early problems (ADA, 2004). Callus can be debrided with a scalpel by a foot care specialist or other health professional with experience and training in foot care. People with bony deformities e.g., hammer toes, prominent metatarsal heads may need extra-wide shoes or shoes with depth. People with extreme bony deformities e.g., Charcot foot that cannot be accommodated in commercial therapeutic footwear may need custom-molded shoes (ADA, 2004).

Management of DFU

Successful management of diabetic foot ulcer in diabetic patients is as follows: Debridement, offloading (pressure relief), nail cutting technique, deformity, callus management, appropriate wound management, management of wound infection, management of PAD, management of ischemia, management of morbidities, surgical management, dressing, moisture balance and treatment and control of hyperglycemia (CDA, 2008; Frykberg et al., 2006).

Debridement

Debridement is the most chief part of wound management and is usually carried out with a scalpel. Removal of all necrotic tissue, peri-wound callus

and foreign bodies down to viable tissue, namely wound debridement, is needed. To reduce peri-wound pressure and decrease the risk of infection, proper debridement is necessary to impede normal wound contraction and healing. It reduces the bacterial load of the ulcer even in the absence of overt infection, restores chronic wounds to acute wounds and releases growth factors to aid the healing process (Kruse, 2006). A systematic review was conducted by Smith (2004) to determine the effectiveness of debridement methods for diabetic foot ulcers. Five randomized controlled trials were identified: three involved the use of hydrogels and two involved the use of sharp debridement (as cited in RNAO, 2005). The results suggest that hydrogels were significantly more effective than gauze or standard care in healing diabetic foot ulcers. However, sharp debridement has not been shown to be of significant benefit in promoting wound healing.

There are four types of debridement including autolytic, enzymatic, mechanical and surgical debridement. Naturally autolytic debridement occurs in a healthy, moist wound environment when arterial perfusion and venous drainage are maintained. Enzymatic debridement is commonly used as an adjunctive therapy in the management of chronic wounds. Mechanical debridement, as well as sharp debridement, wet-to-dry dressings and high pressure irrigation are the usual therapeutic measures. Surgical debridement is a key element and a cornerstone in the management of DFU (Frykberg et al., 2006). Removal of necrotic tissue extends as deeply and proximally as necessary until healthy, bleeding soft tissue and bone.

Offloading

The most effective method of offloading to heal a foot ulcer in patients' wheelchair or crutches are used to completely halt weight bearing on the affected foot. Total contact casts also significantly reduce pressure on wounds and have been shown to heal between 73% and 100% of all wounds treated with casts (Kruse, 2006). Total contact casts are used for deep or draining wounds, blind persons, morbidly obese, or severely vascularly compromised patients, but inappropriate application of total contact casts may result in new ulcer. Daily monitoring of wound infection, dressing changes and early detection of infection improve wound healing. A variety of ambulatory braces, splints, modified shoes and sandals can off-load the plantar surface or immobilize the foot and ankle (Cavanagh, Lipsky, Bradbury & Botek, 2005). One randomized controlled trial showed that total contact casting was effective in treating well vascularized non-infected plantar forefoot diabetic foot wounds. Healing rates range from 73% to 100% over a course of five to seven weeks (Armstrong et al., as cited in RNAO, 2005). However, it is important that patients with a diabetic foot ulcer recognize that pressure is the cause of their foot ulcer and that offloading is required whenever they are on their feet.

Nail Cutting Technique

Information on basic foot care as well as nail cutting technique, the treatment of minor injuries and buying of shoes must be given to the patient and caregivers. Nails must be cut after bath when nails are soft. Nails should not be cut too short or left protruding beyond the end of the toe. Patient must never try to cut out the corner of the nail or dig down the sides (Edmonds, 2006). Sensible shoes must be

made of soft leather and have broad rounded or squared toes, with a high toe box. The heels must be low to avoid excessive toe pressure on the fore foot. Shoes must be either fitted with laces or buckle straps to prevent movement within the shoe. Dry skin must be treated with an emollient such as E45 cream or Calmurid cream (Edmonds, 2006).

Deformity

Generally, before DFU occurs deformity must be known early and accommodated in properly fitting shoes. Foot wear can be divided into three broad types: Sensible shoes for patients with only minimal sensory loss; ready-made stock shoes, suitable for neuroischaemic feet that need protection along the margins of the foot but that are not greatly deformed (Edmonds, 2006); customized or bespoke shoes containing cushioned insoles that redistribute areas of high plantar pressure. In a systematic review of interventions to prevent diabetic foot ulcers, two randomized controlled trials on patient footwear were reviewed. One study found that type of shoe may be independently important, and that providing patients with normal well-fitting shoes that distribute abnormal pressures may also reduce ulcer risk (Mason et al., as cited in RNAO, 2005). The second study reported that evidence does not support widespread dispensing of therapeutic shoes and inserts for patients with diabetes and foot deformities. Patient education may be a more important intervention. However, for those patients who cannot be closely monitored (Reiber et al., as cited in RNAO, 2005), or who have severe deformities, specialized foot wear may be beneficial.

Callus Management

Patients must never cut their callus off or use callus removers. Instead, the callus must be removed frequently by the podiatrist to prevent DFU (Edmonds, 2006). Debridement of callus can significantly reduce pressure at the callus site by approximately 30% (Edmonds, Young et al., as cited in RNAO, 2005). Debridement of callus is within the nurses' scope of practice, assuming that the nurse has the knowledge, skill and judgement to perform this procedure (RNAO, 2005). A study found that among 78 diabetic persons, the mean size of plantar calluses decreased in direct proportion with the amount of time spent wearing running shoes. Similarly, high-risk persons, who visited podiatrists frequently every 3-4 weeks, had the lowest mean plantar pressure before and after callus removal (Singh et al., 2005).

Appropriate Wound Management

Usually, wound management is very important to treat DFU. Generally, a moist wound environment bandaged to protect it from trauma and local contamination has been shown to facilitate the healing process (Frykberg et al., 2006). According to the American Diabetes Association's Consensus Development Conference of Diabetic Foot Wound Care (1999), foot wounds in patients with diabetes should be treated for several reasons- improve function and quality of life, control infection, maintain health status, prevent amputation and reduce costs. Sterile normal saline 0.5% is regularly used and is often useful as a standard for wound care. The primary goal in treating chronic ulcer is to change it to an acute wound which will then possess the active matrix and cells needed for healing. Reassessment of the

complete treatment program is the first step in establishing a new directed approach (Frykberg et al., 2006).

Healing of foot wounds improves the appearance of the foot and may allow the patient to return to ambulation in appropriate footwear. Improving function and return to well-being are important goals of therapy (ADA, 1999; RNAO, 2005). With impaired mobility, foot wounds often lead to general reconditioning and psychosocial dysfunction. Tissue-engineered human dermal replacement and human skin equivalent containing the characteristics of dermis or both dermis and epidermis, respectively. Hyperbaric oxygen (HBO) and other alternative or unproven technologies are occasionally used in the management of diabetic foot wound (Frykberg et al., 2006).

Dressing

Simple gauze dressings are frequently used by clinicians; there are new forms of dressings available too. Alginate, foam, hydrogel, and hydrocolloid dressings have been developed, and are provided on the basis that wound exudates and level of wound hydration necessary. Do not use skin cleansers or antiseptic agent's e.g. povidone, iodine, hydrogen peroxide to clean wounds with healthy, granulation tissue. To clean wounds use normal saline, sterile water or non-cytotoxic wound cleansers. Fluid used for cleansing should be warmed to at least room temperature. The wound should be gently irrigated with 100 to 150 ml of solution. Without causing trauma to the wound bed use enough irrigation pressure to enhance wound cleansing (Frykberg et al., 2006).

Management of Infection

Usually poly microbial is a limb-threatening diabetic foot infection. Particularly, oral antibacterial agents can be treated with mild infections with limited ulcer. Several antibacterials have been shown to be successful in clinical trials including cefalexin, clindamycin, ciprofloxacin, ofloxacin, levofloxacin, pexiganan and linezolid (Edmonds, 2006). A study analyzed biopsies from twelve diabetes patients with chronic ulcers and compared them to control biopsies from surgical wounds of patients without diabetes (Galkowska et al., as cited in Simms & Ennen, 2010). The researchers found that the diabetic biopsies showed decreased angiogenesis and extravasations of leucocytes in the tissues surrounding the ulcers compared to the controls. Both of these problems, inhibited angiogenesis and decreased leucocytes in diabetic wound tissues contribute to an increased likelihood of infection. Another study, stated that friable tissue, wound undermining, foul odour and ischaemia are the signs and symptoms of infection (Cavanagh et al., as cited in Simms & Ennen, 2010). It is recommended that patients with diabetic foot ulcer without infection should be educated about these signs and symptoms of infection to receive prompt treatment.

Non limb threatening infections. Ulceration does not need to be present since non-limb threatening infections can result from small puncture wounds, scratches, trauma or heel cracks (Sibbald et al., as cited in RNAO, 2005). Mild to moderate infection can usually be managed on an outpatient basis under close supervision by the medical practitioner. Topical antimicrobials can be used to reduce bacterial burden in superficial infections. There are several iodine and silver

preparations now available that are safe, effective and economical. Systemic antibiotics may be prescribed by the physician or the registered nurse.

Limb threatening infections. Fever, edema, lymphangitis, hyperglycemia, leucocytosis, and ischemia are the cardinal signs of infection (Frykberg et al., 2006). A patient presenting with wet gangrene, deep abscesses, and advancing cellulitis must be transferred to a medical facility for urgent care. Hospitalization is required in order to treat the infection as well as the systemic sequelae (Lepantalo et al., 2011; RNAO, 2005). Patients with poor vascular status and deep infections may require vascular surgery and infectious disease consultation. Urgent surgical intervention may be required. Although many wound drainage procedures can be done at the bedside for patients with diabetic ulcers, most need thorough debridement in the operating room (Frykberg et al., 2006). Even the sickest of patients should be considered for emergent incision, drainage, and debridement procedures since their illness is directly attributable to the severity of their infection. Life threatening infections necessitate immediate surgical attention and such procedures should not be delayed while waiting for radiologic or medical workup of other co-morbid conditions (CDA, 2008; Frykberg et al., 2006; RNAO, 2005).

Management of Peripheral Arterial Disease (PAD)

Peripheral arterial disease indicates high risk for other cardiovascular disease as well as coronary artery disease and stroke. So, medical management of PAD includes all the measures routinely suggested for CVD risk reduction, smoking cessation, optimal glycemic control, treatment of hypertension, use of an anti-platelet agent, use of lipid-lowering drugs, and exercise (CDA, 2008; Gey, Lesho, &

Manngold, 2004). Smoking cessation and a supervised exercise program are the two most important interventions in the treatment of symptomatic PAD. All patients with diabetes and PAD must receive regular preventive foot care including nail cutting techniques, the treatment of minor injuries, and the purchase of shoes to reduce the risk of rising DFU and amputation (CDA, 2008; Edmonds, Wilson, & Foster, 1999). Patients with peripheral arterial disease should be actively discouraged from smoking. All available guidelines to help patients stop smoking including nicotine replacement therapy and counseling should be used (Gey, Lesho, & Manngold, 2004; Regensteiner & Hiatt, 2002).

Hypertensive patients with PAD should be treated to reduce their blood pressure. A meta-analysis and critical review concluded that beta-adrenergic antagonists are safe in patients with PAD, except in those most severely affected (Gey, Lesho, & Manngold, 2004; Scottish intercollegiate guidelines network, 2006). Lipid lowering therapy with a statin is suggested for patients with peripheral arterial disease and total cholesterol level > 3.5 mmol/l (SIGN, 2006). Optimal glycemic control is recommended for PAD and diabetes in order to reduce the incidence of cardiovascular events (Gey, Lesho, & Manngold, 2004; SIGN, 2006). Obese patients with PAD should be treated to reduce their weight (SIGN, 2006). Antiplatelet therapy is recommended for patients with symptomatic peripheral arterial disease. Ankle brachial pressure index should be measured in all patients suspected of peripheral arterial disease. Measurement of ankle brachial pressure index should be taken by properly trained practitioners who should try to maintain their skills (SIGN, 2006). A diabetic patient with evidence of peripheral arterial disease may benefit from anti-

platelet agents: 75mg aspirin daily, or if this cannot be tolerated, clopidogrel 75mg daily (Gey, Lesho, & Manngold, 2004; Edmonds, Wilson, & Foster, 1999).

