Foot, ankle, and leg problems in Australian primary care: consultation patterns, management practices, and costs

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Objective: To explore consultation patterns, management practices, and costs of foot, ankle, and leg problems in Australian primary care.

Study design: We analyzed data from the Bettering the Evaluation and Care of Health program, April 2000 to March 2016. Foot, ankle, and leg problems were identified using the International Classification of Primary Care, Version 2 PLUS terminology. Data were summarized using descriptive statistics examining general practitioner (GP) and patient characteristics associated with a foot, ankle, or leg problem being managed. Cost to government was estimated by extracting fees for GP consultations, diagnostic imaging, and pathology services from the Medicare Benefits Schedule (MBS) database. Costs for prescription-only medicines were extracted from the Pharmaceutical Benefits Schedule and for nonprescribed medications, large banner discount pharmacy prices were used.

Results: GPs recorded 1,568,100 patient encounters, at which 50,877 foot, ankle, or leg problems were managed at a rate of 3.24 (95% confidence intervals [CIs] 3.21–3.28) per 100 encounters. The management rate of foot, ankle, or leg problems was higher for certain patient characteristics (older, having a health care card, socioeconomically disadvantaged, non-Indigenous, and being English speaking) and GP characteristics (male sex, older age, and Australian graduate). The most frequently used management practice was the use of medications. The average cost (Australians dollars) per encounter was A$52, with the total annual cost estimated at A$256 million.

Conclusions: Foot, ankle, and leg problems are frequently managed by GPs, and the costs associated with their management represent a substantial economic impact in Australian primary care.

Key words: diabetic foot, foot, foot diseases, foot injuries, general practice, health care costs, primary health care

Introduction

Foot and ankle problems are highly prevalent in the community and a common reason for primary care consultation. Population-based studies have estimated that 24% of people aged over 45 years have foot and/or ankle pain, and 18–75% of people in different age groups have specific foot problems such as hallux valgus, corns and calluses, and nail disorders. Furthermore, foot and ankle problems are also highly prevalent within those with specific chronic diseases, with 20–50% of people with diabetes, for example, reported to have peripheral neuropathy, foot ulceration, or amputation.

Management of foot and ankle problems involves a range of health professionals, including podiatrists, physiotherapists, rheumatologists, endocrinologists, orthopedic surgeons, vascular surgeons, infectious diseases specialists, and general practitioners (GPs). In countries where GPs play a gatekeeper role in the health care system, the burden imposed by different conditions can be estimated using consultation data. In the United Kingdom, it has been estimated that 3% of GP consultations involve foot and ankle pain and 8% of GP musculoskeletal consultations involve foot or ankle problems, while in Australia, high rates of GP consultations have been reported for foot osteoarthritis, hallux valgus, heel pain, and venous leg ulcers. Given these frequent GP consultation rates, management of foot and ankle problems is likely to account for substantial health care costs.

Studies investigating foot and ankle problem costs have focused on specific conditions (such as diabetes-related foot ulcers and ankle fractures), specific population groups (such as US Medicare recipients), or inpatient settings. In the English National Health Service, the annual cost of managing diabetes-related foot ulcers has been estimated at between £837 (A$1,490) and £962 (A$1,712) million, with 60% incurred in primary care, and in the Netherlands, the annual cost of managing foot and ankle injuries has been estimated at €162 (A$250) million, with less than 10% in GP consultations. However, to our knowledge, no studies have explored the overall consultation patterns and costs incurred for foot and ankle problems in primary care in Australia.

Understanding the consultation patterns, management practices, and costs associated with foot and ankle problems in primary care would help quantify the workload, inform
Foot, ankle, and leg problems are frequently managed in Australian primary care. The estimated annual cost of managing these problems is A$256M. The most frequently used management practice was use of medications. These problems have a substantial economic impact in Australian primary care.

