OFFICE OF THE UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

PERSONNEL AND
READINESS

The Honorable Mike D. Rogers
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515

JUL 10 2024

Dear Mr. Chairman:

The Department's response to both House Report 118–125, page 218, accompanying H.R. 2670, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Impacts on Military," and Senate Report 118–58, pages 178-179, accompanying S. 2226, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Prevalence and Risk to Servicemembers," is enclosed.

Coccidioidomycosis is a reportable condition for which ongoing Department of Defense attention and resources are required to promote provider awareness, improve reporting, and limit the severity of the illness. Nine-hundred eighteen coccidioidomycosis cases were diagnosed among active duty Service members (ADSMs) in the U.S. military between 2007 and 2022. Over 60 percent of these cases were not captured as reportable medical events, signifying that case follow-up by installation public health authorities may not have occurred. Annual incidence rates among ADSMs fluctuated during the reporting period; in the last 4 years (2019-2022), incidence rates fell below the overall unadjusted incidence rate. Most cases occurred in coccidioidomycosis-endemic areas, such as Arizona and California. Among the 918 incident ADSM coccidioidomycosis cases, there were 180 total coccidioidomycosis-associated hospitalizations impacting 155 individual ADSMs. Among military working dogs (MWDs), there were 271 total laboratory tests representing 6 positive incident cases. There were no reported disruptions to training, deployment, or other activities for military or MWD units during the reporting period.

Thank you for your continued strong support for the health and well-being of our Service members. I am sending similar letters to the other congressional defense committees.

Sincerely,

[redacted]

Ashish S. Vazirani
Performing the Duties of the Under Secretary of
Defense for Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable Adam Smith
Ranking Member

[redacted]

OFFICE OF THE UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

PERSONNEL AND
READINESS

JUL 10 2024

The Honorable Jack Reed
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510

Dear Mr. Chairman:

The Department's response to both House Report 118–125, page 218, accompanying H.R. 2670, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Impacts on Military," and Senate Report 118–58, pages 178-179, accompanying S. 2226, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Prevalence and Risk to Servicemembers," is enclosed.

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Sincerely,

[redacted]

Ashish S. Vazirani
Performing the Duties of the Under Secretary of
Defense for Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable Roger F. Wicker
Ranking Member

[redacted]

OFFICE OF THE UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

PERSONNEL AND
READINESS

The Honorable Patty Murray
Chair
Committee on Appropriations
United States Senate
Washington, DC 20510

JUL 10 2024

Dear Madam Chair:

The Department's response to both House Report 118–125, page 218, accompanying H.R. 2670, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Impacts on Military," and Senate Report 118–58, pages 178-179, accompanying S. 2226, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Prevalence and Risk to Servicemembers," is enclosed.

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Sincerely,

[redacted]

Ashish S. Vazirani
Performing the Duties of the Under Secretary of
Defense for Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable Susan Collins
Vice Chair

[redacted]

OFFICE OF THE UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

PERSONNEL AND
READINESS

The Honorable Tom Cole
Chairman
Committee on Appropriations
U.S. House of Representatives
Washington, DC 20515

JUL 10 2024

Dear Mr. Chairman:

The Department's response to both House Report 118–125, page 218, accompanying H.R. 2670, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Impacts on Military," and Senate Report 118–58, pages 178-179, accompanying S. 2226, the National Defense Authorization Act for Fiscal Year 2024, "Valley Fever Prevalence and Risk to Servicemembers," is enclosed.

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Sincerely,

[redacted]

Ashish S. Vazirani
Performing the Duties of the Under Secretary of
Defense for Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable Rosa L. DeLauro
Ranking Member

[redacted]

Report to the Congressional Defense Committees

Valley Fever Impacts on Military

July 2024

The estimated cost of this report or study for the Department of Defense is approximately $51,000 in Fiscal Years 2023 and 2024. This includes $0 in expenses and $51,000 in DoD labor.

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TABLE OF CONTENTS

I: EXECUTIVE SUMMARY

This report is in response to both House Report 118–125, page 218, accompanying H.R. 2670, the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2024, "Valley Fever Impacts on Military," and Senate Report 118–58, pages 178-179, accompanying S. 2226, the NDAA for FY 2024, "Valley Fever Prevalence and Risk to Servicemembers," which both request a report on the impacts of Valley fever on the military. Coccidioidomycosis, also known as Valley fever, is a fungal infection required to be reported by Department of Defense Directive (DoDD) 6490.02E, "Comprehensive Health Surveillance," through the Disease Reporting System internet (DRSi) for human cases. Between 2007 and 2022, a total of 918 incident cases of coccidioidomycosis were diagnosed among active duty Service members (ADSMs), 335 (36.5 percent) of which were reported in DRSi, with 896 (97.6 percent) in the continental United States (CONUS). Cases were mostly reported from coccidioidomycosis-endemic areas, such as California (n = 387, 42.2 percent), Arizona (n = 280, 30.5 percent), and Texas (n = 60, 6.5 percent). Naval Base San Diego (n = 175, 19.1 percent), Naval Air Station Lemoore (n = 142, 15.5 percent), and Luke Air Force Base (n = 104, 11.3 percent) reported the greatest number of cases during the reporting period.

Over the 15-year reporting period, the unadjusted incidence rate of coccidioidomycosis was 4.3 per 100,000 ADSMs. Annual incidence rates fluctuated, with peaks observed in 2007 and 2010 (6.8 and 6.1 cases per 100,000 ADSMs, respectively), and rates falling below the overall unadjusted incidence rate in 2014-2017 and 2019-2022.

Coccidioidomycosis is typically diagnosed by taking a blood sample to look for *Coccidioides* antibodies or antigens. A suspected ADSM case often has at least two coccidioidomycosis laboratory tests; however, the number of tests ordered can vary for a variety of clinical and administrative reasons. In 2007-2022, 24,486 coccidioidomycosis laboratory tests were ordered at CONUS locations. Most of these laboratory tests were ordered in California (n = 12,309, 50.3 percent), Arizona (n = 6,360, 26.0 percent), and Texas (n = 2,072, 8.5 percent). A total of 8,477 ADSMs were tested for coccidioidomycosis in the reporting period. Laboratory tests were performed primarily in the endemic areas of California (n = 3,636, 42.9 percent), Arizona (n = 2,165, 25.5 percent), and Texas (n = 902, 10.6 percent). A total of 714 ADSMs had a positive coccidioidomycosis laboratory result in a CONUS location; these cases were concentrated in the endemic areas of California (n = 336, 47.1 percent), Arizona (n = 205, 28.7 percent), and Texas (n = 46, 6.4 percent).

Coccidioidomycosis is likely underdiagnosed both nationally and within the Military Health System (MHS) due to the non-specific clinical manifestation of the disease and because most cases are mild and self-limited. In addition to the issue of underdiagnosis, potential reasons for underreporting of coccidioidomycosis in DRSi include lack of awareness of the reporting requirements among healthcare providers, lack of awareness of the disease due to the rotational nature of MHS healthcare providers in and out of endemic areas, and insufficient personnel resources available to carry out the mission of public health surveillance and reporting at some military medical treatment facilities (MTFs).

