Background: Homeless people live in poverty, with limited access to public health services. They are likely to experience chronic medical conditions, such as diabetes mellitus; however, they do not always receive the necessary services to prevent complications. This study was designed to determine the effectiveness of a volunteer health service outreach to reduce disparity in diabetic foot care for homeless people.

Methods: The research was conducted on 21 patients with diabetic ulcers of 930 homeless people visited between 2008 and 2013. Each ulcer was treated with regular medication every week for a mean ± SD of 17.6 ± 12 months. The inclusion criteria were 1) homeless with a previous diagnosis of diabetes or a blood glucose level greater than 126 mg/dL at first check and 2) foot ulcer caused by diabetic vasculopathy or neuropathy. The efficacy of the interventions was assessed against the number of successfully cured diabetic feet based on a reduced initial Wagner classification score for each ulcer.

Results: Clinical improvement was observed in 18 patients (86%), whose pathologic condition was completely resolved after 3 years and, therefore, no longer needed medication. One patient died of septic shock and kidney failure, and two patients needed amputation owing to clinical worsening of ulcers (Wagner class 4 at the last visit).

Conclusions: Most homeless people who have diabetes and diabetic foot encounter many difficulties managing their disease, and a volunteer health-care unit could be a suitable option to bridge these gaps. (J Am Podiatr Med Assoc 105(5): 424-428, 2015)
scenario, but this could be avoided through the monitoring of blood sugar levels to delay or prevent microvascular and neuropathic complications of type 1 and type 2 diabetes.9

The overall scope of this work is to bridge the gaps between conventional public health services and the need among homeless people for diabetic foot care through volunteer health service outreach. The nonprofit volunteer association that is the object of this study has been providing services to the homeless, refugees, and the Roma people since 1996. Between 2008 and 2013, the volunteers of this association worked 864 shifts in Rome municipalities I, XVII, and XVIII. On each shift, volunteers delivered freshly cooked food, water, tea, milk, biscuits, seasonal clothing, and blankets for 50 to 60 homeless individuals. Furthermore, medical and nursing staff provided weekly on-site assistance via a mobile health service unit.

The purpose of this study was to assess the impact of a charitable volunteer health service intervention on diabetic foot treatment. The desired outcome was resolution of the treated pathologic abnormalities. The research was conducted on a sample of 930 homeless men and women.

Materials and Methods

This prospective study was started in January 2008 and was conducted in compliance with the Declaration of Helsinki and Good Clinical Practice guidelines and with local legislation and ethics. All of the clinical data were confidential and respected the privacy of the involved patients. The study includes patients treated until October 2013. During this period, approximately 864 volunteer shifts were performed, with approximately 7,500 homeless people treated. Of these individuals, 930 were checked by four physicians for a total of 2,526 health-care interventions. The volunteer physicians who worked with the patients during those years were a vascular and interventional radiologist, a radiation oncologist, a general physician, a hygienist, and a dermatologist. This volunteer activity used different physicians with different experiences who applied a standard protocol of wound management. Every patient was followed once a week by the same physician who performed the first examination.

The inclusion criteria were 1) homeless with a previous diagnosis of diabetes or a blood glucose level greater than 126 mg/dL at first check and 2) foot ulcer caused by diabetic vasculopathy or neuropathy. The efficacy of the interventions was assessed against the number of successfully cured diabetic feet.

Data collected from recordings of interventions between January 2008 and August 2013 were based on a predesigned questionnaire containing the following information: age, sex, nationality, place of residence, recent or long-term alcohol intake, reason for intervention, type of intervention, drugs or other therapy administered, and possible need for hospitalization. Alcohol intake was established after clinical examination of breath or after dialogue with the patient. The level of blood sugar was measured using a handheld blood sugar meter; if the sugar level was greater than 126 mg/dL or the patient had a clinical diagnosis of diabetes, the blood glucose level was measured at each of the following interventions.

The state and extension of ulcers at the inferior limbs were evaluated and classified using the Wagner classification,10 which distinguishes six grades of wound (scored 0–5) to assess ulcer depth (Table 1).

Examination of affected feet before treatment included front and rear artery pulse palpation, plain tests for loss of sensation (10-g monofilament

