



New Insights into Preventing Diabetic Foot Disease: Part 1

With doctors' treatments often at the whims of their controllers, holistic prevention is more important than ever.

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Author's Note: This is part 1 of a 2-part article. Part 1 deals with the challenges of preventing diabetic foot disease; part 2 will focus on the solutions, culminating in updated guidelines.

Ask any health care provider. The practice of medicine, and, indeed, the role of the doctor, has been transformed significantly.¹ Time was, a patient would come in to the office and the doctor could take all the time required, order the tests needed and make the necessary referrals such that an optimum diagnosis and treatment plan could be formulated. The doctor was in charge, not the system. No formularies, no authorizations, no disputing who the patient can go to for what; no ambiguity on what is covered by insurance; and whatever the physician thought was in his patient's best interest was implemented. No more. The doctor is now at the whim of his controllers.² The patient is no longer getting the care, attention, or time spent with the doctor needed for optimal treatment, let alone solid preventive care. And what is the result? Poor health care! Who suffers? The patient suffers! Those with foot problems related to their diabetes are certainly not excluded from this dismal state of affairs.

The obstacles, including the social challenges intertwined here as well, are so extensive and so complex that prevention seems to be the only way out!³ Given this set of circumstances, the old guidelines for foot care in diabetes—i.e., dealing with just the feet—are passé. The attention on prevention needs to be more holistic. The feet are attached to the rest of the body and new guidelines have to reflect that

an unusual occurrence. At breakfast time at the same eatery, it is hard to miss the preponderance of patrons indulging in unhealthfully delicious pancakes or waffles smothered with butter and syrup next to the greasy sausage and fried eggs, all with a side order of white bread toast with all the nutrients and fiber bleached out of them.

Similarly, the desirable shelf space in any typical supermarket is

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in order to obtain unchecked prevention. This article makes an effort to put together all the many ingredients of the “prevention soup”, if only just to put it out there; and to clarify that it needs to be dealt with.

What Is Preventing Prevention?

Look around you. Everywhere you turn, people are unwittingly torturing their bodies and minds by doing and eating the worst perpetrators of ill health. At the average restaurant, ordering a portion of “mystery meat” with a side of fructose corn syrup and trans fat is not

dominated by imitation food, which contains an abundance of preservatives and unhealthy sugars. By the same token, it is not unusual to find students hanging out” at a fast food or a convenience store, drinking large sodas, snacking on bags of chips, and smoking cigarettes.⁴

Correspondingly, at the emergency room, private office or the community clinic, it is not uncommon to see patients with deep ulcers, infections, gangrene, or Charcot deformity with uncontrolled diabetes, who do not take their medication, watch their diet or monitor

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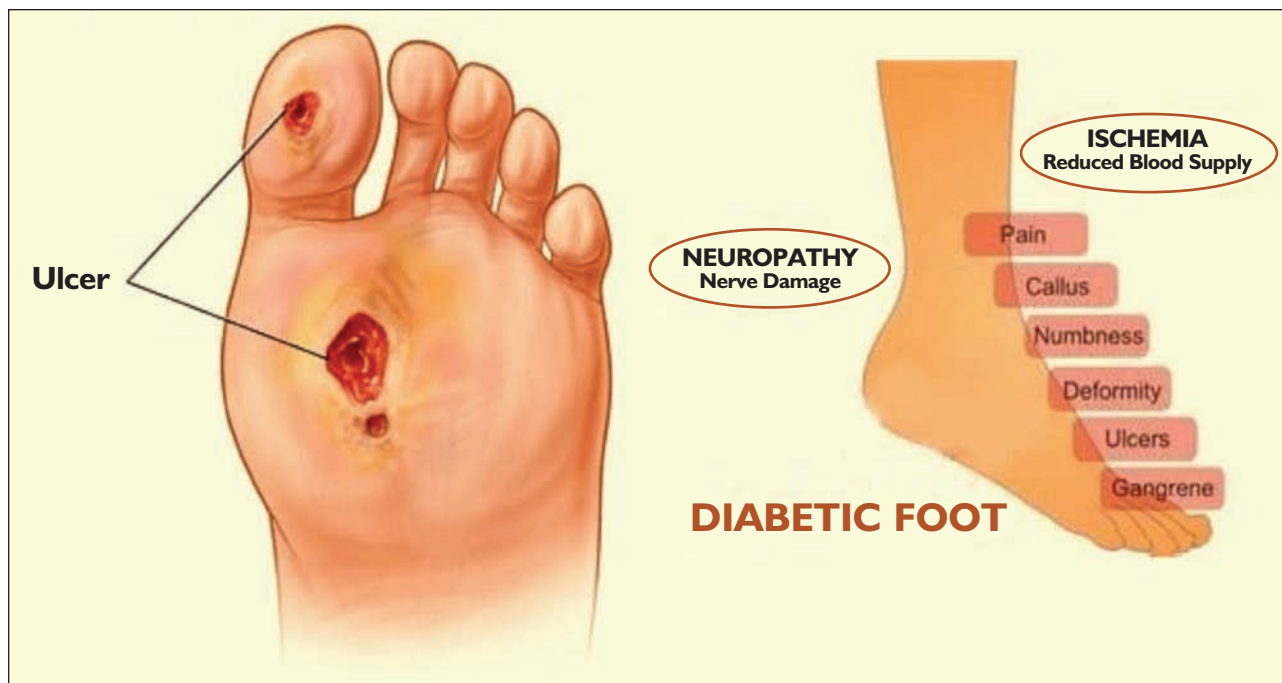