During the reporting period, 155 (16.9 percent) ADSM cases of coccidioidomycosis required hospitalization. There were 180 total hospitalizations among the 155 individual ADSMs who required hospitalization. The number of hospitalizations ranged from 1-4, with an average and median number of bed days of 10.5 (standard deviation = 19.7 days) and 5.0 days (interquartile range = 6.0 days), respectively. The most common complication specific to a diagnosis of coccidioidomycosis among hospitalized cases was any extrapulmonary coccidioidomycosis (n = 55, 35.5 percent), which was not mutually exclusive of other complications. Over 21 percent of hospitalized cases had a disseminated diagnosis, indicating the infection spread beyond the lungs to other parts of the body, (n = 33), and nearly 8 percent (n = 12) had a coccidioidomycosis meningitis diagnosis.

Available military working dog (MWD) data for the period from January 1, 2014 through September 6, 2023, reported 271 total coccidioidomycosis laboratory tests among 107 individual MWDs. These tests were mostly conducted in Arizona (n = 230, 85.0 percent), California (n = 14, 14.1 percent), and Virginia (n = 9, 3.3 percent). Of the 271 tests, there were 15 positive results, corresponding to 6 incident MWD coccidioidomycosis cases. Within the reporting period, only one new MWD case has been identified since 2017. No disruption to training, deployment, or other activity for any identified MWD case occurred, as infections were identified prior to training and deployment of MWDs. Furthermore, no evidence exists linking coccidioidomycosis to the death of any MWD.

No known disruptions to training, deployment, or other activity were reported for military units during the reporting period. That is, there were no records of any coccidioidomycosis outbreaks via the DRSi outbreak reporting module. Although individual ADSMs diagnosed with coccidioidomycosis may have personally experienced disruptions to their training, deployment, and other activities, there are no available data to quantify this assumption.

The Department of Defense (DoD) does not conduct air sampling or monitoring for fungi of any specific type, including the fungus *Coccidioides*, due to the significant challenges associated with air samples containing diverse varieties of fungi. Fungi are ubiquitous in the environment, and no Environmental Protection Agency (EPA) regulations or standards for airborne fungi are currently available.

There are two main gaps in the understanding of health risks associated with exposure to *Coccidioides*: 1) a lack of health-based exposure guidelines for minimum infectious dose and doses that result in predictable illness of known severities; and 2) quantitative measurement of environmental sources and levels of *Coccidioides*.

II. ACKNOWLEDGMENTS

The Defense Health Agency (DHA) compiled this report with contributions from the Defense Centers for Public Health – Aberdeen (DCPH-A), the Defense Centers for Public Health – Falls Church, and the Defense Centers for Public Health – Portsmouth.

Collaboration between the following individuals and organizations facilitated estimation of the prevalence of coccidioidomycosis for MWDs, broken out by State for CONUS: Commander,

341st Training Squadron; Department of the Air Force MWD Program Manager; Department of the Air Force Executive Agent Program; and the Chief, Strategic Initiatives, Veterinary Services Systems Management, Defense Health Agency Veterinary Services Division. Data management and analyses were completed by Team Cherokee Nation Strategic Programs, contracted to DHA Public Health, Armed Forces Health Surveillance Division, Army Satellite, at DCPH-A.

III: ASSESSMENT OF VALLEY FEVER IMPACTS ON MILITARY

House Report 118–125 requests that the DoD Valley fever report include information from the past 20-year period, based on:

> (1) The prevalence of Coccidioidomycosis cases, broken out by state for CONUS;
> (2) cases reported OCONUS;
> (3) the prevalence of Coccidioidomycosis tests provided for service members and military working dogs, broken out by state for CONUS;
> (4) an accounting of the severity of reported human cases, including the prevalence of cases with complications;
> (5) types of care provided by the military in response to these cases;
> (6) known disruptions to training, deployment, or other activity;
> (7) the relative trend in overall case numbers over the past 20 years;
> (8) any information the Department has regarding air sampling; and
> (9) gaps in the Department's understanding of risks associated with the condition or expanded region with risk of exposure.

Senate Report 118–58 requests that the DoD Valley fever report include information from the past 20-year period, based on:

> (1) The prevalence of coccidioidomycosis cases, broken out by state for CONUS and by country for OCONUS;
> (2) The prevalence of servicemembers and military working dogs coccidioidomycosis cases, broken out by installation for CONUS and OCONUS;
> (3) An accounting of the severity of reported Service member cases, including prevalence of cases with complications;
> (4) Types of care provided by the military in response to these cases;
> (5) Known disruptions to training, deployment, or other activity;
> (6) The relative trend in overall Service member case numbers over the past 20 years;
> (7) Any information the Department has regarding sampling of coccidioidomycosis; and
> (8) Gaps in the Department's understanding of risks associated with coccidioidomycosis infections.

This report addresses the nine House Armed Services Committee requests and eight Senate Armed Services Committee requests cited above.

Background

Coccidioidomycosis, also called Valley fever, is a respiratory infection caused by the fungi *Coccidioides immitis* and *Coccidioides posadasii*, a naturally occurring fungus found in arid and semi-arid soil. The fungus is known to be endemic to the southwestern United States, primarily in Arizona and California but also in New Mexico, Nevada, Utah, Texas, and Washington State (Centers for Disease Control and Prevention (CDC) 2020; Freedman et al. 2018; McCotter et al. 2019). Outside of the United States, the fungus is endemic in Mexico and portions of other countries in Central and South America (CDC 2020; Laniado-Laborín et al. 2019).

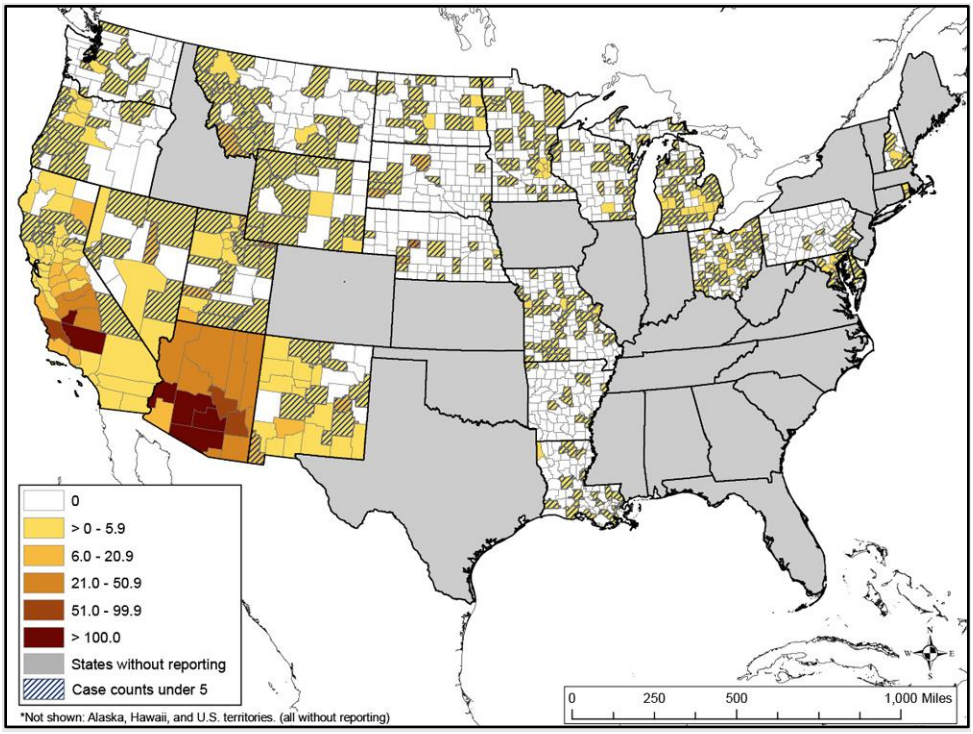
In the areas where it is endemic, the *Coccidioides* species of fungi grows effectively in arid and semi-arid soils, particularly following heavy rainfall events. During hot, dry weather conditions, the fungal spores, called arthrospores, become airborne when fungi-containing soil is disturbed either by weather events (e.g., earthquakes, high winds, dust storms, and fires) or human activities (e.g., construction, recreation, and agricultural activities). Once airborne, arthrospores can remain suspended in the air for hours up to days (Lauer et al. 2020).

