Contents available at ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

International Diabetes Federation

Identifying patterns of general practitioner service utilisation and their relationship with potentially preventable hospitalisations in people with diabetes: The utility of a cluster analysis approach

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ARTICLE INFO

Article history:
Received 18 August 2017
Received in revised form
24 November 2017
Accepted 26 January 2018
Available online 9 February 2018

Keywords:
Cluster analysis
Primary health care
Potentially preventable hospitalisation
Diabetes
Data linkage

ABSTRACT

Aims: We aimed to characterise use of general practitioners (GP) simultaneously across multiple attributes in people with diabetes and examine its impact on diabetes related potentially preventable hospitalisations (PPHs).

Methods: Five-years of panel data from 40,625 adults with diabetes were sourced from Western Australian administrative health records. Cluster analysis (CA) was used to group individuals with similar patterns of GP utilisation characterised by frequency and recency of services. The relationship between GP utilisation cluster and the risk of PPHs was examined using multivariable random-effects negative binomial regression.

Results: CA categorised GP utilisation into three clusters: moderate; high and very high usage, having distinct patient characteristics. After adjusting for potential confounders, the rate of PPHs was significantly lower across all GP usage clusters compared with those with no GP usage; IRR = 0.67 (95%CI: 0.62–0.71) among the moderate, IRR = 0.70 (95%CI 0.66–0.73) high and IRR = 0.76 (95%CI 0.72–0.80) very high GP usage clusters.

Conclusions: Combination of temporal factors with measures of frequency of use of GP services revealed patterns of primary health care utilisation associated with different underlying patient characteristics. Incorporation of multiple attributes, that go beyond frequency-based approaches may better characterise the complex relationship between use of GP services and diabetes-related hospitalisation.

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https://doi.org/10.1016/j.diabres.2018.01.027
0168-8227/

1. Introduction

Diabetes is an increasing public health issue causing a substantial burden on health care systems around the world [1]. In Europe, the number of people with diabetes was nearly 60 million in 2013, and is estimated to increase to 70 million by the early 2030s [2]. Similarly, in the United States the prevalence of diabetes was estimated at 29.1 million in the national report in 2014 [3]. In Australia, a country of approximately 24 million people, the prevalence of diabetes was about 1.2 million in 2014–15 [4] and is estimated to increase to 3.4 million by early 2030s [5].The condition costs the Australian Health system more than $AU6.5 billion each year [5]. Diabetes is considered an ambulatory care sensitive condition [5], and consequently enhancing primary health care to better manage diabetes has been a major approach in the health care system of Australia [5,6].

The literature suggests that better primary health care delivery reduces the risk of hospitalisations for ambulatory care sensitive conditions in general [7–9]. With respect to diabetes, a recent systematic review indicated that regular primary care was associated with reduced risk of hospitalisation [10]. However, other aspects such as frequency of visits or access to primary health care show inconsistent results [10].

In Australia, primary care services, mainly provided by general practitioners (GP), are subsidised through a universal health insurance scheme, Medicare, on a fee-for-service basis [6]. Dedicated financial incentives have been provided under Medicare for GPs to provide comprehensive care for diabetes [6]. However, to our knowledge, limited research has evaluated patterns of utilisation of primary health care services for people with diabetes and their impact on health outcomes. Current studies are limited to examining the utilisation of primary health care based on single indicators such as frequency [6] or regularity of services used [11].

Since patterns of primary health care utilisation are likely to be complex, more advanced approaches that account for multiple factors are required to more accurately classify and discover meaningful patterns of primary health care utilisation by people with diabetes. K-mean cluster analysis, a data-driven approach, is capable of taking into account multiple dimensions simultaneously and is suitable for use with large datasets [12]. The technique can classify individuals with similar characteristics into homogeneous groups which can also maximise heterogeneity between groups [12]. The technique has been applied to a variety of settings, for example, health behaviour [13]; health psychology [14]; health care cost analysis [12] and genetic classification [15].

Thus, our study aims to apply K-mean cluster analysis to identify GP utilisation patterns using multiple attributes of GP usage among people with diabetes. We will also examine the impact of identified GP utilisation patterns on the risk of potentially preventable hospitalisations (PPHs). Understanding patterns of GP utilisation and how they impact on health outcomes is useful for planning health care provision targeted to encouraging particular patterns in utilisation and enhancing the relationship between patients and their primary health care provider.

2. Material and methods

2.1. Data sources

The Western Australian (WA) linked data used for this study comprised whole-of-population administrative health data linked at the individual level, for residents of WA aged 18 years or older who were registered at any time on the WA Electoral Roll [16]. The data included a complete set of WA Hospital Morbidity Data System (HMDS) records; Medicare Benefit Scheme (MBS) claim records; WA Electoral Roll (ER) records; and WA mortality records for each individual subsequent to their first ever WA Electoral Roll record. Details of each dataset have been described previously [17]. In brief, the datasets provide statutory information on all hospitalisations (HMDS), claims for medical services out-of-hospital including GP visits (MBS), dates individuals migrated in and out of WA or changed address while living in WA (Electoral Roll) and date/cause of death.

2.2. Study population

Annual panel data from 1998/1999 to 2003/2004 were constructed consisting of individuals with diabetes identified via HMDS or MBS data prior to the start of or in the baseline financial year (1998/99). Diabetes mellitus was determined using the International Classification of Disease (ICD), 9th edition-clinical modification (ICD-9-CM) codes in HMDS records and MBS claims indicative of the presence of diabetes as described elsewhere [17]. All individuals were observed annually from the baseline year to 30 June 2004, last year living in WA or death (whichever occurred first) for any change in GP utilisation, hospitalisations and clinical and demographic characteristics. GP utilisation and demographic and clinical characteristics were measured in the exposure year, and PPH outcomes measured in the following year. Only individuals who were alive and resident in WA for at least two consecutive years were included in the study. The couplet design (ie. comprising pairs of years, the exposure year followed by an outcome year) has been applied in recent publications [6,17].

Ethical approval was provided by The University of Western Australia and Curtin University Human Research Ethics Committees who exempted the study from obtaining individual patient consent.

2.3. Study outcome and predictors

2.3.1. Diabetes related potentially preventable hospitalisations

The primary outcome measure was diabetes related potentially preventable hospitalisations (PPH) during the following-up year of each couplet. Hospitalisations were deemed PPHs based on either their principal diagnosis being identified by the National Health Performance Framework [18] as a diabetes related PPH or identification by Davis et al. [19] as associated with increased risk for people with diabetes. Principal diagnoses were captured using ICD-9-CM and Aus-