<table>
<thead>
<tr>
<th>Grade</th>
<th>Lesion</th>
</tr>
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<tbody>
<tr>
<td>0</td>
<td>No open lesions: may have deformity or cellulitis</td>
</tr>
<tr>
<td>1</td>
<td>Superficial ulcer</td>
</tr>
<tr>
<td>2</td>
<td>Deep ulcer to tendon or joint capsule</td>
</tr>
<tr>
<td>3</td>
<td>Deep ulcer with abscess, osteomyelitis, or joint sepsis</td>
</tr>
<tr>
<td>4</td>
<td>Local gangrene: forefoot or heel</td>
</tr>
<tr>
<td>5</td>
<td>Gangrene of entire foot</td>
</tr>
</tbody>
</table>
applied in various spots along the plantar area of the foot), and physical examination of the ulcer. Infected wounds were clinically diagnosed by the presence of systemic symptoms (eg, fever or chills); purulent secretions (pus); or more than two typical signs of inflammation, such as heat, redness, pain/tenderness/hardening, slow healing, abnormal coloration, frailty, or foul odor. Diabetic foot treatments were standardized and were performed in the sterile environment of an equipped ambulance: impurities and necrotic tissues were surgically removed, and incisions and drainage were performed on infected areas or abscesses, which were also treated with antibiotic ointment (gentamicin or silver sulfadiazine) and systemic antibiotics when systemic signs of infection were present. The wound was then disinfected and dressed with iodine and hydrocolloids. External compression therapy and immobilization were used to reduce edema. All of the patients were provided with protective footwear.

Oral analgesics (tramadol or acetaminophen) or local anesthetics (lidocaine), if necessary, were administered for pain relief. Patients in need of more complex interventions, such as revascularization, amputation, negative pressure wound therapy, major surgery, or septic status management, were hospitalized.

**Statistical Analysis**

Patient information was entered into a logbook, and each patient was numbered. Data were managed and analyzed with spreadsheet software (Excel 5.0; Microsoft, Redmond, Washington), word-processing software (Word 6.0.1; Microsoft), and statistical analysis software (MedCalc for Windows, release 10.4.8; MedCalc Software, Ostend, Belgium). Sample characteristics are described by recurrences and percentages or by means and standard deviations. Data analysis to assess differences between two means was performed with the Student t test or a similar nonparametric test (Wilcoxon test) where appropriate. The Pearson \( \chi^2 \) test was used to compare categorical data. The level of statistical significance was set at 0.05.

**Results**

During 6 years of health services, 930 people were examined, for a total of 2,526 interventions in Rome municipalities I, XVII, and XVIII. As displayed in Table 2, most participants were men (87%), and the mean ± SD age was 43 ± 12 years, with most (24%) aged 30 to 35 years. Thirty-six patients (3.9%) had no identification documents or did not want to reveal their nationality. Most patients were Eastern European (65%), mostly Polish (42%) and Romanian (13%), and 10% were Italian. No patients were from North America, China, Japan, France, or England.

Of the 930 patients, 738 (79%) were alcohol consumers or abusers. There was a higher incidence of alcohol consumption in the male population (85%) than in the female population (38%).

Fifty-four patients (6%) were diagnosed as having diabetes by a random plasma glucose level greater than 200 mg/dL or three fasting glucose cutoff points greater than 126 mg/dL; they were mostly

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total (N = 930)</th>
<th>Men (n = 813)</th>
<th>Women (n = 117)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean [years])</td>
<td>43</td>
<td>44</td>
<td>41</td>
</tr>
<tr>
<td>Nationality (No. [%])</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eastern Europe</td>
<td>603 (64.8)</td>
<td>522 (64.2)</td>
<td>81 (69.2)</td>
</tr>
<tr>
<td>Central Europe</td>
<td>141 (15.2)</td>
<td>123 (15.2)</td>
<td>18 (15.3)</td>
</tr>
<tr>
<td>Asia</td>
<td>90 (9.7)</td>
<td>87 (10.7)</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Africa</td>
<td>42 (4.5)</td>
<td>36 (4.4)</td>
<td>6 (5.1)</td>
</tr>
<tr>
<td>South America</td>
<td>15 (1.6)</td>
<td>6 (0.7)</td>
<td>9 (7.7)</td>
</tr>
<tr>
<td>Australia</td>
<td>3 (0.3)</td>
<td>3 (0.4)</td>
<td>0</td>
</tr>
<tr>
<td>Unspecified country</td>
<td>36 (3.9)</td>
<td>36 (4.4)</td>
<td>0</td>
</tr>
<tr>
<td>Alcohol consumer/abuser (No. [%])</td>
<td>738 (79.3)</td>
<td>693 (85.2)</td>
<td>45 (38.5)</td>
</tr>
<tr>
<td>Diabetes (No. [%])</td>
<td>54 (5.8)</td>
<td>51 (6.2)</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Hypertension (No. [%])</td>
<td>81 (8.7)</td>
<td>78 (9.5)</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Diabetes + hypertension (No. [%])</td>
<td>27 (2.9)</td>
<td>24 (2.9)</td>
<td>3 (2.5)</td>
</tr>
<tr>
<td>Diabetic ulcer (No. [%])</td>
<td>21 (2.2)</td>
<td>18 (2.2)</td>
<td>3 (2.5)</td>
</tr>
</tbody>
</table>
men (n = 51; 94.4%), with a mean age of 44 years. Eight hundred seventy-three interventions (35%) were performed in this category of patients. Most of these interventions (n = 666; 76%) were for the management of diabetes complications, such as diabetic foot, hyperglycemic or hypoglycemic status, and antihyperglycemic therapy management. The remaining interventions addressed traumas (n = 90; 10%), infections (n = 72; 8%), and gastrointestinal diseases (n = 45; 5%).

