Diabetes Foot Care

A Web-based Training

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Introduction

Hello, My name is Steve Rith-Najarian, I'm a Family Physician with Indian Health Service and an Area Diabetes Consultant with a special interest in diabetic foot care. This web-based training module is designed to improve your foot care skills for management of the patients you serve in Indian Health.

At the conclusion of this training, we hope to meet the following objectives: first to list 4 risk factors associated with diabetic foot complications; second to be able to conduct a complete diabetic foot exam; third, list 3 interventions associated with decreasing risk for diabetic foot complications; fourth, state 4 educational objectives for patients at high risk for foot complications; and last, describe 4 components of the chronic care model related to improving diabetic foot care.

This training is divided into 3 sections: First, how to screen for patients who are at high risk, second, the practical interventions that are associated with improved clinical outcomes, and lastly, how to implement these practices into your own clinic.

Diabetic foot care is important for primary clinicians because it's a common problem that we take care of and there are opportunities for prevention. Consider these facts, 1 in 4 adult patients we see in Indian Health are likely to have diabetes, and of these, 20% who present to clinic will have an acute problem on foot examination. Over the course of their lives, people with diabetes have a 15% chance of developing a foot ulcer and 5-10% will progress to amputation. Those who experience an amputation have a 50% mortality rate within 5 years. And most importantly, amputations and ulcerations can be prevented with resources that are currently available in our clinics.

Screening for High Risk Patients:

Risk Factors

Foot related risk factors for ulcerations include neuropathy, deformity and limited joint mobility, prior ulceration and amputation, peripheral vascular disease, and fungal infections of the nails.

Non-foot related risk factors for ulceration and amputation include male sex, long-duration diabetes, and advanced age. Those that are modifiable include hyperglycemia, high blood pressure, dyslipidemia, tobacco use and smoking, poor vision and other complications, especially renal disease. In fact, patients who are on dialysis experience a 20-fold risk for ulceration and amputations.

These are simple criteria for identifying patients who are at high risk for developing foot complications. They include insensitivity to a 10-gm monofilament, or insensitivity to the 128Hz tuning fork, foot deformity, prior ulceration or amputation, and an absent pulse, or abnormal ABI, ankle brachial index.

Screening for High Risk Patients: Sensation

The monofilament examination is performed by taking a 10 gram monofilament and applying it perpendicular to the skin, just to the point of bending, hold for 1 second and release. I first demonstrate on my own hand because the monofilament can appear sharp and raise anxiety in the patient. Next I test the patient's hand so that they have a reference point for what normal feels like. When testing the feet, I have the patient sit down on a table with their feet elevated and the sole of their feet exposed, I apply the monofilament, as described, to the great toe, 1st, 3rd and 5th metatarsal heads on each foot. You have the patient close their eyes and acknowledge, "yes" when

they feel the monofilament. An abnormal test is when the patient cannot feel the monofilament in any one of the 4 sites on each foot.

We recently have added vibration sensation testing with a 128 Hertz tuning fork to the foot examination. To perform this exam, take the tuning fork and give the end of it a gentle tap against the ball of your hand. Then apply the vibrating tuning fork to the great toe, applying it to one of the boney structures at either the tip or the first joint. Have the patient tell you if they can feel the buzzing sensation and have them tell when they feel the sensation stop. An abnormal test is when the patient can no longer feel the vibration and you can still feel it in your hand.

Screening for High Risk Patients: Foot Deformities

This slide illustrates what happens when you have atrophy of some of the muscles due to nerve damage, which can result in a deformity such as hallux valgus. This photograph illustrates a bunion deformity. Notice how the boney prominence sticks out and this puts the area at increased risk for friction and ulceration. Notice the redness or what we call a pre-ulcer.

This series of photographs illustrates the claw toe and hammer toe deformities. Notice the areas of redness or pre-ulcers over the tops of toe and the frank ulcer on the bottom of the toe.

The Charcot foot deformity is the most serious diabetic foot abnormality. It's caused by an interaction of vasculopathy and neuropathy in which there are microscopic fractures in the tarsal bones leading to an exaggerated inflammatory response and subsequent collapse of the arch. The end result is what we call a rocker bottom sole, where the sole is very prominent and sticks out. You can see the callous formation in this photograph, and the frank ulcer in this one.