Figure 1: Diabetic neuropathy and PAD are always intertwined

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their blood sugars, while at the same time refusing to wear appropriate footwear and neglecting to show up for their appointments to see their healthcare providers.

And one also cannot overlook the primary care physician who just doesn't have the time to

their hands in exasperation. They are like salmon swimming upstream, struggling with a host of discordant issues, not the least of which is the corporate food structure, the financial challenges of all parties involved and the frustrating issues involved in patients' non-compliance and non-adherence. How can they do their best for their patients when

complication can be predominant, with any of its many manifestations, or can exist as co-equals, but are always intertwined (Figure 1). Because neuropathy is, in part, a microvascular condition, structural damage to the microvasculature can ultimately lead to nerve dysfunction, which is central to the pathogenesis of peripheral nerve injury in diabetic neuropathy. Other factors, depending on the type of diabetic neuropathy involved, include the following:

- Metabolic factors, such as high blood glucose, long duration of diabetes, abnormal blood fat levels, and possibly low levels of insulin.
- Autoimmune factors that cause inflammation in nerves
- Mechanical injury to nerves, such as tarsal tunnel syndrome
- Inherited traits that increase susceptibility to nerve disease
- Lifestyle factors such as smoking, alcohol use and the effects of recreational and/or prescription drug regimens.

The end result of these destructive influences can result in lower extremity amputation, in the following ways (Figure 2):

Sensory neuropathy can cause

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The cornerstones of this devastating complication of diabetes are the onset of peripheral arterial disease and also peripheral neuropathy.

delve as deep as need be into a patient's history to uncover a masking truth, which may change the course of his or her patient's care. How about the clinician who hears hoof beats but misses the zebras because he is just looking for horses? How about the podiatrist who is seeing the patient for nail care but misses a stage I ulceration of the heel?

In partial defense, most podiatrists, along with other health care providers involved in chronic illness are, understandably, throwing up

there are so many adverse, conflicting circumstances?

What Exactly Do We Want to Prevent?

First, to better understand *precisely what it is that we want to prevent* (ultimately in order to save patients from lower extremity amputation), let's discuss and define diabetic foot disease.

The cornerstones of amputation in diabetic patients are the onset of peripheral arterial disease and also peripheral neuropathy. Clinically, either



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loss of sensation, which can trigger an amputation because the patient is unable to feel a mechanical insult to the foot. This insult is invariably associated with three basic types of pressure: direct pounding, friction rubbing, and shearing tearing. These forces cause tissue damage, inflammation, callus formation, ulceration and ultimately infection. There is a fourth type of pressure, which is a permissive factor for amputation, and not necessarily associated with sensory neuropathy, which is the pressure of spreading infection.

Motor neuropathy is associated with weak, tight and imbalanced muscle groups, mallet and hammer-toe formation and altered gait. This in turn can trigger pressure points and ulcerations by being a source of harmful contact of the foot with the floor and with the shoe. When loss of protective sensation co-exists, the foot continues to ulcerate to a deeper level, potentially/eventually infecting the bone. Lower extremity amputations are caused by these destructive influences.

