

EDUCATING REGISTERED NURSES TO PERFORM MONOFILAMENT EXAMS
ON TYPE 2 DIABETICS TO DETECT PERIPHERAL NEUROPATHY

by

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ABSTRACT

Diabetic Peripheral Neuropathy (PN), a serious complication of diabetes, affects nearly 50% of diabetics. Complications of PN are pain, foot wounds, infection, and amputation of the lower extremity. These complications cost the healthcare system billions of dollars annually. Assessing for loss of sensation in the feet is an American Diabetes Association (ADA) standard of care. This exam is vital in preventing further complications and is done with a simple tool called the monofilament wire. Currently registered nurses are not educated in school or on the job on how to use this simple tool; therefore it is unknown how effective registered nurses could be at detecting PN. This study aimed to determine if registered nurses could be educated on the use of a monofilament tool and perform these exams accurately and obtain reliable results.

Five registered nurses in an outpatient diabetes clinic were educated on how to perform a monofilament exam using recommendations by the ADA. The nurses performed practice exams on each other while being observed by the author. After successfully completing the education process they performed the exam on patients. The nurses performed 15 monofilament exams. A negative result indicates sensation in the feet is intact. A positive indicates loss of sensation.

The patient's primary care provider verified all 15 results obtained. The nurses' results were congruent 100% of the time when compared to the provider's. Of the 15 exams, 53% were positive and 47% were negative.

The results of this study indicate that nurses can be educated on how to perform the monofilament exam accurately, based on the verification of results by the primary care provider. Although a small sample size, the results show that the nurses picked up 53% of cases of loss of sensation, which will increase patient awareness and provide opportunity for education on foot health and how to prevent foot wounds and infections. Allowing the nurse to participate in this simple exam, as part of their assessment on diabetic patients, will increase the number of cases of PN detected, decrease costs to the healthcare system, and increase patient quality of life.

CHAPTER ONE

INTRODUCTION

Diabetes

Diabetes Mellitus (DM) is one of the nation's largest healthcare crises and type 2 diabetes accounts for 95% of all diagnosed cases (Center for Disease Control (CDC), 2012). This disease affects the body's ability to make or utilize insulin, which is necessary for the body to metabolize carbohydrates, fats, and proteins for cellular energy (Mulcahy & Lumber, 2004). Without insulin, the body has increasingly high blood sugar, also known as hyperglycemia, which can damage vessels and nerves that maintain normal organ function (Mulcahy & Lumber, 2004). In 2006, this disease was ranked as the 7th leading cause of death (Molinaro, 2011).

Micro and macro vascular complications associated with diabetes affects the heart, kidneys, eyes, and blood vessels, and may lead to organ failure. When the micro vascular complications affect the nerves in the foot, it leads to a common complication known as diabetic peripheral neuropathy (PN) (diabetes.org).

Anywhere between 12-50% of persons with diabetes mellitus have some degree of neuropathy (Gordois, Oglesby, Schuffham, Shearer, & Tobin, 2003). PN can lead to very debilitating complications, including diabetic foot wounds (Molinaro, 2011). These foot wounds not only increase patient mortality due to amputations and lower quality of life, but also cost the healthcare systems billions of dollars annually (Kruse & Edelman, 2006). By the year 2020, the cost associated with healthcare expenditure related to

diabetes is estimated to reach nearly 192 billion dollars (Molinaro, 2011). Yet a simple test using a monofilament wire that touches the bottom of the foot can detect neuropathy simply and be incorporated as part of routine healthcare. It is within the scope of nursing practice to perform the monofilament test, yet only 18% of baccalaureate nursing programs in the US were found to be teaching students how to perform one (Zulkowski et al, unpublished data).

Problem Statement

Diabetic Peripheral Neuropathy can easily be screened for using a monofilament tool, yet nurses are not including this as part of routine diabetic care. Therefore it is not known how effective nurses could be at detecting the loss of sensation in the feet of persons with diabetes mellitus (DM) and therefore decreasing the prevalence of diabetic foot wounds.

Purpose

The purpose of this study is to describe the relationship between Registered Nurses trained to perform monofilament exams and the accuracy of the results when compared to the results of a primary care provider. A secondary aim is to describe a process for educating the nurses to perform these exams.

Research Question

Can registered nurses in an outpatient diabetes clinic accurately perform monofilament exams to detect PN after being properly educated on the process?