Screening for High Risk Patients: Vascular

There are a number of non-invasive tests for peripheral vascular disease. The palpation of pedal pulses is most simple, an absent pulse is considered abnormal. The Ankle Brachial Index is another commonly used test. It involves a handheld doppler and a blood pressure cuff, with an abnormal threshold being less than 0.8. Some professionals recommend using toe brachial index because it's a better and more accurate test than the ABI, but this requires specialized equipment that is not commonly available in most primary care settings, and so we do not recommend it routinely.

There are two main arties in the foot: the dorsalis pedis and posterior tibial. Dorsalis pedis is superficial and located on the top of the foot and the easier of the two to feel. However, 15% of people have a congenitally absent dorsalis pedis, so if you can't feel this pulse, next try the posterior tibial. This is located behind the anklebone on the instep, or what we call the medial malleolus.

To measure the Ankle Brachial Index, there are 3 steps, first measure the doppler pressure in each arm over the brachial artery. To do this, locate the brachial artery with the handheld doppler, take a pen and mark the spot. Then apply the blood pressure cuff inflate it apply the doppler over the pen-marked spot, and listen for when you hear the whooshing sound indicating blood flow. Record that number. Repeat this in the other arm.

Next, repeat this procedure on each ankle. This photograph illustrates the cuff applied to the calf and the hand held doppler applied to the posterior tibial artery.

The third step is to calculate the ABI; and this is done by dividing the ankle pressure by the higher of the two brachial pressures

There are no clear-cut thresholds for abnormality with ABI's. This table illustrates commonly accepted values including normal, borderline, mild, moderate, and severe. Most people accept the value of either less than 0.9 or less than 0.8 as being the threshold relevant for screening purposes.

Screening for High Risk Patients: Complete Foot Exam

Provider: Steve Rith-Najarian, MD
Patient: Leslie Rith-Najarian

Provider: We're going to do an examination of your feet. I'd like you to prop your foot up here and we're going to check to make sure that you don't have any infections or sores or calluses. Inspect between the toes. Now we're going to check your pulses. This is the dorsalis pedis pulse and it's strong. I'm going to check the pulse behind your ankle, called the posterior tibial pulse and it's also strong.

Now we're going to test your feeling. This is a monofilament. It's just a piece of fishing line that tests your feeling. If you can put out your hand; it doesn't hurt. Okay. Now I'm going to press this on the bottom of your foot and I want you to tell me when you feel the pressure on your foot…

Patient: Sure.

Provider: …with the word "Yes."

Patient: Yes. Yes. Yes. Yes.

Provider: Notice how I press for one second and release. Excellent. Now I'm going to check your vibration sensation. I'm going to put this tuning fork, which is buzzing, on your toe. Can you feel that?

Patient: Yeah.

Provider: Tell me when you feel the buzzing stop.

Patient: Stop.

Provider: Good. That's it.

Patient: Well thank you.

Interventions:

Causal Pathways

Complications are rarely the result of a single event; but rather, a sequence of events occurring over time in a process called causal pathways. Understanding these causal pathways is important for forming a basis of prevention. The most common causal pathway is a person with neuropathy and deformity with subsequent minor trauma leading to foot ulceration. Then this is aggravated by poor circulation and infection, leading to gangrene; and subsequently amputation.

Moreover, it's rarely a single abnormality that results in an ulcer but it's a combination of factors… A plus B plus C leads to the ulcer. And if you can prevent any one of these, then you can prevent the

ulcer, you don't necessarily have to prevent all of them. And so the strategy is to identify the component causes and then target them with specific interventions.

Here we have a list of component causes and their associated intervention strategy. Top three are neuropathy, minor trauma and deformity, with their respective interventions being good glycemic control, clearing walking spaces of dangerous objectives, and using accommodative footwear. Most of these interventions have a common thread of self-management education. Not surprisingly, self-management education programs have been associated with high rates of risk reduction in a wide variety of settings.

Interventions: Patient Education

For patients who are low risk, the focus of self-management education should be on glucose control, blood pressure control, lipid control, and smoking cessation for those who smoke.

For patients at high risk the education objectives should focus on daily washing and inspection of feet, clearing walking spaces of dangerous objects, appropriate use of footwear including selection, use and fitting, the use of slippers indoors and avoiding walking barefoot, appropriate nail care, callous care and avoiding bathroom surgery is also important. Avoiding extreme temperatures either hot or cold and avoiding soaking is important. This is because people with diabetes have autonomic neuropathy, which controls the sweat glands, and these nerves are often damaged impairing the ability to sweat leading to dry feet. Soaking the feet aggravates this, leading to cracking, fissures and can cause infections. Lastly, people with diabetes need to be instructed to report problems promptly; including infections, ulcers, cuts that do not heal or anything that they're concerned about.

