

New Insights into Preventing Diabetic Foot Disease: Part 2

Here are some new solutions to these challenges,
along with updated guidelines.

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Author's Note: This is part 2 of a 2-part article (part 1 appeared in November '17). Part 1 dealt with the challenges of preventing diabetic foot disease; part 2 focuses on the solutions, culminating in updated guidelines.

The Wisdom of Dr. Brand

To start our discussion offering solutions to the hurdles that need to be overcome while traversing this muddled and enormously rocky pathway to prevention of foot problems in the person with diabetes, let's recount some of the wisdom of Dr.

running barefoot with deep, infected and open ulcers on the bottom of their feet, throwing their crutches away, merely to have a chance at being seen and treated by the visiting medical practitioners, who came to their village only very rarely. Dr. Brand describes their running so hard and for such a distance that their tibia became disconnected from their foot, which became entrenched with the



Figure 1: Dr Paul Brand, Pioneer of Diabetic Foot Disease Prevention. Permission authorized from Carville Video Library

Brand, this is the pillar of life, without which life becomes meaningless. We are therefore dependent entirely on our senses. Because life is in the brain and not in the hands or feet, if we are not informed of something through our senses, to us that thing does not exist. Accordingly, if we do not feel our feet because of this insensate problem, those feet do not exist in our minds, and then we do not bother to take care of

them. This is the crux of the reason, according to Dr. Brand, that the diabetic patient with loss of sensation appears non-compliant and non-adherent.

Further, touch is our most important validating sense, the sense that ensures us that things are real. We learn to trust our eyes only when we validate what we see with other senses, especially with touch. What we trust more than anything else is touch, because touch means you have made contact with that something. Touch makes it real, and therefore, according to experts, is more fundamental than sight.

Consequently, if we see something, but cannot validate that, we feel deceived; and once we are deceived our life changes. Hence the non-compliant and non-adherent be-

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Paul Brand (Figure 1), who dedicated his life to research and treatment of the neuropathic and insensitive hand and foot in diabetes and leprosy. He was a pioneer in the psychology, techniques and treatment regimens we use today to deal with the problems associated with these conditions. Dr. Brand offers some very convincing discourse illuminating the psychological makeup that influences non-compliant and non-adherent behavior.

He describes people coming to his leprosy clinic in India who were

gravel from the surface they were running on, as if they were not aware and did not care about their diseased foot. They were not and they did not—but that's only the surface of the story!

In diabetes and in leprosy, people lose their instruments of sensation and therefore its connections to the brain. If nothing comes from the brain, the brain shuts down. Our life is in the brain and our brain is informed by our senses. We are flooded with information from the senses all the time; and according to Dr.

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havior ascribed to the person who has diabetes with a threshold loss of sensation.

In amputations people trust their phantom feeling and body image more than they trust what they see. The most profound deception in the world is when this touch is deceived.

Those who have diabetes with peripheral neuropathy and a fully-developed insensate foot are actually experiencing what providers for patients that suffer from insensate feet call *reverse phantom syndrome*. That person does have a foot; but there is no body image, as expressed through touch, that confirms and reinforces that. They admit they have a useful instrument to walk on but it doesn't feel like the feet are actually part of them.

It is interesting to note that when asked to draw themselves, people with insensate feet will invariably draw themselves without a foot. In fact, there are research studies as described by Dr. Brand¹ that demonstrate that rats who do not have sensation in their feet will eat them, as they would any other extraneous piece of meat.

Another root of non-compliant

ers now regard their insensate feet as being presumably dead, disgusting tissue. And so, just as the person himself has a body image that denies the foot, their perception is that other people have developed the same image as well. It's easy to see how this reinforces the negative behavior.

