

Burden of serious fungal infections in the Czech Republic

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Summary

We have estimated the number of serious fungal infections in the Czech Republic. All published epidemiology papers reporting Czech fungal infection rates were identified. Where no data existed, we used specific populations at risk and fungal infection frequencies in those populations. Population statistics were obtained from the 2011 Census data, prevalence and incidence data for at-risk conditions were obtained from publicly accessible healthcare statistics and relevant surveys. We estimate that 152 840 Czech women suffer with recurrent vaginal thrush. Allergic bronchopulmonary aspergillosis is likely in 4739 adults and 6581 more have severe asthma with fungal sensitisation. Hypersensitivity pneumonitis secondary to fungi is estimated in 1050 cases and 365 people may have chronic pulmonary aspergillosis. Oesophageal candidiasis is estimated in 210 HIV-positive people. There are 12 cases of *Pneumocystis* pneumonia in HIV population and 60 more cases in non-HIV population. There are an estimated 526 cases of candidaemia, 79 cases of *Candida* peritonitis and 297 cases of invasive aspergillosis a year. About 176 000 (1.67%) Czech people suffer from severe fungal infections each year, predominantly from recurrent vaginitis and allergic respiratory conditions. Substantial uncertainty surrounds these estimates except for invasive aspergillosis in haematology and candidaemia in critical care.

Key words: Czech Republic, disease burden, epidemiology, fungal infections.

Introduction

Fungal infections have been a plague to the weak and underprivileged for ages. It was a Czech pathologist Jirovec who first identified *Pneumocystis jirovecii* as the pathogen responsible for interstitial plasmocytic pneumonia, the historical clinical term for *Pneumocystis*

pneumonia (PCP) in a case series of preterm infant deaths in 1950s in the Czech Republic.¹ The pandemic of HIV/AIDS has made its entrée with PCP being 'the opportunistic infection of AIDS' after a new syndrome of immune system dysfunction was first reported in 1981.² Chronic pulmonary aspergillosis (CPA) and/or aspergilloma in cavitary pulmonary disease take its toll in both mortality and disability as a complication of survivors of pulmonary tuberculosis and other pulmonary conditions. In recent decades, with advent of more invasive and more immunosuppressive life-saving therapies, opportunistic fungal infections entered the stage. Invasive mould infections have become prominent killers in cancer and transplant patients while yeast contribute to death of surgical and critical care patients. In those with chronic airway diseases, fungal sensitisation is newly recognised as a significant

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contributor to asthma severity and worse lung function in chronic obstructive pulmonary disease (COPD) and cystic fibrosis patients. Both corticosteroids and artificial ventilation of severe COPD may precede fatal invasive aspergillosis in those who should otherwise benefit from supportive respiratory interventions. Recurrent vaginal thrush and oropharyngeal/oesophageal candidiasis along with tinea corporis or capitis are not lethal, though debilitating recurrent conditions with defined significant burden on quality of life due to its high prevalence and recurring pattern.³

All these scenarios combined cry out for better awareness, better understanding, better diagnostics and better therapies, with better accessibility of currently available therapies. The first step to accomplish this is to obtain a perspective of the total burden of fungal infections, so that discussions concerning improved management of fungal infections with key groups of stakeholders in healthcare may be based on best available data. Unfortunately, there is much unknown about the incidence and prevalence of serious fungal infections worldwide as many go undiagnosed or unreported and prevalence literature data are scarce. Hence, the Global Action Fund for Fungal Infections (GAFFI, www.gaffi.org) and the Leading International Fungal Education (LIFE, <http://life-worldwide.org>) have attempted to estimate the global burden of fungal infections globally and this work is the first attempt to review and estimate the fungal burden in the Czech Republic.⁴

Methods

All published epidemiology papers reporting Czech fungal infection rates were identified.^{5–12} In other conditions, where no data existed, we used specific populations at risk and fungal infection frequencies in those populations to estimate national incidence or prevalence, depending on the condition.

