Estimating the burden of serious fungal diseases in Canada

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Introduction
Serious fungal diseases represent a growing health concern worldwide. The global burden of these infections in Canada is unknown. In this study, we sought to estimate the national incidence and prevalence of serious fungal diseases in Canada.

Methods
We aggregated data derived from various sources:
- A literature review was conducted in PubMed to identify published reports on local epidemiology.
- Data on notifiable fungal diseases were obtained directly from national and provincial public health agencies.
- When no local data was available on a specific fungal disease, relevant at-risk populations were used to estimate frequencies, using previously described methodology by LIFE. Population data were obtained from Statistics Canada, Canadian scientific organizations, as well as The Organization for Economic Co-operation and Development (OECD) and the World Health Organization (WHO).

Conclusions
The present study indicates that around 2% of the Canadian population may be affected by a serious fungal infection.
- Nearly 3000 cases of invasive fungal infections are expected to occur annually in Canada.
- Despite the high estimated burden, there is a paucity of epidemiological data on mycoses in Canada. Further epidemiological studies are needed to validate and extend these estimates.

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Canadian population was 35,546,419 in 2014 with 50.4% female. Median age was 46.4 years old and 80.5% of the population was over 18 [1].

Invasive fungal infections (Figure 1):
- Invasive candidiasis (IC) annual incidence was estimated at 1,983 cases (candidemia, n=1,724; peritonitis, n=259), based on published incidence data [2] applied to the Canadian population, corroborated by local data for the Province of Quebec [3].
- Invasive aspergillosis (IA) annual incidence was estimated at 659 cases, based on at-risk population estimates [4-6]. Recently published data on local incidence among acute leukemia patients supports these estimates [7]. A total of approximately 59,514 hospital admissions for chronic obstructive pulmonary disease (COPD) [8] account for 214 of IA cases [9].
- Cryptococcal disease incidence was estimated at 64 cases per year. Investigators have found 81 cases during a 2-year period in 1992-1994 [10], prior to the C. gattii outbreak [11]. Between 2010 and 2013, a mean of 23 cases of C. gattii infections were notified annually to the British Columbia CDC [12]. Specifically, cryptococcal meningitis was estimated to occur in 12 AIDS patients annually, representing 6% [13] of 209 new AIDS cases in Canada [14]. Data derived from the TRANSNET study [15] translated to 6 cases among Canadian solid organ transplant recipients.
- Pneumocystis pneumonia (PCP) was estimated to occur in 34 AIDS patients annually, representing 17% [13] of 200 new AIDS cases in Canada [14]. Considering that approximately 50% of PCP cases occur in HIV-negative patients [16], we estimated a total number of 68 cases.
- No data was available for mucormycosis, but an incidence of 43 cases was inferred from a 0.12/100,000 incidence reported in the literature [17].

Endemic mycoses (Figure 2):
- Blastomycosis is endemic in Ontario, Quebec and Manitoba. In the former 2 provinces, a mean of 44 culture-proven cases occur annually, as per recently published data [18, 19]. In the latter province where the infection is notifiable, 19 cases were reported in 2013 [20], for a national incidence of at least 63 cases.
- Histoplasmosis incidence was estimated at 27 cases per year based published data from 1992-1994 in Canada [10].
- Coccioidiomycosis incidence was limited to 9 cases annually [10].

Noninvasive pulmonary aspergillosis (Figure 3):
- Chronic pulmonary aspergillosis (CPA) prevalence was estimated at 1,214 cases, including 227 cases following tuberculosis [21-23].
- Allergic bronchopulmonary aspergillosis (ABPA) prevalence was estimated at 61,120 cases, derived from the number of Canadian adults with asthma estimated at 6,444,904 [24, 25].
- Severe asthma with fungal sensitization (SAFs) prevalence was estimated at 80,679 cases, based on Canadian asthma prevalence data [24, 25].
- There is likely some duplication between ABPA and SAFS depending on the severity of asthma in ABPA and the relative frequency of Aspergillus sensitization in SAFS.

Mucoal candidiasis (Figure 4):
- Recurrent oropharyngeal candidiasis (RVC) was the most frequent serious fungal infection with an estimated prevalence of 498,689 cases, representing 6% [26] of adult women (between 15 and 50 years old) [8,13,47] [1].
- Oropharyngeal candidiasis (OPA) prevalence was estimated at 26,110 cases, representing approximately 90% of untreated HIV-positive patients. There were 71,300 HIV-positive patients in 2013 in Canada, among which 59% received antiretroviral treatment [14, 27, 28].
- Orophagial candidiasis (EC) prevalence was estimated at 7,950 cases, representing approximately 20% of untreated HIV-positive patients [14, 28-30].