Management of Co-morbidities

Diabetes is a multiorgan systemic disease, and co morbidities should be assessed and managed via a multidisciplinary team approach for optimal outcomes. Patient agreement has been identified as an important factor in the expected prognosis and the prevalence of both ulceration and limb loss (Frykberg et al., 2006). Many systemic manifestations affect wound healing. Among the most common co-morbidities are hyperglycemia and vascular diseases such as cerebral vascular accidents, transient ischemic attacks, myocardial infarctions, angina, renal dysfunction, hypertension and hyperlipidemia (Frykberg et al., 2006). A prospective study in the United Kingdom reported that optimal treatment of hypertension results clinically important reductions in micro vascular and macro vascular complications and diabetes related death (CDA, as cited in RNAO, 2005). Individuals with co-existing hypertension have a five-fold increased risk of developing peripheral vascular disease and therefore are at increased risk for amputation, compared to normotensive individuals with diabetes (Royal Melbourne Hospital, as cited in RNAO, 2005).

Moisture Balance

Dressing selection should promote a moist wound environment that minimizes trauma and risk of infection. Selection should be based on the wound to provide local moisture balance. Modern, moist interactive dressings used for diabetic foot ulcers include foams, calcium alginates, hydrogels, and adhesive membranes

(Inlow et al., as cited in RNAO, 2005). The following consideration should be given when choosing a moist wound dressing for a diabetic foot ulcer: assess the wound bed for bacterial balance, exudates level and the need for debridement; select a dressing or combination of dressings that can manage and control the above wound environment; use a dressing that will keep the wound bed continuously moist and the peri-wound skin dry; choose a dressing that controls exudate but does not dry the ulcer bed; consider the caregiver's time when selecting a dressing; eliminate wound dead space by loosely filling all cavities with dressing material; assure that the patient is aware that there is to be reduced pressure to the affected area; and evaluate the wound frequently to determine efficacy of treatment plan (Sibbald et al., as cited in RNAO, 2005)

Treatment and Control of Hyperglycemia

Efficient glycemic control is very essential in the management of DFU. It is well established that hyperglycemia may increase the risk of diabetes related complications especially arterial disease, neuropathy, and increased risk of infection (UKPDS, 1998). The International Diabetes Federation (2005) global guidelines inform people with diabetes should maintain blood glucose levels, as measured by the HbA1c test, below 6.5%. The HbA1c test provides a measure of glycosylated hemoglobin in the blood over a period of time, usually 2-6 monthly intervals. A randomized single-blind study was performed with the application of a bioengineered human dermal derma graft (Marston et al., as cited in Simms &Ennen, 2010). In this study, the researchers analyzed the effect of HgbA1c levels on wound healing as a variable. The researchers found that decreased HgbA1c level was significantly

attributed to ulcer healing while using dermagraft, but increased HgbA1c levels during treatment with dermagraft were associated with poorer outcomes of wound healing.

Begum (2010) reviewed a literature and concluded that 3 D's i.e., "Diet, Drug, and Discipline" are three principles for management of diabetes. Use of combination therapy like drug therapy, dietary therapy and exercise can reduce hyperglycemia. Encourage the patient about diet control to control glycemia. Diet is the first principle to be followed by diabetic patients. The diet will be healthy but low in fat, sugar, and salt, high in fruit and vegetables and moderate in bread, potatoes, cereals, pasta and rice (McIntosh, 2006). Exercise is very important to control glycemia. Exercise increase the cells sensitivity to insulin, improve blood glucose control, decrease hypertension, and improve lipid metabolism. A comprehensive physical activity routine includes three kinds of activities: aerobic exercise, strength training anaerobic exercise and flexibility exercise (Begum, 2010).

Existing Evidence-based Guidelines for Prevention and Management of DFU

A search from databases such as CINHALL, PubMed, Science Direct since 1999-2012 was performed. Three existing guidelines related to prevention and management of DFU was found. They are presented as follows.

Nursing Best practice Guideline on Assessment and Management for People with Diabetes

The Registered Nurses' Association of Ontario (RNAO)'s nursing best practice guidelines statements were systematically developed to assist nurses and patients in decision-making about appropriate healthcare (RNAO, 2005). This guideline has been developed to address the question of how to assess and manage patients with established diagnosis of diabetic foot ulcers. The intention is to offer nurses, and other healthcare providers to perform evidence-based practice.

They recommended six areas of practice for the assessment and management of foot ulcers for people with diabetes with clear delineation of the level of evidence used to guide each recommended statement. These areas are formed as components that include patient empowerment and education, holistic assessment, foot ulcer assessment, identifying goals of care, management of systemic, local, and extrinsic factors, and evaluation. Firstly, patient empowerment and education is a foundation in the care of all patients with DFU or caregivers should have an understanding of their condition and the resources available to optimize their general health, diabetes management and ulcer care. Nurses should have knowledge about concept of patient empowerment and be able to empower them. They must also know and then educate these patients to perform preventive measures, identify potential risk factors and manage identified risks.

Secondly, holistic assessment requires nurses having knowledge and capability in assessing all aspects of the patient's feet including vascular status, signs and symptoms of infection, diabetic neuropathy (DNP), as well as foot deformity and pressure. Thirdly, nurses must know how to assess and record the characteristics of

the ulcer. Nurses have to identify the location, length, width, depth and classify the ulcers and assess ulcer bed, exudate, and odour and peri ulcer skin. Fourthly, nurses must know and practice in identifying goals of care in mutual agreement with the patient and family. Next, in order to successfully achieve the goals once DFU develops, nurses must be able to identify and manage systemic, local, and extrinsic factors that can promote wound healing. Finally, nurses must know what to evaluate and perform comprehensive evaluation in order to determine the impact and effectiveness of the treatment plan reassess for additional correctable factors if healing does not occur at the expected rate and consider the use of biological agents, adjunctive therapies and surgery if healing does not occur at the expected rate.

Clinical Practice Guidelines for the Prevention and Management of Diabetic Foot Ulcer

This clinical practice guideline for the prevention and management of diabetic foot ulcer was initially developed by the Saskatchewan Health Quality Council and published in (2008). This guideline provides evidence-based guidance for general patterns of practice and not to necessarily dictate the care of a particular patient. It is also intended for use by all healthcare professionals for the adult population with diabetes. An interdisciplinary approach should be used for the prevention and management of diabetes foot complications. It is recognized that each healthcare professional brings a different level of knowledge/expertise to this area. The prevention and treatment of diabetic foot problems includes the following: annual inspection of the foot, identification of the foot at risk, education of people with diabetes and healthcare professionals, appropriate footwear and rapid treatment of all

foot problems. Education is an essential element in the empowerment of people with diabetes, helping to develop an effective partnership between healthcare professionals and the individual, which is key to achieving effective care.

Diabetic Foot Disorders: A Clinical Practice Guideline

This clinical practice guideline was initially developed by the Clinical Practice Guideline Diabetes Panel of the American College of Foot and Ankle Surgeons in 2000 and the revision was made and published in 2006. This guideline focuses on three major foot complications: diabetic foot ulcers, diabetic foot infections, and the diabetic charcot foot. It is aimed to offer guidelines to multidisciplinary team members. Six clinical pathways were included: Pathway ≠ 1: Assessment of the diabetic foot disorders, Pathway ≠ 2: Diabetic peripheral arterial disease, Pathway ≠ 3: Diabetic foot ulceration, Pathway ≠ 4: Diabetic foot infections, Pathway ≠ 5: Diabetic charcot foot (neuropathic osteoarthropathy), and Pathway ≠ 6: Surgical management of the diabetic foot.

In summary, all three guidelines have quite similar major contents. However, The RNAO's nursing best practice guideline on assessment and management of foot ulcers for people with diabetes was considered most appropriate to guide this present study with the following reasons. Firstly, it is targeted for nurse users and includes major nursing contribution in diabetic foot care that other two guidelines do not have. For example, patient empowerment and education is considered important for nurses. So, the practice recommendations offered under those content areas are considered much appropriate for nurses. Secondly, it offers clear evidence support at each recommendation statement by providing the

information regarding level of evidence so that nurses can make decision whether they would choose for their patients. Thirdly, it also offers strategies to implement the guideline effectively. Although this present study was not aimed at implementing this guideline for practice, its structure and contents were considered appropriate to further develop the questionnaires regarding nurses' knowledge and nurses' practice in the prevention and management of DFU.

Current Situation Regarding DFU Care in Bangladesh: Nursing Education and Practices

In Bangladesh, the Directorate of Nursing Services under the Ministry of Health and Family Welfare employs the majority of practicing nurses. Approximately, 22,000 nurses registered with the Bangladesh Nursing Council. About 15,000 nurses work in the public sector, 3,000 in the private sector, and 3,000 overseas (World Health Organization, 2009a). As of 2005, the comparable nurse/population ratio was 1: 6,400 (World Health Organization, 2009b). Thirty-eight public and five private training institutes provide training towards a 3-year diploma in general nursing and a 1-year diploma in midwifery/orthopedic nursing. According to the World Health Organization's report, the annual intake of students is 1,135, based on a central admission system (World Health Organization, 2009a).

A College of Nursing affiliated to the University of Dhaka traditionally offered a 2-year post diploma programme leading to the Bachelor of Science (BSc) (Akhter, as cited in Berland, Richards, & Lund, 2010). After 2007, the government allowed five more government funded nursing institutions to offer a Bachelor of Science in Nursing programmes. Currently, a master's level education in nursing is

not available in Bangladesh (Berland et al., 2010). For diploma and bachelor degree curricula, as well as the currently implemented BSN curriculum, only limited contents regarding foot care are offered.

Similarly, very limited information and nursing research on prevention and management of diabetic foot ulcer strategies are available in Bangladesh. Even though it is available, its use by nurses may be limited due to limited accessibility. Most nurses utilize their personal clinical experience to prevent and manage of diabetic foot ulcers. There are not available in-service education and training programs for nurses in Bangladesh on the prevention and management of diabetic foot ulcer. Current situation in Bangladesh, diabetic patients and patients with DFUs are increasing day by day in hospitals and the incidence of DFU is present among them. Nurses provide both general and diabetic foot ulcer care for diabetic patients. Based on the researcher's experience, nurses are accountable for providing appropriate general care, such as administering medication, maintaining diet, assisting in investigation, receiving admitted patient, checking vital signs. In addition, nurses provide diabetic foot ulcer care, such as wound assessment, wound dressing, as ordered by surgeons, nutritional support and maintain blood sugar. But, the researcher found that Bangladeshi nurses do not know how to detect loss of protective sensation of the feet by using Semmes-Weinstein monofilament and assessment of DFU. Nurses do not have adequate knowledge and skills in care of callus formation to prevent DFU. They do not instruct the patients with DFU to perform activity of daily living in order to self manage their foot ulcer. Nurses cannot setting a goal for prevention of amputation once the DFU is healed. They never check the pulses on the legs and the feet of diabetes patients.

On the other hand, standard nursing guidelines in prevention and management of DFU are not available nowadays. Furthermore, the nurse-patient ratio is 1: 15 that is against international standard for 1: 4 (Arju, as cited in Islam, 2010). Therefore, the adequate proportion of nurses and patients would affect quality of nursing. It is recognized that nurses' knowledge and skills based on evidence-based practice are essential to prevent and manage of DFU. Moreover, most nurses in Bangladesh graduated in the diploma degree followed by bachelor degree in which contents of prevention of DFU has not been specifically included in those curricula. Although, nowadays diabetes control training programs organized by the government are available, the contents of these training programs are not specific to prevention and management of DFU. Currently, there is no such kind of research in Bangladesh to examine the nurses' knowledge and practice regarding prevention and management of DFU. Hence, researcher is alert that there is a need to examine the existing nurses' knowledge and practice regarding prevention and management of DFU.