Education materials are more likely to be effective if they've been pre-tested for learner comprehension in the community in which they are to be used. These are examples of education materials developed by the Indian Health Service Diabetes Program and are available at the Diabetes Program website.

Interventions: Foot Wear

The use of protective footwear is the second intervention that we recommend. Protective footwear is associated with reduced peak plantar pressures, reduced callus formation, reduced recurrence ulcer rates and reduced amputation rates.

Before we review footwear selection and prescription, it's important for us to review the basic anatomy of a shoe so we are all speaking the same language. This picture illustrates the different components: Starting at the back, we have the collar, which goes around the ankle. These can be padded or straight; there's the heel counter just below that. This is usually stiffened in order to provide lateral support. On top we have the upper and these can be adjustable with laces, Velcro or a buckle. In front we have the toe box and these can vary in depth. They can even be increased by as much as half an inch to a quarter inch in what we call an added depth shoe. Inside the shoe we have an insert, which can be padded or covered with a liner. On the bottom we have the sole. Notice in this picture the front of the sole is beveled. We call this a "rocker" sole and it can reduce the pressure at the forefoot. Shanks sometimes are inserted into the sole to provide some stiffening.

When counseling patients on footwear selection, you need to know the risk status. Patients with normal feet can wear a standard shoe. Those with insensitive feet, particularly to the monofilament, you want to recommend a quality walking shoe, or an extra depth shoe. These should have adjustable uppers for a snug fit, a firm heel counter to provide lateral stability, a padded insert and a padded collar to reduce friction, and a broad sole with nominal lift.

For those with insensate feet and minor deformities, such as bunion or minor hammertoe, most of the time they can be accommodated with an added depth shoe. Custom molded inserts can also be put into these. For patients with major deformities such as Charcot foot, a custom molded shoe is required. These shoes vary in cost. A basic walking shoe can cost between $40-80. An extra-depth shoe can cost between $100-200, and custom molded shoes range from $600-1200.

When fitting shoes, counsel patients to select shoes that match the shape of their foot. Have them measure both feet while standing. Fit while wearing standard socks. The shoe size you select should fit the largest foot. In general we recommend 1cm length between the longest toe and the shoe tip.

Footwear precautions include instruction on how to break in shoes. Recommend that the patient wear the shoe a half-hour for the first day then increase the duration by half-hour increments each day. Make sure that they check their feet for redness after wearing to see if any pre-ulcers have developed. One way of preventing this is to have them change their shoes several times a day because each shoe applies a different set of pressures and can reduce the risk of injury. Make sure that the shoe is inspected for foreign bodies because patients with neuropathy might not feel something inside the shoe. And lastly it is important to replace shoes when they are worn out.

Here are some pre-tested education materials on footwear that are available on the IHS website.

Patients who have Medicare part B can take advantage of the Medicare Therapeutic Footwear Benefit. This is a three-step process that at first involves getting a physician to certify that you are eligible. The eligibility criteria are the same that we use for our screening criteria. The provider would fill out a form. Next, you would need to see a podiatrist who can fill out a footwear prescription. And last, you need to have the shoes fitted and dispensed; and this is usually done by a pedorthist. In certain circumstances where there are limited accesses to pedorthists, podiatrists can be certified to dispense the shoes.

Interventions: Podiatry Care

The third intervention that is associated with improved clinical outcomes for the diabetic foot is routine podiatry care. Such care has been associated with increased self-management knowledge, reduced ulceration and reduced amputation rates.

There are three components of routine podiatry care including lubricating the skin, trimming the nails, and reducing callus.

Lubricating dry skin is important because patients who are at high risk often have autonomic neuropathy that contributes to dry skin. You need to instruct the patient to apply a moisturizing lotion daily. It doesn't matter if its oil or water based, it's more a matter of patient preference. You may need to involve a caregiver to assist the patients if they have difficulty reaching their feet. It's important to wipe off excess cream or lotion from between the toes so there isn't any maceration. To see a demonstration on how to apply lubricating lotion, click on the link.