Coccidioides can cause infection when aerosolized arthrospores are inhaled. An estimated 60 percent of *Coccidioides* infections are asymptomatic (Brown et al. 2013; Crum 2022; Freedman et al. 2018; Smith and Beard 1946). Approximately 40 percent of infected individuals develop symptoms within 1-3 weeks of exposure (Galgiani et al. 2016). Common symptoms include cough, shortness of breath, fever, and fatigue. These symptoms usually resolve on their own without treatment. However, approximately 5-10 percent of people diagnosed with coccidioidomycosis develop chronic pulmonary issues after infection, and an even smaller proportion of infections (<2 percent) result in more serious disease, where disseminated, meningitis, or extrapulmonary infection develops (Crum et al. 2004; Thompson 2011). Extrapulmonary infection can occur in the brain, spinal cord, soft tissues, skin, bones, and joints.

Coccidioidomycosis is a notifiable disease in 26 States and the District of Columbia and is a reportable medical event (RME) across the DoD (Armed Forces Health Surveillance Division (AFHSD) 2022; CDC 2022a; DoD 2012). According to the most recent CDC data reports, coccidioidomycosis incidence in the United States increased from 8,121 cases in 2007 to 19,220 cases in 2020 (CDC 2022b). Some of the increased incidence could be due to increased awareness of the disease or changes in the surveillance of the disease. Almost 97 percent of coccidioidomycosis cases are reported from Arizona and California; 2 percent of cases are reported from Nevada, New Mexico, and Utah combined; the remaining cases are reported from other States (Figure 1) (CDC 2022b).

In Arizona, approximately 95 percent of cases are reported from Maricopa, Pima, and Pinal counties (McCotter et al. 2019). These data have relevance to the DoD because Luke Air Force Base (AFB) is located in Maricopa County, and Davis-Monthan AFB is located in Pima County. In California, 70 percent of cases are reported from seven counties, three of which are home to DoD installations (McCotter et al. 2019). Edwards AFB and Naval Air Weapons Station China Lake are located in Kern County, and Naval Air Station (NAS) Lemoore is located in Kings County. Fort (Ft.) Irwin and Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms are located in San Bernadino County, which environmental studies identified as a Coccidioides-endemic area (Lauer et al. 2020).

Figure 1. Average incidence of reported Valley fever per 100,000 people, by county, during 2011–2017 (Source: Centers for Disease Control and Prevention, 2020)



Because of a lack of testing availability and robust surveillance programs outside the United States, the epidemiology of coccidioidomycosis is not well documented within the endemic areas in Central and South America. However, identification of the *Coccidioides* fungal spores in human, animal, and environmental samples from these areas indicates that the fungus is endemic in Mexico, Guatemala, Honduras, Colombia, Venezuela, Brazil, Paraguay, Bolivia, and Argentina (Laniado-Laborín et al. 2019). In Mexico, coccidioidomycosis was a reportable disease until 1994, and at that time the disease incidence was similar to the incidence reported in Arizona and California (Hernandez et al. 2019). Researchers believe the incidence of the disease in Mexico remains similar to the incidence reported in Arizona and California (Hernandez et al. 2019; Laniado-Laborín et al. 2019).

(1) The Prevalence of Coccidioidomycosis Cases, Broken Out by State for CONUS

DoDD 6490.02E (DoD 2012) requires reporting of notifiable medical conditions. The guidelines and specific case definitions for all medical conditions that are required to be reported are described in, "Armed Forces Reportable Medical Events Guidelines and Case Definitions," (AFHSD 2022). Notifiable medical conditions, such as coccidioidomycosis, are reported through a single electronic system, the DRSi, available at all MTFs (AFHSD 2022).

An analysis of ADSM coccidioidomycosis cases from 2007 to 2022, and associated demographic characteristics, was conducted using standardized surveillance methods. The AFHSD uses standard surveillance case definitions for routine surveillance and reporting. These case definitions were designed for use with administrative healthcare data derived from the MHS

electronic health record and contained in the Defense Medical Surveillance System and other available datasets (DoD 2012).

A case of coccidioidomycosis was defined as an ADSM with 1) one positive laboratory test; 2) an RME from DRSi; 3) a hospitalization record with a primary diagnosis of coccidioidomycosis; or 4) two or more outpatient encounters with a primary diagnosis of coccidioidomycosis within 14 days of each other (but not on the same day) between January 1, 2007 and December 31, 2022. Hospitalization and outpatient encounters were examined for International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) or International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) diagnosis codes listed in Table 1 (CDC 2021a, 2021b; Williams et al. 2018). The incident date was considered the date of the earliest encounter that included a qualifying diagnosis (Williams et al. 2018). ADSMs meeting the case definition for coccidioidomycosis before 2007 and after 2022 were excluded from the analysis.

Geographic location was derived from the earliest record meeting the case definition for coccidioidomycosis. The installation, State, and country code associated with the MTF were used to estimate the geographic location of the case. If the cases could not be mapped to a specific installation, but the State code was available, then the case was listed as "Other – State" (e.g., "Other – AZ").

Table 1. ICD-9-CM and ICD-10-CM codes included in coccidioidomycosis case definition

Condition	ICD-10-CM Codes	ICD-9-CM Codes
Coccidioidomycosis (Pulmonary)	B38 (coccidioidomycosis)	--
	B38.0 (acute pulmonary coccidioidomycosis)	114.0 (primary coccidioidomycosis; pulmonary)
	B38.1 (chronic pulmonary coccidioidomycosis)	114.4 (chronic pulmonary coccidioidomycosis)
	B38.2 (pulmonary coccidioidomycosis, unspecified)	114.5 (pulmonary coccidioidomycosis, unspecified)
Coccidioidomycosis (Extrapulmonary)	B38.3 (cutaneous coccidioidomycosis)	114.1 (primary extrapulmonary coccidioidomycosis)
	B38.4 (coccidioidomycosis meningitis)	114.2 (coccidioidal meningitis)
	B38.7 (disseminated coccidioidomycosis)	114.3 (below)
	B38.8 (other forms of coccidioidomycosis)	--
	– B38.81 (prostatic coccidioidomycosis)	114.1 (above)
	– B38.89 (other forms of coccidioidomycosis)	114.3 (other forms of progressive coccidioidomycosis)
	B38.9 (coccidioidomycosis, unspecified)	114.9 (coccidioidomycosis, unspecified)

Between 2007 and 2022, there were 918 incident cases of coccidioidomycosis among ADSMs, as shown in Table 2. Most cases were male (84.3 percent) and between 20 and 39 years of age (74.6 percent). Cases were distributed evenly across the Air Force (29.0 percent), Army (29.1 percent), and Navy (31.8 percent), while the Marine Corps (10.1 percent) had a lower proportion of cases.