Moreover, when a healthcare professional, unfamiliar with and un-

He specifies that the insensate patient is task-oriented. For instance, if these patients want to go to a party wearing pointed or high-heel shoes, then that's what they want to do regardless of the effect it has on their feet. Remember, their feet are not real to them. On the other hand, the person who has no loss of sensation in their limbs is body-oriented. Every

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trained in the management of the insensate patient, sees how this person treats their own feet, they then would look askance at this person with disdain, as being complacent, ignorant and uncaring about their life and limb. Dr. Brand speaks of the person who suffers from a limb-threatening foot ulcer to which the healthcare professional has painstakingly applied a series of plaster casts for offloading. When the wound is finally and totally healed, the professional instructs the patient, in no uncertain terms, stressing time and

part of their body, especially the limbs, *is* real to them; and the body, then, naturally becomes the center of their perception of themselves, and therefore factors into every decision that is made regarding their health.

Therefore, the heart of the compliance and adherence issues with the insensate person, according to Dr. Brand, is that they do not regard their perceived-to-be-disgusting foot as actually being part of themselves. He states emphatically that the healthcare provider for these patients has the power to reverse the course of this unhealthful, self-destructive pathological pattern, and is indeed obligated to do so.

Dr. Brand puts forward a solution pathway. In addition to all the good medical attention that is expected from any healthcare provider who's committed to quality care, such as appropriate education and counseling, encouraging optimum medical care, good shoes and inserts, healthful diet, blood sugar control, exercise, etc., this healthcare professional must focus on his and the patient's attitude and perceptions. The most salient feature of the doctor-patient relationship must be that the doctor needs to tune in to the mind of the patient. Doing this requires showing absolute respect for the patient, and being able to demonstrate that in a rather vociferous way. He advocates the provider making it obvious that he knows how good the foot still is, even though the patient

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non-adherent behavior in the person with insensate limbs, according to Dr. Brand, stems from when they're adversely affected by the negative regard with which they perceive other people treating them. The insensate person senses disgust in other's faces when these people look at their ulcerated feet; and subsequently this makes the insensate person feel that they're offensive in some way. People then become ashamed of their ulcerated feet, even after the wounds have healed, not only because of the factors previously discussed surrounding loss of sensation, but also for the reason that they feel that oth-

time again the absolute importance of wearing appropriate properly-fitting shoes—and avoiding going barefoot lest they get another ulcer and put themselves at risk for possible loss of limb. He custom-makes expensive prescription shoes for them and conscientiously educates them on their use as well as any other preventive measures. All this, only to bump in to them on the street, and see them wearing tight, pointed or high-heeled shoes.

With his characteristic intuitive instincts, Dr. Brand encourages the healthcare professional to look at this person from another point of view.

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doesn't think so. It is important to show that there is still a healthy part of the foot, and that this part is precious and wonderful.

He recommends the provider never examining the foot without finding something to praise and showing appreciation for, telling his patients things such as: "Look at how your wound is healing and how wonderful it is that your body has the power to do that." He advocates that the provider demonstrates to the patient that the foot is real by touching it and pointing out things such as—even though they may have lost some nerves—it still has blood vessels that provide the ability to heal. Show them the healing cells and emphasize that the body is working well in order to produce them. All this while pointing out that it's still a good functional foot and that it will last for years to come.

One major point Dr. Brand emphasizes is that people who are healing need to feel that they're not alone in their disease, that someone is in on this mission with them and cares about the outcome as if they were close family (Figure 2). That is exactly why, as research shows, people with a close family structure and support do much better in the healing arena.²

Dietary and Nutritional Recommendations

In addition to the aforementioned issues, it is vitally important to discuss updated dietary and nutritional recommendations. The American Diabetes Association has replaced its nutrition therapy recommendations published in 2008 with newer ones published in 2013.³ It calls for all adults diagnosed with diabetes to eat a variety of nutrient-dense foods. It is advised that these be consumed in appropriate portions and can be consistent with a person's cultural, traditional and personal preferences and metabolic goals. The rationale is that a person is more likely to be nutritionally more compliant if their overall dietary construct is consistent with previous customs, patterns and religious beliefs. It is the actual