Methods

Population and setting
We analyzed data from the Bettering the Evaluation and Care of Health (BEACH) study, a continuous, nationally representative study of GP activity. The BEACH study methods have been described in detail elsewhere. Briefly, in each data year, approximately 1,000 randomly sampled GPs recorded the content of 100 consecutive GP–patient encounters, including the patient's reason/s for the encounter, problems managed, medications, pathology, or imaging tests ordered, referrals made, and any other treatments provided. All management actions were linked to the problem being managed by the GP. Nonpharmaceutical data were classified according to the International Classification of Primary Care, second edition (ICPC-2), and coded more specifically using the Australian GP interface terminology known as ICPC-2 PLUS. Pharmaceutical data were coded using the Coding Atlas of Pharmaceutical Substances (CAPS), an inhouse pharmaceutical classification system that enables recording of medications at the product level and is mapped to the Anatomical Therapeutic Chemical Classification System. BEACH data have been shown to be representative of GPs and their patient encounters. The BEACH program was approved by the Human Research Ethics Committee of the University of Sydney (Ref: 2012/130) and (from 2000 to 2010) the Australian Institute of Health and Welfare Ethics Committee.

Data elements
We selected ICPC-2 PLUS terms primarily related to problems specifically affecting the foot and ankle, but also included conditions that manifest in the lower leg below the knee (such as ischemia and varicose veins), neurological conditions associated with foot symptoms (such as peripheral neuropathy and foot drop), and congenital lower limb conditions that may alter foot and ankle function (such as clubfoot and genu valgum). The list of terms is provided (see Supplementary Material), and we refer to these conditions as ‘foot/ankle/leg’ problems throughout the manuscript. We examined the management rate within data collected from April 2000 to March 2016. We then used the most recent 5 years of BEACH data (April 2011–March 2016) to examine patient and GP characteristic-specific management rates, how foot/ankle/leg problems were managed and to estimate the cost of managing these problems.

Cost estimates
We estimated the cost to government of managing foot/ankle/leg conditions by extracting fees for GP consultations, diagnostic imaging and pathology services from the Medicare Benefits Schedule (MBS) database. We took a conservative approach based on the following assumptions. First, where there were multiple documented problems managed at the encounter (i.e., one foot/ankle/leg-related and one not related), we only attributed the proportion in which the foot/ankle/leg problem accounted (i.e., half if it was one of 2 problems, a third if it was one of 3 problems, etc). Second, for GP home visits and residential aged care facility attendances, since the value of the Medicare rebates are based on the number of patients seen at the same residence (with the rebate lowering with each additional patient seen to a maximum of 6), we assumed that the number of patients seen was 2 and 6, respectively. Third, where detail was missing related to diagnostic imaging, we selected the least expensive MBS fee (e.g., for CT scans, if not specified, it was assumed that a contrast agent was not used, as this attracts a higher fee). Fourth, for pathology tests, we only selected the 3 most expensive items ordered for the management of the foot/ankle/leg problem. Finally, although we report the frequency of GP referrals to other health professionals, we were not able to ascertain costs associated with these subsequent consultations.

For prescription-only medications, we used the dispensed price for maximum quantity from the Pharmaceutical Benefits Schedule (in 2016, A$38.30 for general beneficiaries and A$6.20 for health care concession card holders) and assumed that patients did not exceed the annual safety net (in 2016, A$1,475 for general beneficiaries and A$372 for health care concession card holders). For nonprescribed (Schedule 2) medications, we estimated the current cost for each item from a large banner discount pharmacy and adjusted this for inflation (6.5%, over 4 years, assuming an average annual inflation rate of 1.6%). This approach allowed us to estimate both the cost to government and the cost to the patient (i.e., the safety net plus any nonprescription costs).

All costs are reported in Australian dollars. At the time of publication, A$1 was worth approximately €0.64, £0.56, and US$0.63.

