



# Vaccine-preventable disease-related hospitalization among immigrants and refugees to Canada: Study of linked population-based databases



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## ABSTRACT

While immigrants tend to be healthier especially when they first arrived, this healthy immigrant effect may not apply to vaccine-preventable diseases (VPD) especially among immigrants from countries without vaccination programs. There is therefore an important information gap regarding differential health outcome and hospitalization usage by immigrant status, landing cohort, world region and immigrant category. This study focused on acute-care hospitalization, and used two recently linked population-based databases in Canada, namely, the 2006 Census linked to the Hospital Discharge Abstract (DAD), and the Immigrant Landing File linked to the DAD (ILF-DAD) to estimate crude and age-standardized VPD-related hospitalization rates (ASHR) by the above-mentioned immigrant characteristics to be compared with that for overall Canadian-born reference population. Based on the 2006 Census-DAD linked database, VPD-specific ASHR for overall immigrants was significantly higher than that for the Canadian-born population (1.6, 95% CI, 1.5, 1.6 vs 1.2, 95% CI, 1.1, 1.2, respectively). VPD-specific ASHRs by landing cohorts also increased with years in Canada (e.g. 1.4, 95% CI, 1.3, 1.5 for the 1990–2006 cohort, and 1.6, 95% CI, 1.5, 1.7 for the pre-1980 cohort). Based on the 1980–2006 ILF-DAD, the VPD-specific ASHRs were highest among Southeast and East Asians (e.g. 2.1, 95% CI, 1.9, 2.3 for East Asia). Compared with the Canadian-born, economic class immigrants overall had significantly lower ASHR (1.4, 95% CI 1.2, 1.6), but the low rate was mainly due to the dependants (spouse or children) within this class (0.8, 95% CI 0.6, 1.1). Both family and refugee categories had significantly higher ASHRs (1.3, 95% CI, 1.2, 1.5 and 1.7, 95% CI, 1.4, 2.1, respectively), especially among those refugees assisted by government (2.0, 95% CI, 1.4, 2.6). With increasing immigration, changing source countries and emerging needs for refugee settlements in Canada, these newly linked datasets help to monitor VPD-related hospitalization pattern among Canadian immigrants.

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## 1. Introduction

Infectious diseases, once the leading cause of death worldwide, have decreased in Canada, in part, due to immunization [1]. Immunization programs have saved lives in Canada in the last 50 years more than any other public health intervention [2]. Despite nationally-implemented vaccination programs in Canada for highly infectious diseases, such as measles, mumps, and rubella, outbreaks continue to occur in specific subgroups, including immigrants [3].

Immigrants represent approximately one-fifth (20.6%) of Canada's population, the highest among all G8 countries [4]. While

immigrants to Canada, especially those new arrivals, tend to experience better health, compared to their local-born counterparts, Canadian evidence suggests that this healthy immigrant effect may not apply to selected health conditions such as infectious diseases, especially among refugees [5–7]. Vaccine-Preventable Diseases (VPD), while well controlled in Canada may become a challenge as immigrants are increasingly arriving from source countries that have inadequate access to vaccination [8–10].

While there is generally a high acceptance of immunization among immigrant groups [11], concerns have been raised regarding the extent of vaccination among new immigrants, many of whom came from world regions where vaccine coverage may be suboptimal or from countries without a national vaccination program [12], not coinciding with the routine Canadian immunization schedule. As such, some immigrants may have suffered from the long-term effects of infectious diseases developed prior to

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benefiting from Canadian immunization programs or prior to arrival in Canada from high VPD endemic countries. Challenges remain due to missed opportunities of vaccination, vaccine underutilization and lower immunization rates among selected immigrants groups in Canada [13,14]. Furthermore, it is not known whether under-vaccination is equally distributed by landing cohort, and/or across immigrant categories (e.g. economic class, family class, refugees) and sub-categories.

The aim of this study is to use two linked datasets with immigration information to evaluate if there are differences in VPD-related hospitalization among immigrants compared with the Canadian-born population at the national level by immigrant status, landing cohort, world region and immigrant category. To our knowledge, this is the first national study of immigrant status and hospitalization of infectious disease.

## 2. Data and methods

### 2.1. Data sources

Statistics Canada has recently linked large-scale health administrative databases that allow researchers to evaluate hospital use by immigrant characteristics [15,16]. Two of these data linkages are based on the 2006 Census long form and then the Immigrant Landing File (ILF) from 1980 to 2006, both of which have been separately linked to hospital data at the national level. The data linkages result in two new databases that enable us to estimate hospitalization rate by immigrant related characteristics, compared to that for the Canadian-born reference population.