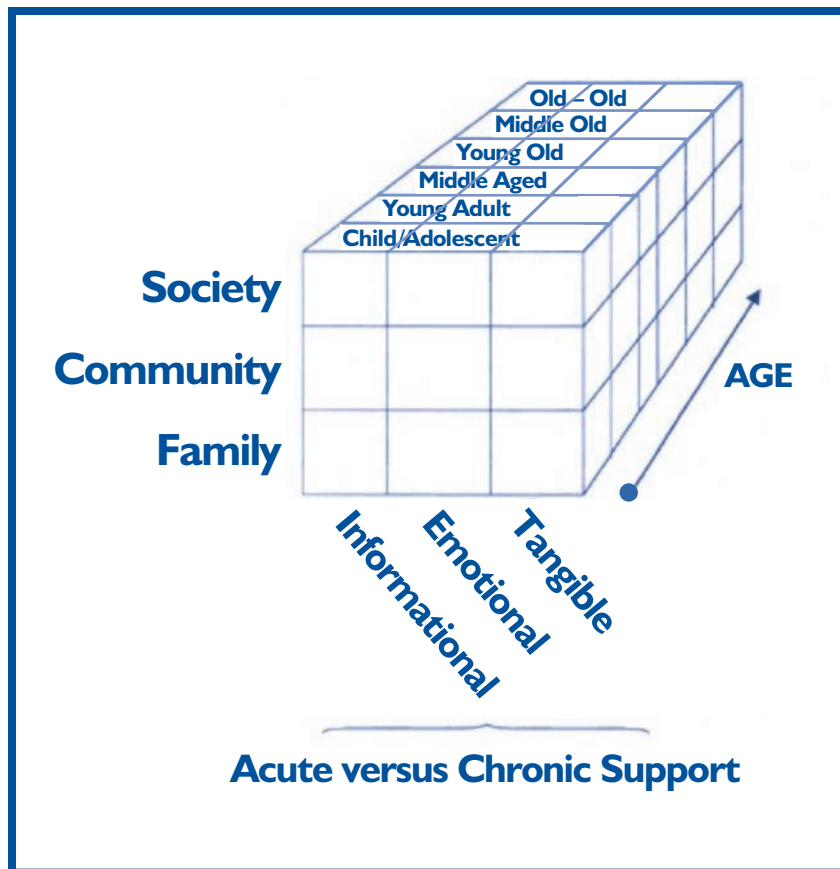


Figure 2: Many different possible levels of effective social support in diabetes

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amount and types of carbohydrates, protein and fat eaten that are more important than the ethnic or regional style of preparation. Among the critical factors discussed is that the goal of nutritional therapy in an adult person with diabetes must be a commitment to appropriate behavior change brought about by a collaborative development of an individualized eating plan reinforced by ongoing counseling and social support.

Further updated recommendations for people with diabetes include:

1) Carbohydrates should come from vegetables, whole grains, fruits, legumes and dairy products and

should not be in the form of a processed sugar, but be accompanied by its native fiber, which improves its metabolic processing.

2) Fat quality is more important than quantity. Selecting monounsaturated and polyunsaturated fats, while avoiding trans fats and saturated fats is critical to nutritional success. Please note that individuals working to manage their weight should, however, still eat even healthy fats in moderation.

3) Avoidance or limitation of any added sugars and syrups to foods and beverages, sugar-sweet-

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ened foods, which include many different types of added sugars, such as fructose corn syrup, fructose, sucrose, anything with the word syrup in it, among a host of other names. This recommendation does not in-

clude those sugars that occur naturally such as those fruits or vegetables, because they are metabolized in the body differently when they are linked to their native fiber. Added sugars are highly inflammatory and promote the toxic process of glycosylation.

Recent data elucidates the pathways in which hyperglycemia induces the functional and morphologic changes that describe diabetic complications.

4) Limitation of sodium consumption to less than 2300 mg per day for people with diabetes. Individualized restrictions should be in place for those with hypertension.

5) Eating a fatty fish at least two times a week will satisfy the need for the omega-3 fatty acids, which are anti-inflammatory and are found to decrease insulin resistance in persons with diabetes.

Following this line of thinking, additional research⁴ has shown that appropriate additional antioxidant micronutrients can be of benefit as an adjunct therapy in patients with diabetes. Indeed, some minerals and additional supplements are able to improve glycemic control in addition to being able to exert antioxidant activity.