Background and Significance

Diabetes Mellitus is diagnosed when there is a random blood glucose level over 200, or fasting blood glucose over 126, on 2 or more occasions (Mulcahy & Lumbar, 2004). However, the new diagnostic guidelines are to use the hemoglobin A1C level, with diabetes being diagnosed if this number is 6.5% or greater. Normal A1C levels are between 4-5.7% and pre-diabetes is 5.8-6.4% (ADA).

There are numerous complications associated with DM. It is a cause of lower extremity amputation, loss of vision, and kidney failure (Molinaro, 2011). In the United States, 19.3 million people older than 20 have diabetes (Murphy, Laforet, Da Rosa, P., Tabamo, F. et al, 2012). Pre-diabetes, an impaired tolerance of glucose, is an indicator of future type 2 DM, and affected almost 79 million adults in 2010 (CDC, 2011). Type 2 DM is caused by 3 different issues: a resistance to insulin, which means the body makes insulin, but cannot use it for glucose transport into the cell, decreased insulin secretion, or excessive glucose production in the liver (Mulcahy & Lumbar, 2004).

Diabetic foot wounds are the most common cause of amputation in the United States, and account for approximately 60% of lower extremity amputation (Scollan-Koliopoulos, Walker, & Bleich, 2010). According to Scollan-Koliopolus et al (2010), the peripheral vascular system issues in the lower extremities are the direct cause of these

wounds. Diabetic Peripheral Neuropathy is loss of sensation in the feet (Dros, Wewrinke, Bindles, & van Weert, 2009). This loss of sensation is a result of damage to the vessels in the legs and feet (Perkins, Orszag, Ngo, Ng, New, and Bril, 2010). Consequently the person with diabetic neuropathy cannot feel if they have a cut, or wound on their foot. As a result these wounds can become large and possibly infected before they are found. The vascular complication in the wounded area makes healing difficult. Each year, throughout the world, 4 million people will develop a diabetic foot wound (Murphy, et al, 2012).

Monofilament testing is one of the first line tests used by healthcare providers and clinical staff for assessing sensation in the feet, according to the American Diabetes Associations (ADA) Clinical Practice Guidelines for 2012. Inability to sense the 10-gram monofilament, along with decreased vibration sensation with tuning fork can predict future risk for foot wounds (ADA, 2012). According to Boulton, et al, 2005, early detection and management of neuropathy is vital to improving outcomes for the patient with diabetes.

Definitions for the Purpose of this Study

Diabetes Mellitus: There are many types of Diabetes Mellitus, but the most common forms are type 1 in which there is a complete loss of the beta cells, and even more common is type 2, which is insulin resistance (Molinaro, 2011). This study will be assessing type 2 DM and its affects on the peripheral vascular system.

Nurse: Nursing is a career that encompasses many different levels of educational preparedness. There are Licensed Practical Nurses (LPN) and Registered Nurses(RN).

RN's encompass a broader scope of practice. For the purpose of this study, the term nurse will refer to registered nurses who work in an outpatient ambulatory diabetes clinic.

Monofilament: Monofilament testing is performed by using a tool that has a plastic handle and a nylon string attached at the end. It is pressed against 10 different areas on the plantar side of the foot. If sensation is not felt, it is assumed that sensation is suboptimal (Kruse and Edelman, 2006). For the purpose of this study, monofilament will refer to the use of the Semmes –Weinstein 10 gram monofilament tool, which exerts 10-grams of pressure, the accepted standard according to the ADA.

Primary Care Provider (PCP): The use of the term primary care provider in this study refers to a Physicians Assistant, Nurse Practitioner, or Physician who work in the primary care setting (American Academy of Family Physicians). The PCPs in an outpatient clinic were chosen for this research study. PCPs are the patients' main healthcare provider and in this setting is usually the person performing the monofilament exams.

Theoretical Framework

The theoretical model used in this study is based on Donabedian's theory of quality health care. The theory suggests that outcomes be identified and connected to the processes that brought about these outcomes (Glickman, Baggett, Krubert, Peterson, & Schulman, 2007). The model is comprised of three components, which are structure, process, and outcomes. Avedis Donabedian developed this model. It is often used in healthcare settings as a tool for quality improvement and his model measures quality by

the outcomes. The structure is defined as the characteristics of the environment in which the care is given. The process includes factors such as whether or not patients receive care and how that care is given, and the outcomes are broken down into patient related outcomes and health systems performance outcomes (Glickman, et al, 2007).