Statistical analysis
BEACH has a single-stage cluster sample study design with the GP as the sampling unit and the GP–patient encounter as the unit of inference. The survey means procedure in SAS V9.4 statistical software (SAS Institute Inc, Cary, NC) was used to adjust for the cluster effect. Significant statistical differences were judged by nonoverlapping 95% confidence intervals (CI). This is a conservative estimate of significance.
compared with a traditional alpha of <0.05. To calculate the number of foot/ankle/leg problems managed per 100 head of population for each year, we extrapolated the rate of management at encounters in BEACH to the number of non-referred Medicare Benefits Schedule GP attendances claimed each year divided by the annual population.

Results

GP management rate for foot/ankle/leg problems

Between April 2000 and March 2016, 15,681 GPs recorded 1,568,100 patient encounters, at which 50,877 foot/ankle/leg problems were managed at a rate of 3.24 (95% CI 3.21–3.28) per 100 encounters. The management rate of foot/ankle/leg problems increased 18% across the study, from 3.0 (95% CI 2.9–3.1) in 2000–2001 to 3.5 (95% CI 3.4–3.7) per 100 encounters in 2015–2016 (Fig. 1). When extrapolated to the rate per head of population, the increase was 34%, from 15.8 (95% CI 15.1–16.6) in 2000–2001 to 21.2 (95% CI 20.2–22.3) per 100 people in 2015–2016.

GP and patient characteristics associated with management of foot/ankle/leg problems

Between 2011-16, 4,881 GPs recorded 488,100 encounters at which 16,949 foot/ankle/leg problems were managed at a rate of 3.5 per 100 encounters (Table 1). The management rate significantly increased with patient age from 1.8 among 0–14 year olds to 6.6 per 100 encounters in patients aged 85+ years. Other patient groups that had a significantly higher foot/ankle/leg problem management rate (per 100 encounters) were patients from the most disadvantaged socioeconomic areas (3.7) compared with those from higher advantaged areas (3.4); patients who held a Commonwealth health care concession card (CHCC) (4.2) compared with those who did not (2.9); patients from an English-speaking background (3.6) compared with those from a non-English-speaking background (3.1); and non-Indigenous patients (3.5) compared with Indigenous patients (2.9).

Male GPs managed foot/ankle/leg problems at a significantly higher rate (3.7 per 100 encounters) than female GPs (3.2). GPs aged less than 45 years managed foot/ankle/leg problems significantly less frequently (3.2) than those aged 45–54 years (3.5) or 55+ (3.6). GPs who graduated medical school in Australia managed foot/ankle/leg problems at a significantly higher rate (3.6) than those who graduated overseas (3.3).

Management rate of specific foot/ankle/leg problems

The management rate of the most commonly-encountered foot/ankle/leg problem groups is shown in Table 2. The most frequently managed problem group was infection (6.4 per 1,000 encounters), followed by injury (5.4), musculoskeletal disorders (4.4), and ulceration (4.4). The most frequently
managed individual conditions were leg/venous/varicose ulcers (3.5 per 1,000 encounters), plantar fasciitis (2.1), and cellulitis of the leg (1.9).

Management actions for foot/ankle/leg problems
The most frequently used management actions by GPs for foot/ankle/leg problems is shown in Table 3. The most frequently used management action was the use of medications (46.0 per 100 foot/ankle/leg problem encounters, primarily antibiotics, and analgesics), followed by procedures/physical medicine (24.5), and imaging (19.2, primarily x-ray). Specialist or allied health referral was undertaken for 15.0 per 100 foot/ankle/leg problems and primarily involved podiatrists (5.6) and orthopedic surgeons (2.1).