#### 2.1.1. 2006 Census–Discharge Abstract Database (DAD). linked data

First, the 2006 Census (long form) was linked to the Discharge Abstract Database (DAD). The long form census represents approximately 20% of the non-institutional population in Canada and provides information on immigrant status, including place of birth and period of arrival of immigrants (but no information on immigrant category, such as refugees and economic class immigrants). The DAD includes all acute care hospital discharges from all public hospitals in Canada (excluding Quebec), provided to Statistics Canada by the Canadian Institute for Health Information (CIHI) [17]. The DAD contains demographic, administrative and clinical data with approximately 3 million hospital records annually occurring between April 1 to March 31 (fiscal year). Approximately 4.6 million census long form respondents (excluding Quebec) were linked to the DAD for three fiscal years from 2006/07 to 2008/09, by a hierarchical deterministic linkage using birthdate, sex, and residential postal code. Results of a validation study of the linked data concluded that the linked file is suitable for health-related research and is broadly representative of immigrants. Additional information regarding the linkage is reported elsewhere [15]. For the purposes of this study, the 2006 Census–DAD linked database is used to report on VPD-related hospitalizations among immigrants compared with non-immigrants.

#### 2.1.2. Immigrant Landing File (ILF)–DAD linked data

Second, the Immigrant Landing File (ILF) is a national database provided by Immigration, Refugees and Citizenship Canada (IRCC) (formerly Citizenship and Immigration Canada) to Statistics Canada. It is a registry of all immigrants entering Canada since 1980 with comprehensive information including timing of entry, source country and category (i.e. economic immigrants, family class, and refugees) [18]. The ILF–DAD linkage was done based on a deterministic exact matching process using the 2006 Census as a “bridge” file; this was possible as the 2006 Census was previously linked to the ILF and to the DAD (2006–2008) in two previous link-

age projects [15,19]. The ILF–DAD was composed of 2,594,600 ILF records linked to about 359,400 hospital discharges. Details of linkage are available elsewhere [20]. Here, the ILF–DAD linked data are used to report on VPD-related hospitalization by immigrant categories for those immigrants entering Canada on or after 1980.

Both linkages were approved by the Statistics Canada’s Executive Management Board at Statistics Canada [21]. Use of these linked data is governed by the *Directive on Record Linkage* [22].

### 2.2. Variables of interest

According to 2006 Census, a landed immigrant is a person who is not a Canadian citizen by birth, but who has been granted the right to live in Canada permanently by Canadian immigration authorities [23]. Landing year was based on year of landing reported in the Census. Landing cohorts are defined as by landing years as follows: before 1980 (established), 1980 through 1989 (medium-term), and 1990 through 2006 (recent). While such categorization was mainly of methodological convenience, those landing before 1980 were more likely to be from the West. World regions were classified from the birth place information in the ILF with the following groupings: United States, Caribbean/Central and South America, Western Europe, Eastern Europe, Sub-Saharan Africa, North Africa/Middle East/West Asia, South Asia, South East Asia, East Asia, and Oceania [24].

According to the ILF, the main categories of entry to Canada considered by IRCC were as follows: economic immigrants (selected for their potential contribution to Canada’s economy), family class (sponsored by family members or close relatives for family reunion purpose), and refugees (in Canada or abroad for humanitarian purpose) [9]. An additional “others” category was used in this analysis defined as certain foreign nationals admitted under humanitarian and compassionate ground, but not qualify in any class. Economic immigrants were further divided into principal applicants and dependants (spouse or child), while refugees were sub-divided into the following three sub-categories: those assisted by the Canadian government (GARs); those sponsored by a private sponsorship group in Canada (PSRs); or those who landed in Canada (refugee claimants), as well as dependants of all of the above refugee sub-categories.

Age was classified first as those aged 0–6, 7–17, 18–39, 40–64 and 65 and over, reflecting the vaccination schedule from a life-cycle perspective. Due to rarity of VPD in Canada, age was further re-grouped for age standardization and for presentation as follows: 0–17, 18–64 and 65 and over.

### 2.3. Outcome measures

The primary outcome is inpatient acute-care VPD-related hospitalizations occurring between April 1, 2006 and March 31, 2009. Hospitalizations were defined as being VPD-related if any one of the 25 diagnosis fields in the DAD discharge record included an ICD-10 diagnosis code for the following: Tetanus (A33), Diphtheria (A36), Pertussis (Whooping Cough) (A37), Sepsis due to Haemophilus influenza (A41.3), Acute Poliomyelitis (A80), Varicella (B01), Zoster (B02), Measles (B05), Rubella (B06), Mumps (B26), Chronic Hepatitis B (B18.0, B18.1, B19.1), and Meningococcal (A39) and Pneumococcal (G00.1) infections. Only the first VPD diagnosis was used for those records with multiple VPD codes.

### 2.4. Statistical methods

Descriptive statistics are provided to profile Canadian-born and the overall immigrant populations from the 2006 Census and the overall recent immigrants from ILF. Crude and age-standardized hospitalization rates (ASHR) were derived using the

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