According to Glickman, et al, 2007, quality in healthcare process is deficient, and evaluating processes and outcomes is gaining widespread attention in healthcare settings. Donabedian believed that by evaluating processes continually and implementing changes where they are needed, outcomes will improve. According to Perides, 2003, with the increasing demands on PCPs to monitor and meet certain quality targets, the use of Donabedian's idea of comparing outcomes to the structure and processes in which care is delivered is a simple method for quality improvement within healthcare organizations.

Donabedian's framework can be used in many different structures, whether a large hospital or a small outpatient clinic. There are quality health indicators for diabetic patients, which include yearly monofilament testing at yearly visits (ADA, 2012). The process of monofilament testing could be performed by nurses, and by doing so, possibly improve patient outcomes by early detection of PN and increase the quality of care for the patient.

Conclusion

PN is a serious complication, affecting an estimated 50% of all diabetics, and half of those who have PN will not present with any symptomology (Dros, Wewerinke, Bindles, & van Weert, 2009). Without any symptoms to lead the patient to a healthcare

provider, risk for foot ulcers increases. Foot ulcers are the main reason for hospitalization in patients with diabetes, and will cost the healthcare system billions of dollars annually (Kruse & Edelman, 2006). Routine foot examinations, including the Semmes-Wenstien monofilament, should be performed on all diabetics to detect possible PN (ADA, 2012). Any healthcare provider, including nurses, can perform this test.

Monofilament testing will help the healthcare provider determine if further studies are needed to evaluate neuropathy and the possible etiology (Kruse & Eckleman, 2006). The goal of this research study was to evaluate the structure, processes, and outcomes from utilizing the RN to perform monofilament testing on persons with Type 2 DM, utilizing the framework of Donabedian. This involves analyzing outcomes and the processes that lead to these outcomes, and then implementing the changes necessary to reproduce the outcomes.

CHAPTER TWO

REVIEW OF LITERATURE

General Search Efforts

The purpose of this literature review was to determine the amount of previous research done related to monofilament testing and who is qualified to perform the test. To begin searching the literature, the researcher used PubMed and searched phrases such as “Diabetic Neuropathy”. This search term returned 18, 762 articles. Terms were then narrowed down to “diagnosing diabetic neuropathy” which returned 9,378 articles. Finally, the search term was narrowed down to the specific tool being studied so that the articles would be related to the effectiveness of diagnosing neuropathy. Using the search phrase “monofilament testing and diagnosing diabetic neuropathy” produced only 57 articles. Using the search term “nurses and foot exams” in CINAHL produced 5 relevant articles, but none specific to nurses being trained to perform the monofilament exam.

Diabetes Mellitus

Standards of care for persons with DM are usually derived from the recommendations of the ADA. These recommendations are updated yearly. The guidelines do state that the monofilament exam should be performed yearly, and may be performed by clinical staff or the healthcare provider (ADA, 2012). This would include nurses. The current clinical practice recommendation for monofilament testing is that all diabetic patients should have a comprehensive annual foot exam, done by a healthcare

provider, which includes visual assessment, assessment of pedal pulses, tuning fork for vibration, and the use of a 10 gram monofilament tool to detect any loss of sensation in the feet (ADA, 2012). These ADA guidelines also recommend assessing for tobacco use, previous history of foot wounds or peripheral vascular disease, as these can increase a patient's risk for foot wounds.

Micro and Macro-vascular Changes

The vascular damage in the peripheral regions in a person with diabetes mellitus is most commonly related to a continued state of uncontrolled blood glucose levels, known as hyperglycemia. Research literature has defined hyperglycemia as a continued elevated blood glucose level of 250 or greater with symptoms of polyuria, polydipsia, and extreme fatigue (Mulcahy & Lumbar, 2004). According to the Center for Disease Control, PN appears more commonly in persons who have problems maintaining good blood glucose control, those over the age of 40, and those with hyperlipidemia and hypertension. All of these disease processes lead to vascular damage if left untreated.