Population statistics, including the number of women aged between 14 and 55 years of age, were obtained from the 2011 Census data.¹³ Numbers of fungal skin infections have been obtained from three sources. The first one was voluntary notifications of culture-positive cases obtained from the State Institute for Public Health statistics.¹⁴ Second source was a multicentre longitudinal genotyping study collecting *Dermatophytes*-positive cultures from six regional centres.¹⁰ The third source for estimated prevalence of skin fungal infections was an extrapolation from a published global estimate.³ A 6% discounted rate of recurrent vulvovaginal candidiasis in females over

15 years of age was used to accommodate for possible over-reporting of any genital discharge or irritation as 'thrush'. The 6% rate was conservative estimate based on two thirds of a 9% prevalence recently reported in European population survey¹⁵ where 'recurrent' was defined as four and more episodes per year.

The 2012 HIV/AIDS statistics were obtained from the State Institute of Public Health¹⁶ reports of notified cases along with WHO numbers of patients in the Czech Republic on antiretroviral treatment.¹⁷ The ratio of those affected with oral or oesophageal candidiasis was obtained from Danish and US population estimates, where those off antiretroviral treatment (ARV) experience oral and oesophageal candidiasis in 90% and 20%, respectively, while those on ARV, 5% develop oesophageal candidiasis.^{18,19}

We have obtained the estimates of occurrence of cryptococcal meningitis from the largest HIV centre that serves about half of the Czech HIV-positive population (Personal communication, Dr Hanuš Rozsypal, Nemocnice Na Bulovce, Prague).

The proportion of *Pneumocystis* pneumonia (PCP) in all AIDS cases was estimated to be 40% based on the proportion of opportunistic infections in AIDS populations.²⁰

The numbers of PCP cases in both HIV and non-HIV immunosuppressed population were obtained from the internal registry of the Laboratory of Parasitology at the Department of Tropical and Infectious Diseases in Prague. These data reflect only the catchment area of this Prague-based hospital in time period 2002–2012. As no other data were available, the nationwide HIV/non-HIV ratio based on the Prague cohort was estimated to be 1:5.⁷

We have estimated that 70% of patients registered in a specialised respiratory clinic use inhaled corticosteroids (ICS) for airway disease. Up to 70% of those who do not rinse after inhaling are reported to have oral candidiasis, however, of those who do rinse, it is estimated that 6% suffer with this side effect.^{21,22} In our estimates, we have assumed that all patients using ICS in long term do rinse.

We have neither found official record or studies on prevalence of oral candidiasis in patients with cancer or after transplant nor the number of patients, who are denture wearers as these are other conditions commonly associated with oral candidiasis. The same applies to people living with diabetes mellitus.

The number of pulmonary tuberculosis (PTB) cases²³ were obtained from the Czech Institute of Health Information and Statistics (IHIS) and using the approach taken by Denning *et al.* [24] in their global

estimates, where the number of annual PTB cases with cavities (12%) was multiplied by the incidence of CPA in cavities (22%) and the number of PTB cases without cavities (88%) was multiplied by CPA incidence (2%). The 5-year point prevalence of chronic pulmonary aspergillosis (CPA) was estimated based on previously estimated incidence rate using a 3.152 index.²⁴

The number of sarcoidosis cases was derived from the IHIS 2012 Annual Report¹³ for patients registered with respiratory physician with ICD-10 diagnosis code D86.0 and D86.2 (sarcoidosis of lung and sarcoidosis of lung with sarcoidosis of lymph nodes, respectively). The estimates for proportion of those with sarcoidosis having CPA was derived from the global estimates of prevalence of CPA in sarcoidosis, namely 6%. The same paper provided another estimate of country-specific prevalence.²⁵

The number of asthma in adults was calculated using three different prevalence estimates for asthma. The first source was the World Health Survey (WHS) estimates for clinical asthma.²⁶ The second source was the Organisation for Economic Co-operation and Development (OECD) self-reported asthma prevalence survey.²⁷ The third source were the data from 2012 Annual Report of the Czech Institute of Health Information and Statistics, page 89, which lists the numbers of patients registered with a respiratory physician practice for the diagnoses of asthma codes J45 and J46 in the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10).²⁸ The paediatric population with asthma was not considered as ABPA and fungal sensitisation are very uncommon in children.