Cost estimates
The estimated cost of GP management of foot/ankle/leg problems in 2015–2016 is shown in Table 4. The average cost per foot/ankle/leg encounter was A$52.30, with the total cost A$256m, based on an estimate of 4,880,000 foot/ankle/leg encounters in 2015–2016 (using GP attendances claimed each year31 divided by the annual population32). Of this total cost, MBS items comprised most of this cost (A$139m), followed by imaging (A$69m), medications (A$29m), and pathology

| Table 1. Patient and GP specific management rate of foot/ankle/leg problems per 100 encounters, 2011–2016. |
|---------------------------------------------------------------|
| Patient characteristics                                      | Sample size (n = 488,100) | Number of problems managed (n = 16,949) | Distribution (%) of problems managed by patient and GP characteristics | Characteristic specific rate of problems per 100 encounters |
|----------------------------------------------------------------|---------------------------|------------------------------------------|--------------------------------------------------------------------------------|-----------------------------------------------------------|
| Sex (missing)                                                  | (4,261)                   | (154)                                    | 41.5 (40.6–42.4)                                                               | 3.6 (3.5–3.7)                                             |
| Male                                                          | 195,991                   | 6,976                                    | 41.5 (40.6–42.4)                                                               | 3.6 (3.5–3.7)                                             |
| Female                                                        | 287,848                   | 9,819                                    | 58.5 (57.6–59.4)                                                               | 3.4 (3.3–3.5)                                             |
| Age(missing)                                                  | (4,146)                   | (110)                                    | 5.9 (5.5–6.3)                                                                 | 1.8 (1.7–1.9)                                             |
| 0–14 years                                                    | 55,289                    | 990                                      | 5.9 (5.5–6.3)                                                                 | 1.8 (1.7–1.9)                                             |
| 15–24 years                                                   | 39,075                    | 1,058                                    | 6.3 (5.9–6.7)                                                                 | 2.7 (2.5–2.9)                                             |
| 25–44 years                                                   | 107,575                   | 2,542                                    | 15.1 (14.5–15.7)                                                               | 2.4 (2.3–2.5)                                             |
| 45–64 years                                                   | 132,027                   | 4,610                                    | 27.4 (26.6–28.1)                                                               | 3.5 (3.4–3.6)                                             |
| 65–84 years                                                   | 123,224                   | 5,871                                    | 34.9 (34.0–35.7)                                                               | 4.8 (4.6–4.9)                                             |
| 85+ years                                                     | 26,764                    | 1,768                                    | 10.5 (9.9–11.1)                                                                | 6.6 (6.3–7.0)                                             |
| Socioeconomic level (missing)                                 | (10,464)                  | (338)                                    | 41.6 (40.2–43.1)                                                               | 3.7 (3.6–3.8)                                             |
| Most disadvantaged                                            | 189,031                   | 6,915                                    | 41.6 (40.2–43.1)                                                               | 3.7 (3.6–3.8)                                             |
| Most advantaged                                               | 288,605                   | 9,696                                    | 58.4 (56.9–59.8)                                                               | 3.4 (3.3–3.4)                                             |
| Health care card (missing)                                    | (41,176)                  | (1,203)                                  | 54.0 (52.9–55.0)                                                               | 4.2 (4.1–4.3)                                             |
| Health care card                                              | 200,495                   | 8,501                                    | 54.0 (52.9–55.0)                                                               | 4.2 (4.1–4.3)                                             |
| No health care card                                           | 246,429                   | 7,245                                    | 46.0 (45.0–47.1)                                                               | 2.9 (2.9–3.0)                                             |