Financial Impact

Once the diabetic foot ulcer occurs, patients may lack either awareness and/or education of how to care for these wounds. Prevention of diabetic foot wounds is the best defense and is related to the most positive patient outcomes. In an article by Safford, et al, 2005, of 1482 diabetic patients interviewed about self- foot exams, only $\frac{3}{4}$ spent time

daily engaging in foot care hygiene and assessment. This leaves a great deal of patients who are not performing self- foot examinations susceptible to foot wounds.

One diabetic foot wound will cost an estimated \$8,000 by the time the healing process is done (Kruse & Edelman, 2006). If there is an infection present in the wound, the cost can rise to almost \$17,000. According to Kruse and Edelman, 2006, if complications occur and the wound does not heal, amputation becomes necessary and this will raise the cost to upwards of \$45,000. These costs are all in regards to one person with a diabetic foot wound. In 2007, it was estimated that complications from diabetes cost the United States 116 billion dollars, with approximately 33% of that cost going to the treatment of foot wounds (Driver, Fabbi, Lavery, and Gibbons, 2010).

Early detection of PN would undoubtedly improve patient outcomes by preventing future complications. PN is directly linked to a high morbidity rate (Gordois et al, 2003). Presently, one of the preferred methods to detect PN is the monofilament test. The most commonly used monofilament in practice is the 10- gram monofilament (Young, 2009). The monofilament is applied to different areas of the patients' foot and they are asked to respond yes if they can feel the pressure in those areas. If they do not feel the pressure, it is considered to be a positive test, meaning they lack sensation. However, in the medical community there seems to be a debate about whether or not this testing is the best standard of care to use when trying to detect PN (Miranda-Palma, Sosenko, Bowker, Mizel, & Boulton, 2005).

Monofilament Testing

Based on this literature review, the agreement regarding the effectiveness of the monofilament test in detecting PN is inconclusive. Some researchers have concluded that the use of the 10- gram monofilament is reliable in detecting changes in the amount of sensation in the lower extremities (Young, Schuerman, Flynn, Hartig, & Altenburger, 2011). Yet others concluded that the use of a monofilament tool to detect sensation changes may not be the most accurate tool and that it should not be the only test used to determine if a patient is at risk for diabetic foot ulcers (Dros, Wewerinke, Bindles, & van Weert, 2009).

However for a first screening tool researchers agree that monofilament testing is acceptable to use in the general diabetic population to help detect early stages of PN (Perkins, et al, 2010). Monofilament testing has become the standard for testing loss of sensation in the diabetic foot, but the provider must know how to accurately use this tool to assure the results are accurate (Young, 2009). Early detection and the means of how to test for neuropathy appear to be lacking by healthcare providers (Perkins, et al, 2009). Monofilament testing seems to be the current standard for detection, and its use should be a more common clinical practice among nurses in the outpatient setting, yet research is lacking on the benefits of using nurses to perform this test.

Gap in Literature

There appears to be lack of research in the area of what the definition of healthcare provider means, who is clinically qualified to do monofilament testing, and the

training it takes to become clinically qualified to perform this particular exam. Lack of education of primary care providers and clinical staff on how and when to perform a monofilament exam also seems to be an issue in the medical community, and a protocol for use needs to be determined (Tan, 2010).

Registered nurses are licensed to perform a monofilament test, but they are underutilized as a resource to perform this exam and save the provider time for addressing other health concerns with the patient. The reasons behind the underutilization of nurses in this capacity are also a problem. There is little research on how many clinics and hospitals use Registered Nurses in this capacity. One explanation for the monofilament test not being performed by nurses on a regular basis could be that only 18% of United States baccalaureate nursing programs were found to consistently teach this to students (Zulkowski et al unpublished data). There is also little research on the processes needed to educate office nurses to perform this test and the patient outcomes when the nurse does perform the test. There also is a lack of research on whether or not results from the monofilament exam are different depending on who is using the tool. It is not known if Physicians and Mid-level providers are more accurate with the use of this tool, versus a nurse, or if the reason nurses are not performing this is just out of lack of training.

Conclusion

With the increasing rate of diabetes mellitus and the extraordinary costs related to foot wounds, having the nurse perform this exam on the patient will not only save the

provider time, but improve patient outcomes by early detection of PN. Nurses are the first person most diabetics come into contact with when they come in to see a provider for their routine checkups. Therefore the nurse could perform the monofilament exam and discuss the results with the provider before the visit begins.