The prevalence of ABPA complicating asthma has been estimated elsewhere using scoping review methodology and found 2.5% (range 0.7–3.5%).²⁹ The prevalence of severe asthma is 10% in total asthma population and the prevalence of fungal sensitisation is ranging from 30% to 40%.³⁰

The numbers of chronic obstructive pulmonary disease (COPD) cases in 2012 were derived using two sources, namely reports from the Institute of Health Information and Statistics¹³ using the ICD-10 diagnostic codes J42, J44, J43 (COPD) and chronic bronchitis code J41,²⁸ along with country-specific estimates from the OECD.²⁷ The number of COPD admissions was also obtained from the IHIS report.³¹ As the invasive aspergillosis (IA) in intensive care are mainly in COPD cases, the total number of COPD admissions was obtained from IHIS data, and the rate of IA in COPD admissions was used to be 1.3% as

extrapolated from a Spanish study.³² The number of critical beds was derived from the 2011 Health Statistics report.³³

Cases of hypersensitivity pneumonitis (HP) are caused by late sensitisation to moulds (not only thermophilic *Actinomyces*, *Thermopolyspora faeni*, *Aspergillus* species, but also *Candida* species). Epidemiological data can be only estimated because the IHIS statistical data list its prevalence together with all interstitial lung fibroses (ILF).¹³ For this article, we consider in accordance with ILF/HP ratio in the Thomayer University Hospital Respiratory Clinic cohort that one half of this group was HP and one third of HP is triggered by fungi [unpublished data, personal communication, Prof Martina Vašáková].

The numbers of transplant cases were obtained from the Czech Transplant Coordination Centre,³⁴ the incidence of invasive aspergillosis (IA) was obtained from published epidemiological studies. From these studies we derived the occurrence of IA in 10% acute myeloid leukaemia patients, 10% in bone marrow transplants, 6% in heart, 4% lung and liver and 1% in kidney transplants.³⁵

The number of cystic fibrosis cases was obtained from the European Cystic Fibrosis Society.³⁶ The rate of CPA, ABPA and AB in cystic fibrosis was obtained from Armstead *et al.* [37]

Incidence of haematological diseases in 2010 was obtained from the IHIS Cancer Registry.³⁸ The Czech epidemiological studies were used to supply data from specific haematological populations.^{8,9}

The number of haematological patients with mucormycosis was estimated from two single centre experiences.^{11,12}

The candidaemia rates were estimated based on Europe reported prevalence 5/100 000 (range 2–12/100 000), of which 1.5/100 000 were estimated in the critical care population and 3.5/100 000 in other hospitalised patients, usually immunocompromised.³⁹ We have also found an epidemiological study of candidaemia cases from nine Czech teaching hospitals,⁵ and invasive candidiasis from haematology units in six Czech and Slovak teaching hospitals.⁶ The cases of *Candida* peritonitis were estimated as the proportion of candidaemia cases in ICU, while there was one case of peritonitis per every two cases of candidaemia.⁴⁰ The number of abdominal surgeries was obtained from the IHIS.³³

As there are no endemic mycoses in the Czech territory, we have not estimated this number.

All calculations were performed in Excel 2013 for Windows (Microsoft, Redmond, Washington, USA).

Ethics clearance was not required, as the study does not involve any human subjects and uses only publicly accessible data.

