Introduction
Individuals with diabetes experience an increased risk of amputation. Co-morbid conditions like peripheral neuropathy (i.e., reduced sensation) and/or peripheral vascular disease (i.e., arterial disease that reduces blood flow) in addition to practicing inadequate foot care increases the likelihood that people with diabetes may overlook minor foot injuries. Over time, such injuries may become infected, thereby necessitating medical interventions such as revascularization or amputation. Revascularization procedures are intended to restore blood flow to an injured limb, while amputation, most frequently of the toe or foot, is used either as a first treatment or when revascularization measures are deemed ineffective.\textsuperscript{1-3} Interventions focusing solely on disparity reduction among individuals diagnosed with peripheral arterial disease (PAD), resulting from atherosclerotic disease, are beyond the scope of this topic brief.

A disproportionate number of racial/ethnic minorities in the US have diabetes.\textsuperscript{4} Numerous studies have reported that among patients with diabetes, there are disparities between racial groups and between genders with respect to rates of lower extremity amputations (LEAs). Diabetes-related LEAs are performed disproportionally more often among blacks and Hispanics. With respect to gender differences, men, especially non-Hispanic black and Hispanic men, are more likely to receive LEAs than women. Among women, black women are more likely to receive LEAs than white women.\textsuperscript{5-12} Information about the effectiveness of interventions aimed at reducing these disparities may help racial/ethnic minorities gain greater access to better preventive health management for diabetes,\textsuperscript{13} multidisciplinary foot care specialists, and foot care self-management education to prevent amputations.
Burden on society
Diabetes is prevalent, underdiagnosed, and disproportionately affects racial and ethnic minorities. According to the 2011 National Diabetes Fact Sheet, 8.3% (25.8 million people) of the US population has diabetes, although it is highly underdiagnosed: only 27% (7.0 million people) of those with diabetes have received a clinical diagnosis (See Table 1). In 2010, 26.9% of people aged 65 and older had diabetes. Diabetes is also prevalent in younger age groups. Among those 20 years and older, 10.8% of females and 11.8% of males have diabetes. With respect to race-ethnicity, 7.1% of non-Hispanic whites, 12.6% of non-Hispanic blacks, 8.4% of Asian Americans, and 11.8% of Hispanics aged 20 years or older had diagnosed diabetes.

Lower extremity amputations are much more common among those with diabetes, and racial/ethnic disparities in amputation rates exist. Complications from diabetes are numerous, with amputation being one of the most common, costly, and severe. The Centers for Disease Control and Prevention (CDC) report that over 60% of LEAs are performed on people with diabetes. From 1996 to 2009, the age-adjusted hospital discharge rate for nontraumatic LEA declined from 9.0 to 3.2 per 1,000 diabetic population. With respect to sex, from 1998 to 2009, compared to females, males had a consistently greater age-adjusted hospital discharge rate for nontraumatic LEA. By 2009, the rate for males was almost twice the rate for females (4.1 vs. 2.2 per 1,000 diabetic population). Despite declining nontraumatic LEA rates among blacks beginning in 1988 and whites beginning in 1999, the rate among blacks remained nearly twice that of whites in 2009 (4.5 vs. 2.3 per 1,000 diabetic population, respectively). Compared to people without diabetes, people with diabetes are 7 years younger at age of first amputation, more likely to be men, and have more comorbidities.

Diabetes is a common cause of death, and those with LEAs are more likely to die prematurely. Mortality: In 2007, the CDC reported that diabetes was the seventh leading cause of death in the US, and the risk of death was almost twice as great for people with diabetes compared to people without. Moreover, mortality rates are higher among blacks and Hispanics with diabetes compared to whites.