| Language background (missing)                                 | (48,528)                  | (1,419)                                  | 7.7 (7.1–8.4)                                                                 | 3.1 (2.9–3.3)                                             |
| Non-English speaking                                          | 38,901                    | 1,199                                    | 92.3 (91.6–92.9)                                                               | 3.6 (3.5–3.7)                                             |
| English speaking                                              | 400,671                   | 14,331                                   | 92.3 (91.6–92.9)                                                               | 3.6 (3.5–3.7)                                             |
| Indigenous status (missing)                                   | (48,417)                  | (1,418)                                  | 1.6 (1.3–1.9)                                                                 | 2.9 (2.5–3.3)                                             |
| Indigenous                                                    | 8,820                     | 254                                      | 98.4 (98.1–98.7)                                                               | 3.5 (3.5–3.6)                                             |
| Non-Indigenous                                                | 430,863                   | 15,277                                   | 98.4 (98.1–98.7)                                                               | 3.5 (3.5–3.6)                                             |
| GP sex (missing)                                              | (0)                       | (0)                                      | 60.8 (59.2–62.4)                                                               | 3.7 (3.6–3.8)                                             |
| Male                                                          | 278,700                   | 10,304                                   | 39.2 (37.6–40.8)                                                               | 3.2 (3.1–3.3)                                             |
| Female                                                        | 209,400                   | 6,645                                    | 24.5 (23.0–25.9)                                                               | 3.2 (3.1–3.3)                                             |
| GP age (missing)                                              | (2,900)                   | (69)                                     | 24.5 (23.0–25.9)                                                               | 3.2 (3.1–3.3)                                             |
| <45 years                                                     | 128,300                   | 4,129                                    | 24.5 (23.0–25.9)                                                               | 3.2 (3.1–3.3)                                             |
| 45–54 years                                                   | 143,000                   | 5,024                                    | 29.8 (28.2–31.3)                                                               | 3.5 (3.4–3.6)                                             |
| 55+ years                                                     | 213,900                   | 7,727                                    | 45.8 (44.1–47.5)                                                               | 3.6 (3.5–3.7)                                             |
| Practice location (missing)                                   | (1,300)                   | (36)                                     | 69.0 (67.4–70.6)                                                               | 3.4 (3.3–3.5)                                             |
| Major cities                                                  | 343,500                   | 11,657                                   | 69.0 (67.4–70.6)                                                               | 3.4 (3.3–3.5)                                             |
| Inner regional                                                | 95,800                    | 3,545                                    | 20.9 (19.5–22.3)                                                               | 3.7 (3.5–3.9)                                             |
| Outer regional/remote                                         | 47,500                    | 1,711                                    | 20.9 (19.5–22.3)                                                               | 3.7 (3.5–3.9)                                             |
| Country of graduation (missing)                               | (1,700)                   | (50)                                     | 10.1 (9.0–11.1)                                                               | 3.6 (3.4–3.8)                                             |
| Australian graduate                                           | 323,100                   | 11,567                                   | 68.4 (66.9–70.0)                                                               | 3.6 (3.5–3.7)                                             |
| Overseas graduate                                             | 163,300                   | 5,332                                    | 31.6 (30.0–33.1)                                                               | 3.3 (3.2–3.4)                                             |
For medications, the cost to the patient was A$24m and the cost to the government was A$5m.