The use of minerals such as vanadium, chromium, magnesium, zinc, selenium and copper are reviewed as well as vitamins or cofactors, including vitamin E, vitamin C, coenzyme Q, nicotinamide, riboflavin, alpha lipoic acid and flavonoids. This analysis was done with a particular focus on the prevention of diabetic complications.

Results show that dietary supplementation with these micronutrients may be an effective adjunct to

customary treatment regimens for preventing and treating diabetic complications. The results of appropriate supplementation are more striking when a deficiency in these micronutrients exists. Nevertheless, these studies have reported beneficial effects in individuals without deficien-

cies. It is important to note, however, that persons with diabetes should be educated about the importance of consuming adequate amounts of vitamins and minerals from natural food sources, within the constraints of recommended dietary guidelines. Moreover, recent studies⁵ suggest that aged garlic extract (AGE) inhibits the formation of advanced glycation end products and formation of glycation-derived free radicals. This is also very promising news that establishes a possible role for aged garlic in the prevention of all diabetes-related complications.

Recent data⁶ obtained from the Diabetes Control and Complica-

linked to the development of pathologies affecting both large and small vessel complications.

2) Increased formation of advanced glycation end products. These highly oxidant compounds, also known as glycotoxins, are pathogenic in diabetes but also in other chronic diseases. They are created by non-enzymatic reaction between reducing sugars and free amino groups of proteins, lipids and nucleic acids. This is known as the Maillard or browning reaction and is thought of as the rusting of the target tissues, reminiscent of that 1960 Chevy you remember.

3) Increased glucose flux through the aldose reductase pathway, causing a pathogenic increase in this enzyme. High levels of aldose reductase is linked to basement membrane thickening, demyelination, and impaired axonal transport and is reminiscent of the pathology involved in retinopathy and overt neuropathy.

The salient outcome of this research is that a single unifying mechanism of action responsible for the damage involved in all diabetic complications, including diabetic foot disease, has been identified.

It is through preventing the activation of these three pathways that we can halt the injury to tissues and therefore the complications of

Prevention strategies should be incorporated at any and every step along the progression pathway.

tions Trial elucidates the pathways in which hyperglycemia induces the functional and morphologic changes that describe diabetic complications. Hyperglycemia increases reactive oxygen species production (ROS) inside the vascular endothelial cell. Consequently, three major pathways are activated, which results in the tissue damage that defines diabetic complications. (Figure 3) These seemingly independent biochemical pathways involved in this pathogenesis are:

1) Glucose-induced activation of protein kinase C isoforms which are

diabetes mellitus. Pharmacological research is developing inhibitors to these reactions, but also one must consider the fundamental importance of any lifestyle change that will allow the body to circumvent these pathways, such as dietary and nutritional compliance, stress management, development of healthy sleep patterns, acquiring a suitable and consistent exercise regime, among a host of other possible healthful solutions.

In patients with insulin-dependent diabetes mellitus (IDDM)^b, a

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closely related relevant finding from this research clearly indicates that intensive insulin treatment effectively delays the onset and slows the progression of long-term diabetic complications, including those which are associated with diabetic foot disease. It can be concluded therefore that, along with lifestyle improvements, in persons with insulin dependent diabetes that tight glycemic control has been found to be the most effective way of preventing or decreasing these pathologic consequences.

Any discussion of diabetic foot disease would have to include recognition and acknowledgment of the proximate cause of any lower extremity amputation. The subject of prevention should incorporate prevention of

diabetes itself, then consider prevention of any complication, especially in the light of the information brought out in this paper, that all sequelae of diabetes have a unifying mecha-

egies should be incorporated at any and every step along the progression pathway. In any event, the immutable question is: "Are we in touch with the proximate cause of the foot dis-