Eighty-one patients (9%) were diagnosed as having hypertension or arterial blood pressure greater than 140/85 mm Hg. Twenty-seven patients (3%), mostly men (n = 24; 80%), presented both diabetes and hypertension; in this group, 18 patients had diabetic foot (67%).

Thirty patients had already been diagnosed as having diabetes and had been prescribed an antihyperglycemic agent when they joined this project. When necessary, volunteer physicians intervened to facilitate adherence to the prescribed therapies, administering oral hypoglycemic drugs and insulin. After accurate examination and anamnesis, physicians prescribed antihyperglycemic drug therapy (metformin) as first treatment to 24 patients (14) in addition to lifestyle counseling.

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Most of the interventions (n = 849; 97%) were performed on site, whereas 3% (n = 24) needed hospitalization for major procedures, intravenous therapy, or diagnostic imaging.

Treatment of minor wounds was always performed inside the mobile unit in a sterile environment, using bandages, gauze, disinfectant, surgical instruments (eg, forceps, scissors, needle holders, and wires), and ointments. Of those procedures, 369 were directed to manage diabetic feet in 21 patients living with diabetes (38% of diabetic individuals). Each ulcer was evaluated and classified at first examination using the Wagner classification. 10

In this subgroup, most patients were men (85%), with a mean ± SD age of 42 ± 10.4 years. A mean ± SD of 18 ± 14 interventions was necessary to resolve the foot disorder. No significant decrease in blood sugar level was observed in this subgroup (P = 0.8) after the first examination. Each diabetic ulcer was treated with regular medication every week for a mean ± SD of 17.6 ± 12 months. Clinical improvement (P = 0.0002) was observed in 18 patients (86%); their pathologic conditions were completely resolved (Wagner class 0 at the last visit) in 13 and partially resolved (Wagner class 1 at the last visit) in five, and, therefore, they no longer needed medication. One patient died of septic shock and kidney failure 6 months after the first examination; during that time, two interventions of foot amputation and one application of negative pressure wound therapy were performed. Two patients needed amputation owing to clinical worsening of ulcers (Wagner class 4 at the last visit).

Discussion

Although 86% of the treated diabetic feet were resolved through regular medication use, the management of diabetes in these patients is undermined by a variety of factors. The most commonly reported difficulties are inadequate diet, access to medications, and the coordination of medications with meals. No significant improvement was detected in blood sugar levels.

Alcohol intake and mental health problems were relatively common comorbidities in this group, and they represent barriers to adequate health management and to adherence to the prescribed therapy. Oliveira et al 15 found a 9% prevalence of patients living with diabetes in their target population. In our study, blood sugar concentration was measured in every patient examined; approximately 6% of the studied population had diabetes. It was not possible to establish the prevalence of diabetes, hypertension, or cardiac disease in the entire homeless population because the study examined only patients who called in on a voluntary basis.

In our study, the Wagner classification was used to evaluate the extension of foot ulcer. 10 This is not the most complete evaluation method because it does not fully address infection and ischemia. To our knowledge, the system used by the University of Texas 16,17 is the most complete method for clinically evaluating diabetic foot; however, it is too complex and time consuming to be used effectively in a mobile health-care unit.

The purpose of this analysis was to demonstrate the social utility of a mobile health-care unit operated by volunteers to reach homeless people who are not able to access public health services or who might not receive adequate care through national health services. 18 Volunteer physicians need to possess basic knowledge of infective and dermatologic diseases because skin medications were the most demanding interventions and helped improve health status in approximately 86% of the patients affected by diabetes-related and infected ulcers, with complete resolution of this skin condition in 18 of 21 patients.

Most homeless people who have diabetes and diabetic foot encounter many difficulties in managing their disease, with extreme detriment to their...
health. Although it may be impossible to totally prevent foot ulceration in poor and underserved patients, this study demonstrates that a volunteer health-care unit could be a suitable option to prevent the progression of small ulcers to infection, sepsis, osteomyelitis, or gangrene.

Challenges

The main challenge to the implementation of this project was gathering important health information from the patients owing to linguistic and cultural differences or mental health status. Difficulties were also brought about by the errant nature of their living, which made it difficult to trace them for follow-up therapies. This was not a randomized controlled trial, thus findings should not be generalized to the greater population of homeless individuals with mobility impairments. Health conditions and disabilities were mostly self-identified and may not present a complete picture of the health status of this population. The management of peripheral arterial disease in patients with diabetic foot ulceration is complex. In the present study, front and rear artery pulse palpation was performed only by hand; it was not the most accurate way to estimate vascular status, but the central point of this work was to assess and treat on site diabetic feet in homeless people by a traveling volunteer health-care team and using imaging (Doppler ultrasound, computed tomography, and plain films) only in the most dramatic cases (3%).

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Conflict of Interest: None reported.

References