To trim normally shaped nails, use a standard nail nipper; either straight or curved. Make sure you have good lighting and a comfortable position for the patient to sit and wear safety glasses. Stabilize the toe with one hand and cut with the other. Start at one edge and follow the curve of the nail and file off any sharp edges at the end with emery board.

When cutting curved nails, start at one edge and follow the curve of the toe but make sure you avoid cutting into the corners. When you are done, file any sharp edges with emery board.

Caution needs to be advised when trimming thick and mycotic nails, they tend to be very brittle. You can use a standard nail nipper or a dremel to trim off any sharp edges. In my experience, its best to refer this to a podiatrist or a certified foot care nurse, or a provider who is experienced in nail care.

For callus debridement, you need to have good lighting, gloves, an alcohol swab, and a disposable #15 blade. Start by wiping the callus with the alcohol swab, because this will turn the callus a whiteish color and demarcate it and give you an idea as to where to start. Start in the center with a paring down motion gradually removing small bits of the callus. Palpate the callus intermittently and when you feel the tissue to be soft and pliable, you are getting close the “normal” tissue, and that’s a sign to stop. To view a video on callus debridement, click on the link.

To summarize our evaluations and interventions, start by removing the shoes at each visit and inspect the foot for acute deformities. Realizing that up to 1 in 5 patients will have a problem. If there is no problem and no ulcer noted, perform our annual diabetic foot exam testing with the monofilament, inspecting for deformity and assessing circulation. Ask the patient if they have a history of ulceration and amputation. If they have none of these, they are at low risk and the focus should be on self-management education, to keep them at low risk, including blood glucose control, blood pressure control, and smoking cessation if they smoke. Follow up should be annually.

If they have an abnormal exam, they are at high risk and the emphasis should be on self-management education, protective footwear, podiatry care, plus all the measures we did for low risk patients. Follow up should be every 2 to 3 months.

Implementation:

Clinical

When we got into the business of trying to improve our diabetic foot care over 20 years ago we started by convening our clinic diabetes team. At that time it had the usual cast of characters including the primary care providers, our nursing staff, clinic registration and field health. We later added administration, which was very important for us being able to get the support for training and allocating nursing staff for a diabetic foot care clinic. We included our podiatrist and regional consultant surgeon and then later got input from our patients through initially surveys and also asking for input from the clinic staff who happen to be people with diabetes and patients at our clinic.

One of the first things we recognized as the diabetes team was there was a lot of variability in the care that our patients received who had diabetic foot complications. For example a patient who presenting to clinic with a foot ulcer could be admitted to the hospital, some were sent home, others were sent to the local surgeon and still others were sent to the wound healing center at the University of Minnesota. And so one of the things we wanted to do was standardize care. We started by reviewing the evidence and created a clinical practice guideline that was customized to our particular facilities needs and resources.

Developing the clinical practice guideline is only the first step. Next you have to move it into clinical practice. And this involves team coordination. You have to get input from each individual to figure out who is going to being doing what, delineating roles, how is it going to be documented, what are the training needs, and how are we going to measure and monitor outcomes for evaluation purposes

An integral part of a successful foot care programs is to have a foot care case manager. This is Charmaine Branchaud RN. She practiced as a nurse in a major medical center in Minneapolis for most of her career. And in the early 1990's, returned home to her home reservation at Red Lake.

Her life having been touched by several family members who were affected by diabetes made her particularly motivated to want to make a difference for the lives of people with diabetes in the Red Lake Community. And so when she returned, she became part of the diabetes team. When we started to discuss foot care as one of our objectives for improvement, we were very fortunate to have our clinic administration as part of that team. Because with their support, Charmaine was able to get some additional training and block off one-half day a week to run a foot care clinic.

Now they didn't have specialized foot care training for nurses back then. So what Charmaine had to do was work with our local podiatrist and shadow him for several months to pick up basic foot care skills. And then with that, she started out with nail and subsequently callus care.

A little bit later on, Charmaine had partnered with a vascular surgeon from Minneapolis, who came up once a week and ran a wound care clinic. And working with him, had acquired a lot of basic wound debridement skills added that to the repertoire of the foot care clinic.

Now Charmaine being very successful, integrated this whole program into the background of the whole clinic, so it wasn't just Carmine's show. But it involved physical therapy, which did all the pedorithics. It involved the patient registration who kept track of all the patients.