**Discussion**

The objective of this study was to explore consultation patterns, management practices, and estimate the costs of GP management of foot/ankle/leg problems in Australian primary care. Between 2000 and 2016, GPs managed 50,877 foot/ankle/leg problems at a rate of 3.24 per 100 encounters, which increased by 18% over the study period. The most frequently used management action was the use of medications, followed by procedures/physical medicine and imaging. We estimated the annual cost at A$256m, which was primarily attributable to consultation fees, followed by diagnostic imaging, medications, and pathology services. These findings confirm that foot/ankle/leg problems are commonly managed by GPs, and the costs associated with their management represent a substantial economic cost in Australian primary care.

Consultation for foot/ankle/leg problems was associated with increased age, which is consistent with the association between age and the prevalence of foot problems reported in population-based studies.33–35 Health care concession card holders (which includes age pensioners, disability support pensioners, and those on lower incomes) had a higher management rate than those without, as did those from a non-Indigenous and English-speaking background. GP characteristics also influenced the management rate, with male,

**Table 2.** Management rate of specific foot/ankle/leg problem groups per 1,000 encounters, 2011–2016.

| Specific foot/ankle/leg problem group | n  | Rate per 1,000 encounters (95% CIs) |
|--------------------------------------|----|-------------------------------------|
| Infection                            | 3,100 | 6.4 (6.1–6.6) |
| Cellulitis of the leg                | 917  | 1.9 (1.7–2.0) |
| Onychomycosis/fungus nail            | 763  | 1.6 (1.4–1.7) |
| Tinea/fungal skin infection          | 685  | 1.4 (1.3–1.5) |
| Infected ingrown toenail            | 281  | 0.6 (0.5–0.6) |
| Injury                               | 2,652 | 5.4 (5.2–5.7) |
| Sprained ankle                       | 861  | 1.8 (1.6–1.9) |
| Injury ankle                         | 251  | 0.5 (0.4–0.6) |
| Fracture metatarsal                  | 241  | 0.5 (0.4–0.6) |
| Musculoskeletal                      | 2,127 | 4.4 (4.2–4.6) |
| Plantar fasciitis                    | 1,028 | 2.1 (2.0–2.2) |
| Arthritis ankle                      | 279  | 0.6 (0.5–0.6) |
| Arthritis foot/feet                  | 279  | 0.6 (0.5–0.6) |
| Ulceration                           | 2,164 | 4.4 (4.2–4.7) |
| Leg/venous/varicose ulcer           | 1,705 | 3.5 (3.3–3.7) |
| Foot ulcer                           | 459  | 0.9 (0.8–1.0) |
| Unspecified pain                     | 1,640 | 3.4 (3.2–6.5) |
| Pain foot/feet                       | 690  | 1.4 (1.3–1.5) |
| Pain leg                             | 551  | 1.1 (1.0–1.2) |
| Pain ankle                           | 297  | 0.6 (0.5–0.7) |
| Venous/swelling                      | 1,501 | 3.1 (2.9–3.3) |
| Edema of ankle/foot/feet             | 243  | 0.5 (0.4–0.6) |
| Dermatological                       | 905  | 1.9 (1.7–2.0) |
| Ingrown toenail                      | 515  | 1.1 (1.0–1.2) |
| Corns/calllosities                   | 376  | 0.8 (0.7–0.9) |
| Neuropathy                           | 848  | 1.7 (1.6–1.9) |
| Restless leg syndrome                | 383  | 0.8 (0.7–0.9) |
| Ischemia                             | 844  | 1.7 (1.6–1.9) |
| Peripheral vascular disease          | 575  | 1.2 (1.1–1.3) |
| Nonspecific foot/ankle/leg problem   | 297  | 0.6 (0.5–0.7) |
| Cramps                               | 290  | 0.6 (0.5–0.7) |
| Management of foot/ankle/leg         | 269  | 0.6 (0.5–0.6) |
| Congenital                           | 238  | 0.5 (0.4–0.6) |
| Amputation                           | 69   | 0.1 (0.1–0.2) |
| Total                                | 16,949 | 34.7 (34.1–35.4) |