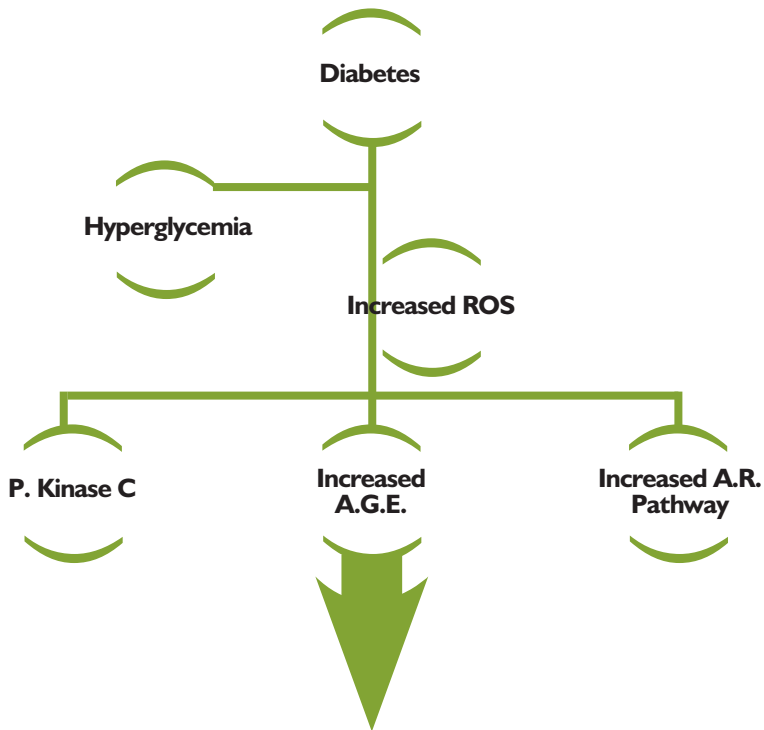
**A keen sense of diagnostic intuition
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nism of etiology, and then address prevention of foot disease itself. But it goes one step further: preventing the *progression* of the foot disease. For instance, if you have an amputated toe, preventive measures should be incorporated to prevent any further amputations. Prevention strat-

ease or amputation?" For instance, if a person has sensory neuropathy, are we dealing with the psychological component of losing our validating sense, as written extensively by Dr. Paul Brand? He stated that we tend to disown and neglect parts of the

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**FIGURE 3:
Unifying Factors Causing Damage to Tissues in Diabetes**



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Figure 3: Demonstration of the unifying factors causing damage to tissue in diabetes

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body we can't feel. If this were the case, wouldn't the disregard for that injured part, which is neuropathic, be the would-be cause of an amputation? If a person has a hammertoe deformi-

ty have been demonstrated to be *essential* for prevention of foot disease in diabetes:

- **Medical History:** the patient should become intimately familiar with family medical history and risk factors. The old adage is truly appli-

cal role in being a healthy person who wants to prevent the onset of diabetes or in controlling the disease. It is part of any weight control program and is essential for improving circulation to the whole body or strength-training program. Do not forget the importance of overall strength to optimize the mechanics of gait or when one is confined to a wheelchair or the bed, so common in the life of people with diabetes. Imagine all the ulcerations on the sacrum, the heel and wheelchair scrapes that would be avoided. Exercise needs to be consistent and directed to be efficient. Exercising the foot alone plays an important role in mobilizing waste products, managing the process of nonenzymatic glycosylation, maintaining soft tissues mobile and pliant, and increasing circulation to the feet.

- **Biomechanical Stability:** paying attention to the mechanical stability of the foot, how it relates to overall balance and the effect it has on the whole kinetic chain is fundamental to preventing foot disease in the person with diabetes. Remember that the foot is attached to the rest of the body, and to make the recommendation of appropriate shoes and inserts for patient with diabetes more meaningful, one has to consider the whole person.

- **Keep Yourself in Check...Keep your Feet in Check:** when patients visit their primary care physician for that proactive checkup, they need to always make sure that their foot health is discussed, their feet are examined and they are prepared with any thoughts and questions. The status of their circulation and whether there is neuropathy present should always be addressed. Referral to a podiatrist for regular foot exams and inspecting one's own feet every day has a critical impact on foot health in the person with diabetes. Patients must make certain that they create time in their schedule to care for their diabetes...and their feet.

