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# Cost of diabetic foot in France, Spain, Italy, Germany and United Kingdom: A systematic review

*Coût du pied diabétique en France, Espagne, Italie, Allemagne et Royaume-Uni : revue systématique*

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## Abstract

**Aim.** – Cost estimates for diabetic foot are available for developed countries based on cost data for different years. This study aimed to provide a comparison of the cost of diabetic foot in E5 (France, Spain, Italy, Germany, and the United Kingdom) and its characteristics across different conditions. **Methods.** – PubMed, Central and Embase databases were searched in February 2017 for English language publications. Bibliographies of relevant papers were also searched manually. Reviews and research papers from E5 regions reporting on cost of diabetic foot were included. Reported cost was converted to equivalent 2016 \$ for comparison purposes. All the costs presented are mean cost per patient per year in 2016 \$. **Results.** – Nine studies were included in the analysis. The total cost of amputation ranged from \$ 15,046 in 2001 to \$ 38,621 in 2005. The direct cost of amputation ranged from \$ 13,842 in 2001 to \$ 83,728 during 2005–2009. Indirect cost of amputation was more uniform, ranging from between \$ 1,043 to \$ 1,442. The direct cost of gangrene ranged from \$ 3,352 in 2003 to \$ 8,818 in Germany. Although, for the same year, 2003, the cost for Spain was almost double that for Germany. The total cost of an uninfected ulcer was \$ 6,174 in 2002, but increased to \$ 14,441 in 2005; for an infected ulcer the cost increased from \$ 2,637 to \$ 2,957. The different countries showed variations in the components used to calculate the cost of diabetic foot. **Conclusions.** – The E5 incurs a heavy cost from diabetic foot and its complications. There is an unmet need for the identification of cost-cutting strategies, as diabetic foot costs more than major cardiac diseases.

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**Keywords:** Cost; Diabetic foot; Foot ulcer; Health economics; Gangrene; Amputation

## Résumé

**Objectif.** – Les estimations de coûts pour le pied diabétique sont disponibles pour les pays développés en fonction des données sur les coûts pour différentes années. Cette étude visait à comparer le coût du pied diabétique dans E5 (France, Espagne, Italie, Allemagne et Royaume-Uni) et ses caractéristiques dans différentes conditions. **Méthodes.** – Les bases de données PubMed, Central et Embase ont été consultées en février 2017 à la recherche des publications en langue anglaise. Les bibliographies des documents pertinents ont également été effectuées manuellement. Les examens et les documents de recherche provenant des régions E5 rapportant le coût du pied diabétique ont été inclus. Le coût déclaré a été converti en équivalent 2016 \$ pour obtenir une comparaison. Tous les coûts correspondent au coût moyen par patient et par année en 2016 \$. **Résultats.** – Neuf études ont été incluses dans l'analyse. Le coût total de l'amputation variait de 15 046 \$ en 2001 à 38 621 \$ en 2005. Le coût direct de l'amputation

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variait de 13 842 \$ en 2001 à 83 728 \$ dans la période 200 à 2009. Le coût indirect de l'amputation était plus uniforme entre 1043 \$ et 1442 \$. Le coût direct de la gangrène en Allemagne variait de 3352 \$ en 2003 à 8818 \$. A partir de l'année 2003, le coût pour l'Espagne était presque le double de celui de l'Allemagne. Le coût total d'un ulcère non infecté était de 6174 \$ en 2002 et de 14 441 \$ en 2005, et pour un ulcère infecté il variait de 2637 à 2957 \$. Entre les différents pays il existait des variations dans la façon de calculer le coût du pied diabétique.

**Conclusions.** – Le pied diabétique et ses complications entraînent un coût élevé pour le système de soins des pays E5. Il devient urgent d'identifier les stratégies de réduction des coûts, car le pied diabétique a un coût plus élevé que les principales maladies cardiaques.

