

# Diabetic foot ulcers

## Part I. Pathophysiology and prevention

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#### Learning Objectives

After completing this learning activity, participants should be able to assess the epidemiology of diabetes mellitus and its complications; identify the high risk diabetic foot; delineate diabetic foot ulcer (DFU) prevention strategies; outline the pathophysiology of a DFU; review factors associated with delayed DFU healing (suboptimal diabetes control with elevated HbA1c levels, vascular compromise, increased bacterial burden or deep and surrounding infection, increased plantar pressure due to neuropathy and foot deformities.); and describe clinical characteristics and stage of DFUs based on depth and causative factors.

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Diabetes mellitus is a serious, life-long condition that is the sixth leading cause of death in North America. Dermatologists frequently encounter patients with diabetes mellitus. Up to 25% of patients with diabetes mellitus will develop diabetic foot ulcers. Foot ulcer patients have an increased risk of amputation and increased mortality rate. The high-risk diabetic foot can be identified with a simplified screening, and subsequent foot ulcers can be prevented. Early recognition of the high-risk foot and timely treatment will save legs and improve patients' quality of life. Peripheral arterial disease, neuropathy, deformity, previous amputation, and infection are the main factors contributing to the development of diabetic foot ulcers. Early recognition of the high-risk foot is imperative to decrease the rates of mortality and morbidity. An interprofessional approach (ie, physicians, nurses, and foot care specialists) is often needed to support patients' needs. (J Am Acad Dermatol 2014;70:1.e1-18.)

**Key words:** diabetes; diabetic foot ulcer; neuropathy; wounds.

The number of people with diabetes mellitus (DM) has increased dramatically. DM is a serious, lifelong condition that is the seventh leading cause of death in North America.<sup>1</sup> Persons with DM have a 15% to 25% chance of developing a diabetic foot ulcer (DFU) during their lifetime, and a 50% to 70% recurrence rate over the ensuing 5 years.<sup>2-4</sup> Early detection and effective management can reduce the severity of complications, including preventable amputations. Dermatologists assessing and treating patients with DM and DFUs can benefit from an interprofessional team to optimize patient management and outcomes.

## THE BURDEN OF DIABETES MELLITUS AND COMMON DIABETIC COMPLICATIONS

### Key points

- **More than half of persons with diabetes mellitus are unaware of their disease**
- **2.5% to 15% of annual global health care budgets are spent on diabetes mellitus**
- **Diabetes mellitus is the seventh leading cause of death in the United States**
- **Diabetes mellitus is the leading cause of kidney failure, nontraumatic lower extremity amputations, and new cases of blindness in adult Americans**
- **Diabetic foot ulcers are often preventable, and treatment is frequently suboptimal**

DM is an increasing problem in both developed and developing nations. The majority of persons with DM have type 2 DM, with only 5% to 10% of patients diagnosed with type 1 DM.<sup>5,6</sup> Several studies

have concluded that >50% of people with DM (according to World Health Organization criteria) are unaware of their disease.<sup>7,8</sup> Early DM detection and treatment can improve overall quality of life (QOL) and increase the life expectancy of persons with DM. The prevalence of DM is also increasing. For example, in North America, DM affects up to 20% to 25% of the elderly population over 65 years of age.<sup>1,9</sup> Worldwide estimates have calculated that 2.5% to 15% of global annual health care budgets are spent on DM, and the annual direct medical cost worldwide is as high as \$241 billion.<sup>7</sup>

In their 2009 report, the Canadian Diabetes Association labeled the increased prevalence of DM an "economical tsunami," with a doubling of the number of people diagnosed in the past decade.<sup>10</sup> In 2010, 26.9% of US residents above 65 years of age (10.9 million) had DM.<sup>1</sup> DM is the leading American cause of kidney failure, non-traumatic lower extremity amputations, and new cases of adult blindness.<sup>1</sup>

DM is a serious, lifelong metabolic condition that is the seventh leading cause of death in North America.<sup>1</sup> By 2025, it is predicted that  $\geq$  333 million people will develop DM worldwide; this increase creates growing health and economic issue.<sup>11-13</sup> In the developing world, the rise in the number of persons with DM will have a devastating negative impact on health care systems and individual health.<sup>1</sup> Every year, 1 million people worldwide lose their lives to DM-associated complications, with most of these deaths being preventable.<sup>7</sup>

Chronic wounds, including DFUs, are a common yet challenging problem. These ulcers often display

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