Table 2. Incident cases of coccidioidomycosis by demographic and military characteristics, ADSMs, U.S. Armed Forces, 2007-2022

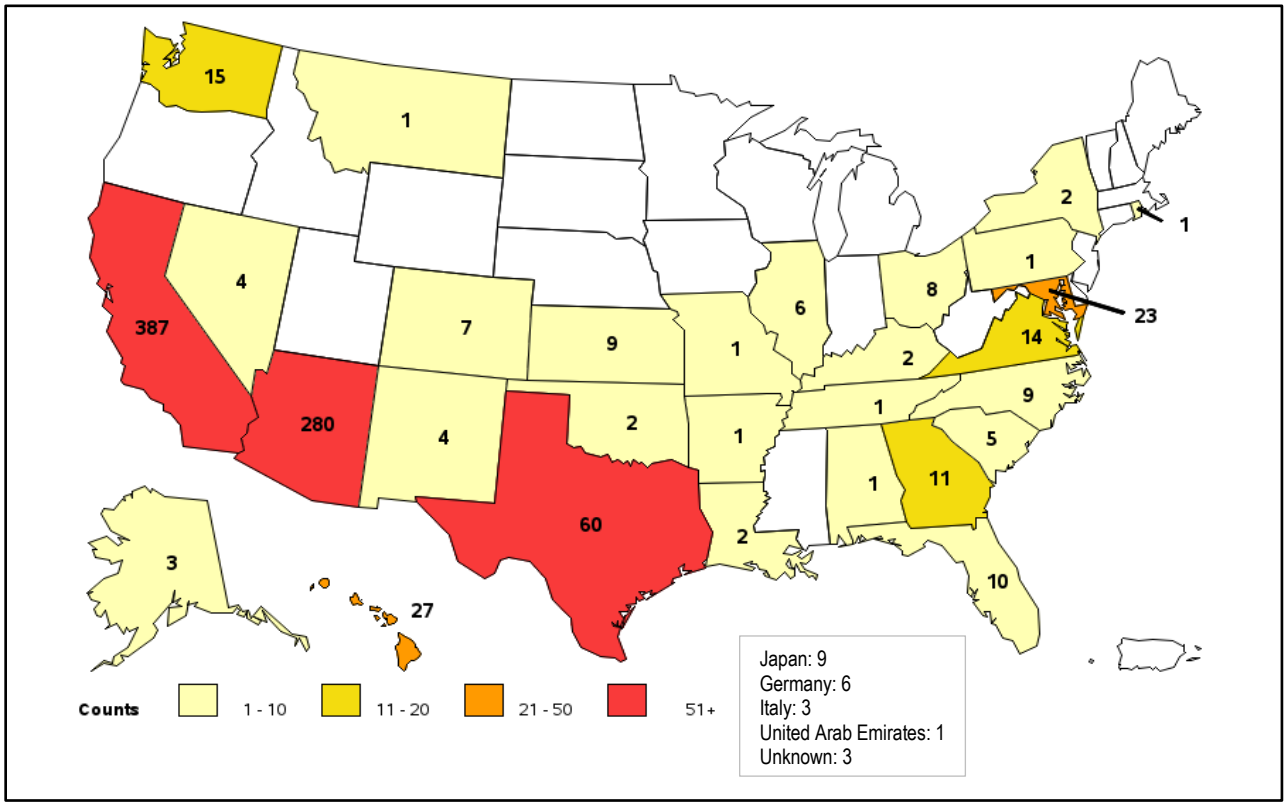
Description	No.	%
Total	918	100.0
Sex		
Male	774	84.3
Female	144	15.7
Age Group (years)		
<20	53	5.8
20–29	409	44.6
30–39	276	30.1
40–49	130	14.2
50+	50	5.4
Service		
Army	267	29.1
Navy	292	31.8
Air Force	266	29.0
Marine Corps	93	10.1

Figure 2 displays the incident number of coccidioidomycosis cases by State for ADSMs between 2007 and 2022. Of the 918 incident cases, 896 (98 percent) were reported in CONUS locations. Most cases were reported in the known endemic areas (81.7 percent), which included California (n = 387, 42.2 percent), Arizona (n = 280, 30.5 percent), Texas (n = 60, 6.5 percent), Washington (n = 15, 1.6 percent), New Mexico (n = 4, 0.4 percent), and Nevada (n = 4, 0.4 percent). The top three non-endemic States included Hawaii (n = 27, 2.9 percent), Maryland (n = 23, 2.5 percent), and Virginia (n = 14, 1.5 percent).

See Appendix Table A1 for a tabular data display of incident coccidioidomycosis cases stratified by installation, State, outside of continental United States (OCONUS) or CONUS location, country, and disease-endemic area. Case counts for CONUS installations in endemic and non-endemic areas are provided below.

Installations with the highest case counts were all located in the disease-endemic areas: Naval Base San Diego (n = 175, 19.1 percent), NAS Lemoore (n = 142, 15.5 percent), Luke AFB (n = 104, 11.3 percent), Davis-Monthan AFB (n = 89, 9.7 percent), Ft. Huachuca (n = 80, 8.7 percent), and Ft. Bliss (n = 27, 2.9 percent). The largest numbers of cases reported from installations in non-endemic areas were located at Walter Reed National Military Medical Center (n = 23, 2.5 percent), Ft. Shafter (n = 22, 2.4 percent), Naval Medical Center Portsmouth (n = 9, 1.0 percent), Fort Eisenhower (n = 8, 0.9 percent), Fort Riley (n = 8, 0.9 percent), and Wright-Patterson Air Force Base (n = 8, 0.9 percent).

Figure 2. Number of incident coccidioidomycosis cases, by State, ADSMs U.S. Armed Forces, 2007-2022



The findings of this analysis should be interpreted cautiously in view of the following methodological limitations. The use of administrative data from health records likely underreports the true number of cases due to the severity of illness necessary for ADSMs to seek care (Chiller et al. 2003; Cox and Magee 2004; Hector and Laniado-Laborin 2005). Further, DoD MTFs began transitioning to a new electronic health record, MHS GENESIS, in July 2017. From 2017 to 2021, MTFs in the Pacific Northwest and western States, which are coccidioidomycosis endemic areas, deployed MHS GENESIS. MHS GENESIS data are included in this analysis; however, the reliability and understanding of MHS GENESIS data, its capture, content, and structure, are still being investigated. The impact(s) on the accuracy of results for facilities transitioned to MHS GENESIS are unclear.

It is highly unlikely that cases reported outside of known endemic areas were exposed to *Coccioides* in these non-endemic areas, and location results should be interpreted with the

following considerations. First, ADSMs are a highly mobile population, and most ADSMs had a history of travel to the known endemic areas, whether it be through prior or current residency, travel, training, or duty location. Administrative records rarely capture the full extent of travel per ADSM. Second, coccidioidomycosis is frequently misdiagnosed due to the obscure nature of the course of infection (Benedict et al. 2018; Benedict et al. 2021; Cox and Magee 2004; Hector and Laniado-Laborin 2005). By the time other more common conditions are ruled out and coccidioidomycosis is tested for and diagnosed, the location of the ADSM may differ from where the exposure occurred.

Some health providers may not be aware of reporting requirements pursuant to DoDD 6490.02E, as about 64 percent (n = 583) of cases during the reporting period were never reported in DRSi (data not shown) (DoD 2012). Personnel resources available to carry out the mission of public health surveillance and reporting may also vary widely from one MTF to another. In the context of coccidioidomycosis, underreporting is often influenced by the severity of illness, as approximately 60 percent of those who are exposed to the fungus *Coccidioides* never present with symptoms (Chiller et al. 2003; Cox and Magee 2004; Hector and Laniado-Laborin 2005). For approximately 30 percent of cases, the symptoms often go away on their own within weeks to months (Cox and Magee 2004; Hector and Laniado-Laborin 2005; Smith and Beard 1946; Smith et al. 1961). Mild coccidioidomycosis with a self-limited duration is unlikely to be identified when laboratory testing does not occur.