Research Evidence Related to Nurses' Knowledge and Nurses' Practice Regarding Prevention and Management of DFU

This section reviews the literature related to nurses' knowledge and their practices regarding prevention and management of DFU.

Nurses' Knowledge Regarding Prevention and Management of DFU

Nurses' knowledge regarding prevention and management of DFU is based on the hypothesis about what nurses should know and value to provide a high

quality of care for patients suffering from DFU and nurses can perform many evidence-based interventions for prevention and management of DFU (CDA, 2008; RNAO, 2005). Adequate teaching offered by nurses is very useful component for people with diabetes, helping to build up an effective partnership among healthcare professionals and the individual, which is key to achieving effective care (CDA, 2008). Thus, it is important to explore whether nurses have adequate and accurate knowledge to do so. In Hong Kong, a cohort study was conducted to examine the registered nurses' level of diabetes foot care knowledge (Shiu & Wong, 2011). The plan of this study was to build up registered nurses' ability in diabetes care. Sixty RNs had attained a bachelor degree or above and their mean age was 33 years old. Thirty-seven RNs had never received any training in diabetes foot care knowledge and twenty-two RNs (34%) had been working in diabetes care specialty in Hong Kong. Interestingly, registered nurses with and without work experience in diabetes care had similar knowledge scores and those with prior training in diabetes foot care scored higher than those without it. The finding signifies that training may have a higher impact on the development of knowledge than work experience (Shiu & Wong, 2011).

Stolt et al. (2010) conducted a literature review and synthesized knowledge from 35 articles, published between 1980 and January 2008. Here, only two main findings are presented: nurses' knowledge of foot care and nurses' foot care activities. They found that nurses' knowledge of foot care has been seldom studied and the findings varied. Some had knowledge and some were lacking; for example, toe nail cutting that they lacked of knowledge and lacked of experience in cutting. Regarding whether providing educational programs for nurses would improve their knowledge, they found two studies reporting significant improvement in knowledge at

posttest and at 12 months when compared with pretest. Similar to studies on nurses' knowledge, only a few studies investigated nurses' foot care activities or nurses' practices. Although nurses recognized the need for foot care, they were uncertain about their role and reported lack of assessment skills. After receiving educational programs, nurses' competence and confidence in foot hygiene assessment and toenail clipping improved (Stolt et al., 2010). The findings of this study offer ground rationale to explore nurses' knowledge and nurses' practice, so that diabetic foot care knowledge and skills initiatives can be further developed.

In Bangladesh, there is no known published study with nurses. The only accessible research evidence is Begum's study (2010). Begum studied knowledge and practice of prevention of foot ulcer among patients with diabetes mellitus. Her findings do indirectly imply that nurses may not offer adequate knowledge for patients. It is then worth to further investigate if nurses have knowledge to teach their patients with diabetes mellitus.

Nurses' Practice Regarding Prevention and Management of DFU

Nurses are the key persons and a provider of prevention and management of DFU in hospital setting. They assess DFU and arrangement to decrease the DFU appropriately by using the available resources and facilities, and evaluate the effectiveness of their actions and interventions (RNAO, 2005). Efforts have been made to help nurses working with patients with diabetes be able to assess and manage foot ulcers. The RNAO diabetic foot care best practice guidelines was developed and disseminated for nurses in Canada (RNAO, 2005). Ritchie and Prentice (2011) conducted a qualitative study to examine nurses' perceptions

regarding the implementation of a best practice guideline (BPG) on the assessment and management of foot ulcers for people with diabetes. Three focus groups and one individual interview involving 14 nurse participants were conducted. The participants were asked if and how implementing the RNAO BPG had worked for them. It was revealed that implementing the RNAO BPG had changed their practice, particularly, foot assessment. As the RNAO BPG itself is complex, they suggested providing educational sessions at orientation and at 6-month intervals. In addition, they perceived that after implementing this BPG, prevention and health teaching were promoted. Positively, its implementation was also perceived to have positive effects on patient outcomes (wound healing) as well as team working.

Foot problems and foot care should be most concerned when nurses are caring for patients with old age. This is because foot problems delay older people to perform basic activities of daily living and are significant predictors of falls in this group of population (Menz, Morris, & Lord, as cited in Stolt et al., 2010). Nurses should have evidence-based knowledge about key areas and how to deliver care in several areas with chronic diseases. Hence, nurses functioning in a variety of roles are involved in the treatment and management of patients with diabetes and its familiar complications such as hypertension, hyperlipidemia and cardiovascular disease (CVD). In the UK, the roles of registered nurses are expanded and that they should maintain their professional knowledge and competence about DFU throughout their working life. In addition, in the UK health care delivery system, nurses adopt the new role to be nurse prescribers, particularly those who are working in primary care setting (Carey & Courtenay, 2010). Similar to this present study's focus, if their role is to be

expected, their knowledge, practice, and continuing professional development needs should be investigated.

In the US and Canada, a large survey was conducted in 692 clinical nurses (Ayello et al., as cited in McIntosh & Ousey, 2008). Ayello et al. found that 70% of nurses reported that they did not have sufficient knowledge on chronic wound care from their basic nursing education. Similar to nurses' knowledge, there is no known study to what extent Bangladeshi nurses have practiced for prevention and management of DFU. Therefore, an exploration to this phenomenon would offer an evidence to further improving DFU condition in Bangladesh.

Summary

In summary, DFUs are the most common foot injuries leading to lower extremity amputation. Every year 2.5% diabetic patients developed foot ulcer. Diabetic foot problems are common throughout the world and the economic consequences are major, both to society and to the patients and their families. Several risk factors influence the development of DFUs that includes peripheral neuropathy, peripheral arterial disease, foot injury, foot infection and past foot health history. The prevention of DFUs include optimal diabetes management, patient and family education, daily foot care, annual examination of the foot, interdisciplinary team approach, screening for peripheral vascular disease, assessment of history of previous ulceration and amputation, assessment of high risk conditions and management of high risk conditions. Management of diabetic foot ulcer includes debridement, offloading (pressure relief), nail cutting technique, deformity, callus management,

appropriate wound management, management of wound infection, management of PAD, management of ischemia, management of morbidities, surgical management, dressing, moisture balance and treatment and control of hyperglycemia

Nurses' proper knowledge and practice can delay, reduce or prevent the development of foot ulcer of diabetic patients. The RNAO's nursing best practice guideline is used to guide by area of nurses' knowledge and practice. Nurses must acquire the recommended knowledge and practice including patient empowerment and education, holistic assessment, foot ulcer assessment, identifying goals of care, management of systemic, local and extrinsic factors and evaluation. The RNAO suggests that nurses should provide education for the enhancement of foot care knowledge. Nurses' sufficient knowledge about optimal diabetes management, annual examination of the foot, daily foot care, risk identification, prevention of high risk conditions and appropriate foot wearing can prevent DFU.

Nurses' adequate skills are required to achieve such activities as nail, corn, and callus care to establish prevention and management of DFU. Adequate practice can contribute to modify neuropathy symptom score (NSS) including assessment using a Semmes Weinstein 10-gram monofilament, and assessment of sensitivity and vibration perception, big-toe flexion, foot deformities, dry cracked skin and loss of hair. Nurses' practices such as dermatologic examination, assessment of foot pressure, deformity, gait, footwear and use devices can prevent DFU. Nurses' adequate practices such as debridement, how to use offloading, nail cutting technique, identify foot wear, callus management, appropriate wound management, dressing, control of infection, proper PAD management, management of co-morbidities, moisture balance, and treatment and control of hyperglycemia can manage DFU.

At present, nursing practice regarding prevention and management of DFU in Bangladesh is based on nurses' experiences and their clinical assessments. Standard nursing guidelines in prevention and management of DFU are missing in Bangladesh.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter describes the research design, setting, population and sample, sampling technique, research instrumentation, ethical considerations, data collection procedures and data analysis.

Research Design

A descriptive, cross-sectional study was conducted to identify the nurses' knowledge and their practices regarding prevention and management of diabetic foot ulcer.

Setting

The study was conducted at Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, which is a 2,500-bed public multidisciplinary and medical college hospital, located in Dhaka, Bangladesh. Daily, over 3,000 patients attend the outpatient departments of the hospital. BIRDEM provides comprehensive healthcare services including primary, secondary and tertiary level of care. The usual routine services include regular diabetes checkup, prescribing medication and sometimes health education is provided by a nurse or physician to respond to the patient's and family's needs. Initially, this hospital provided primary services with diabetes patients but day-by-day it improves its services and expands these services to cover other groups of patients as well. It

provides advanced medical care such as kidney transplantation and dental implant. There are 28 different wards of the hospital. These 28 wards cover all areas of specialty.

Population and Sample

The population of this study was nurses working in the Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital. A total of 480 nurses were working in this hospital. Nurses who have a minimum of diploma degree in nursing and have at least three months of working experience in this hospital were recruited in order to ensure that they have exposure in caring for patients with diabetes.

Sample Size

The samples were randomly drawn from the target population. The sample size was estimated by using the following formula (Yamane, as cited in Akhter, 2010).

$$n = \frac{N}{1 + Ne^2}$$

N= Total number of Nurses (480) in BIRDEM hospital, Dhaka.

E= error estimation (this study used .05)

$$n = \frac{480}{1 + 480 \times (.05)^2}$$

$$n = \frac{480}{1 + 1.2}$$

$$n = \frac{480}{2.2}$$

$$n = 218$$

An additional 5% of a total required number was established and rounded up to be 230 in order to overcome non-response subjects. There were two hundred eighteen completed returned questionnaires yielding a response rate of 94.78%.

Sampling Technique

Simple random sampling was used to select the subjects from the above target population. In order to quantify and randomly select subjects from each ward, the researcher calculated the number of subjects based on the total number of nurses working in each ward by using the following formula

$$n_a = \frac{\text{Total number of nurses of a ward} \times 230}{480}$$

Research Instrumentation

Instruments

A set of questionnaires was developed for use in the study. Three parts of the questionnaires were Part I: Demographic Data Form, Part II: Nurses' Knowledge Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NKPM-DFUQ), and Part III: Nurses' Practice Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NPPM-DFUQ). The details of each part were explained as following.

Part I: Demographic Data Form. This 9-item data collecting form assessed the subjects' demographic data including age, gender, religion, level of nursing education, marital status, short course training on foot ulcer care or diabetic foot care, current area of practice, and duration of practice with patients with DM and whether they have taken care of patients with diabetic foot ulcers.

Part II: Nurses' Knowledge Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NKPM-DFUQ). This questionnaire was used to examine the level of nurses' knowledge regarding prevention and management of DFU. The questionnaire was designed using the RNAO's structure of recommendations for assessment and management of DFU in integration with related literature on diabetes, prevention and risk management of DFU. The NKPM-DFUQ has six components composing of (1) patient empowerment and education, (2) holistic assessment, (3) foot ulcer assessment, (4) identifying goals of care, (5) management of systemic, local and extrinsic factors and (6) evaluation. It comprised of 40 items divided into two sets. In the first set, twenty true-false items were constructed. If the subjects did not know the answer, they selected "Don't Know" option. The second set comprised of twenty multiple-choice items with 5 options for each item. The correct answer of each item was scored "1" and "0" for incorrect and "Don't Know" responses (Appendix B). The total score ranged from 0 to 40 and were transformed to percentage. The higher scores indicated the higher level of knowledge. For interpretation, the transformed scores were categorized into the following five categories (McDonald, as cited in Basak, 2010).

Composite Percent Score (%)	Level of Knowledge
<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 III: Nurses' Practice Regarding Prevention and Management of Diabetic Foot Ulcer Questionnaire (NPPM-DFUQ). This questionnaire was used to investigate the level of nurses' practice regarding prevention and management of DFU. Its structure is similar to that of the NKPM-DFUQ being composed of six components, and 30 items. The questionnaire was rated on a 5-point Likert scale ranging from 0-4, where 0 = never practiced, 1 = seldom practiced, 2 = sometimes practiced, 3 = practiced most of the time, and 4 = practiced all the time. The total scores ranged from 0-120 and were transformed to percentage. The higher scores indicated the higher level of practice. The interpretation of the transformed scores of the total practice score was the same as that of the knowledge scores.