Table 1. Demographic Characteristics of the 2010 US Diabetic Population

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Individuals with Diabetes (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Diagnosis:</td>
<td></td>
</tr>
<tr>
<td>Diagnosed</td>
<td>27%</td>
</tr>
<tr>
<td>Not Diagnosed</td>
<td>73%</td>
</tr>
<tr>
<td>Age¹:</td>
<td></td>
</tr>
<tr>
<td>65 and older</td>
<td>26.9%</td>
</tr>
<tr>
<td>Sex¹:</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>10.8%</td>
</tr>
<tr>
<td>Male</td>
<td>11.8%</td>
</tr>
<tr>
<td>Race-Ethnicity²:</td>
<td></td>
</tr>
<tr>
<td>Asian American</td>
<td>8.4%</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>12.6%</td>
</tr>
<tr>
<td>Hispanic</td>
<td>11.8%</td>
</tr>
<tr>
<td>White, non-Hispanic</td>
<td>7.1%</td>
</tr>
</tbody>
</table>

¹Among individuals with a clinical diagnosis.
²Heart disease and stroke, hypertension, blindness and eye problems, kidney disease, nervous system disease, dental disease, complications of pregnancy, diabetic ketoacidosis, hyperosmolar coma, greater susceptibility to other illnesses, depression, reduced ability to walk distances, climb stairs, or do housework.
Among people who have undergone amputation, 29% of individuals with diabetes die within 30 days of the operation and 67% die within 1 year.\textsuperscript{21,22}

**Burden:** Efforts to explain racial/ethnic disparities in the use of amputation vary. Some research finds that, relative to whites, blacks tend to be diagnosed with diabetes or seek treatment for diabetic complications too late for limb-saving measures. In such cases, blacks may initially seek treatment with worse circulation, greater nerve damage, and more severe damage, making them less viable candidates for revascularization efforts.\textsuperscript{6,12,13} Systemic reasons such as racial/ethnic minorities lacking access to and receiving lower quality medical and preventive, multidisciplinary foot care than whites,\textsuperscript{1,15,23,24} may explain why they have more advanced disease when they initially seek care. Research also indicates that provider bias or stereotyping negatively impacts the quality of physician-patient communication for racial/ethnic minority patients.\textsuperscript{25} Other reasons for racial/ethnic differences in amputation may include socioeconomic status, level of education, low health literacy, or cultural beliefs.\textsuperscript{15,24,26-29}

**Options for addressing the issue**

Patient education and increasing access to multidisciplinary foot care facilities were the most commonly utilized interventions in a recent literature search on efforts to reduce disparities in revascularization efforts among racial/ethnic minorities. \textit{Evidence from existing literature:} We identified four studies in the last decade focused on interventions to reduce diabetes-related amputation rates and health disparities by educating racial/ethnic minorities about foot care self-management practices or increasing access to foot care services in low-income communities.\textsuperscript{3,30-32} These studies were not designed specifically to increase use of revascularization procedures. One case study\textsuperscript{30} used a multi-faceted community-level approach to amputation reduction and foot care examination by implementing individual targeting provider, policy, and health-systems interventions. The study showed statistically significant amputation reductions among blacks, whites, and the overall study population. However, despite reductions, LEA remained high for blacks. A single cohort study\textsuperscript{31} to determine the change in prevalence of diabetes-related foot problems and the rate of LEAs after implementing a 1 year multidisciplinary diabetes LEA prevention program among low income blacks found a statistically significant reduction in LEAs, foot operations, and other outcomes. Another study\textsuperscript{3} described the impact of a church-based educational intervention on proper foot care techniques and risk factors to prevent amputation. A small sample composed of 25 black participants completed pre- and post-education surveys, and their changes in scores were reported. While study results are inconclusive, given the small sample size and lack of formal statistical analyses, researchers were optimistic about the educational intervention’s utility.

Improving access to quality medical care and increasing access to and knowledge about preventive management for diabetes and its complications appear to be promising research aims for reducing the disparity in revascularization efforts to prevent foot amputation among racial/ethnic minorities.

**Potential for New Information to Improve Care and Patient-Centered Outcomes Rapidly**

The relatively few interventions included in this topic brief indicate that efforts to improve patient-centered foot-care education and increase access to multidisciplinary foot care practices are currently being underutilized by physicians, researchers, and community educators. These interventions have the potential to improve diabetic self-management practices and to reduce the prevalence of amputations.
in this population. Furthermore, these interventions appear to have had some success with improving the quality of care received by and reducing the need for amputation in people with diabetes. Available evidence on the efficacy of future interventions targeting this population is likely to be adapted and applied quickly if disseminated broadly to providers, community outreach coordinators, and educators. Additional research is needed to examine the benefits and harms of these interventions and to examine the comparative effectiveness of these interventions to improve diabetes-related outcomes and reduce disparities.
References