In autonomic neuropathy, dry, cracked, scaly skin can be a nidus for infection and can cause loss of limb (Figure 3).

Peripheral arterial disease. After an insult to the diabetic person's foot, usually an ulceration associated with loss of protective sensation or traumatic skin injury, lack of circu-

arthropathy" is used to describe the Charcot process because the central problem is that the weight bearing joints of the foot are pathologically affected by lack of appropriate nervous input. This can result in the bones of the feet fracturing or becoming "powder", thereby allowing the foot to become misaligned. This process is associated with diabetic

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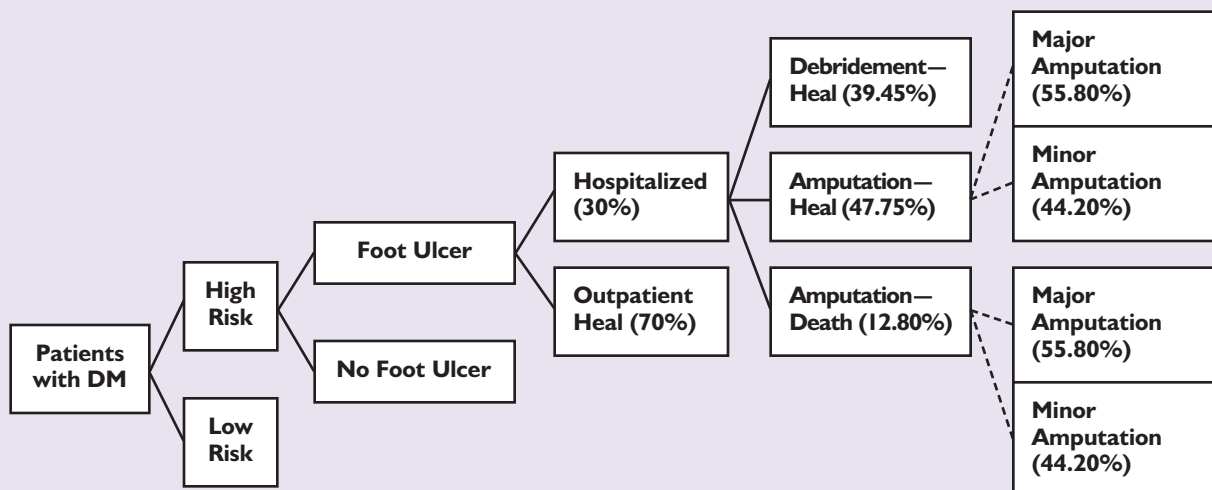
lation to the affected area makes it difficult or even impossible to heal, allowing gangrene or infection to progress. If circulation is not restored via vascular surgery or interventional procedures, surgical intervention or antibiotic therapy is often unsuccessful and amputation becomes the only alternative to save a patient's life.

Charcot foot deformity is often part of the clinical picture of diabetic foot disease. The term "neuropathic

sensory, autonomic and motor neuropathy. As peripheral neuropathy progresses, the joints are not reactive to the forces put across them and movement of the various joints is distorted. The body does not adjust to these forces and positions, thereby acting as a permissive factor for microtrauma, microfractures, and frank fractures. Repetitive trauma or microtrauma that exceeds the rate of healing may cause the clin-

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**FIGURE 2:
Decision Tree for Patients with Diabetes
at Risk for Amputation**





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ical manifestations of Charcot foot, such as dislocations, additional fractures and breakdown of the weight bearing joints. Motor neuropathy contributes to this collapse as the muscles lose the ability to support the foot properly. Autonomic neuropathy, nerve pathology of the au-

tonomic nervous system, which controls regulation of blood vessels, and skin moisture is contributory here as well. This disorder may result in increased blood flow to the lower extremity and therefore may contribute to the edema and osteoporosis that ensues as the Charcot process progresses. In addition, the skin is more susceptible to breakdown, given the

effects of the autonomic neuropathy.

Prevention is always the best treatment when it comes to Charcot deformity. In a person with Charcot and diabetic neuropathy, awareness of trauma to the foot, any temperature variations between right and left feet or changes in the appearance of the feet are all absolutely necessary and key to stopping Charcot foot in its tracks before the destructive processes become too advanced. Weight bearing without specifically designated footwear is likely to make the condition worse, keeping in mind, however, that the gold standard for treatment is the total contact cast. This modality is the optimum mode for reducing pressure on the affected foot and represents the clinical application of the formula $Pressure = Force/Area$.