Translation of the Instruments

The original instruments were developed in English language, and then they were translated into Bangla language with the help of three bilingual experts (Appendix E). The first translator translated the original English version instruments to Bangla version, and then the second translator translated the Bangla version

instruments to English version. The third translator compared the two English versions (the original and the translated English versions) to see the consistency and appropriateness of the meaning of the instruments. Finally, it was found that there was consistency between the original English version instruments and the translated English instruments. The instruments were then used for reliability test, then actual data collection.

Validity and Reliability of the Instruments

Validity. The instruments: NKPM-DFUQ and NPPM-DFUQ were developed for this study in the light of the healthcare context of Bangladesh and an understanding of the researcher's major advisor, who has been working with nurses in Bangladesh for approximately 7 years. Further, the content validity of the questionnaires was validated by three experts who were nurse educators of Faculty of Nursing, Prince of Songkla University. All of them were experts in diabetic care. Two of them worked with Bangladeshi nurses as well, so they understand the healthcare context of Bangladesh. The experts assessed the validity of the questionnaires, structure, and the appropriateness of the language use. The questionnaires were finalized on expert's recommendations.

Reliability. For reliability, the NKPM-DFUQ and the NPPM-DFUQ were tested with 20 nurses, who had the same characteristics as subjects in the actual study but not included as study sample. The reliability was tested for internal consistency reliability, using KR-20 coefficient, and the test-retest reliability using intraclass correlation coefficient or ICC. For the NKPM-DFUQ, KR-20 and ICC were used to determine internal consistency and stability, yielding the values of .64 and .78,

respectively. The stability reliability of the NPPM-DFUQ yielded the ICC of .89. The reason to choose only the stability reliability for the NPPM-DFUQ was that it was not a measure of conceptual construct. A test of stability reliability was considered appropriate.

Data Collection Procedures

The data collection procedures consisted of two phases: preparation phase and implementation phase.

Preparation Phase

After getting written permission from the Research Ethics Committee of Faculty of Nursing, Prince of Songkla University, then the researcher met and submitted application to the Director of the BIRDEM Hospital for asking permission to collect data. After obtaining permission from the Director, the researcher met the nursing superintendent of the Nursing Department; the researcher was then introduced to the ward in charge of every ward followed by introducing to the nurses in order to obtain volunteer nurses to participate in the study.

Implementation Phase

1. The researcher contacted the eligible subjects, introduced herself and explained the purpose of the study.
2. The researcher explained and provided the informed consent form (Appendix A) to every volunteered subject before distributing the questionnaires to

ensure that subject's rights were strictly maintained. Some subjects who did not sign the informed consent form but still willing to join the study, they would receive the questionnaires.

3. The volunteered subjects received the questionnaires after they signed the informed consent form or if some of them did not give the informed consent right away, the researcher allowed them to think and informed them that their returned questionnaires without signature on the informed consent form could be used as a consent.

4. The researcher requested the subject to complete the questionnaire in one week, and then the researcher checked the completeness of the returned questionnaires.

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

Ethical Considerations

The permission for data collection was obtained from the Research Ethics Committee, Faculty of Nursing, Prince of Songkla University (PSU), Thailand and from the Director of Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, Bangladesh. Finally, the invitation letter and consent form were distributed to the selected subjects for seeking their willingness to participate in the study. The identity of the subjects was anonymous by using codes instead of their names to ensure confidentiality and

anonymity. The researcher ensured the subjects that they were allowed to withdraw from the study at any time, if they wanted.

Data Analysis

Data from the questionnaires were coded and entered into the statistical analysis software to form a dataset. Each variable in the dataset was screened for correctness of data entry using frequency distribution and outlier identification. Errors were cleaned prior to the actual data analysis.

The nurses' knowledge scores (from the NKPM-DFUQ) and the nurses' practice scores (from the NPPM-DFUQ) were transformed to percentage by using the following formula: $\text{Transformed score} = \text{Actual score} \times 100 / \text{Total score}$.

Descriptive statistics was used to describe the demographic variables, the nurses' knowledge scores, and the nurses' practice scores. Categorical variables including gender, religion, level of nursing education, marital status, short course training regarding DFU/FU care, current area of practice, and taken care of DFU patients were described in frequency and percentage. Continuous variables including age, duration of practices with patients with DM, the nurses' knowledge scores, and the nurses' practice scores were described using minimum and maximum scores, mean scores and standard deviation.

In addition, post-hoc item analysis of the nurses' knowledge and nurses' practice regarding prevention and management of DFU was done in order to identify certain areas that the subjects may lack in knowledge and improper practice. Also additional analyses were conducted in an exploratory manner in order to

examine if some subjects' demographic variables could help explain the phenomena under this investigation.

CHAPTER 4

RESULTS AND DISCUSSION

The purpose of this chapter is to present the results of the study and to discuss the findings of each research question. The results and discussion of the study are presented as the following headings.

1. Nurses' Demographic Characteristics
2. Nurses' Knowledge Regarding Prevention and Management of DFU
3. Nurses' Practice Regarding Prevention and Management of DFU
4. Additional Analyses

Results

Nurses' Demographic Characteristics

The demographic characteristics of the nurses are presented in Table 1. The majority of the subjects were female (96.3%). The mean age of the subjects was 32.11 years (SD = 6.37), ranging from 23 to 53 years. More than half of them were Muslim (60.1%). For the educational level, most of them (97.2%) completed diploma degree and only one nurse completed master's degree. The majority were married (82.6%). All of them had never received any training regarding prevention and management of diabetic foot ulcer. Surgical (33.9%) and medical (25.2%) areas of practice comprised three-fifths of the subjects. The average years of duration of

working was 8.03 (SD = 5.82), ranging from 1-27 years. The majority of them indicated having taken care of patients with diabetic foot ulcer (98.2%).

Table 1

Nurses' Demographic Characteristics (N=218)

Characteristics	n	%
Age (years): M = 32.11, SD = 6.37, Median (IQR) = 30(10), Min-Max = 23- 53		
Gender		
Female	210	96.3
Male	8	3.7
Religion		
Islam	131	60.1
Hindu	48	22.0
Christian	38	17.4
Buddhist	1	0.5
Level of nursing education		
Diploma in nursing	212	97.2
B.Sc. in nursing	5	2.3
Master of nursing	1	.5
Marital status		
Married	180	82.6
Single / Separate	38	17.5
Area of Practice		
Surgical	74	33.9
Medical	55	25.3
Orthopedic	12	5.5
Others (CCU, ICU, Urology)	77	35.3

Table 1 (Continued)

Characteristics	n	%
Duration of practice (years)		
M (SD) = 8.03(5.82), Min- Max = 1-27, Median (IQR) = 7(9)		
Having taken care of patients with DFU		
Yes	214	98.2
No	4	1.8

Nurses' Knowledge Regarding Prevention and Management of DFU

The analysis revealed that the level of total knowledge regarding prevention and management of DFU in this group of subjects was at a very low level (M = 52.60%, SD = 7.86), ranging from 35% to 80% (Table 2). When categorizing the nurses according to their level of knowledge, it was found that only four nurses (1.9%) had the total knowledge scores 70% and above (Table 3). In other words, only four nurses could answer correctly for 28 questions and more out of 40 questions (Table 3).

Table 2

Descriptive Statistics and the Level of Total Knowledge Regarding Prevention and Management of DFU (N=218)

Variable	Min-Max	Median (IQR)	Mean	SD	Level
	(%)				
Total Knowledge	35-80	52.5(10)	52.60	7.86	Very low

Note: Total knowledge scores were transformed to percentage

Table 3

Frequency and Percentage of Nurses' Classified According to the Level of Nurses' Knowledge Regarding Prevention and Management of DFU Scores (N=218)

Level of Knowledge (Total score %)	n	%
Very low (<60%)	180	82.5
Low (60-69.99%)	34	15.6
Moderate (70-79.99%)	3	1.4
High (80-89.99%)	1	0.5
Very high (90-100%)	0	0

Table 4 shows the mean, SD and levels of each component score of Nurses' Knowledge Regarding Prevention and Management of DFU. The subjects had all components of knowledge at very low level, except two components: identifying goals of care (M = 68.89%, SD = 15.47) and patient empowerment and education (M = 61.79%, SD = 11.63) which were scored at a low level. Whereas the component that had the lowest score was foot ulcer assessment (M = 42.01%, SD = 19.50).

Table 4

Mean, SD, and Level of Nurses' Knowledge Regarding Prevention and Management of DFU Classified by Its Components (N = 218)

Characteristics	M	SD	Level
1. Patient Empowerment and Education	61.79	11.63	Low
2. Holistic assessment	43.42	13.82	Very Low
3. Foot ulcer assessment	42.01	19.50	Very Low
4. Identifying goals of care	68.89	15.47	Low
5. Management of systemic, local and extrinsic factors	48.11	10.29	Very Low
6. Evaluation	58.62	17.59	Very low

Further item analysis was made to find out which items more nurses could answer correctly. The five items with highest percentage of nurses (> 95%) answered correctly are presented in Table 5. Five items that highest numbers of nurses answered the items on the NKPM-DFUQ correctly, in order, were related to (1) empowering and reassuring patients to have routine foot care, (2) educating patients to control blood sugar level, (3) further investigating if the wound is infected,(4) promptly treating wound infection to prevent amputation, and (5)having family members involved in diabetic foot care.

Table 5

Five Items with Highest Percentage of Nurses Answered Correctly on the Nurses' Knowledge Regarding Prevention and Management of Diabetic foot Ulcer Questionnaire (NKPM-DFUQ)

Statement (Item No.)	n	%
1. Empowering and reassuring patients to have routine foot care (3)	216	99.6
2. Educating patients to control blood sugar level (Keeping fasting blood sugar < 125 mg/dl or < 125 mg% or < 6.9 mmol/L) (2)	215	98.6
3. Further investigating if the wound is infected (8)	214	98.2
4. Promptly treating wound infection to prevent amputation (17)	211	96.8
5. Having family members involved in diabetic foot care (1)	210	96.3

Table 6 presents the item analysis to examine which items fewer nurses could answer correctly. Five items that lowest numbers of nurses (<13%) answered the items on the NKPM-DFUQ correctly, in order, were: (1) Semmes-Weinstein Monofilament is used to detect loss of protective sensation of the feet, (2) caring of callus formation to prevent diabetic foot ulcer, (3) encouraging patients to have activity of daily living in order to self-manage their foot ulcer, (4) setting a goal for prevention of amputation once the DFU is healed, and (5) giving advice to

patients that causes of diabetes is the least important element in diabetic foot care program.

Table 6

Five Items with Lowest Percentage of Nurses Answered Correctly on the Nurses' Knowledge Regarding Prevention and Management of Diabetic foot Ulcer Questionnaire (NKPM-DFUQ)

Statements (Item No)	n	%
1. Using of Semmes-Weinstein Monofilament to detect loss of protective sensation of the feet (31)	2	0.9
2. Caring of callus formation to prevent diabetic foot ulcer (34)	2	0.9
3. Encouraging patients to have activity of daily living in order to self manage their foot ulcer (26)	8	3.7
4. Setting a goal for prevention of amputation once the DFU is healed (13)	22	10.1
5. Giving advice to patients that causes of diabetes is less important in foot care program (22)	27	12.4

Nurses' Practice Regarding Prevention and Management of DFU

The results showed that the level of nurses' practice regarding prevention and management of diabetic foot ulcer in this study was at a moderate level according to a total practice score ($M = 72.30\%$, $SD = 21.28$), ranging from the scores of 5% to 100% (Table 7). Table 8 presents the frequency and percentage of

nurses according to the level of their practice. Overall, nearly half of the subjects reported that their practices regarding prevention and management of DFU was at a high to a very high level.

Table 7

Descriptive Statistics and the Level of Total Practice Regarding Prevention and Management of DFU (N=218)

Variable	Min-Max (%)	Median (IQR)	Mean (%)	SD	Level
Total Practice	5-100	79.17 (18)	72.30	21.28	Moderate

Note: Total practice scores were transformed to percentage.