There are numerous potential reasons for underreporting, misdiagnosis, and delayed diagnosis of coccidioidomycosis. Alterations in coccidioidomycosis surveillance, such as case detection, case reporting, provider awareness, and public awareness could impact reporting (Benedict et al. 2018; Benedict et al. 2021; CDC 2022a; CDC 2022b; Elconin et al. 1957; Williams and Chiller 2022). The non-specific clinical manifestation, delayed onset of symptoms, and reactivation of a latent infection pose significant challenges to a provider's differential diagnosis when an ADSM presents for care (Benedict et al. 2021; Williams and Chiller 2022). A 2021 study demonstrated that 70 percent of patients had another condition diagnosed prior to testing for coccidioidomycosis, and of those, 83 percent were prescribed antibiotics prior to testing for coccidioidomycosis (Benedict et al. 2021). Coccidioidomycosis has been nicknamed the "great imitator" due to its mirroring of other conditions such as community-acquired pneumonia, tuberculosis, chronic obstructive pulmonary disease, chronic fatigue syndrome, and, more recently, coronavirus disease 2019 (Benedict et al. 2021; Williams and Chiller 2022).

The scientific literature on incident cases of coccidioidomycosis among ADSMs is limited; however, the results of this analysis are similar to a report by the AFHSD in 2018 (Williams et al. 2018). The concentration of cases across the southwestern U.S. mirrors what is seen in the general U.S. population, where the largest concentration of cases occur in Arizona and California (CDC 2022b; Crum 2022; Freedman et al. 2018). The annual fluctuations in disease incidence are not well understood and are likely multifaceted. Environmental factors such as temperature and rainfall may impact the growth of the fungus and arthrospore dispersal (CDC 2022b; Williams and Chiller 2022). Natural environmental events such as earthquakes, dust storms, and wildfires have been suggested to increase exposure (Crum 2022; Donnelly et al. 2022; Lauer et al. 2020; Schneider et al. 1997; Williams and Chiller 2022). Increased exposure may also be due to human-related events, such as increased travel to disease endemic areas, military training, recreational activities, construction, and agriculture (Crum 2022; Donnelly et al. 2022; Lauer et al. 2020; Williams and Chiller 2022).

(2) Cases Reported OCONUS

Figure 2, in the preceding section, displays the incident number of coccidioidomycosis cases by State and OCONUS for ADSMs between 2007 and 2022. OCONUS cases comprised 2 percent (n = 22) of the total cases and were reported from Japan (n = 9), Germany (n = 6), Italy (n = 3), and United Arab Emirates (n = 1). There were three cases where the OCONUS location could not be identified. See Appendix Table A1 for a tabular data display of incident coccidioidomycosis cases stratified by installation, State, OCONUS or CONUS location, country, and disease-endemic area.

(3) The Prevalence of Coccidioidomycosis Tests Provided for Service Members and MWDs, Broken Out by State for CONUS

Figure 3 displays the location of case-defining positive coccidioidomycosis laboratory tests by State for ADSMs between 2007 and 2022. A total of 714 case-defining positive laboratory tests were reported during the reporting period. Most of the case-defining positive coccidioidomycosis laboratory tests were reported from endemic areas (n = 605, 84.7 percent). The greatest numbers of positive laboratory results were reported from California (n = 336, 47.1 percent), Arizona (n = 205, 28.7 percent), and Texas (n = 46, 6.4 percent). See Appendix Table A2 for a tabular data display.

Figure 3. Location of case-defining positive coccidioidomycosis laboratory tests, by State, ADSMs, U.S. Armed Forces, 2007-2022

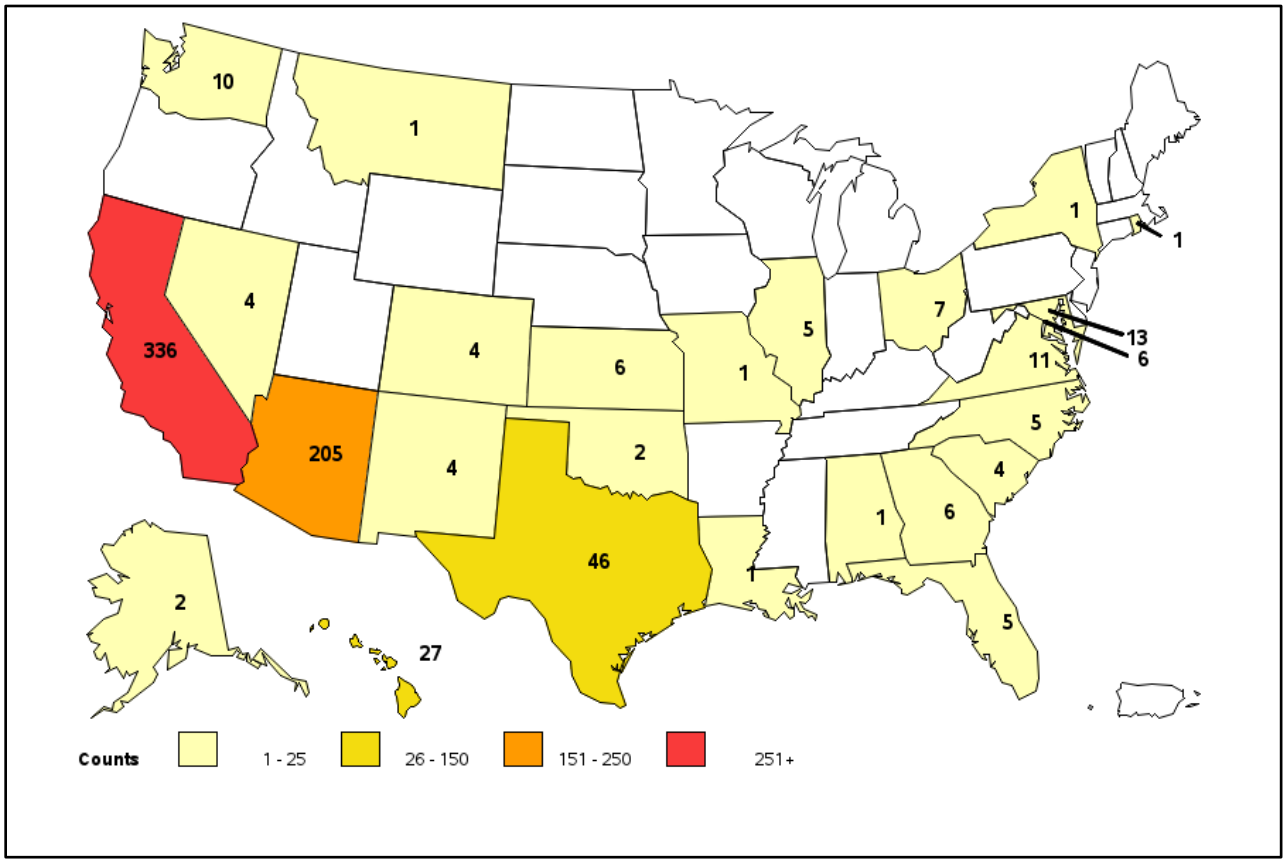
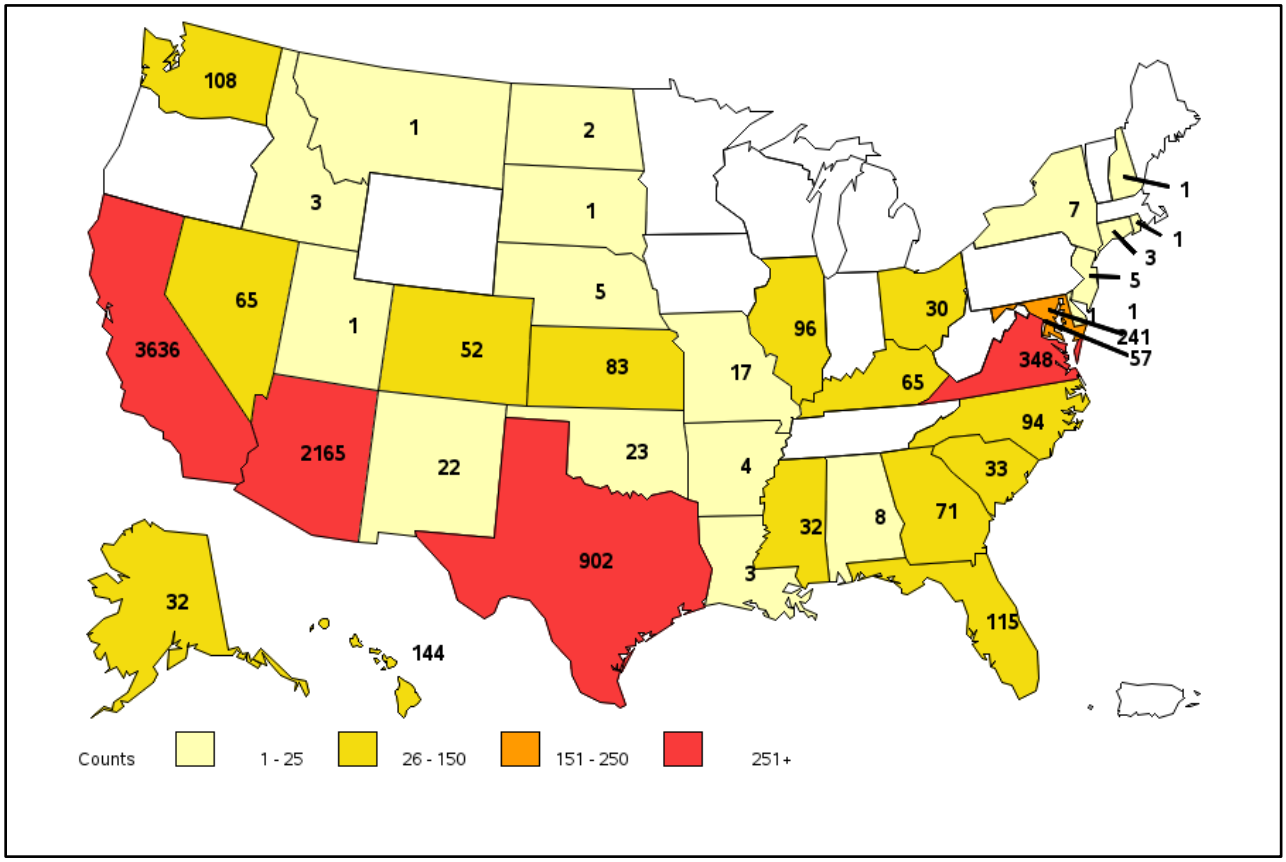