- **Skin and Nail Health:** Problems in the feet often start with the onset of various diseases on the skin, such as fungus conditions and xerosis, both of which are niduses for

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Exercise has been shown to lower HgA1C's and play an essential role in being a healthy person who wants to prevent the onset of diabetes or in controlling the disease.

ty caused by motor neuropathy, does he need loss of sensation to develop a blister there from new shoes, perhaps? If dry, cracked skin that results in part from autonomic neuropathy, becomes infected, is it not the immunopathy and consequent infection that becomes the proximate cause of the amputation? A keen sense of diagnostic intuition comes from the familiar obligation of "when you hear hoof beats think not only of horses but zebras as well." This was the mantra of Dr. Philip Gardner, a distinguished professor at California College of Podiatric Medicine, who in the early years of podiatry consistently preached that to his students.

In summary, many additional avenues of preventive measures and considerations were brought forth in this discussion of staving off foot disease in the person with diabetes. This paper was not a proposal to abandon the traditional recommendations for foot care in the person with diabetes, but a recommendation to expand it. Considering the breadth and depth of topics presented, it is obligatory for the sake of completeness to organize these ideas in a format that would be a usable stratum. Hence, it would be prudent to extrapolate from this treatise a new set of guidelines that could serve as a fresh approach to the prevention of diabetic foot disease.

Updated Guidelines for Foot Care in Diabetes

This algorithmic list highlights the elements of intervention that that

cable here: An ounce of prevention is worth a pound of cure.

- **Education:** the patient needs to educate him/herself from reliable sources so that his/her future behavior and choices are based on sound information and not on hearsay or unfounded information.

- **Mental, Psychological and Emotional Fitness:** the patient must accept and reframe the diagnosis of diabetes so that perspective is gained and self-esteem is maintained. S/he should know that s/he is not a "diabetic" but rather a person who has diabetes. This powerful paradigm shift gives the person the mental power to develop a preventive strategy: after all, *if you think you don't matter, then you think it doesn't matter.*

- **Social Well-Being:** patients should develop their own health team, health-promoting strategy and supportive and nurturing relationships. This connectivity to others is a necessary element to any prevention program. To be isolated is certainly not a healthful way to be.

- **Medical and Nutritional Health:** healthiness in general lends the body support and strength to deal with diabetes and all its complications. It's important for patients to be proactive with their health and be aware of even the subtle dietary considerations that negatively affect the diabetic condition.

- **Exercise:** exercise is essential to foot health in the person with diabetes. Exercise has been shown to lower HgA1C's and play an essen-

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further infection. Patients must treat the feet well, and that includes cutting the nails in length and thickness, preventing accumulation of toxic debris, managing corns and calluses and developing a cleansing, moisturizing and conditioning program for the feet. If they are at risk with compromised circulation or loss of protective sensation, then visit a podiatrist on a regular basis for this type of care.

• **Foot Safety and Freedom from Foot Disease:**

Patients must be reminded to “keep your feet clean, protected and warm at all times. Do not go barefooted anywhere. Wear slippers or shoes and socks in the house. Never get too close to a fire or expose your feet to toxic substances and harsh soaps; and watch those outdoor activities such as cutting the lawn, extensive hikes or activities at the gym.”

• **Financial Considerations:** Diabetes care can be intense, and proper care can be expensive. The ability to have quality care can make a difference when it comes

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to saving “life and limb”. Patients need to make sure that their insurance covers appropriate medical care, foot care, hospitalization and post-hospital care—these elements are essential when planning a limb preservation program. But patients must also not expect insurance to pay for everything they may need, so they should be prepared for some needed out-of-pocket expenses.

In conclusion, this article is the culmination of my personal journey, searching for the unifying mechanisms directed at prevention of diabetic foot disease. It’s the outcome of over 40 years of treating patients with diabetes; and identifying the circumstances that cause the catastrophic, traumatic and destructive complications of this syndrome. There isn’t a day that goes by that I don’t struggle to uncover the reasons why the devastating problems I see as a result of diabetes are not being prevented. I can point the finger at the system, the primary care physicians, my fellow podiatrists, or the patient. However, the answer lies not in blaming any one entity in particular but in coordinating and navigating care in such a way that each ingredient required is working in sync with the others, engaging in a coordinated harmonious balance, such that the fine art of prevention can prevail. This article is an attempt to lend insight, clarity and possibly some simplicity to this overwhelming task at hand and advance a proactive strategy that works. **PM**

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