Table 8

Frequency and Percentage of Nurses' Classified According to the Level of Nurses' Practice Regarding Prevention and Management of DFU Scores (N=218)

Level of Practice (Total score %)	n	%
Very low (<60%)	40	18.3
Low (60-69.99%)	28	12.8
Moderate (70-79.99%)	45	20.6
High (80-89.99%)	66	30.2
Very high (90-100%)	39	17.9

Table 9 shows the mean, SD and levels of each component score of Nurses' Practice Regarding Prevention and Management of DFU. The subjects indicated that they had practiced in the three out of six components at a moderate level, and rated the lowest practice in foot ulcer assessment (M = 54.90%, SD = 29.81) with the highest practice in evaluation (M = 82.11%, SD = 23.50).

Table 9

Mean, SD, and Level of Nurses' Practice Regarding Prevention and Management of DFU Classified by Its Components (N = 218)

Characteristics	M	SD	Level
1. Patient Empowerment and Education	75.62	18.28	Moderate
2. Holistic assessment	63.51	25.12	Low
3. Foot ulcer assessment	54.90	29.81	Very Low
4. Identifying goals of care	78.27	25.51	Moderate
5. Management of systemic, local and extrinsic factors	78.74	23.13	Moderate
6. Evaluation	82.11	23.50	High

Table 10 shows five items of practice questionnaire that highest percentage of nurses had practiced all the time. These were: (1) offering a new sharpest blade to doctors to perform debridement of diabetic foot ulcer, (2) keeping the ward environment cleaned to reduce pathogens and wound infection, (3) advising patients and relatives to clean the patient's body and wound area to prevent infection,

(4) consulting doctors if the ulcers do not heal properly, and (5) advising patients do not walk bare foot.

Table 10

Five Items of Nurses' Practice that Highest Percentage of Nurses Reported "Practice All the Time" (N=218)

Statement (Item No.)	n	%
1. Offering a new sharpest blade to doctors to perform debridement of diabetic foot ulcer (27)	168	77.1
2. Keeping the ward environment cleaned to reduce pathogens and wound infection (24)	167	76.6
3. Advising patients and relatives to clean the patient's body and wound area to prevent infection (25)	167	76.6
4. Consulting doctors if the ulcers do not heal properly (30)	164	75.2
5. Advising patients do not walk bare foot (20)	160	73.4

Table 11 shows five items of practice questionnaire that lowest percentage of nurses had practiced all the time. These were: (1) checking all DM patients if they have received an annual examination of the feet, (2) assessing patients holistically (e.g. vascular status, infection, etc.), (3) assessing location, length, width, and depth of the ulcers, (4) advising patients to do exercise daily to improve cold skin and weak pulse, and (5) checking the pulses on the legs and the feet

Table 11

Five Items of Nurses' Practice that Lowest Percentage of Nurses Reported "Practice All the time" (N = 218)

Statement (Item No.)	n	%
1. Checking all DM patients if they have received an annual examination of the feet (6)	28	12.8
2. Assessing patients holistically (e.g. vascular status, infection, etc).(7)	30	13.8
3. Assessing location, length, width, and depth of the ulcers (12)	41	18.8
4. Advising patients to do exercise daily to improve cold skin and weak pulse (19)	53	24.3
5. Checking the pulses on the legs and the feet (13)	55	25.2

Additional Analyses

In order to explain the phenomena under this investigation, additional analyses were conducted. Available and relevant nurses' personal data were identified as potential factors contributed to their knowledge and practice regarding prevention and management of DFU. These included age, area of practice, and duration of practice (Table 12). As the variables age and duration of practice were not normally distributed, they were grouped using median to make a cut-off point and were used as categorical variables. Age was categorized into younger group (≤ 30 years old) and older group (> 30 years old) whereas duration of practice was categorized into shorter group (≤ 7 years) and longer group (> 7 years). The variable, area of practice, was used as presented in Table 1 (4 groups). The analyses revealed that there was no

significant age difference in nurses' knowledge ($t = 1.305$, $p > .05$), the duration of practice ($t = -0.377$, $p > .05$), and the area of practice ($F = 2.151$, $p > .05$).

Table 12

Comparisons of Nurses' Knowledge Regarding Prevention and Management of Diabetic Foot Ulcer Between Age Groups, Between Duration of Practice Groups and Among Area of Practice

Factor	Nurses' Knowledge			t/F*	p
	n	M (SD)	Med (IQR)		
Age Group				1.305	.193
Younger (< 30 years old)	118	53.24 (7.85)	55 (10)		
Older (> 30 years old)	100	51.85 (7.84)	52.50 (8)		
Duration of Practice Group				- 0.377	.707
Shorter (≤ 7 years)	115	52.41 (6.97)	55 (10)		
Longer (> 7 years)	113	52.82 (8.78)	52.50 (10)		
Area of Practice				2.151*	.095
Medical	55	52.91 (7.71)	52.50 (10)		
Surgical	74	51.25 (7.93)	52.50 (10)		
Orthopedic	12	50.00 (5.84)	52.50 (6)		
Others (CCU, ICU, Urology)	77	54.09 (7.98)	55 (8)		

t = Independent t- test, F= Analysis of Variance (*)

It was revealed that there was no significant age difference in nurses' practice ($Z = -0.503$, $p > .05$) and the duration of practice group ($Z = -0.962$, $p > .05$). For the area of practice, there was a significant difference ($\chi^2 = 20.86$, $p < .05$) (Table 13).

Table 13

Comparisons of Nurses' Practice Regarding Prevention and Management of Diabetic Foot Ulcer Between Age Groups, Between Duration of Practice Groups and Among Area of practice

Factor	Nurses' Practice			Z/X ² *	P
	n	M (SD)	Med (IQR)		
Age group				- 0.503	.615
Younger (< 30 years old)	118	71.25 (22.52)	79.17 (21)		
Older (> 30 years old)	100	73.54 (19.76)	78.75 (18)		
Duration of Practice Group				- 0.962	.336
Shorter (≤ 7 years)	115	73.23 (21.104)	80.00 (19)		
Longer (> 7 years)	103	71.26 (21.532)	76.67 (18)		
Area of practice				20.86*	.000
Medical	55	75.11 (19.52)	82.50 (95)		
Surgical	74	63.82 (25.01)	70.00 (39)		
Orthopedic	12	62.85 (21.42)	68.33 (42)		
Others (CCU, ICU, Urology)	77	79.92 (14.35)	81.67 (160)		

Z = Mann-Whitney U test, X² = Kruskal-Wallis test (*)

Discussion

The discussion of the study findings is presented in the following sequence: Nurses' profile, nurses' knowledge regarding prevention and management of diabetic foot ulcer, and nurses' practice regarding prevention and management of diabetic foot ulcer.

Nurses' Profile

Nurses participated in this present study were at their productive years in nursing services. They were young to middle-aged adults with a mean age of 32.11 years, which was comparable to previous studies conducted in Bangladesh (Basak, 2010; Islam, 2010). The majority of them were female which not only was comparable to Basak's and Islam's studies but also was to studies in other countries such as the UK (McIntosh & Ousey, 2008). The researcher obtained adequate number of nurse subjects as well as these representing age and gender groups lead to some certainty that they were good representatives of nurses working in this field.

From the study subjects' religious backgrounds, more than half of them were Muslim (60.1%), which is consistent with the Bangladesh context. Bangladesh is a Muslim country and 90% of its people are Muslim and 10% are of other religious beliefs. This is also similar to Basak's study (2010). She revealed that nearly 60% of her nurse participants were Muslim.

It was also noted that most of the nurses had only a diploma in nursing and only one had a master degree. In addition, there was no any subjects in this study had received or attended any courses or training programs related to prevention and

management of diabetic foot ulcer. This finding is not surprising as nurses have not yet been prepared to be specialized, although they are working in the specialized hospital. It may be time to offer specific training courses so that nurses can gain more knowledge of the diabetic foot ulcer care. Consequently, it can facilitate them to provide nursing care more effectively.

Nurses' Knowledge Regarding Prevention and Management of DFU

The findings showed that the nurses who participated in this study had a very low level of knowledge regarding prevention and management of diabetic foot ulcer, presenting by the mean score of 52.60% (Table 2). This finding was not surprising because in this study nurses' knowledge regarding prevention and management of DFU was very low. Nurses did not have adequate knowledge how to prevent and manage DFU. This finding was similar to the study of Basak (2010) who found that Bangladeshi nurses had inadequate knowledge regarding post-operative pain management. There was no subject in her study had received any course or training program related to post-operative pain management. This may imply that the basic nursing education in Bangladesh does not adequately prepare nurses to have knowledge necessary for care of certain problems (e.g., acute post-operative pain, found in Basak's study) or specific populations and complex problems (e.g., DM and DFU demonstrated in this present study). This may not limit to the situation in Bangladesh. Rather, the finding of this present study, though, was comparable to other studies which found that nurses had insufficient and poor knowledge about chronic wound care (McIntosh & Ousey 2008). McIntosh and Ousey found that nurses did not receive sufficient training and knowledge on chronic wounds from their basic nursing

education. Another study was conducted in Hong Kong. Lui, So, and Fong(2008) found a deficit in knowledge and attitudes related to pain management among 143 nurses participated in the study with a mean percentage score of 47.72%, ranged from 20-76%.

Numerous factors might contribute to the very low level of knowledge regarding prevention and management of DFU among nurses in this study. Firstly, the majority of them (97.2%) had nursing education at diploma level, and that they were not provided to have specialized knowledge nor were expected to provide such specialized care, such as prevention and management of DFU, discussed earlier. These findings were generally similar to Basak's study, mentioned earlier. In addition, the focus on evidence-based practice and knowledge regarding prevention and management of DFU has not been implemented, although this novel concept, evidence-based practice, has been recently integrated in a newly offered bachelor of science in nursing curriculum (W. Petpichetchian, personal communication, June 13, 2013). Therefore, no specific contents of prevention and management of DFU included in the nursing program would be one factor for very low level of knowledge in this area.

Secondly, less short course training in prevention and management of diabetic foot ulcer might affect the low level of knowledge among nurses. There was no subject in the present study had received any course or training programs related to prevention and management of diabetic foot ulcer. For the lack of training about DFU, nurses do not know how to prevent and manage DFU. This finding is similar to the previous study conducted by Shiu and Wong (2011) who found that RNs who had

received prior training, diabetes foot care knowledge scored higher than those who did not receive. McIntosh and Ousey (2008) found that nurses who had received sufficient education on chronic wounds in their basic training had better wound management performance compared to those who did not receive sufficient education on chronic wounds. Another studies estimated that education and training prepared nurses to gain more knowledge (Najeeb & Taneepanichsakul, 2008; Suchitra & Devi, 2007).

Thirdly, duration of practice might affect the very low level of knowledge among nurses. However, this was not observed in this present study. Additional analysis findings did not support this explanation (Table 12). Unlike other studies, Vij, Williamson, and Gupta (2001) found that nurses who had more years of working experience had knowledge level of infection control higher than that of those who had less years of experience. Lui, So, and Fong (2008) also revealed that nurses who had more working experience had better pain management performance compared to those who had less year of experience. Normally, nurses can gain knowledge during their practice through the discussion with medical doctors and from other sources. Unfortunately, an observational study in Bangladesh at medical college hospitals, healthcare facilities, and specialized hospital across the country (N = 18) revealed that nurses spent only 8.6% of time in interacting with doctors and that was limited to only for clarification of doctors' orders and obtaining a signature for death certificates or prescription (Hadley &Roques, 2007). Further study to examine how this specialized DM hospital can improve nurses' knowledge through improving the communication between nurses and doctors for the best benefits of their patients is challenging.