CHAPTER THREE

METHODS

Study Design

The purpose of this descriptive research study is to describe the relationship between monofilament exam results and the nurse's accuracy in performing this test. Another aim is to describe a process in which a nurse can be educated to accurately perform a monofilament test and evaluate the results so that patient outcomes may be improved. This process will possibly improve quality of care for the patient and identify more possible cases of PN before problems occur.

Tools

The tool used for assessing sensation in this study is the Semmes Weinstein 10 gram monofilament wire. It has been used as a tool for assessing foot sensation for many years, and is the one of the most inexpensive and easiest tools to use for assessing sensation (Groner, 2012). The competency tool used to train the nurses on how to perform the monofilament exam was obtained from the recommendations of the ADA and is listed in APPENDIX A.

Setting

This study was conducted in an outpatient Internal Medicine and Diabetes Clinic that is associated with a urban Montana hospital. This particular diabetes clinic sees an

average of 1,000 Type 2 diabetic patients every year. The clinic also has a Diabetes Center staffed with 4 RN certified diabetes educators who specialize in diabetes self management education.

Sample

Nurses

The sample of nurses trained was purposful, and included 5 RN's that work in the clinic and work closely with the diabetic patients. Two of the RN's are also Certified Diabetes Educators. The other 3 are clinic RN's. The inclusion criteria for the nurses trained was willingness to participate in the monofilament training process and no prior knowledge of how to use the monofilament accurately.

Patients

The sample of patients was random and based on scheduled appointments. The inclusion criteria was being a type 2 diabetic and willingness to participate. The goal for this study was to obtain at least 25 monofilament exams in a 3 week period, from October 10th, 2012 through November 1st, 2012.

Demographic Data Collected

The participants gender and length of time with Type 2 DM was collected prior to performing the exam. No patient identifiers were obtained on the data collection forms. No demographics on the nurses was obtained.

Assessing for Presence of Neuropathy

The nurse had the patient remove their shoes and socks to perform the ten point monofilament exam on the patient, assessing for the presence of neuropathy. If the patient had any areas where there was diminished or absence of sensation, the test was considered positive for neuropathy. After the exam, symptoms of burning or tingling in the extremities were assessed by the nurses. The PCP also performed the exam to verify the results obtained by the nurse. Results were documented on the data collection form (APPENDIX B).

Data Collection and Analysis

- 1: IRB approval was obtained
2. Nurses were trained based on ADA guidelines
3. Exams were performed on patients
4. Results were documented and verified by the PCP

IRB approval through Montana State University Institutional Review Board (IRB) was obtained. The application was reviewed and the study was found to be exempt based on the research being based on use of educational materials and no patient identifiers will be available to the researcher. The Montana State IRB waived the need for a full application based their exempt findings. Permission was granted to proceed with the study. The office manager and PCPs at the outpatient clinic were consulted and approval was given to conduct this study.

Nurses were trained by the researcher on how to accurately perform a 10 point monofilament exam, based on the ADA Guidelines for performing a foot exam with a monofilament tool (APPENDIX A). They participated in a 30 minute educational in-service based on the ADA recommendations on staff training for foot examinations. The nurses were observed by the researcher while performing 2 exams on each other to ensure continuity in performance of the exam by all participating nurses. Interrater reliability of the researcher and the step by step ADA guidelines were used to evaluate continuity of performance among the nurses, as was verification from the PCP once results were obtained. Once continuity was determined, the nurses then proceeded to perform the rest of the exams on their own. The nurse did not know ahead of time if there is a pre-existing diagnosis of PN in the selected patients. They were not allowed to ask about past history of foot problems, or access the patients charts prior to the monofilament exam.

While the nurse performed the exam, they explained to the patient that there will be a thin wire pressed against different areas on the plantar and dorsal sides of the feet, They instructed the patient before beginning that if they feel the wire, they should respond "yes." The nurse did not prompt the patient before each poke as not to provide anticipatory guidance as to where the next pressure point will be, as this could lead to inaccurate responses by the patient. The results of a monofilament exam were recorded as either positive or negative, and areas where the patient cannot feel the monofilament were circled on the data collection tool (APPENDIX B). A positive result means there is a lack of sensation in one or more areas on the foot, while a negative exam means that all sensation was intact. Nurses documented results on the form provided (APPENDIX B).

The results were reviewed by the author . The PCP verified the results by performing the exact same monofilament exam to prove reliability.