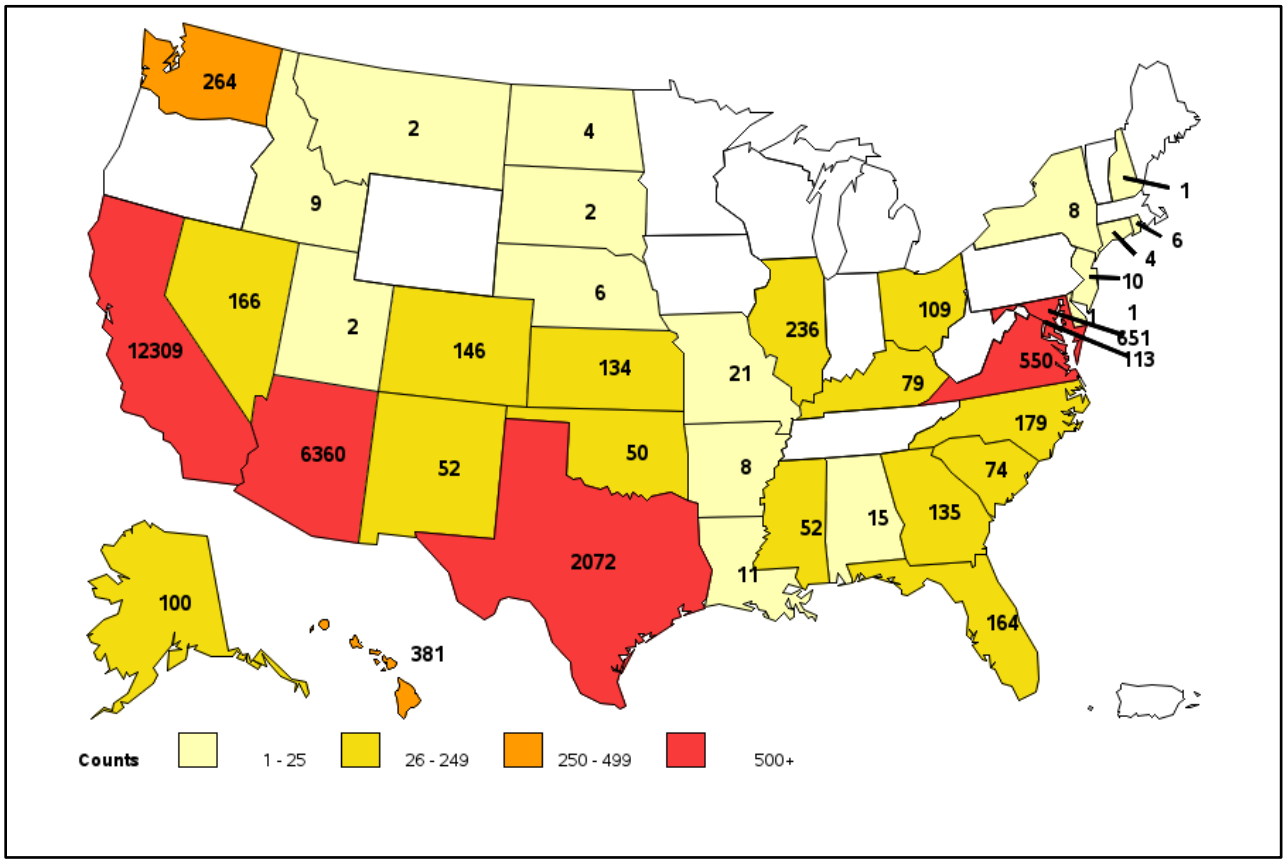
Figure 4 displays the State in which each ADSM's *initial* coccidioidomycosis laboratory test occurred between 2007 and 2022, regardless of test result (e.g., positive, negative). A total of 8,477 initial laboratory tests were reported between 2007 and 2022. Initial coccidioidomycosis laboratory tests were reported primarily in the endemic areas (n = 6,898, 81.4 percent) (Figure 4). California (n= 3,636, 42.9 percent), Arizona (n= 2,165, 25.5 percent), Texas (n = 902, 10.6 percent), Virginia (n = 348, 4.1 percent), and Maryland (n = 241, 2.8 percent) reported the greatest number of initial coccidioidomycosis laboratory tests during the reporting period (Figure 4). See Appendix Table B2 for a tabular data display.