**Table 3.** Management actions used by GPs per 100 foot/ankle/leg problems, 2011–2016.

| Management action                          | n   | Rate per 100 problems (95% CIs) |
|--------------------------------------------|-----|-------------------------------|
| Medication                                  | 7,799 | 46.0 (44.9–47.1) |
| Antibiotics for systemic use                | 1,938 | 11.4 (10.9–12.0) |
| Cephalexin                                  | 1,063 | 6.3 (5.9–6.7) |
| Flucloxacillin                              | 248  | 1.5 (1.3–1.7) |
| Dicloxacillin                               | 165  | 1.0 (0.8–1.1) |
| Analgesics                                  | 1,370 | 8.1 (7.6–8.6) |
| Nonopiod analgesic                          | 696  | 4.1 (3.8–4.4) |
| Paracetamol                                 | 628  | 3.7 (3.4–4.0) |
| Oxycodon                                    | 182  | 1.1 (0.9–1.3) |
| Anti-inflammatory and antirheumatic products| 938  | 5.5 (5.1–5.9) |
| Ibuprofen                                   | 330  | 1.9 (1.7–2.2) |
| Meloxicam                                   | 222  | 1.3 (1.1–1.5) |
| Antifungals for dermatological use          | 835  | 4.9 (4.6–5.3) |
| Oral terbinafine                            | 209  | 1.2 (1.1–1.4) |
| Clotrimazole                                | 168  | 1.0 (0.8–1.1) |
| Diuretics                                   | 398  | 2.3 (2.1–2.6) |
| Furosemide                                  | 330  | 1.9 (1.7–2.2) |
| Anti-Parkinson                              | 213  | 1.3 (1.1–1.4) |
| Procedures/physical medicine                | 4,153 | 24.5 (23.6–25.4) |
| Imaging                                     | 3,246 | 19.2 (18.4–19.9) |
| X-ray                                       | 2,031 | 12.0 (11.4–12.5) |
| Ultrasound                                  | 956  | 5.6 (5.2–6.0) |
| Pathology                                   | 3,156 | 18.6 (17.4–19.8) |
| Full blood count                            | 477  | 2.8 (2.6–3.1) |
| Other microbiology                          | 298  | 1.8 (1.5–2.0) |
| Electrolytes, urea, creatinine              | 279  | 1.6 (1.4–1.8) |
| Multi-biochemical analysis                  | 205  | 1.2 (1.0–1.4) |
| Fungal ID/sensitivity                       | 196  | 1.2 (1.0–1.3) |
| Liver function                              | 167  | 1.0 (0.8–1.1) |
| Counseling/advice/education                | 2,613 | 15.4 (14.7–16.1) |
| Referral                                    | 2,547 | 15.0 (14.4–15.7) |
| Podiatrist                                  | 945  | 5.6 (5.2–6.0) |
| Orthopedic surgeon                          | 354  | 2.1 (1.9–2.3) |
| Physiotherapist                             | 317  | 1.9 (1.7–2.1) |
| Vascular surgeon                            | 208  | 1.2 (1.1–1.4) |
young and Australian-trained GPs more likely to see patients with foot/ankle/leg problems. However, the influence of GP age and sex appears to vary across specific conditions. For example, while younger GPs are more likely to manage heel pain,12 age does not appear to influence the management rate of foot/ankle osteoarthritis,10 hallux valgus,11 or venous leg ulcers.13 Similarly, male GPs are more likely to manage heel pain12 and venous leg ulcers,13 although no GP sex differences have been identified in relation to the management of foot/ankle osteoarthritis.10 Further studies are required to understand the underlying reasons for the variable impact of GP age and sex on the management of lower limb conditions.

The most frequently used management action by GPs for foot/ankle/leg problems was the use of medications, primarily antibiotics and analgesics. This is to be expected given that the most common presenting conditions were infections, followed by injuries and other musculoskeletal conditions. The use of procedures/physical medicine, imaging (primarily x-ray), pathology referral (primarily full blood count) were also commonly used. Specialist or allied health referral was also frequently undertaken, with patients most likely to be referred to podiatrists. Interestingly, referral patterns for foot/ankle/leg problems also seem to be influenced by the specific presenting condition, with previous studies using BEACH data finding that GPs are more likely to refer to orthopedic surgeons for foot/ankle osteoarthritis10 and hallux valgus,11 and more likely to refer to podiatrists for heel pain.12