Conclusion

Training nurses based on ADA approved guidelines showed to be an effective training tool. The nurses correctly followed the steps they were taught to perform these exams to help detect PN. Their results were verified by having the PCP perform the same exam, without knowing what the results were from the nurses exam. This process will help ensure reliability of the nurses results without introducing bias.

CHAPTER FOUR

RESULTS

Overview

The purpose of this study was to describe the relationship between nurses performing the monofilament exam and the accuracy of results, and also to describe the process for educating RNs to perform this exam. The nurses who participated in the educational training program all passed the ADA checklist (APPENDIX A) and performed the first exam on each other accurately, however to ensure consistency in technique, they each performed another exam on each other before being allowed to perform the exams on the participants. Once the nurses began performing the exams on patient participants, the results were then verified by the patients PCP. The goal of 25 exams was not reached, mainly due to the newness of the process and the nurses self-reported time constraints, or forgetting to ask patients to participate.

Data Analysis

Subject Demographics

Table 1 and 2 show the demographics of the participants, the results of each participant, and the percentage of the positives versus the negatives. There were 2 male participants and 13 female participants. The 2 male participants had negative exams. Of the 13 female participants, 62% had positive results. The average length of time with

diabetes was 13.8 years. Only 1 participant did not know how long they had diabetes, so they were not included in the average length of time.

Staff Information

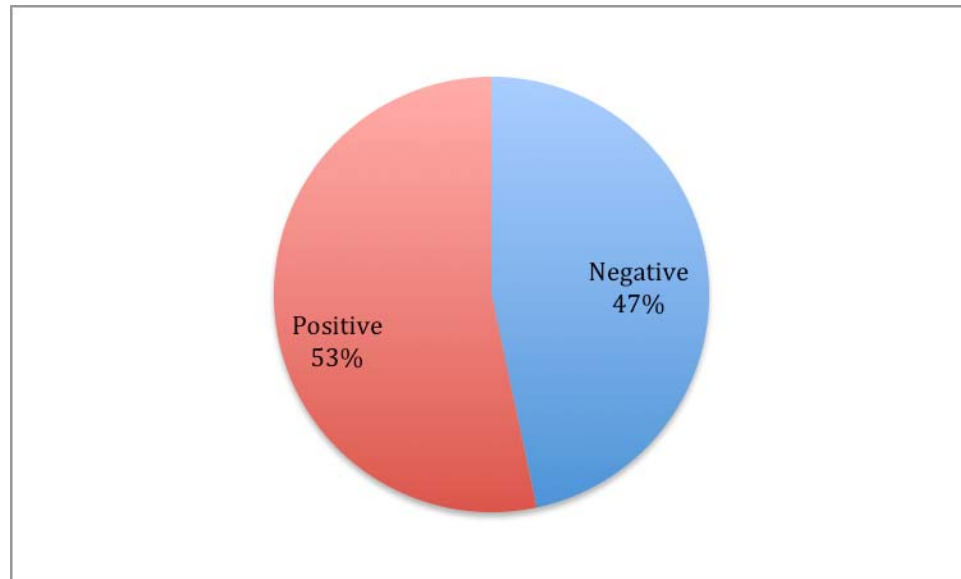
Between the 5 trained RNs, only one did not perform any monofilament exams, due to self-reported lack of access to diabetic patients, and her PCPs scheduled patients during the 3 week time period for this study. The other 4 nurses performed a total of 15 monofilament exams. All 15 of the exams performed were verified by the PCP, and results were consistent between the nurse and the PCP. The PCPs felt comfortable with the nurses performing this exam on their patients.

Table 1: Results by participant

Participant	Years with T2 DM	Results	Gender
#1	20	neg	M
#2	19	neg	F
#3	26	neg	F
#4	U	pos	F
#5	6	neg	F
#6	3	pos	F
#7	2.5	pos	F
#8	10	pos	F
#9	12	pos	F
#10	17	pos	F
#11	3	pos	F
#12	15	neg	F
#13	30	neg	F
#14	20	neg	M
#15	10	pos	F

U= Unknown pos= positive neg= negative

Table 2: Percentage of results (15 exams total): Verified by PCP



Research Question Review

Question 1: Can Registered Nurses in an outpatient diabetes clinic accurately perform monofilament exams to detect DPN after being properly educated on the process?