Figure 4. Location of initial coccidioidomycosis laboratory tests, by State, ADSMs, U.S. Armed Forces, 2007-2022



In contrast to Figure 4, Figure 5 displays the *total* number of coccidioidomycosis laboratory tests ordered for ADSMs, by State, between 2007 and 2022. An ADSM may have been tested multiple times and may have been tested in multiple States. A total of 24,486 laboratory tests were reported during the reporting period. The greatest total number of laboratory tests were ordered in California (n = 12,309, 50.3 percent), Arizona (n = 6,360, 26.0 percent), Texas (n = 2,072, 8.5 percent), Maryland (n = 651, 2.7 percent), Virginia (n = 550, 2.2 percent), and Washington (n= 264, 1.1 percent). See Appendix Table B2 for a tabular data display.

Figure 5. Total number of coccidioidomycosis laboratory tests, by State, ADSMs U.S. Armed Forces, 2007-2022



For MWDs, a case of coccidioidomycosis was defined as any MWD with at least one reported positive coccidioidomycosis laboratory test in its electronic health record between January 1, 2014 and September 6, 2023. Geographic location was derived from the earliest record meeting the case definition for coccidioidomycosis. Table 3 provides the complete data associated with MWD coccidioidomycosis cases and testing; a summary appears below.

Of 271 total tests between 2014 and 2023, 15 total positive results were detected. Six of these 15 positive results were indicative of new infections. A total of 107 unique MWDs were tested in this timeframe (Annual median = 25, Annual range = 5–37). The total population of MWDs in the DoD ranged from 1,425 to 1,723. The majority of tests conducted among MWDs between 2014 and 2023 were in Arizona (n = 230, 85 percent), followed by California (n = 14, 4.1 percent), and Virginia (n = 9, 3.3 percent). The number of tests in all other States which conducted testing ranged from 0 to 2 per year. Five of six (83 percent) positive cases of new infections occurred in Arizona, with the sixth occurring in California (17 percent). Four cases (67 percent) were diagnosed at Davis-Monthan AFB, Arizona (one in 2015, two in 2016, and one in 2021); one case (17 percent) at Ft. Huachuca, Arizona, in 2015; and one case (17 percent) at NAS Lemoore, California, in 2016.

Within the reporting period, only one new case was identified since 2017, and only six cases were identified between 2014 and 2023. Any inferences regarding trends or definitive

conclusions should not be drawn due to the limited number of cases. It was determined that no disruption to training, deployment, or other activity for any identified MWD case occurred, as the infections were identified prior to the training and deployment of those MWDs. Furthermore, no evidence exists linking coccidioidomycosis to the death of any MWD.

Table 3. Coccidioidomycosis testing among MWDs, January 1, 2014-September 6, 2023

Year	State					Installation(s) with New Cases
	AZ	CA	Other[1]	Unknown	Total	
2014						
Total Tests	4	0	1	0	5	
Total Positives	0	0	0	0	0	
Total Newly Identified Cases[2]	0	0	0	0	0	
2015						
Total Tests	9	0	2	0	11	Davis-Monthan Air Force Base (1)
Total Positives	2	0	0	0	2	Fort Huachuca (1)
Total Newly Identified Cases[2]	2	0	0	0	2	
2016						
Total Tests	40	3	6	1	50	Davis-Monthan Air Force Base (2)
Total Positives	6	1	0	0	7	Naval Air Station Lemoore (1)
Total Newly Identified Cases[2]	2	1	0	0	3	
2017						
Total Tests	30	7	6	0	43	
Total Positives	1	3	0	0	4	
Total Newly Identified Cases[2]	0	0	0	0	0	
2018						
Total Tests	27	0	7	0	34	
Total Positives	0	0	0	0	0	
Total Newly Identified Cases[2]	0	0	0	0	0	
2019						
Total Tests	36	2	3	0	41	
Total Positives	0	0	0	0	0	
Total Newly Identified Cases[2]	0	0	0	0	0	
2020						
Total Tests	28	1	0	0	29	
Total Positives	0	0	0	0	0	
Total Newly Identified Cases[2]	0	0	0	0	0	
2021						
Total Tests	19	0	0	0	19	Davis-Monthan Air Force Base (1)
Total Positives	1	0	0	0	1	
Total Newly Identified Cases[2]	1	0	0	0	1	

[1] Includes the following: Alabama, Delaware, Florida, Georgia, Illinois, Maryland, Missouri, North Carolina, North Dakota, South Carolina, Texas, Utah, and Virginia.

[2] Total newly identified cases are determined by the first positive test for an individual patient within their medical record.

Table 3. Coccidioidomycosis testing among MWDs, January 1, 2014-September 6, 2023—Continued

2022						
Total Tests	23	0	1	0	24	
Total Positives	1	0	0	0	1	
Total Newly Identified Cases[2]	0	0	0	0	0	
2023						
Total Tests	14	1	0	0	15	
Total Positives	0	0	0	0	0	
Total Newly Identified Cases[2]	0	0	0	0	0	
2014-2023						
Total Tests	230	14	26	1	271	Davis-Monthan Air Force Base (4)
Total Positives	11	4	0	0	15	Fort Huachuca (1)
Total Newly Identified Cases[2]	5	1	0	0	6	Naval Air Station Lemoore (1)

[1] Includes the following: Alabama, Delaware, Florida, Georgia, Illinois, Maryland, Missouri, North Carolina, North Dakota, South Carolina, Texas, Utah, and Virginia.

[2] Total newly identified cases are determined by the first positive test for an individual patient within their medical record.

(4) An Accounting of the Severity of Reported Human Cases, Including the Prevalence of Cases with Complications

Within the reporting period, approximately 17 percent of ADSM cases required hospitalization during their course of illness (Table 4). Most of the 918 total cases, did not have coccidioidomycosis complications specified in their medical record; however, 28.3 percent had a primary diagnosis indicating any extrapulmonary coccidioidomycosis, 4.8 percent had a disseminated coccidioidomycosis primary diagnosis, 2.0 percent had a chronic pulmonary coccidioidomycosis diagnosis, and 1.5 percent had a coccidioidomycosis meningitis diagnosis (Table 4).

Cases with complications were defined as those requiring inpatient care or having a history of a chronic coccidioidomycosis, disseminated coccidioidomycosis, coccidioidomycosis meningitis, or any extrapulmonary coccidioidomycosis diagnosis in the primary diagnostic position associated with the hospitalization (Table 5).

Table 4. Incident coccidioidomycosis cases by complications, ADSMs, U.S. Armed Forces, 2007-2022

Description	No.	%
Total Cases	918	100.0
Individuals Requiring Hospitalization		
Yes	155	16.9
No	763	83.1
Complications[1,2,3]		
Chronic Pulmonary	18	2.0
Disseminated	44	4.8
Meningitis	14	1.5
Any Extrapulmonary	260	28.3
Not Specified	538	58.6

[1] Complications defined as having an inpatient, chronic, disseminated, meningitis, or any extrapulmonary coccidioidomycosis diagnosis code reported in the first diagnostic position at the time of the incident encounter.
[2] Complication categories were determined in accordance with the ICD-10-CM and ICD-9-CM diagnosis codes.
[3] Complications are not mutually exclusive.