The costs associated with GP management of foot/ankle/leg problems were substantial, estimated at a quarter of a billion Australian dollars per annum. As we took a conservative approach to the assumptions underpinning this calculation, this is likely to be a considerable underestimate. Furthermore, our data pertain only to the bulk-billed GP management of these problems and therefore exclude out-of-pocket expenses incurred by patients who are not bulk-billed, the costs associated with specialist and allied health consultations, and the costs of inpatient or outpatient care. For example, Medicare subsidies for private podiatry services under the chronic disease management program cost A$189 million in 202016 (which represents only a small proportion of the private cost to patients), while the annual cost burden of managing foot disease in the Australian public hospital system was estimated at A$4 billion in 2017.37 It is not possible to compare our cost estimate to previous studies, due to differences in methodology and health care funding models used in other countries. However, to place this figure in the context of estimates for other health conditions from similar Australian primary care studies, the average costs per GP encounter for pneumonia,38 genital warts,39 and herpes zoster40 (the only other conditions for which cost estimates are available from BEACH data) are higher than our estimated cost of managing a foot/ankle/leg problem (A$52), yet due to the much higher prevalence of foot/ankle/leg problems, our total cost estimate is considerably larger (A$256m vs. A$20m for pneumonia, A$9.6m for genital warts, and A$4.2m for herpes zoster).

These findings have important implications in relation to the design of cost-effective models of care for foot/ankle/leg problems. First, although these conditions frequently present to GPs, the cost associated with managing foot disease in the public hospital system is substantially higher,37 which suggests that improving access and optimizing foot and ankle problem management in primary care could help prevent more costly downstream effects. Second, while GP referrals to podiatrists have increased 5-fold since the introduction of Medicare funding,41 expansion of this program to cover more consultations and the cost of evidence-based treatments such as wound dressings and offloading devices could significantly improve the management of foot problems associated with diabetes.42 Third, the relative merit of GP referral of patients with foot problems to podiatrists or orthopedic surgeons needs to be evaluated, as experience in the public hospital system suggests that a podiatry-led triage service is cost-effective and improves the utilization of orthopedic surgeons and other specialists by screening out those unlikely to require operative intervention.14,43

Key strengths of this study include the large, representative sample of GPs and the linkage of management actions to specific conditions. However, our findings need to be interpreted in the context that the BEACH study is cross-sectional and provides consultation data rather than patient-longitudinal data, and it is not possible to identify how GPs manage the care of individual patients over time.21 Furthermore, because the assumptions underpinning our cost analysis were conservative, and we were unable to incorporate other primary care-related costs (such as consultations with other health professionals) into the calculation, this figure is likely to be a considerable underestimate of the actual costs of foot/ankle/leg problems in primary care.

In summary, this study of national patient-encounter records has shown that foot/ankle/leg problems are a relatively common reason for consultation with GPs in Australia, and the costs associated with their management are substantial. Further studies are required to determine whether the management of these conditions in primary care is both clinically effective and cost-effective or whether more efficient models of care can be developed and implemented.

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Author contributions
H.B.M. and C.H. conceived the idea for the analysis. H.B.M., C.M.W., and P.A.L. selected the relevant ICPC-2 PLUS terms under guidance from J.G. and C.H. C.M.W. extracted medication cost data. C.H. extracted the consultation data and performed the analysis. H.B.M. drafted the manuscript. All authors contributed to the interpretation of the findings and read and approved the final manuscript.

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Conflict of interest
The authors declare that they have no conflicts of interest.

Ethical approval
The BEACH program was approved by the Human Research Ethics Committee of the University of Sydney (from 2000 to 2016) and the Australian Institute of Health and Welfare Ethics Committee (from 2000 to 2010). In compliance with the ethics protocol for the BEACH study, verbal informed consent was obtained from all participating GPs at time of recruitment, and each patient was provided with a written patient information card and then required to give verbal informed consent. If the patient refused, details of the encounter were not recorded. Data collected were anonymized before use. Permission to access the data was granted by the BEACH study custodian, Dr Christopher Harrison, Menzies Centre for Health Policy, School of Public Health, Faculty of Medicine and Health, University of Sydney, Sydney.

Data availability
The data that support the findings of this study are available from the BEACH study (https://www.sydney.edu.au/medicine-health/our-research/research-centers/bettering-the-evaluation-and-care-of-health.html), the University of Sydney, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of the BEACH study, the University of Sydney.

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