After performing the exams, the PCP repeated the exams and found the same results as the RN. It appears that if nurses are trained properly on the process of performing the monofilament exams that they can accurately perform the exam and detect cases of DPN.

Conclusion

Although subject group was small, the nurses performed the tests accurately, and based on the results, were able to identify 8 cases of PN out of the 15 subjects. Since

early identification of PN is vital to improving patient outcomes, these results would indicate that nurses play an important role in the assessment of the diabetic foot.

CHAPTER FIVE

DISCUSSION

Introduction

The purpose of this study was to determine the relationship between educating nurses to perform a monofilament exam and the accuracy of the results when compared to the PCP performing the exam. The results obtained by the nurses were verified as accurate by the PCP, indicating that there is a place for diabetic foot exams to be included in the duties performed by nurses. The data obtained in this study also indicates that the results of the monofilament exam may not vary based solely on the level of education of the person performing the exam, but may vary based on the training received to use the monofilament tool accurately. PN is a serious complication of diabetes, and one that needs to be screened far more frequently than it currently is. Currently nurses are not educated in school on how to use the monofilament tool, but the results of this study indicate that they are able to be trained to accurately perform this simple exam and possible decrease complications caused by undetected PN.

Evaluation of Results

Once the 5 nurses in this study satisfactorily performed the ADA steps to performing a monofilament exam (APPENDIX A) on 2 separate occasions among each other, they were allowed to perform them on participants. The 4 nurses who had access to type 2 diabetic patients obtained 15 monofilament exams. The results of the exam were

then verified with the patients PCP, and the results were determined to be accurate. Of the 15 participants, only 2 were male. Both males had negative results. Of the 13 females, 62% had positive test results. The total positives were 53% among all participants.

The results of this study are comparable to national averages of PN. According to the National Diabetes Information Clearinhouse (NDIC), 2012, 60-70% of all diabetics have some form of neuropathy, and risk goes up the longer the patient has diabetes. According to Dros, et al, 2009, 50% of all diabetics have DPN, which is close to the results obtained in the study, with 53% of participants having positive exams indicating loss of sensation.

Potential Limitations

There are 3 possible limitations in this study. First, the study was completed in a large outpatient clinic, where the nurses are expected to complete many tasks for patients, so time constraint was an issue reported by the nurses who participated. Secondly, the sample size was small, limiting the number of times the nurses were able to practice using this tool. The third limitation is that responses from patients while the exam is being performed may be inaccurate due to their anticipation of the monofilament wire touching their feet.

Implications for Education

Performing a monofilament exam is in the nursing scope of practice, but yet is not taught in many nursing programs. Although a small study, the results of the research does

show that nurses are capable of being trained on how to use of monofilament tool. The training class in this study took approximately 30 minutes. Nursing programs could implement a training curriculum while students are learning about diabetes and how to care for patients with this disease. Nursing students are required to spend clinical time learning how to do far more invasive procedures, such as inserting catheters, intra-venous lines, and giving injections. Adding a 30- minute educational session about how to perform a monofilament exam would be ideal, and could easily be worked into clinical practice sessions.

Implications for Clinical Practice

Nurses in an outpatient diabetes center were used for the purpose of this study. Other than self-reported time constraints, the nurses reported that use of the monofilament tool was simple and took less time to use the more they became familiar with it. They also stated that the reason they did not perform more exams was that they were not used to including this exam as part of their normal clinic duties, but with time felt that it would become familiar and they would be able to assess all diabetic patients to assure they have had the monofilament exam at least yearly.

Nurses have a checklist of duties that they perform when assessing a patient. They assess vital signs, pain level, mental status, and medications. To ensure that this simple exam is performed on all diabetics in the outpatient and inpatient setting, adding the monofilament exam to the checklist on patient intake forms would serve as a reminder to the nurse that assessing the feet of a diabetic is vital, and should be a part of routine care

in diabetics. Nursing managers could use the ADA guidelines to help train the nursing staff on how to use the monofilament tool. Also, for nurses already in practice, nurse managers could offer continuing education credits to the nurses who participate in the class. Training staff nurses already in practice is a quality improvement process for diabetic patients and the facilities that treat these patients. Having the nurse perform foot assessments on diabetic patients also opens the door for discussion and education of the patient about foot health and proper self-care of their feet.