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Disordered Nerve Function Presentations in Patients with Diabetes

Types	Consequences
Sensory	<p>Increased Pain Sensation Allodynia Hyperesthesia Hyperpathia</p> <p>Decreased Pain Sensation Hypesthesia Paresthesia Anesthesia Proprioception loss</p>
Motor	<p>Increased Activity Imbalances → Contractures → Deformities Spasticity</p> <p>Decreased Activity Weakness → Muscle atrophy → Arthropathy (Charcot)* Paralysis</p>
Autonomic	<p>Dysfunction Manifestations Impaired skin hydration Decreased skin turgor Atrophy of skin & soft tissue padding Vasomotor</p>

*Loss of proprioception and altered vasomotor activity probably contribute to Charcot neuroarthropathy deformities.

Putting Our Challenges to Prevention in Context

Our healthcare system is in crisis, and we are trying to fix it with insurance-related solutions, but it's actually more of a cultural, societal, psychological-social challenge.⁵ To remedy this state of affairs, every person must assume a fair amount of responsibility for his or her own health status and become an active and proactive participant in his/her healthiness instead of remaining passive and reactive.

A certain segment of those suffering from disease will not be able to attain such lofty status; health care "providing", then, must incorporate the roles of mentor, coach, motivator, psychologist, teacher and of course, physician. To accomplish all of this surely requires a team approach, and there is substantial evidence that such an approach is considered by experts to be the gold standard in the care of those afflicted with chronic diseases such as diabetes mellitus.⁶ The ordinary guidelines (Figure 4) for prevention of diabetic foot disease must be augmented; and by necessity they must include strategies for mental, psychological, social, educational and over-

Figure 3: Clinical presentation of diabetic peripheral neuropathy

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all physical well-being. It's vital to pay close attention to preventing events that may precipitate amputation (Figure 5) as well as incorporating the customary model for diabetic foot care.⁷ The following discussion will therefore give the captain of the "health ship" a map in which to navigate through the stormy seas of prevention.

Compliance and Adherence

It is important to differentiate between the concept of "compliance" and "adherence".⁹ Most health care providers use these two terms interchangeably, when in fact they have two distinct meanings.

Compliance has been defined as "the extent to which a person's behavior coincides with medical advice". Non-compliance then essentially means that a patient disobeys the advice of his/her health care provider.

Adherence, on the other hand, has been defined as the "active, voluntary, and collaborative involvement of the patient in a mutually acceptable course of behavior to produce a therapeutic result."

The two most common models

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FIGURE 4: Typical Diabetic Foot Care Guidelines

- Clean feet with a mild soap daily; do not soak. A pumice stone can be used to gently abrade corns and calluses. Vigorous abrasion should be avoided.
- Dry feet gently but thoroughly, especially between the toes.
- Use a moisturizing lotion on all areas of dry skin, except between the toes.
- Keep toenails short. Trim nails straight across using nail clippers. Use an emery board (not a nail file) to shape nails.
- Examine feet daily for blisters, calluses, or other problems. Use a mirror to look at the soles of each foot.
- Inform the diabetes care provider as soon as lesions are detected.
- Wear shoes or slippers to protect the feet at all times, even in the house.
- Invest in well-fitting shoes. New shoes should be broken in gradually to avoid blisters.
- Wear socks with shoes.
- Be sure that shoes are empty and free from rough edges before putting them on.
- Visit a podiatrist regularly when indicated.

Antecedent/precipitating event	Frequency (%)	^a No.(% of total) amputation	^b No.(% of total) major amputation
Acute idiopathic soft tissue infection/ulcer ^c	39 (30.5 %)	26 (34.7 %)	11 (26.8 %)
Chronic neuropathic ulcer	30 (23.4 %)	18 (24 %)	9 (22 %)
Closed puncture wound	25 (19.5 %)	^d 6/23 (8 %)	^d 2/23 (4.9 %)
Critical ischemia	10 (7.8 %)	^e 9/9 (12 %)	^e 9/9 (22 %)
Bruise/blunt trauma	9 (7 %)	7 (9.3 %)	4 (9.8 %)
Laceration	5 (3.9 %)	3 (4 %)	1 (2.4 %)
Furuncle on lower limb	2 (1.6 %)	0	0
Chronic leg ulcer (venous)	2 (1.6 %)	1 (1.3 %)	1 (2.4 %)
Hot water burn	1 (0.8 %)	1 (1.3 %)	1 (2.4 %)
Sunburn	^f 1 (0.8 %)		
Ingrown toenail	1 (0.8 %)	1 (1.3 %)	0
Toenail fungus	1 (0.8 %)	1 (1.3 %)	1 (2.4 %)
Bullosis diabeticorum	1 (0.8 %)	1 (1.3 %)	1 (2.4 %)
Re-infection of surgical wound	1 (0.8 %)	1 (1.3 %)	1 (2.4 %)
Total	128 (100 %)	75 (100 %)	41 (100 %)