Results

The Czech Republic is a country of 10.5 million population located in the moderate climate of central Europe. It is a middle to high income country (gross domestic product USD 19 845 per person in 2013) with a low prevalence of tuberculosis and HIV/AIDS, and a developed healthcare system with state-subsidised mandatory medical insurance enabling access to medical care for all residents.

Skin and mucosal fungal infections

There have been 637 cases of tinea capitis and/or corporis notified (ICD-10 code B35) to the national statistics, but this may be grossly underrepresented, as this is not a notifiable disease.¹⁴ There have been 3235 isolates of *Dermatophytes*-positive cultures collected in a 24-month study involving six-regional centres, of which fungi were cultured in 946 cases of tinea corporis and 24 cases of tinea capitis.¹⁰ Thus, there are annually at least 480 culture-positive cases of tinea corporis and/or capitis in a catchment area of less than half of the Czech population. That would extrapolate to at least 960 culture-positive cases in the Czech Republic. When the global estimate was used, which reports 14.3% of population worldwide affected with fungal skin diseases,³ this would make 1.5 million people affected with fungal skin infection every year.

In the 10.5 million population, 85% were adults, 15% were children below 14 years. There were 4.6 million women over 15 years of age, of whom 45% are over 50 years of age. With fungal disease burden estimates of 6% among the women over 15 years of age, there were 152 840 Czech women getting recurrent vaginal thrush.¹⁵

HIV

There were 1691 people known to be living with HIV in the Czech Republic in 2012. Of those, 760 were receiving ARVs. Oral candidiasis is estimated to occur in 773 cases and oesophageal candidiasis in 210 cases in this population. There are only sporadic individual cases of cryptococcal meningitis and maximum one case per year diagnosed in the largest HIV/AIDS centre in the Czech Republic.

PCP

There were 30 AIDS cases reported in 2012. With the estimate of 40% AIDS case defining illness being PCP, this implies 12 cases of PCP annually. The Prague Na Bulovce Hospital Laboratory has detected 24 PCP cases in HIV and 123 cases in non-HIV population over 10 years interval. The number of PCP cases in non-HIV immunosuppressed population is estimated at 60 cases, a total of about 72 cases of PCP annually.

Pulmonary tuberculosis

Of the 552 cases of pulmonary tuberculosis in 2012, we estimate²⁴ that 23 new cases of chronic pulmonary aspergillosis (CPA) developed and the estimated 5-year period prevalence was 73 cases. The incidence rate of pulmonary tuberculosis is lower than the European average, so by us used a 20% proportion of post TB CPA among all cases of CPA is probably underestimate, however, if used, this would result in at least 365 cases of CPA.

Sarcoid

The IHIS reports the diagnosis of pulmonary sarcoidosis (with or without lymph node involvement) in 8843 cases, with prevalence rate as high as 84/100 000. Most of these patients do not have cavitating or fibrocystic disease though. On the other side, other literature reports a prevalence rate for the Czech Republic to be 3.4/100 000, which would result in only 357 cases of sarcoidosis in the country.²⁵ There are over 150 sarcoid patients in the Thomayer Hospital Department of Respiratory Medicine from the catchment area of approximately 700 000 population (estimated prevalence over 20/100 000), and cavitating disease in this cohort has been extremely rare and pulmonary aspergillosis has not been diagnosed so far in a single patient (personal communication, Prof Martina Vašáková, Thomayer University Hospital, Prague). However, with estimated 6% prevalence of CPA in sarcoid used in global estimates,²⁵ there could be between 21 and 531 cases of CPA in this population.

Asthma

The number of adult patients registered in a respiratory specialist practice was found to be 188 030 (prevalence 1788 per 100 000, 2.1% of the adult population). Reported adult asthma prevalence for the Czech Republic stated in other global estimates is 4% (357 000

cases according to OECD) and 4.56% (420 367 according to World Health Survey), respectively.