Fourthly, lack of problem-oriented nursing care may contribute to the level of nurses' knowledge. According to Hadley and Roques's study (2007), the researchers found that nurses spent only approximately 5.3% of their time in providing direct patient care. Most of their direct care activities were basic nursing tasks, such as medication administrations and intravenous fluids infusion as prescribed, attending to patients before and after death, changing bed sheets, taking vital signs, helping doctors during wound dressing change with high contribution through the hands of nursing students. This type of task-oriented care prevents nurses to be interested in seeking new knowledge to provide better care as they may not see whether it is useful.

Finally, even though this hospital provides special services for patients with diabetes mellitus, the service is still general. Neither is there any special care offered nor use of assessment tools for assessing diabetic neuropathy. Furthermore, BIRDEM hospital is a research centre mainly led by physicians, not by nurses. In other words, nurses are not involved in research or any policy decision making. For this reason, poor knowledge in special care and research might affect the low level of knowledge among nurses.

Furthermore, this study was to identify the level of six components of nurses' knowledge regarding prevention and management of DFU. All of the subjects in this study rated their overall NKPM-DFU at very low level, except patient empowerment and education was at a low level. Analyzing each component of NKPM-DFU, subjects got the highest marks on the identifying goals of care component ($M = 68.89\%$), followed by the patient empowerment and education

component ($M = 61.79\%$) and the lowest marks were on the foot ulcer assessment component and holistic assessment components ($M = 42.01\%$ and 43.42%), respectively (Table 4). An item analysis finding showed that two out of seven items in patient empowerment and education had nearly all nurses answered them right (99.6% and 98.6% , respectively). This is not surprising. Knowledge regarding goals of care and patient empowerment and education covered those basic diabetes knowledge and some items can be answered using their clinical knowledge (such as family members should be involved when nurses educate patients). This finding was supported when item analysis was performed (Table 5). Three out of five items with highest percentage of nurses answered correctly were falling in this “patient empowerment and education components.” The other items were spreading, one was in “holistic assessment component” (i.e. “further investigating if the wound is infected”); another was in “management of systemic, local, and extrinsic factor” (i.e. “promptly treating wound infection to prevent amputation”).

In contrast, knowledge regarding foot ulcer assessment is more specific and requires not only technical knowledge (such as knowledge related to characteristics of wound infection) but also the conceptual/theoretical knowledge (such as the most common area of DFU development). This is more obviously seen when item analysis was conducted (Table 6). There were two items that only two subjects could answer correctly. These items were: “using of Semmes-Weinstein Monofilament to detect loss of protective sensation of the feet,” and “caring of callus formation to prevent diabetic foot ulcer.” This knowledge is highly specialized and nurses may not be educated or even observe in their real practice settings.

In order to examine whether some demographic variables of the subjects may help explain the very low level of their knowledge, the additional analysis was performed (Table 12). It was found that duration of practice (addressed earlier), age, and area of practice had no relationship with the nurses' knowledge scores. It may be due to the restrict range of the knowledge scores that contribute to this non-significant findings. Further investigation is worth investigated. Partly, the finding is comparable to Shiu and Wong's study (2011). They found that nurses with and without work experience in diabetes care specialty services had similar level of knowledge.

Nurses' Practice Regarding Prevention and Management of DFU

In this present study, nurses had a moderate level of practices regarding prevention and management of diabetic foot ulcer, presenting by the mean score of 72.30% (Table 7). More than half of them had practiced at a very low to moderate levels (Table 8). This finding was similar to Basak's study (2010). She reported that nurses had a moderate level of practice in managing acute post-operative pain. Determining which components of their practices were reported at what level, it was revealed that the practice score was lowest in the component of "foot ulcer assessment," followed by "holistic assessment" and highest in the component of "evaluation," followed by "management of systemic, local, and extrinsic factors" (Table 9).

Some factors may contribute to a moderate level of the overall nurses' practices regarding prevention and management of DFU, found in this study. Firstly,

this may be related to their level of knowledge. In other words, their low level of knowledge may lead to a moderate level of their practice. In addition, there was no subject in the present study who had attended continuing education on DFU topic in Bangladesh. Similar to Basak's study (2010), she found that there was no subject in her study received continuing education on pain topic. This is a common phenomenon in the context of hospitals in Bangladesh where the focus is to offer training to improve general nurses' competencies, rather than specialized ones. The Government and the Directorate of Nursing Services in collaboration with Bangladesh Nursing Council have actually offered several training courses, including the one collaborated with the International Council for Nurses (e.g., Leadership for Change Program), and other programs supported by international organizations such as the World Bank and WHO (Andaleeb, Siddiqui, & Khandakar, 2007). These existing courses are important but continuing education programs or training courses on other specialized care including care for prevention and management of DFU in patients with diabetes is also essential. It has been confirmed to be useful in increasing nurses' skill in the area of prevention and management of DFU (Aalaa, Sanjari, Peimani, & Mohajeri-Tehrani, 2012; RNAO, 2005).

Secondly, the shortage of nursing staff and the limited working time available for direct patient care in prevention and management of DFU may be an organizational factor related to a moderate level of practice. The findings in this study were consistent with previous study which found that there were a shortage of nursing staff and a limited working time available for direct patient care in preventing pressure ulcers (Islam, 2010). In Bangladesh it has been revealed that nurses in government hospitals spent only 5.3% of their working time in direct contact with

their patients (Hadley & Roques, 2007). The nurse patient ratio is 1: 15 in hospital settings (Arju, as cited in Islam, 2010) and about one nurse to 7,368 people in general population (Omar & Rubayat, 2007). It was reported in another government document that the ratio of nurses to the Bangladesh population was 11 nurses for 100,000 people (Ministry of Health and Family Welfare, 2004). This inadequate nurse to patient ratio may limit the implementation of quality care to prevent and manage DFU development. A previous study indicated that a majority of nurses reported lack of staff and lack of time as barriers to carry out pressure ulcer prevention care into effective practice (Moore & Price, 2004; Ulrika & Bjorn-Ove, 2009). It would be impossible for nurses to offer quality care with this manpower constraint.

Thirdly, education and training, administrative support, and supplies of available resources are particularly essential for nurses to prevention and management of the development of DFUs. In this present study, there was no in-service education or training available in the hospital. There were also inadequate supplies of resources for use in preventing and managing diabetic foot ulcer development. For example, there is no Semmes-Weinstein Monofilament to detect diabetic peripheral neuropathy. The same situation occurs in other health conditions, such as prevention and management of pressure ulcers. Islam (2010) found that there was no education and training, administrative support, and adequate supplies of resources. Rahman, Shahidullah, Shahiduzzaman, and Rashid (2012) found that Bangladeshi nurses were not trained and equipped for providing a good standard of nursing care to prevent pressure ulcers. They discussed that it was due to lack of proper education and training, inadequate resources, and an inappropriate supervision and management.

Fourthly, the provision of using clinical practice guidelines for the prevention and management of diabetic foot ulcers is an important factor for nurses in providing standard nursing care. However, this was not investigated in this present study. Based on the researcher's experience working in Bangladesh, it can be addressed that nurses have limited access to up-to-date evidence-based clinical practice guidelines for prevention and management of diabetic foot ulcer. There is no known organizational policy to produce clinical practice guidelines for nurses to guide their decision making in preventing and managing diabetic foot ulcer. This was also observed in Islam's study (2010). He found that no organizational policy or guidelines had been developed for nurses to prevent pressure ulcers. Developing and disseminating the guidelines may lead nurses to increase their awareness to perform practice regarding prevention and management of diabetic foot ulcer (RNAO, 2005).

Furthermore, this study was to identify the level of six component scores of nurses' practice regarding prevention and management of DFU (Table 9). Three out of six components were rated at a moderate level. The subjects rated their practice highest on "evaluation" component ($M = 82.11\%$, $SD = 23.50$) and lowest on "foot ulcer assessment" component ($M = 54.90\%$, $SD = 29.81$). It can be observed that the component receiving the highest practice score was different from the knowledge score which was the component "identifying goals of care." This may be simply explained by the fact that knowledge does not always guide practice. Three practice items fall in the "evaluation" component included activities related to checking whether the patients stop smoking, reassessing DFU, and convincing patients and their relatives to consult doctors if the ulcers do not heal properly. These are activities needless of high level of knowledge or even any equipment.

Examining which activities nurses had frequently practiced, more than 70% of nurses rated that they “practice all the time” in these following five items: offering a new sharpest blade to doctors to perform debridement, keeping the ward environment cleaned, advising patients and relatives to clean patient’s body and wound area, consulting doctors if the ulcers do not heal properly, and advising patients do not walk bare foot (Table 10). Although they are all important, they are quite basic nursing tasks, not requiring any advanced nursing skills. As opposed to the ones with lowest number of nurses indicating that they “practice all the time” (Table 11), there were about one-fourth and lower number of nurses who reported they had practiced them. This finding highlights a need for training nurse specialist in providing specialized care to this group of patients. Without this quality services, the nursing profession in Bangladesh would continue to be unaccepted. For several decades, nursing profession’s dignity in Bangladesh is entirely absent (Uddin, Islam, & Ullah, 2006).

Furthermore, the examination of factors that may help explain nurses’ practice regarding prevention and management of DFU was also conducted in the same manner as the nurses’ knowledge variable. The analysis findings show that only area of practice was significant (Kruskal-Wallis test, $X^2 = 20.86$, $p = .000$) (Table 13). Nurses who worked in medical wards as well as those categorized as “others” (CCU, ICU, Urology) reported that they had practiced regarding prevention and management of DFU more often than those who worked in surgical and orthopedic wards. This may be due to the fact that nurses working in the first two areas had more frequently seen patients with diabetes as opposed to the latter two groups.

It should be noted that the findings of this study must be viewed with caution. Some factors may threaten the validity of the study findings. Similar to many other studies using self-report questionnaires, issues pertaining to measurement errors are hardly avoided. The most common one is subjects' response to self-report questionnaire towards social desirability resulting in response bias (Polit & Beck, 2012). This may happen when the subjects responded to the items in the practice questionnaire to get high score (in this case, answered that they often practice it) even in fact they might not perform such practices. In addition, as our Bangladeshi nurses are working in a high constrained condition due to high patient load, their responses to the questionnaires may be done after their long working hours. Responding to a bit lengthy set of questionnaires when subjects are feeling fatigue may contribute to their responses as well. The researcher had actually tried to overcome this problem by leaving time and allowing them to complete the questionnaires within one week. As a consequence, there was also a possibility that they may discuss among themselves.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

This chapter presents the conclusion, strengths and limitations of the study, and implications and recommendations for future studies. This descriptive study was to examine the level of nurses' knowledge and their practices regarding prevention and management of diabetic foot ulcer in Bangladesh. Data were collected in February, 2013. The instrument for data collection was a set of questionnaires which composed of three parts: Demographic Data Form, Nurses' Knowledge Regarding Prevention and Management of DFU Questionnaire (NKPM-DFUQ) and Nurses' Practice Regarding Prevention and Management of DFU Questionnaire (NPPM-DFUQ). Collected data were analyzed by using descriptive statistics.

Conclusion

This descriptive study recruited 218 nurses working at a specialized diabetes hospital, located in Dhaka city of Bangladesh. Their average age was 32 years old ranging from 23 to 53 years. More than half of them were Muslim. The majority was women, married and completed diploma degree. The duration of practice of the subjects ranged from 1 to 27 years. More than three-fourths of subjects indicated having taken care of patients with diabetic foot ulcer. They were working in different areas of practice including surgical, medical, orthopedics, critical care unit (CCU), intensive care unit (ICU), and urology.

This study revealed that nurses possessed a very low level of knowledge regarding prevention and management of DFU with a mean total

knowledge score of 52.60% (SD = 7.86). For the component scores, four out of six components had the average scores at a very low level and two components were at a low level with the scores ranging from 42.01% to 68.89% in foot ulcer assessment component to identifying goals of care component, respectively. The items that the majority of them could answer correctly were related to basic, technical type of knowledge. In contrast, the items requiring high level and specialized care kind of knowledge received very low scores that the majority of them could not answer.