Several years ago, Charmaine was moved from the clinic nursing staff to a clinic case manager. And then stepped in Emily Heinrich. Emily, an LPN, had shadowed Charmaine for several months to gain some of the skills and then took a two-day course in Wisconsin. She worked under Charmaine's direct supervision.

One of the critical information technology pieces for an effective foot care program is having a diabetes registry that can track all of your patients and their particular complications.

Implementation: Community

Creating linkages between the clinic resources and those that are in the community is the last and important link of the Chronic Care Model. To start with, we need to look at where patients can get appropriate footwear. I recommend that, as a provider, take a look at the shoes that are in the stores and the local community. Get an idea of what shoes meet the basic criteria for appropriate footwear, look at their name brands and prices and that way, when you see your patients, you can give them some concrete examples of where they can buy shoes, what styles and what they might expect to pay for them. Lastly, you can look at some of the local vendors in your region who have specialized diabetic footwear including extra depth shoes to see if they are willing to come up to your clinic on a certain day a week or a month to fit patients for shoes and to dispense them.

Other kinds of linkages you can establish are with wound care outreach programs. This is Dr. Craig Walvatne; he is a vascular surgeon from Minneapolis who's been coming up to Red Lake one day a month for the past eight years. And, as a result of this, people who normally would be lost to follow up are getting their follow up care and screening for vascular disease and as a result of his involvement, there's been a substantial improvement in the clinical outcomes. Part of the success of this is that when patients come in to see Dr. Walvatne they're accompanied by their CHR, and that way the person who's going to be assisting them with their care in their homes is learning what the care needs and requirements are and this greatly facilitates appropriate aftercare

You will see that we have incorporated the components of the chronic care model into our Foot Care program. As you may know the Chronic Care Model provides a framework for utilizing community resources, policies and the organization of health care system to create effective patient interactions and positive outcomes. The components of this model are self-management support, delivery system design, decision support, clinical information systems, leadership committed to improvement and integration with community resources. In addition, the chronic care model promotes a productive interaction between an informed patient and a prepared practice team.

Now, to summarize the impact of all of these interventions on clinical outcomes, such as amputation prevention, we have been tracking rates of amputation in the Red Lake community for over the past 20 years. Here we can see that the rates of amputation at baseline in the blue were 26/1000 nearly 4 times the national rate. After we started a diabetic foot care team that stressed education and screening of high-risk patients we saw a 25% reduction in those rates. Later on when we adopted clinical practice guidelines and did some clinic redesign we saw an additional 25% reduction. When we engaged with clinical resources, providing our-reach services, getting pedorthic services onsite, then we saw the most substantial drop, down to 25% of the original rate or a 75% reduction overall. More importantly these gains were held onto over the past 10 years, shown in the yellow, to indicate

that they were integrated into the overall clinic structure. Even as resources were shifted through the Special Diabetes Program as well as the transition of foot care case managers.

Resources and Summary

To assist you in getting additional foot care training, I have listed selected Internet resources for diabetic foot care. On top is the IHS Diabetes Program Best Practice for Foot Care and it can be downloaded from the IHS Division of Diabetes website. Also listed is *Feet Can Last A Lifetime*. This is a guidebook on developing diabetic foot care programs developed by the National Institutes for Health with input from Indian Health Service. Lastly, we have the *Lower Extremity Amputation Prevention Program* or LEAP for short. And this is from the Bureau of Primary Health Care and it has at this website a number of links to sites where you can get additional training and specialized diabetes foot care for health professionals.

In this training module we have reviewed important concepts of diabetic foot care. First, how do we as health care professionals screen and identify those patients who are at highest risk for diabetic foot problems? Second, we reviewed the evidenced-based best practices associated with improved outcomes including self-management education, the use of protective footwear and routine podiatry care. Lastly we have gone over how you can integrate these principles into your clinical practice using the chronic care model. This model recognizes that you have to have strong leadership that is engaged in improving and supporting quality care initiatives. It has to have an activated patient whose understands what is going to be expected to be able to achieve those outcomes and a receptive care team that is going to be providing evidenced-based care; that has a clinic that is organized in a way to deliver care appropriately, guidelines that direct them to provide the appropriate care, and an information technology system that supports all of the documentation, and prompts and reminders. These programs will only be as effective to the degree to which they are integrated into the overall community for support. With these programs in place you can expect improved clinical outcomes for the patients you serve. We wish you well with your patients and thank you for the ongoing support you provide to our communities.