Given these estimates, in this population, there are likely 1316–14 712 (Best guess 4701) patients with allergic bronchopulmonary aspergillosis (ABPA)²⁹ and 5641–16 814 more people (Best guess 6581) having severe asthma with fungal sensitisation (SAFS).³⁰ Based on 70% asthma patients in respiratory practice using ICS and 6% of them having oral candidiasis, there are estimated 7558 ICS users who have oral candidiasis^{21,22} (Table 1).

COPD

IA in critical care is mainly attributed to COPD. The total numbers of patients with COPD of all GOLD stages obtained from the Annual Report of patients registered and followed up by a respiratory specialist in 2012 was 263 753 in 2012.²³ The OECD self-reported COPD prevalence was 2.7%, which would correspond to 241 755 people living with COPD. As there were 15 826 COPD admissions in 2012, and given that 1.3% of COPD admissions have or develop IA, based on Spanish data,³² this would result in 206 cases of IA in COPD, predominantly in intensive care.

Hypersensitivity pneumonitis

The estimated prevalence of all HPs (caused by all sources of organic dusts and haptens) is 30/100 000

Table 1 Estimates of oral candidiasis/ABPA/SAFS cases according to IHIS/OECD/WHS.^{26–28}

	IHIS data	OECD estimate	WHS estimate
	2.1%	4.0%	4.71%
Asthma prevalence in adults	188 030	357 000	420 367
Oropharyngeal candidiasis in ICS with estimated 6% prevalence	7558		
ABPA prevalence			
0.7%	1316	2499	2942
2.5%	4701	8925	10 509
3.5%	6581	12 495	14 712
SAFS prevalence 30–40% of most severe 10%			
3%	5641	10 710	12 611
3.5%	6581	12 495	14 712
4%	7521	14 280	16 814

ABPA, allergic bronchopulmonary aspergillosis; SAFS, severe asthma with fungal sensitisation; ICS, inhaled corticosteroids; IHIS, Czech Institute of Health Information and Statistics; OECD, Organisation for Economic Co-operation and Development; WHS, World Health Survey. The bold values indicate minimum, best, and maximum estimates, respectively.

inhabitants. From this count, we postulate that about 33% is caused by moulds. Therefore, it is estimated that there are 1050 people living with fungi-triggered hypersensitivity pneumonitis.

Cystic fibrosis

In the Czech Republic, 216 adult patients with cystic fibrosis are reported. The estimates for *Aspergillus*-associated disease were 38 (95% CI: 26–54) having ABPA, 32 (95% CI: 21–47) have *Aspergillus* sensitisation, and 65 (95% CI: 49–83) would have *Aspergillus* bronchitis. There were also 16 children reported to have ABPA, which is 5.5% of all children with cystic fibrosis.³⁷

Invasive aspergillosis

There have been a total of 256 probable and 58 proven IA cases reported in 2001–2011 in 10 Czech haematology centres⁹ which corresponds to 30 cases of IA per year. There were 12 proven and 20 probable IA in children in four haematology centres in 2002–2012, which contributes three more cases per year.⁸

In 2012, 344 allogeneic stem cell transplants³¹ and 651 solid organ transplantation procedures were done.³⁸ Our estimate is 48 cases of IA in these transplant patients (Table 2). Much higher rates of colonisation and bronchitis in lung transplant, as well as less frequent solid organ transplants have been ignored. Apart from that there were 429 patients with acute myeloid leukaemia³⁸ with estimated IA incidence rate 10%, which would result in 43 cases of IA. Invasive aspergillosis in immunocompromised patients is therefore estimated at 297 patients annually,^{8,9} including 206 COPD cases in critical care.^{31,38} Smaller number of IA cases occur in other immunocompromised patients.

