

**ABSTRACT**

**Background**

The incidence and prevalence of fungal infections (IFIs) in Mexico is unknown. We estimated the burden of IFIs in Mexico from published literature and modelling

**Methods**

There were few epidemiology papers reporting fungal infection rates from Mexico. A full literature search was done to identify all epidemiology papers reporting fungal infections in Mexico. In addition, some estimates were based on modelling. We extracted data from the WHO and PAHO annual reports, Mexican National Health and Statistics System. Other assumptions were based on incidence rates reported in the local and international literature. The denominator included the overall Mexican population, number of patients with HIV/AIDS, and overall Mexican women population.

**Results:**

Mexican total population in 2010 was 112, 336, 538, Mexican female population was 57, 481, 307. Prevalence of HIV was 156 cases per 100, 000 (burden 175, 244). Prevalence of asthma in Mexico is 2.4% (2,696, 077 individuals), whereas COPD prevalence is 7.8%. In addition, prevalence of tuberculosis is 33 cases per 100, 000 (burden 33, 700 cases). Local information was used to calculate the burden of histoplasmosis and cryptococcosis HIV population [473 (298-964) cases of HIV and histoplasmosis, whereas 117 cases (88-561) were calculated for cryptococcosis]. We used 2.5% rate of ABPA previously reported to calculate the ABPA burden among asthma individuals (67, 407 cases) and Invasive Aspergillosis (IA) burden among COPD patients was 113, 909 cases. Number of Hematopoietic Stem Cell Transplant recipients in Mexico allowed the calculation of IA burden in this population (N=9). CPA burden after tuberculosis cavity was 1,179-2594 cases. We used prior reported infectious keratitis prevalence (0.091%) to calculate burden of this (102,226 cases). Prevalence of fungal keratitis in Mexico is 7% (burden 7,155 cases). Recurrent vulvovaginal candidiasis burden was 2, 155, 549 cases. Importantly, the prevalence of coccidioidomycosis (skin test) reaches 93% in some states (in Coahuila state the burden is 2, 556, 003 cases using this method). **Conclusion:** IFIs prevalence in Mexico is still unknown. Additional research is needed to employ public health measures towards treatment and improving the reported data of IFIs.

**INTRODUCTION**

Fungal infections in Mexico include opportunistic infection in immunocompromised or critically ill patients, may affect the lungs in those with underlying pulmonary problems, or affect normal people, notably cutaneous infection and endemic mycoses. No attempt has been made to estimate the total burden of fungal infections in Mexico. We attempted this, mostly by identifying rates in underlying populations at risk.

**METHODS**

- Full literature search was done to identify all epidemiology papers reporting fungal infections in Mexico.
- Estimates were based on modelling.
- We extracted data from the WHO and PAHO annual reports, Mexican National Health and Statistics System.
- Other assumptions were based on incidence rates of IFIs reported in local and international literature.
- The denominator included the overall Mexican population, number of patients with HIV/AIDS, and overall Mexican female population.

**BURDEN OF INVASIVE MYCOSIS IN MEXICO**

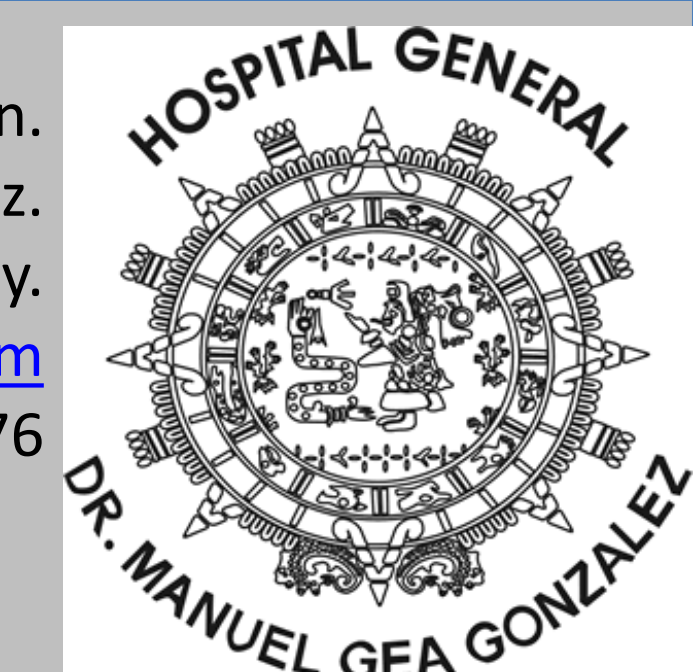
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**RESULTS**

Our results are shown in 4 tables and 1 figure. Table 1 shows the total populations and those of key underlying disease (HIV, transplant, COPD, TB and asthma). Table 2 shows the prevalence rates used to calculate burden. In most cases these are confirmed infections, which will probably under-estimate burden. Table 3 shows the estimated affected patients, and the rate per 100,000 population. In table 4 and figure 1 estimates of exposure and infection of endemic mycosis are shown.