For nurses' practice regarding prevention and management of DFU, the subjects reported a moderate level of practice with a mean score of 72.30% (SD = 21.28). The scores of each component showed that they reported the frequency of their practice at a moderate level in three out of six components. Only one component, evaluation, was rated at a high level (M = 82.11%, SD = 23.50). Two components were reported at very low and low levels with the scores ranging from 54.60% to 63.91% in foot ulcer assessment and holistic assessment, respectively. The items that more than 70% of nurses reported having practiced all the time were basic nursing tasks whereas the ones that a few number of them rated as frequently practiced were those requiring specialized type of care. It was also evident that nurses working in certain areas of practice including medical wards, CCU, ICU, and Urology reported significantly higher practice scores than those working in surgical and orthopedic wards.

Strengths and Limitations

Strengths

This study has some identified strengths. First, it was the first survey study in Bangladesh which explored nurses' knowledge and their practices regarding prevention and management of diabetic foot ulcer. The findings can be good evidence to support further initiation for an improvement of nurses' competencies in caring for patients with diabetes. Second, it was taken place at BIRDEM hospital, a specialized hospital, specially offered to this group of patients. Thus, nurses who are working in this hospital are expected to represent DM nurses who provide such specialized care to patients with diabetes. The findings from this study could then reflect the picture of how they actually are. Third, this study employed the well-established practice guidelines supporting nurses' roles: the Registered Nurses' Association of Ontario (RNAO)'s nursing best practice guideline for assessment and management of foot ulcers for people with diabetes, in the construction of the instruments used to measure nurses' knowledge (NKPM-DFUQ) and their practice (NPPM-DFUQ). It provided a comprehensive but broad range of care in the prevention and management of DFU. Therefore, the findings can also reflect nurses' competencies necessarily required for care of this group of patients.

Limitations

Similar to many descriptive studies, some limitations were identified here. First, using self-report questionnaire may inevitably induce measurement errors. Second, although the questionnaires used in this study were developed based on the

RNAO's nursing best practice guideline mentioned above and were content validated and tested for reliability, their constructed validity were not yet thoroughly examined. Further investigation is still needed. Specifically, confirmatory factor analysis is recommended to examine the construct validity of these newly developed questionnaires.

Implications and Recommendations

The findings of this study indicate that a lack of nurses' knowledge regarding prevention and management of DFU among nurses does exist. To improve the quality of care and the quality of life of patients potentially or currently suffering from diabetic foot ulcer, the following implications and recommendations are offered.

Nursing Practice

It is nearly impossible for nurses to provide quality care in their daily practice to patients with diabetes, particularly those at risks of or currently have DFU, without adequate and necessary knowledge. The findings of nurses' lack of knowledge in most areas of the prevention and management of DFU need urgent attention. Promptly, nurses should be more active in improving their clinical knowledge through support from medical staff. Although this present study did not directly explore factors related to a relationship between nurses and doctors, it is imperative to suggest that nurses can quickly learn necessary knowledge and develop clinical practice skills from their medical colleagues. A user friendly, up-to-date knowledge nursing practice guideline should be developed for nurses working in a

specialized healthcare facility. Support from hospital authority and nursing leaders will accelerate this initiative. In addition, nurses should be trained to care of callus formation or at least, be able to recognize its formation so that consultation can be made promptly. Learning to use a Semmes-Weinstein monofilament to detect diabetic peripheral neuropathy requires training as well as support of its use from hospital authority. This needs further exploration in its feasibility for application in the local context. Lastly, nurses should be encouraged to assess their patients holistically with a focus on their feet as well as coach them to perform foot assessment on a regular basis.

Nursing Education

The results of this study indicated that nurses lacked knowledge regarding prevention and management of DFU. A lack of DFU contents in basic nursing education and no prevention and management of DFU training course offered to nurses working with diabetes patients may contribute to the very low level of knowledge of nurses. The following recommendations can be made:

First, post basic training courses should be offered. This can be done as an in-service training course or as a continuing education program. In order to offer this kind of courses to cover high number of trained nurses, training for the trainers program should be planned. Second, in order to teach the student nurses, nurse educators should also be trained so that they can teach their students. In constructing this training course, careful consideration of local context must be made explicitly so that knowledge given to them and skills further developed can be appropriately used in Bangladesh healthcare delivery system.

Nursing Research

The instruments, the NKPM-DFUQ and the NPPM-DFUQ, developed for use in this study should be further tested for construct validity. Specifically, a confirmatory factor analysis should be done to assess whether or not these two questionnaires are multidimensional as originally constructed. Once they are refined, a replication study with larger sample size and more involved hospital is recommended in order to increase external validity of the findings. In addition, an observational instrument should also be developed and used to complement the findings of a self-report questionnaire, particularly the one use for assessing nurses' practice.

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APPENDICES

APPENDIX A: Research Information Sheet

Informed Consent Form for Participant

Dear Colleagues,

My name is Sharmistha Shil. I am a senior staff nurse of National Institute of Cardiovascular Diseases and Hospital, Dhaka, Bangladesh. I am also a master's student of Faculty of nursing, Prince of Songkla University, Thailand. I ask you to participate in a research project designed to survey of nurses' knowledge and their practices regarding prevention and management of diabetic foot ulcer in Bangladesh. If you decide to participate in this study, you are asked to respond to a set of questionnaires.

Risk and Comforts

There is no known risk to participation in the study. If you may feel tired, you can rest a while and continue doing it on your convenience time. Your participation is voluntary; you have the right to participate or not to participate. There will be no penalty if you decide not to participate. There is neither cost nor will there be any payment to you for your participation.

Benefits

Knowledge of this study will be used as an evidence to support area for further improving Bangladeshi nurses in certain areas that they may lack of knowledge or do not practice in order to prevent and manage diabetic foot ulcer. The findings will be used to write research report and may be presented at professional meetings.

Confidentiality

All information and your responses in connection with this study will remain confidential. Only the researcher and the advisors are eligible in accessing the data. Neither your name nor any identifying information will be used in the report of the study.

Withdrawal from Participation

You have the right to withdraw from participation anytime without any problems prior to completion of data collection.

Legal Right and Signatures

You will receive a copy of this consent form. Your signature on the will indicate that you understand what is involved and that you consent to participate in this study. If you do not want to sign on this consent form but are willing to respond to the questionnaires, your returned questionnaires will be used to indicate your willingness. Thank you for expressing interest in this study.

.....
(Name of Participant)	(Signature of Participant)	Date
Sharmistha Shil
(Name of Researcher)	(Signature of Researcher)	Date

If you have any questions now or at any time during the study, please feel free to ask or discuss with me. You can communicate to me at the following address:shila_shil54@yahoo.com01712608713(Bangladesh)/+660858992287 (Thailand).

Master of Nursing Science (International program)

Prince of Songkla University, Hat-Yai, Thailand.

APPENDIX B: Data Collection Instruments

Dear Colleagues,

My name is Sharmistha Shil, a master student of Faculty of Nursing, Prince of Songkla University. I am now conducting a master thesis to explore how much our nurses who work with patients with diabetes possess knowledge as well as provide care in preventing and managing diabetic foot ulcer.

As I have informed you earlier during the informed consent session, you are now indicating your willingness to participate in this study voluntarily. I am now presenting to you this set of the questionnaires, composing of 3 parts. Please read each statement carefully before giving your response. Again, please note that your contribution to this study is highly valuable for the improvement of quality of care for patients with diabetes, particularly diabetic foot care in the near future.

You do not need to write your name on any parts of this set of questionnaires. I assure you that no one can recognize your answer so please answer freely when you can find the most appropriate time. I am leaving this package with you for one week. Please do not consult other nurses or doctors in responding to the questionnaires. I will come back next week to collect it back.

Thank you for your kind co-operation and valuable contribution.

Please open the next page and start responding to the questionnaires.

Sincerely Yours

Sharmistha Shil

Master of nursing Science (International Program)

Faculty of Nursing, PSU, Thailand.

Part I: Demographic Data Form

Instruction: Please check mark (√) where appropriate or write your answer on given spaces.

1. Age years old

2. Gender 1. Male 2. Female

3. Religion 1. Islam 2.Hindu 3.Buddhist 4. Christian

4. Level of nursing education

1. Diploma in nursing

2. B.Sc in nursing

3. Masters of nursing

5. Marital status 1. Single 2.Married 3. Separated

4. Divorced

6. Have you received any short course training on prevention and management of diabetic foot ulcer or foot ulcer care since you have been certified as a nurse?

1. Yes 2. No

If yes, please specify: Year..... Place

Duration days/weeks/months

7. What area of practice do you work now?

1. Medical 2. Surgical 3. Orthopedic

4. Neuro – surgery 5. Others (specify)

8. How long have you practiced your nursing with patients with DM? years.

9. Have you ever taken care of patients who have diabetic foot ulcer?

1. Yes 2. No

**PART II: Nurses' Knowledge Regarding Prevention and Management of
Diabetic Foot Ulcer Questionnaire (NKPM-DFUQ).**

Instruction:

Nurses who are taking care of persons with diabetes should possess knowledge regarding prevention and management of diabetic foot ulcer. For part of the questionnaire, we want to explore this knowledge. Please answer to the following questions as best as you can. Please do not worry about your scores because we will keep it secretly and no one will know which one is yours. Your answers, however, when combine with other nurses, can let us know what areas our nurses know the best and which ones we may be lacking.

There are twenty (20) True/False questions and twenty (20) Multiple-choice questions. Please check (√) in the True or False of the correct answer or 'Don't Know' and select one best answer from one of five choices by circling on a, or b, or c, or d.

No	Statements	True	False	Don't Know
1	It is not necessary to have family members involved when nurses educate patient with diabetes about foot care because it is a simple task. (F)			
2	Educating patients with diabetes to control blood sugar level (keep fasting blood sugar <125 mg/dl or <125 mg % or <6.9 mmol/L) is the key for successful prevention and			

No	Statements	True	False	Don't Know
	management of diabetic foot ulcer. (T)			
3			
4.			
...			
20	A pink wound bed and an advancing wound margin are good indicators of unhealthy wounds. (F)			

21. Diabetic education is effective if it is.....

- a) Patient- centered (×)
- b) Doctor- focused
- c) Based on nurses' concern
- d) Based on family's concern
- e) Don't know

.....

40. If delayed diabetic foot ulcer healing occurs, the expected outcomes of care that should be further evaluated include the followings, EXCEPT

- a) Reduced pain
- b) Wound stabilization
- c) Reduced bacterial load
- d) Increased dressing change (×)
- e) Don't know

**PART III: Nurses' Practice Regarding Prevention and Management of Diabetic
Foot Ulcer Questionnaire (NPPM-DFUQ)**

Instruction:

This part of the questionnaire asks you to please read each statement and rate how often you have performed each of them by checking mark (√) in the appropriate column using the following description:

Never practice (0) means you have never performed this practice in your entire nursing life working with patients with diabetes.

Seldom practice (1) means you have performed this practice only few times or few patients in your entire nursing life working with patients with diabetes.

Sometimes practice (2) means you have performed this practice sometimes or some patients in your entire nursing life working with patients with diabetes.

Practice most of the time practice (3) means you have always performed this practice with most of your patients in your entire nursing life working with patients with diabetes.

Practice all the time (4) means you have performed this practice every time with every patient in your entire nursing life working with patients with diabetes.

No	Statements	Never practice (0)	Seldom practice (1)	Sometimes practice (2)	Practice most of the time (3)	Practice all the time(4)
1	Before teaching my patients with diabetes who are at risk of diabetic foot ulcer, I assess what they need to know.					
2	I encourage my patients with diabetes to understand how important it is to wash and check their feet daily.					
3	I teach my patients to perform foot assessment.					
4					
5					
...					
30	I convince patients and their relatives to consult doctors if the ulcers do not heal properly.					