There have been nine cases of mucormycosis in a single centre in 2009–2012¹¹ and another paediatric haemato-oncology centre reports eight cases of

Table 2 Invasive aspergillosis in transplant population.^{34,38}

Transplant type	2012 transplants (n)	IA in subgroup (n)
Allogeneic HSCT	344	34
Renal Tx	432	4
Lung Tx	20	1
Heart Tx	73	4
Liver Tx	114	5
Total	983	48

HSCT, haematopoietic stem cell transplant; IA, invasive aspergillosis; Tx, transplant.

mucormycosis in 2005–2010, in a cohort of 399 haematological patients. This makes mucormycosis occur in 1.7% of all haematological patients in this centre, 20% of all invasive fungal infections.¹² Hence we estimate that there is one case of mucormycosis per four cases of invasive aspergillosis in haematological patients.

Candidaemia

In an 18-month epidemiological study in six Czech and Slovak haematology units there were 63 isolates of *Candida* in blood cultures from 61 patients.⁶ In one multicentre longitudinal study of candidaemia,⁵ there were total 2426 candidaemic blood cultures from 1158 patients, mostly from medical ICU, followed by surgical ICU, resuscitation wards and haematology wards. The annual number of candidaemia cases in these nine hospitals grew from 119 in 2000 to 189 in 2006, an increase in 59%. Unfortunately we do not have a population denominator for this study. In Europe, the rate of candidaemia is estimated to 5/100 000 population (ranging from 2 to 11 per 100 000),³⁹ which would be consistent with 526 cases, 158 in critical care and 368 in other hospitalised patients. There are an estimated 79 cases of *Candida* peritonitis among more than 70 000 abdominal surgeries a year,³³ mostly related to perforation.

Discussion

No fungal disease is notifiable in the Czech Republic and current epidemiology papers are few. There are only limited activities for surveillance of fungal diseases in the country. Therefore, we rely largely on crude estimates of incidence and prevalence extrapolated from other countries and populations. These estimates resemble calculations by Fermi (Enrico Fermi, 1901–1954, Nobel Prize winner in physics in 1938). Fermi's assumptions generally provide rough estimates, within the range of one log.⁴¹ In this light, even the large range of estimates in case of ABPA or SAFS fall within the one-log range and therefore may be used as a benchmark to be validated or modified in future studies. However, we could comfortably say that PCP and *Candida* peritonitis occur in dozens, IA, CPA, oesophageal candidiasis and candidaemia in hundreds, ABPA and SAFS in thousands and recurrent vulvovaginal candidiasis in hundred thousands of affected patients annually (Table 3).

There is a large uncertainty concerning oral candidiasis as some of the largest populations at risk could not be assessed. We have neither estimated the

numbers for oral candidiasis in other immunosuppressed patients nor have attempted to look into oral candidiasis in denture wearers, although given the size of these populations relative to a rather small HIV population in the Czech Republic, even with a small proportion of those affected, these cases might significantly multiply our estimates.

The number of sarcoidosis patients in the national statistics is probably overestimated as patients once diagnosed with sarcoidosis remain in life-long care of respiratory clinics and the cumulative number may not properly describe the real burden of active disease. On the other side, cavitating disease is extremely rarely seen by respiratory physicians. Hence the contribution of sarcoidosis to the total of CPA cases remains very uncertain.

In asthma, the lower number of cases registered with respiratory specialist compared to country estimates may reflect the milder cases managed by allergologists/family doctors/general practitioners or cases not treated.

In case of immunosuppressed population, we have not considered other medical conditions known to be associated with invasive fungal infections, such as acute-on-chronic liver failure with reported 5% incidence of IA⁴² or burn injury with reported 6–15% prevalence of significant fungal infection⁴³ as there are no data of prevalence of these underlying conditions.

The large uncertainties around sarcoidosis prevalence really calls for further epidemiological research and if possible, *Aspergillus* serology (both *Aspergillus*-specific IgG and IgE) should be included in the database and as a routine screening test promoted in this group of patients.