**TABLE 1. POPULATIONS AND RATES REQUIRED TO CALCULATE BURDEN OF INVASIVE MYCOSIS IN MEXICO**

POPULATION	BURDEN	PREVALENCE
Total Mexican population in 2010	112,336,538	
Mexican Female population 2010	57,481,307	
COPD 2002	8,762,250	7.8% (5.9-9.7)
COPD GOLD III/IV	43,811/17,524	0.5/0.2
Asthma 2014	2,696,077	2.4%
HIV population 2013	175, 245	156/100,000
Tuberculosis 2013	37, 071	33/100,000
LEUKEMIA 2012	6325	5.6/100,000/yr
RENAL TRANSPLANT RECIPIENTS 2013	2707	
HSCT recipients 2010	11- 560	1-49/10, 000, 000/ yr
HSCT recipients 2012	382	34/10, 000,000/yr
LIVER TRANSPLANT RECIPIENTS 2013	149	
HEART TRANSPLANT RECIPIENTS 2013	44	

**TABLE 2. PREVALENCE RATES PREVIOUSLY REPORTED USED TO CALCULATE BURDEN OF INVASIVE MYCOSIS IN MEXICO**

DISEASE	PREVALENCE	DISEASE	PREVALENCE
ABPA	2.5% (0.7-3.5%)	PCP in HIV	14%
IA IN COPD	1.3%	Cryptococcosis meningitis in HIV	2.8-20%
IFIs in Leukemia	2.5-12%	Histoplasmosis in HIV	3.7-12.7%
IA leukemia	2.6-3.4%	Non Fungal Infectious keratitis	0.148%
IFIs in HSCT	3.4%	Infectious keratitis leading corneal blindness	0.091%
IA in HSCT	1.6%	Fungal Keratitis	7% (6.1-7.9%)
IFIs in renal and liver transplant	1.3-4.7%	Tuberculosis cavity in México	35%
IA in liver and renal transplant	0.7%	CPA in TB cavity	22%
Candidemia	0.005%	VVC	0.29%
Mucormycosis	1.2 cases per million.	rVVC	5-8%

