

of a limb-threatening disease are common, and often lead to unnecessary delays in seeking medical help. Psychological factors may be as equally important for the development and delayed healing of diabetic foot ulcers as physical ones. Emotional support and structured education on foot care, provided by a doctor or nurse, may be beneficial. One of the basic messages for the patient should be to seek professional advice as soon as possible, to minimise the risk of toe or limb amputation. One of the basic messages for health-care professionals is to always examine the feet of patients with diabetes who are at risk.

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I declare that I have no conflict of interest.

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## Preventing foot ulcers and amputations in diabetes

Over the past 25 years, researchers have identified causal pathways and risk factors for foot ulcers and amputations in people with diabetes. Single interventions targeting modifiable risk factors can reduce the incidence of ulcers or amputations.<sup>1,2</sup> Although specific activities or products may modestly benefit individuals in certain risk strata, there is no single magic bullet or intervention sufficiently robust for long-term prevention of such problems in all patients in all health-care settings.

By contrast, integrated patients', providers', and system interventions tested in different settings show significant improvements in prevention and processes of care, and a reduction in ulcers and amputations.<sup>3–8</sup> For example, Rith-Najarian and colleagues' prospective intervention in a US population of Native Americans substantially lowered rates of amputation.<sup>4,5</sup> After a needs assessment of diabetic residents in a reservation community in Minnesota, amputation was identified as

the most common complication of diabetes. Subsequently, a registry was established to follow up 639 diabetic individuals through four phases spanning 14 years.<sup>4,5</sup> During the first 4 years (1986–89), no change was made to the organisation of care, and the observed amputation rate was 29 per 1000 person-years. During the second 4-year period (1990–93), the delivery system was strategically changed, with modifications in self-management support and consistent education for patients, with prophylactic foot care and footwear for those judged to be at highest risk. The amputation rate during this phase was 21 per 1000 person-years. During the next 3 years, further refinements (including access to a multidisciplinary foot-care team in primary care, better communication and coordination, therapeutic targets, treatment options, and improved foot-care monitoring) were undertaken within an overall conceptual framework (Staged Diabetes Management), and the amputation rate fell to

15 per 1000 person-years.<sup>4</sup> During the final 3 years (1997–99), the introduction of an outreach wound-care clinic and the extension of foot-care services to dialysis patients resulted in amputation rates falling to seven per 1000 person-years.<sup>9</sup>

Although this study<sup>4</sup> was in a population with an extremely high baseline incidence compared with other populations, the message is that integrated risk-stratified interventions directed at patients, providers, and health-care systems can have great effect.

The work by Rith-Najarian and colleagues highlights several important areas for study in prevention. About 40 trials of interventions to change diabetes systems were reviewed<sup>10,11</sup> to identify important components of diabetes management. The most successful interventions included multiple components of care, which are contained within the Chronic Care Model, an effective framework for both prevention and care (panel).<sup>12,13</sup>

A high-quality software option, the VistA Electronic Healthcare Record, is available to support clinical information systems and decision making in resource-challenged areas. This successful system, used by the US Department of Veterans Affairs, has been adapted by the US Centers for Medicare and Medicaid Services, and is public-domain software for private-office settings.<sup>14</sup>

Prevention and care of foot problems in people with diabetes needs dedicated leaders, a model for change with sound planning, and participation of providers, patients, and the health-care systems.<sup>15</sup> Certainly, we need additional research on the best ways to bring complex system-wide interventions to bear on this important problem. In the short term, countries, communities, and practices, regardless of resource constraints, can apply an organisational framework that will work well in both prevention and management of foot problems. Preventing foot ulcers and amputations is hard work, and using a framework to approach this challenge allows us to work smarter and to build on lessons learned to achieve future promise.

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We declare that we have no conflict of interest.

#### Panel: Chronic Care Model

*Organisation of care*—preventing ulcers and amputations as organisational priority with leadership support; establishing defined targets, evidence-based policies, and incentives to increase screening

*Clinical information systems*—establishing registries and, if available, using electronic medical records to track patients by risk strata, giving clinicians performance feedback and risk-level-appropriate reminders for patients and providers; extracting and summarising data from previous encounters to facilitate good clinical decision-making

*Delivery system design*—providing planned visits and other proactive mechanisms for risk-stratified screening, clinical care, and follow-up in primary care; facilitating regular, meaningful coordination and interactions of foot-care team members and primary-care providers on basis of stratified risk level (callus and nail care, observation, follow-up)

*Decision support*—implementing evidence-based guidelines, specialist referral guidelines and online tools; training of providers/teams; feedback and patients' progress reports

*Self-management support*—providing self-help instruction and materials to patients and families, linked to patient-identified priorities

*Coordination of community resources*—activating patients' participation in effective community programmes

Adapted from references 12 and 13.

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