^aAmputation at any level out of 124 patient-episodes (four patient-episodes lost to follow-up)

^bMajor amputation, defined as transmetatarsal or higher, out of 124 patient-episodes (four patient-episodes lost to follow-up)

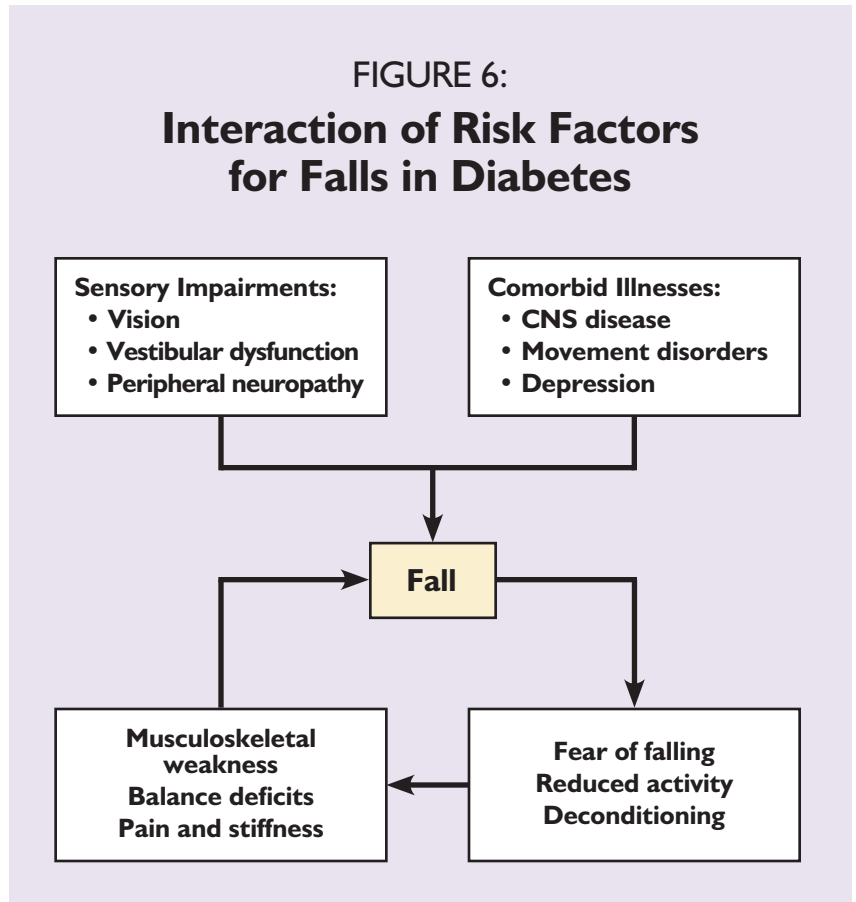
Figure 5: Antecedent or precipitating events leading to amputation: things to prevent



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of care implemented to treat and address the chronic healthcare needs of the person with diabetes are each individually based on either the concept of compliance or adherence. There are significant advantages and disadvantages to each.