Another potential of improving scientific evidence of the burden of serious fungal infections is an educational campaign focusing on tertiary and secondary care physicians of the involved specialities, especially respiratory medicine and critical care. This would make accessible data from hospital cohorts, thus enabling a more precise estimate of real occurrence with known population denominator. These further studies may use the same methodology as we have seen in haematological malignancies and candidaemia cases by prospectively collecting data from multiple laboratories.

Extensive and so far untapped source of data could be the database of medical insurance claims containing ICD-10 codes, and medical insurance claims for reimbursement of antifungal medication, hopefully being able to couple the antifungals use with claimed

Infection	Number of infections per underlying disorder per year					Total burden	Rate /100 000
	None	HIV/AIDS	Respir.	Cancer/Tx	ICU		
Oral candidiasis	?	773	7558	?	?	8331	79
Oesophageal candidiasis	–	210	?	?	–	210	2.0
Candidaemia	–	–	–	368	158	526	5.0
Candida peritonitis	–	–	–	–	79	79	0.75
Recurrent vaginal candidiasis (4×/year)	152 840	–	–	–	–	152 840	3282 ¹
ABPA	–	–	4739 ²	–	–	4739	45
SAFS	–	–	6581 ³	–	–	6581	62
Hypersensitivity pneumonitis	–	–	1050	–	–	–	10
Chronic pulmonary aspergillosis	–	–	365 ⁴	–	–	365	3.5
Invasive aspergillosis	–	–	–	91	206	297	2.8
Mucormycosis	–	–	–	22	–	22	0.2
Cryptococcal meningitis	–	1	–	–	–	–	<0.1
Pneumocystis pneumonia	–	12	?	60	–	72	0.7
Tinea capitis/corporis	960	–	–	–	–	960	9
Total burden estimated	153 800	996	20 293	541	443	176 073 ⁵	

ABPA, allergic bronchopulmonary aspergillosis; SAFS, severe asthma with fungal sensitisation; Tx, transplantation; ICU, intensive care unit. The symbol “?” is used where significant number of cases with particular fungal infection are suspected but no data found to make our estimates.

¹Rate per 100 000 adult women.

²Best estimate, range 1316–14 712.

³Best estimate, range 5641–16 814.

⁴This is the lower estimate, the high estimate could be as much as 604.

⁵Skin fungal infections affecting up to 1.5 million not included.

ICD-10 coding. There might be, however, commercial or administrative barriers unknown to the authors as no research has been published using these databases. Another source of data for research might be antifungals sales from pharmaceutical distributors.

Conclusion

Using local data and literature estimates of the incidence or prevalence of fungal infections, about 176 000 (1.67%) of people in the Czech Republic suffer from severe fungal infections each year. These figures are dominated by recurrent vaginitis, followed by allergic respiratory conditions. Substantial uncertainty surrounds these estimates except for invasive aspergillosis in haematology^{8,9} and candidaemia in critical care,^{5,6} where population-based surveillance studies have been recently presented. Therefore,

epidemiological studies are urgently required to validate or modify these estimates.

Acknowledgments

None.

Conflict of Interest

AC, NM, MV and JH declare no conflict of interest. DWD holds Founder shares in F2G Ltd a University of Manchester spin-out antifungal discovery company, in Novocyt which markets the Myconostica real-time molecular assays and has current grant support from the National Institute of Allergy and Infectious Diseases, National Institute of Health Research, North-West Lung Centre Charity, Medical Research Council, Astellas and the Fungal Infection Trust. He acts as a

consultant to T2 Biosystems, GSK, Sigma Tau, Oxon Epidemiology and Pulmicort. In the last 3 years, he has been paid for talks on behalf of Astellas, Dynamiker, Gilead, Merck and Pfizer. He is also a member of the Infectious Disease Society of America Aspergillosis Guidelines and European Society for Clinical Microbiology and Infectious Diseases Aspergillosis Guidelines groups. He is also President of the Global Action Fund for Fungal Infections.

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