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**Mots clés :** Coût ; Pied diabétique ; Ulcère du pied ; L'économie de la santé ; Gangrène ; Amputation

## 1. Introduction

A staggering 55 million (8.5%) European adults were affected with diabetes mellitus (DM) in 2010. The population of Europe is expected to grow from 891 million in 2010 to 897 million in 2030, and the number of diabetics is expected to reach 66.5 million [1]. Though there is a drastic regional difference in prevalence rates across Europe, up to 12% of Germans are affected by DM.

It is estimated that 15% of diabetics develop at least one foot ulcer in their lifetime [2]. Diabetic foot exhibits rapid and complex progression, leading to neuropathy, infection, and gangrene, which may require lower extremity amputation. Foot ulcers are one of the most complicated conditions to manage in diabetics, as the ulcers attract infections which lead to further complications [3]. Eighty-five percent of amputations in diabetics are preceded by an ulcer [4]. While diabetes itself doubles the rate of mortality by all causes as compared to non-diabetics, foot ulceration imposes an even higher morbidity [4].

Developing countries spend almost 40% of their health expenditure on diabetics; in developed countries, it accounts for approximately 12–15% of health spend [5]. The economic burden of diabetic foot on the national exchequer can be understood by examining the 2010–2011 data for the United Kingdom [6]. Almost 0.6% of the NHS expenditure in England (£580 m) was spent on diabetic foot care; approximately half (£ 307 m) of this was spent on ulcer care at primary and community healthcare centres. Among diabetic hospital admissions in the UK, 8.8% were related to ulcer care or amputation. Further, diabetic foot was associated with a 2.5-fold increase in length of hospital stay. This cost the NHS £ 219 million for diabetic ulcer care, and £ 55 million for amputation. Direct cost estimates ranged from £ 3,456 for an ulcer to £ 9,477 for diabetic foot-associated amputation, per patient and per year.

A comparative examination of the cost of diabetic foot in five European Countries (E5) (France, Germany, Spain, Italy, and the UK) was planned to gain insight into variation in the economic burden of the condition across the major healthcare systems of Europe. Acker et al. conducted in 2014 a similar analysis of data recorded up to 2005, and showed that diabetic foot is a major cost burden [7]. However, the costs were not converted to a fixed year value, which did not allow head-to-head comparison of the costs in different countries.

Therefore, the present systematic review was conducted to study the cost of diabetic foot in the E5 region by extrapolating the costs to an equivalent of the 2016 United States Dollar (\$).

## 2. Methods

This systematic review was conducted and reported as per the PRISMA guidelines, in order to evaluate the cost of diabetic foot in the E5 region [8].

The study question was formed based on the stated aim of understanding and comparing the cost of diabetic foot in the E5 region. A two-step protocol was followed: step one was a literature search, including the identification of suitable studies, and data extraction; and the second step was a cost comparison, where expenditures stated in all the selected studies were converted to an equivalent of year 2016 USD.

### 2.1. Data sources and search terms

PubMed, Cochrane systematic reviews, and Embase databases were searched in February 2017 for all full-length papers reporting on the cost of diabetic foot in at least one of the E5 nations. Different combination of the following keywords were used for the search: “foot ulcer”, “diabetic foot”, and “economics”. The search was limited to studies published after the year 2000. The bibliographies of relevant reviews and research papers were manually searched to further identify potentially relevant studies. Only English language papers were included. No limitations were applied regarding the study design (retrospective/prospective), or type of publication (research/review) if the requirements were met. Studies reporting on the cost of diabetic foot for adults in any setting were eligible.

Exclusion criteria – abstracts, conference proceedings, posters, case series/reports, editorials, and non-English language publications were not considered.

### 2.2. Study selection

Any duplicate articles were identified, and the duplicated record was removed. The titles and abstracts of the remaining articles were reviewed independently by two of the authors, who were responsible for determining whether the articles were eligible for inclusion. To address any inconsistencies, the authors compared listing before full texts were reviewed. When the final

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