First, there is the *provider-directed model* that can be thought of as the traditional approach, which centers on the patient-physician relationship. Patients who feel that their physicians communicate well with them and actively encourage them to be involved in their own care tend to more compliant. If a deep sense of trust is established in this relationship and patients believe that their physician is someone who can understand their unique patiental experience, providing them with reliable and honest advice that is permeated with compassionate expression, then patient outcomes are greatly improved. On the other hand, if the patient-physician relationship is not optimal, patients can feel they are being blamed for their non-compliance via such negative personal qualities as forgetfulness, lack of will power, discipline, or low level of education. This sets up a negative judgment on the part of the physician toward the patient, leaving the patient totally out of the decision-making loop, and perhaps preventing possible negotiable compromises that might have improved the patient's participation in his/her care. Concordance be-



as diabetes mellitus, this model of collaborative or co-managed care is more effective at setting goals and providing on-going support for optimal patient self-management behaviors over time, allowing patients to internalize these, making them a more permanent part of their own

sible for diabetes self-management and in control of decision-making. Providers function in the background when it comes to the daily decisions that patients make to manage their diabetes, making them less dependent on their physicians and more dependent on their own knowledge base. Cooperation and respect are vital to cultivate the adult-to-adult relationship that promotes empowered patients. Provider advice, given in the context of this model, which recognizes the priority of patient decision-making, works very effectively in that set of diabetic patients who suffer from loss of sensation in their limbs.

An important yet little reported area of patient-centered collaborative care, where self-management is the cornerstone, is the recognition and acknowledgment that chronic disease self-management takes a lot of time for patients and possibly their families. Diabetes self-care stands out as especially time-consuming where

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tween physician and patient, and the establishment of mutual responsibilities in the decision loop are all vital to the success of the provider-directed model.

Secondly, there is the *collaborative model of care*. In the care of acute health care conditions, provider-directed, compliance-oriented care may be very helpful. However, for treatment of chronic illnesses such

health management construct.

Implicit in this concept is choice and mutual goal-setting, and treatment planning along with implementation of the treatment regimen. The health care team is clearly identified; each member is a true partner in the outcome. Patients are encouraged to adhere to these mutually agreed-upon guidelines. In this approach patients are taught to be fully respon-



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addressing such things as exercise, dietary changes, self-testing of glucose, administering multiple medications, taking care of your feet and a host of other diabetes-related tasks can certainly be challenging from a time-management perspective.

coping mechanisms, anxiety, depression, alcoholism, drug abuse and dual diagnosis, put patients at risk for ignoring their recommended treatment regimen and poor engagement in their own care and suboptimal diabetes management.

Social issues play a pivotal role in the mindset of the insensate or dia-

Office Of The Assistant Secretary For Planning And Evaluation July 25, 2002. <https://Aspe.Hhs.Gov/Basic-Report/Confronting-New-Health-Care-Crisis-Improving-Health-Care-Quality-And-Lowering-Costs-Fixing-Our-Medical-Liability-System>

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Our goal, then, as health care providers, innovators and reformers is to promote self-responsible behavior and avoid non-compliance and non-adherence problems.

It is generally acknowledged that non-compliance/non-adherence rates for chronic illness regimens and for lifestyle changes can range from 50-70%. As a group, patients with diabetes are no exception and are especially prone to substantial problems in this regard. This commonality and universality begs the questions: Why? And what can be done?

Given providers who are committed to the Hippocratic oath, they might pose the question: is this non-compliance and non-adherence not part of the disease? Isn't this a part of the clinical profile that health care providers should be willing and able to recognize and treat? Or do they turn a blind eye and blame the person in question? What about self-responsibility?

To answer these questions, it is important to understand that patient non-adherence or noncompliance can result from many factors, some of them very simple, such as when advice given to patients by their healthcare professionals is being misunderstood, or when advice is forgotten or even completely ignored. Even challenges with hearing or different languages need to be considered.

Demographic factors such as being an ethnic minority, in a low socioeconomic class and having a low level of education are strongly related to this issue. *Belief systems, perceived lack of seriousness about diabetes and its complications, psychological issues*, such as stress, mal-adaptive

betic patient. Greater levels of social support, more family involvement and closer relationships are associated with greater success in diabetes management¹⁰ and this serves to buffer the stress of the whole disease process. This is also true in cases where nurse case managers provide the social support. Further, research¹¹ indicates a significant relationship between diabetes mellitus, aging and falls; (Figure 6) and poorly controlled diabetes puts that person at an even greater risk of falling than if his/her diabetes were controlled. Support for the elderly person with diabetes by all involved is needed here, to prevent the potentially devastating effects that falls can have.

Our goal, then, as health care providers, innovators and reformers is to promote self-responsible behavior and avoid non-compliance and non-adherence problems. Awareness of these multiple factors is needed to accomplish the desired goal of helping our patients help themselves stay healthy. **PM**

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