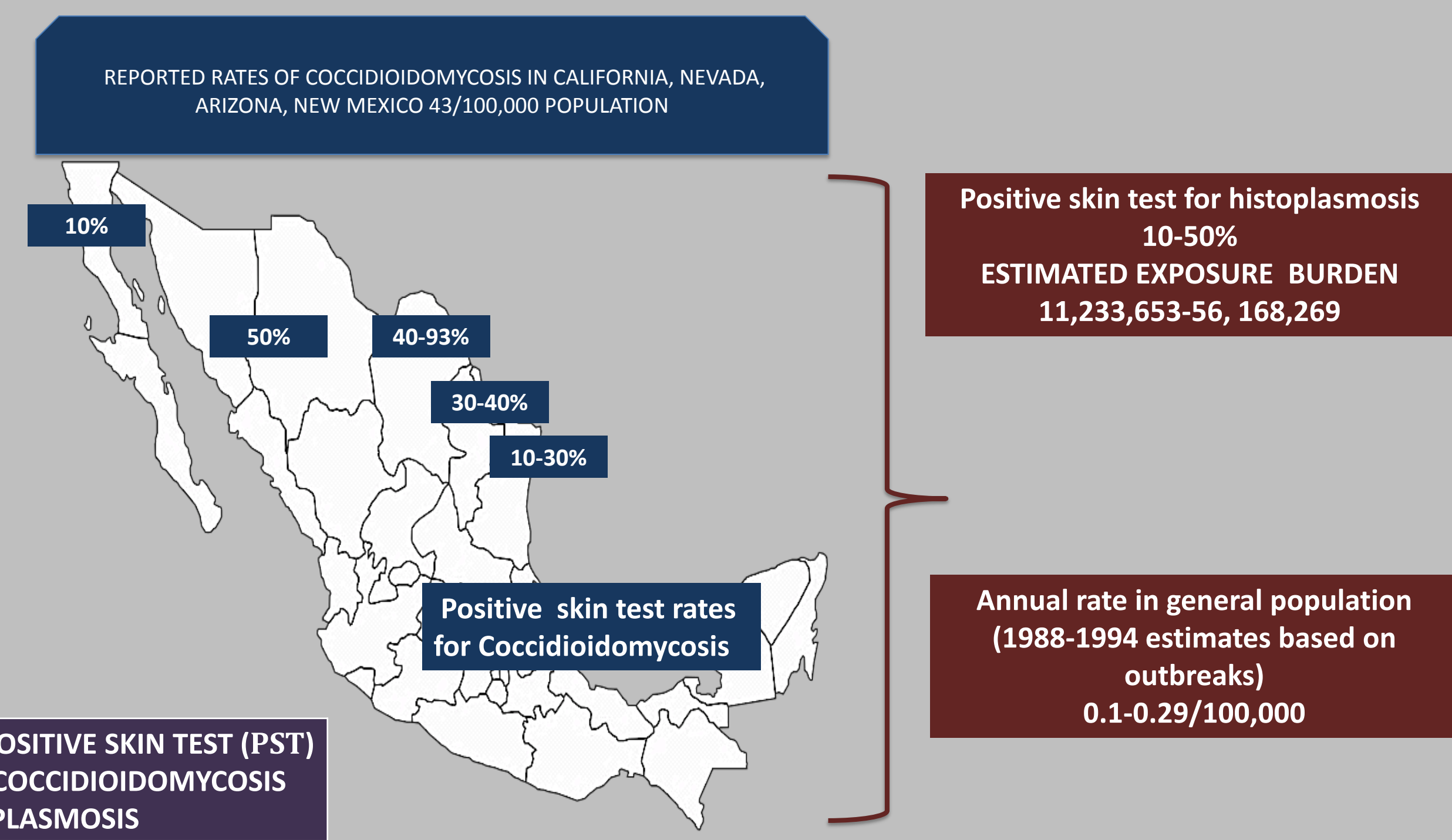
**TABLE 3. ESTIMATED AFFECTED INDIVIDUALS WITH INVASIVE MYCOSIS IN MEXICO**

INVASIVE MYCOSIS	BURDEN	RATE PER 100,000*
ABPA among asthma individuals	18,872-94,363	27
Non-fungal Infectious keratitis	166,258	148
Fungal keratitis	11,638	10.4
Fungal keratitis causing blindness	6,235-7,155	5.5-6.4
VVC (rate per 100, 000 women)	169,569	295
rVVC (rate per 100, 000 women)	8,478-13,565	14.7-23.6
Candidemia	5617	5
CPA after TB cavity	3,257	2.9
IA in COPD**	798	0.71
Histoplasmosis general population (estimates based in outbreaks)	112-325	0.1-0.29
Mucormycosis	134	0.12
INVASIVE MYCOSIS	BURDEN	RATE PER 1000***
Histoplasmosis in HIV**	6,484-22,256	37-127
Cryptococcosis in HIV**	4,906-35,049	28-200
PCP in HIV**	24,534	140
IFIs in Leukemia	158-759	25-120
IA in Leukemia	164-215	26-34
INVASIVE MYCOSIS	BURDEN	RATE PER 100#
IFIs in renal and liver transplant recipients #	42	1.5
IA in renal and liver transplant recipients #	20	0.7
IFIs in HSCT #	13	3
IA in HSCT #	6	1.6

ABPA: allergic bronchopulmonary aspergillosis. IA: Invasive aspergillosis, COPD: Chronic Obstructive Pulmonary Disease, TB: tuberculosis, CPA: Chronic Pulmonary Aspergillosis, IFI: Invasive Fungal Infection, HSCT: Hematopoietic Stem Cell Transplant. VVC: Vulvovaginal candidiasis, VVC: recurrent VVC.  
\*Rate per 100, 000 total Mexican population in 2010.= 112, 336, 538  
\*\*IA in COPD was calculated just for COPD individuals with GOLD III/IV, due to 100% of IA in this population has been documented among these groups.  
\*\*\* Rate per 1000 HIV individuals or leukemic patients.  
# Estimated per 100 solid and HSCT transplants.

ABPA: allergic bronchopulmonary aspergillosis. IA: Invasive aspergillosis, COPD: Chronic Obstructive Pulmonary Disease, TB: tuberculosis, CPA: Chronic Pulmonary Aspergillosis, IFI: Invasive Fungal Infection, HSCT: Hematopoietic Stem Cell Transplant. VVC: Vulvovaginal candidiasis, VVC: recurrent VVC.

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**FIGURE 1. POSITIVE SKIN TEST (PST) RATES FOR COCCIDIOIDOMYCOSIS AND HISTOPLASMOSIS**

**TABLE 4. EXPOSURE AND INFECTION DUE TO COCCIDIOIDOMYCOSIS**

STATE	TOTAL POPULATION	EXPOSURE BASED ON PST RATE	ESTIMATED BURDEN	ESTIMATES OF INFECTION*
Coahuila	2, 748,391	40-93%	1,099,356-2,556,003	1,181
Chihuahua	3,406,465	At least 50%	1,703,232	1, 464
Sonora	2,662,480	At least 50%	1,331,240	1, 144
Nuevo León	4,653,458	30-40%	1,396,037-1,861,383	2,000
Tamaulipas	3,268,554	10-30%	326,855- 980,566	1,405
Baja California	3,159,070	10%	315,907	1,358

\* BASED ON U.S ENDEMIC AREAS (43 PER 100,000 POPULATION)

**CONCLUSIONS**

- Histoplasmosis and cryptococcosis are common in AIDS, with 11,000-57,000 affected
- Nearly 25,000 cases of PCP in AIDS annually, and many more in non-HIV patients but not estimated.
- Over 11,000 patients with fungal keratitis (from 166,000 cases of infectious keratitis), with ~7,000 blind eyes annually
- Asthma in adults is less common than in other countries, but 67,000 affected by ABPA (range 19,000 – 94,000).
- Chronic pulmonary aspergillosis after TB probably affects ~3,000 patients, perhaps 50% of the total of CPA patients.
- Invasive aspergillosis probably affects ~1025 people each year, almost certainly an underestimate.
- The estimates of candidemia per year are 5,617 cases, most of these cases non-diagnosed.
- Recurrent VVC in women affects an estimated 10,000 women per year.