The training method used for this study would also be beneficial in either the inpatient or outpatient setting. The simple educational process of putting together a training session using the ADA guidelines for diabetic foot exams is a quick and cost-effective method for educating nurses on the use of monofilament tools.

Implications for Further Research

There is little available research on how many nursing programs include training on how to perform a monofilament exam. There is also little research on why this is not included as part of the curriculum. Although this study used a small sample of patients, results were comparable to that of the national average of diabetics with neuropathy. The PCP performs most of monofilament exams for diabetic patients, however the results of the exams in this study were verified by the PCP, indicating the nurse's ability to accurately use the monofilament tool.

Further research using a larger patient sample would be needed to determine the continued reproducibility of results between nurses and the PCP. Further research into the

lack of training in nursing programs is also needed to determine the reasons why and what steps can be taken to implement curriculum that educates nurses on how to perform the monofilament exam. Research into how many cases of PN could be detected by nurses is also needed in the future. A clear consensus among providers needs to be reached in order to decide on a protocol that dictates who is clinically qualified to perform this exam and how to adequately train them.

Conclusion

Diabetes mellitus is a national health crisis. Its complications are many, and PN is one of the major complications that can lead to foot wounds, infections, and amputations. PN is the leading cause of lower extremity amputations. Early detection of loss of sensation in the extremities is imperative in the prevention of further diabetic foot complications. Early detection increases patient and PCP awareness and indicates that there is need for close monitoring of the feet for signs of ulcer or infection.

Dros, et al, 2009, states that most of patients with PN will not have any symptomology, which is another reason it is imperative that all patients with diabetes be screened. Use of the monofilament tool is a simple, cost-effective tool for assessing sensation loss in diabetics, and one that nurses should be trained how to use. With nurses being the first person a patient encounters whether in the hospital or in the clinic, it is ideal that the monofilament exam be added to the list of duties that the nurse performs on all patients. Obtaining vital signs is a must when a patient presents to the hospital or office, and assessing for loss of sensation in a diabetic is a vital sign of their health.

If the nurse intake forms at clinics and hospitals had this exam listed as an item to be assessed for on all diabetics, more exams would be performed, and the rates of complications from PN would decrease. Overtime, use of the monofilament tool would become second nature to nurses, just as it is second nature to use a thermometer.

With the increasing rate of type 2 diabetes in our nation, we will unfortunately see an increase in diabetes complications. Educating our nurses to assess for complications, especially PN, is imperative. Having an increased number of trained professionals who know how to use the monofilament tool will likely increase the number of cases detected. Nurses are the first line persons in charge of care, so having them assess for this complication would be simple, cost-effective, and improve patient outcomes by decreasing the rate of foot wounds and amputations and decreasing the costs to the healthcare system.

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APPENDICES

APPENDIX A

MONOFILAMENT FOOT EXAM RN COMPETENCY FORM

Monofilament Foot Exam RN Competency Form

Purpose:

To train Registered Nurses how to screen for diabetic neuropathy of the foot.

Method:

The monofilament foot exam should be performed using a 5.07/10 gram monofilament. The date and signature of the individual supervising the monofilament foot exam will be recorded after the skill is successfully accomplished on 2 separate exams.

Reference:

American Diabetes Association at:

<http://care.diabetesjournals.org/content/31/8/1679.full>

Foot Care Skills and Check List

- _____ Have patient remove shoes and socks
- _____ Inspect skin for any open areas, redness, ulcers, edema, or callous formation
- _____ Palpate skin for coldness or warmth
- _____ Show patient the monofilament
- _____ Touch monofilament to patient's arm to verify it does not hurt
- _____ Hold the monofilament by the handle perpendicular to plantar surface
- _____ Apply monofilament to skin
- _____ Touch the monofilament to surface of alternate toes and metatarsal heads
- _____ Press firmly until monofilament bends and hold for 1-2 seconds

_____ has successfully demonstrated proficiency in performing a monofilament foot exam on _____

_____ Signature of Researcher

APPENDIX B

DATA COLLECTION FORM

Instructions for the nurse: Please perform the Monofilament exam using the 10- gram Semmes Weinstein tool. Have PCP verify results by performing same exam.

Date: _____

Is the Subject: Male/Female

Length of time with Type 2 DM: _____

Please circle any area that the patient could not detect sensation: LABEL RIGHT/LEFT