THANK YOU FOR YOUR KIND COOPERATION

APPENDIX C

Table 14

Frequency and Percentage of Correct Responses to each Item of Knowledge

Regarding prevention and Management of DFU Questions (N=218)

No.	Items	n	%
1	It is not necessary to have family members involved when nurses educate patient with diabetes about foot care because it is a simple task	210	96.3
2	Educating patients with diabetes to control blood sugar level (keep fasting blood sugar <125 mg/dl or <125 mg % or <6.9mmol/L) is the key for successful prevention and management of diabetic foot ulcer.	215	98.6
3	Patients with diabetes should be empowered and reassured on a regular basis of their routine foot assessment.	216	99.6
4	Patients with diabetes must be informed that once the foot ulcer develops, they must stop wearing shoes.	64	29.4
5	In order to prevent diabetic foot ulcer, all patients with diabetes should receive an assessment of foot pressure every three months.	58	26.6
6	According to standard guidelines, patients with diabetes should be assessed holistically including an assessment of sweating of the feet.	144	66.1
7	If the patients with diabetes do not complain about feeling numb at their feet, it is not necessary to assess vascular supply.	139	63.8
8	If the patient with diabetes, who has foot ulcer, develops fever, the wound culture and sensitivity test should be done.	214	98.2
9	The most common area of diabetic foot ulcer which is found in more than half of the patients is at the first metatarsal area.	41	18.8

No.	Items	n	%
10	Regular measurement of the diabetic foot ulcer length and width provides good evidence of wound healing.	122	56.0
11	Identifying the goal of foot care for the prevention and management of diabetic foot ulcer is primarily responsible by doctors and nurses, excluding patient and family members.	187	85.8
12	The primary goal in the management of diabetic foot ulcer is to obtain wound closure as soon as possible.	166	76.1
13	Once the diabetic foot ulcer is closed, the next management goal is to prevent amputation.	22	10.1
14	Wound dressing is the only strategy that can help diabetic foot ulcer healed well.	55	25.2
15	Debridement of callus can reduce pressure at the callus site. So that it helps prevent the development of diabetic foot ulcer, also helps heal the wound.	108	49.5
16	The probability of achieving wound closure is to control other co-morbid diseases, such as peripheral arterial disease.	145	66.5
17	Infection of diabetic foot ulcer must be treated promptly to prevent amputation.	211	96.8
18	Diabetic foot ulcer that has a 50 % reduction of wound surface at four weeks should be expected to heal within 12 weeks.	191	87.6
19	A surgery, such as skin graft, is recommended when diabetic foot ulcer does not heal at the expected rate.	172	78.9
20	A pink wound bed and an advancing wound margin are good indicators of unhealthy wounds.	135	61.9
21	Diabetic education is effective if it is.....	45	20.6
22	The least important element should be included in diabetic foot care program is.....	27	12.4
23	Nurses' should educate patients with diabetes to cut their nails as which one of the followings?	166	76.1

No.	Items	n	%
24	Which type of foot that nurses must pay attention to when they perform foot assessment in order to prevent diabetic foot ulcer?	110	50.5
25	The following items are the risk factors for foot ulcer development in DM patients, EXCEPT.....	85	39.0
26	In order for patients with diabetic foot ulcer to self- manage their foot ulcer, they should be encouraged to	8	3.7
27	Which one of the followings is used as an indicator of peripheral vascular supply?	92	42.2
28	Which one of the followings is a good indicator of wound infection?	48	22.0
29	Purulent wound discharge is indicative of wound infection which is characterized by	150	68.8
30	Assessment at the site of diabetic foot ulcer should cover the followings, EXCEPT.....	97	44.5
31	Which one of the following measures is used to detect loss of protective sensation of the feet?	2	.9
32	In order to improve foot wounds in patients with diabetic foot ulcer, nurses should	177	81.2
33	Once foot ulcers have developed, the ultimate goal of care is	199	91.3
34	Which one is an appropriate measure for prevention of diabetic foot ulcer development?	2	.9
35	Patients who have lost protective sensation should be advised to...	28	12.8
36	For dry feet, what part of the feet is NOT suitable for application of skin lotion?	47	21.6

No.	Items	n	%
37	The principles of management of diabetic foot ulcer should include the followings, EXCEPT.....	157	72.0
38	If patients have foot pain, what should nurses do or advice them?	191	87.6
39	What condition should patients book an appointment with a podiatrist?	79	36.2
40	If delayed diabetic foot ulcer healing occurs, the expected outcomes of care that should be further evaluated include the followings, EXCEPT	62	28.4

Table 15

*Frequency and Percentage of Correct Responses to Each Item of Practice Regarding Prevention and Management of DFU Questions**(N=218)*

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the time n (%)
1	Before teaching my patients with diabetes who are at risk of diabetic foot ulcer, I assess what they need to know.	1 (.5)	4 (1.8)	65 (29.8)	76 (34.9)	72 (33.0)
2	I encourage my patients with diabetes to understand how important it is to wash and check their feet daily.	1 (.5)	1 (.5)	26 (11.9)	107 (49.1)	83 (38.1)
3	I teach my patients to perform foot assessment.	10 (4.6)	35(16.1)	27 (12.4)	73 (33.5)	73 (33.5)
4	I include patient's relatives in patient education session, especially patients who have	2 (.9)	2 (.9)	67 (30.7)	34 (15.6)	113 (51.8)

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the tir n (%)
	difficulty in doing things by themselves.					
5	I help doctors to teach patients how to make wound dressing properly before patients are discharged home.	5 (2.3)	38 (17.4)	16 (7.3)	55 (25.3)	104 (47.7)
6	I assess all patients with diabetes to ensure that they have received an annual examination of the feet for prevention of diabetic foot ulcer.	31 (14.2)	50 (22.9)	71 (32.6)	38 (17.4)	28 (12.8)
7	I assess patients with diabetes holistically including vascular status, infection, neuropathy, foot deformity and pressure.	37 (17.0)	42 (19.3)	87 (39.9)	22 (10.1)	30 (13.8)
8	I ask patients with diabetes	2 (.9)	46 (21.1)	16 (7.3)	92 (42.2)	62 (28.4)

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the time n (%)
	whether they have numbness or heavy leg/feet.					
9	I check the feet as well as patients' shoes and other devices associated with ambulation as a preventive measure to reduce the occurrence and re-occurrence of ulcers.	22 (10.1)	24 (11.0)	51 (23.4)	52 (23.9)	69 (31.7)
10	I consult doctors to take wound culture and sensitivity test of the patients with diabetes who have developed fever with foot ulcer.	21 (9.6)	13 (6.0)	20 (9.2)	44 (20.2)	120 (55.0)
11	I ask if patients with diabetes also have their diseases (e. g., hypertension, kidney disease	1(.5)	35 (16.1)	15 (6.9)	55 (25.2)	112 (51.4)

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the time n (%)
	etc).					
12	I assess ulcers by locating the site and size of the ulcers (length, width, and depth).	27 (12.4)	53 (24.3)	75 (34.4)	22 (10.1)	41 (18.8)
13	I check the circulation to the feet by assessing dorsalis pedis pulse and posterior tibial pulse.	42 (19.3)	62 (28.4)	31 (14.2)	28 (12.8)	55 (25.2)
14	I look for callus formation surrounding the diabetic foot ulcers.	29 (13.3)	44 (20.2)	29 (13.3)	48 (22.0)	68 (31.2)
15	During wound dressing change, I observe wound bed, granulation tissue, and	32 (14.7)	30 (13.8)	38 (17.4)	42 (19.3)	76 (34.9)

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the time n (%)
	exudates.					
16	I talk with doctors about the goal of care in the prevention of diabetic foot ulcer.	17 (7.8)	10 (4.6)	22 (10.1)	57 (26.1)	112 (51.4)
17	I discuss with patients who have diabetic foot ulcers and their relatives about their expectation and co-operation.	2 (.9)	16 (7.3)	43 (19.7)	38 (17.4)	119 (54.6)
18	I perform debridement of thick callus to reduce pressure at the callus site.	19 (8.7)	63 (28.9)	24 (11.0)	52 (23.9)	60 (27.5)
19	I teach patients who have cold skin and weak pulses on their	19 (8.7)	33 (15.1)	68 (31.2)	45 (20.6)	53 (24.3)

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the time n (%)
	feet to do foot exercise daily.					
20	I advise patients with diabetes to do not walk bare foot.	17 (7.8)	5 (2.3)	15 (6.9)	21 (9.6)	160 (73.4)
21	I encourage patients with diabetes always use well-fitted walking shoes or athletic shoes.	2 (.9)	30 (13.8)	8 (3.7)	21 (9.6)	157 (72.0)
22	For patients with foot deformity, I consult doctors for advising the patients about offloading shoes.	19 (8.7)	22 (10.1)	16 (7.3)	44 (20.2)	117 (53.7)
23	I manage blood sugar control and evaluate it to minimize diabetic foot ulcer	19 (8.7)	19 (8.7)	23 (10.6)	34 (15.6)	123 (56.4)

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the time n (%)
	complications.					
24	I keep the ward environment clean to reduce pathogens, which in turn reduce wound infection.	1 (.5)	1 (.5)	37 (17.0)	12 (5.5)	167 (76.6)
25	I encourage patients and their relatives to keep the patient's body clean, particularly the skin surrounding the wound area.	1 (.5)	2 (.9)	34 (15.6)	14 (6.4)	167 (76.6)
26	I assist doctors to irrigate the infected diabetic foot ulcer.		32 (14.7)	2 (.9)	36 (16.5)	148 (67.9)
27	I offer a new, sharpest scalpel (blade) to doctors when they	11 (5.0)	7 (3.2)	15 (6.9)	17 (7.8)	168 (77.1)

No	Items	Never Practice n (%)	Seldom Practice n (%)	Sometimes Practice n (%)	Practice most of the time n (%)	Practice All the time n (%)
	want to perform debridement of diabetic foot ulcer.					
28	I check whether the patient with diabetes could stop smoking and ask the reasons if they could not.	23 (10.6)	12 (5.5)	33 (15.1)	51 (23.4)	99 (45.4)
29	I reassess diabetic foot ulcer for wound closure during dressing change.	1 (.5)	1 (.5)	16 (7.3)	62 (28.4)	138 (63.3)
30	I convince patients and their relatives to consult doctors if the ulcers do not heal properly.	1 (.5)	31 (14.2)	3 (1.4)	19 (8.7)	164 (75.2)

APPENDIX D

Experts of Content Validation of the Instruments

In this study, three experts assisted the investigator in developing the instruments as follows:

1. Assistant Professor Dr. Ploenpit Thaniwattananon, RN, PhD

Nursing Lecturer, Faculty of Nursing, Prince of Songkla University

Hat-Yai, Thailand

2. Assistant Professor Dr. Warapon Kongsuwan, RN, PhD

Nursing Lecturer, Faculty of Nursing, Prince of Songkla University

Hat-Yai, Thailand

3. Dr. Charuwan Kritpracha, RN, PhD

Nursing Lecturer, Faculty of Nursing, Prince of Songkla University

Hat-Yai, Thailand

APPENDIX E

Back Translators of the Instruments

Three experts worked on the translation of the instruments. They were:

1. Md. Sultan Ahmed Siddique, MPH (HE)

Lecturer, Institute of Health Technology

Mohakhali, Dhaka- 1212, Bangladesh

2. Dr. Kamal Ahmed, MBBS, MPH, M. Phil

Associate Professor of Epidemiology

Mohakhali, Dhaka- 1212, Bangladesh

3. Dr. Abu Sayed

Professor of Community Medicine

BIRDEM Medical College, Dhaka

Bangladesh

VITAE

Name Mrs.Sharmistha Shil

Student ID 5410420053

Educational Attainment

Degree	Name of Institution	Year of Graduation
Bachelor of Nursing Science	College of Nursing, Dhaka	2007
Diploma in Midwifery	Nursing Institute, Barisal	1996
Diploma in nursing	Nursing Institute, Barisal	1995

Scholarship Awards During Enrollment

2011-2013 Scholarship for the Degree of Master of Nursing Science
(International program), Faculty of nursing, Prince of
SongklaUniversity, funded by the Government of the people's
Republic of Bangladesh.

Work-Position and Address

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List of Publication and Proceeding

Shil, S., Petpichetchian, W., & Sangchan, H. (2010).A survey of nurses' knowledge regarding prevention and management of diabetic foot ulcer in Bangladesh. Proceedings of the 2013 International Conference on Health, Healing, and Harmony: Nursing Values, Phuket Orchid Resort and Spa, Thailand, May 1-3, 2013.