Table 5. Coccidioidomycosis hospitalized cases with complications, ADSMs, U.S. Armed Forces, 2007-2022

Description	No.	%
Total Hospitalizations	180	100.0
Ever Hospitalized Individuals	155	100.0
History of Complications[1,2] (n = 155)		
Chronic Pulmonary	5	3.2
Disseminated	33	21.3
Meningitis	12	7.7
Any Extrapulmonary[3]	55	35.5
Total Bed Days (n = 180)		
Average (SD)	10.5 (19.7)	
Median (IQR)	5.0 (6.0)	
Minimum and Maximum	1	209
<4 days	42	23.3
4–6 days	61	33.9
7–9 days	27	15.0
10+ days	50	27.8
Number Hospitalizations (n = 155)		
1	138	89.0
2	11	7.1
3	4	2.6
4	2	1.3

[1] Complications defined as having an inpatient, chronic, disseminated, meningitis, or any extrapulmonary coccidioidomycosis diagnosis code reported in the first diagnostic position for a hospitalization.
[2] Complication categories were determined in accordance with the ICD-10-CM and ICD-9-CM diagnosis codes.
[3] Any Extrapulmonary is not mutually exclusive from the other categories.

As shown in Table 5, there were 155 ADSMs who were ever hospitalized with a case-defining diagnosis of coccidioidomycosis in the primary diagnostic position between 2007 and 2022. Of the 155 ever hospitalized cases, 138 (89.0 percent) were hospitalized once, 11 (7.1 percent) were hospitalized twice, 4 (2.6 percent) were hospitalized 3 times, and 2 (1.3 percent) were hospitalized 4 times, for a total of 180 hospitalizations. Most of the complications for hospitalized cases were any extrapulmonary coccidioidomycosis (n = 55, 35.5 percent), which was not mutually exclusive of the other complication categories. Over 21 percent had a disseminated diagnosis (n = 33), and nearly 8 percent (n = 12) had a coccidioidomycosis

meningitis diagnosis, which is considered one of the most severe forms of coccidioidomycosis infections. Nearly 3 percent (n = 5) had a diagnosed chronic pulmonary coccidioidomycosis complication. The number of hospitalizations ranged from 1–4, with an average and median number of bed days of 10.5 days (standard deviation = 19.7 days) and 5.0 days (interquartile range = 6.0 days), respectively. Over 57 percent (n = 103) of the cases were hospitalized for fewer than 7 bed days.

(5) Types of Care Provided by the Military in Response to These Cases

ADSMs presenting with uncomplicated pulmonary coccidioidal infection with mild symptoms are typically provided patient education, supportive therapy recommendations, and are observed for improvement through regular medical follow-ups (Galgiani et al. 2016). Presenting symptoms may include cough, chest pain, dyspnea, fatigue, and fever, which can a last couple of weeks to several months (Crum 2022; Galgiani et al. 2016). Based on the medical provider's experience and clinical judgement, oral antifungal therapy may be provided to reduce symptom duration and prevent potential complications (Galgiani et al. 2016).

Coccidioidomycosis is a common cause of community-acquired pneumonia in endemic areas, as the early manifestations of both are similar (Crum 2022; Valdivia et al. 2006). The Infectious Diseases Society of America guidelines suggest antifungal treatment for primary pulmonary coccidioidomycosis in patients who are immunosuppressed, have severe or significantly debilitating illness, have diabetes, are frail because of age or comorbidities, are pregnant, or are of African or Filipino ancestry (Galgiani et al. 2016). Antifungal therapy is not indicated for uncomplicated pneumonia in healthy individuals but recommended for 3–6 months in the above cases or cases with debilitating illness (Crum 2022; Galgiani et al. 2016) .

Pulmonary cavities may develop as a sequela of primary coccidioidal infection. Although approximately half of these cavities will resolve with oral antifungal infection, cavities that are present for more than 2 years may require surgical resection. In addition, pulmonary cavities with interval growth on periodic imaging surveillance, despite antifungal treatment, or those associated with severe or persistent symptoms may also require surgical resection regardless of chronicity (Galgiani et al. 2016).

Disseminated coccidiomycosis can occur when the infection spreads via the bloodstream from the lungs to other parts of the body. Antifungal treatment, typically fluconazole or amphotericin B, is required over the course of 1 year (Galgiani et al. 2016). In severe cases of infection in the bone or joints that are not responding to medication, surgery such as debridement or stabilization should be considered (Galgiani et al. 2016).

Coccidioidal meningitis requires initial therapy of an antifungal, typically fluconazole (Galgiani et al. 2016). Maintenance therapy of an antifungal medication is required for life to prevent relapse.

Chronic debility caused by coccidioidomycosis is followed-up if symptoms persist. Fatigue is a commonly reported chronic symptom lasting long after the active infection has resolved. Chronic fatigue can lead to depression, inability to perform activities of daily living, and an

overall physically deconditioned state. These can be managed on an individual basis with referrals to address the individual's symptoms (Galgiani et al. 2016). In acute and chronic cases, chest x-rays are repeated to follow pulmonary abnormalities and their resolution or residual effects.

Regardless of initial treatment modality, the possibility of relapse, dormancy of the infection until an individual is immunocompromised, and disease dissemination remain a threat. Given this, all coccidiomycosis patients require follow-up (Crum 2022). It is recommended that untreated patients follow up for 2 years, and treated individuals continue to follow up for 2 years after treatment completion (Crum 2022). Follow-ups consist of clinical assessments, complement fixation titers to track decreasing values, and consideration for imaging on an individual basis (Crum 2022).

(6) Known Disruptions to Training, Deployment, and Other Activity

The first reported significant outbreak of coccidioidomycosis in the U.S. military was observed among military trainees at three Army airfields located in the San Joaquin Valley of California shortly after World War II (Crum-Cianflone 2007). Infection rates were documented at 25-50 infections per 100 susceptible persons, including both asymptomatic and pulmonary cases (Crum-Cianflone 2007). Between 1942 and 1945, there were roughly 4,000 documented cases and 39 deaths associated with coccidioidomycosis among Army Soldiers in California, Arizona, and Texas (Crum-Cianflone 2007).

In 1992, an outbreak of coccidioidomycosis was reported in a U.S. Marine Corps reserve unit from Tennessee that conducted a 3-week training exercise in San Luis Obispo County, California (Crum-Cianflone 2007). An epidemiologic investigation reported that eight of the 27 men (30 percent) had a positive coccidioidomycosis serological test result upon returning to Tennessee. Of the eight, seven reported pulmonary symptoms, and one exhibited dissemination to the skin (Crum-Cianflone 2007).

The most recent reported coccidioidomycosis outbreak occurred in 2001, when a Navy SEAL unit conducted a 6-week sniper training in Coalinga, California (Crum-Cianflone 2007). Ten of the 22 SEALs (45 percent) developed symptomatic pulmonary infections. This was the highest military attack rate ever reported and was likely due to high inoculum exposures from their activities, which included sleeping on desert soil, convoys in open military vehicles, and concealment in man-dug holes in the soil. There were no disseminated disease cases or deaths associated with this outbreak (Crum-Cianflone 2007).

DRSi includes a module for military MTF preventive medicine personnel to report outbreaks of notifiable medical conditions such as coccidioidomycosis (AFHSD 2022). Based on a review of DRSi outbreak module records, there have been no other reported coccidioidomycosis outbreaks associated with military training exercises and no disruptions in training due to coccidioidomycosis within the last 20 years.

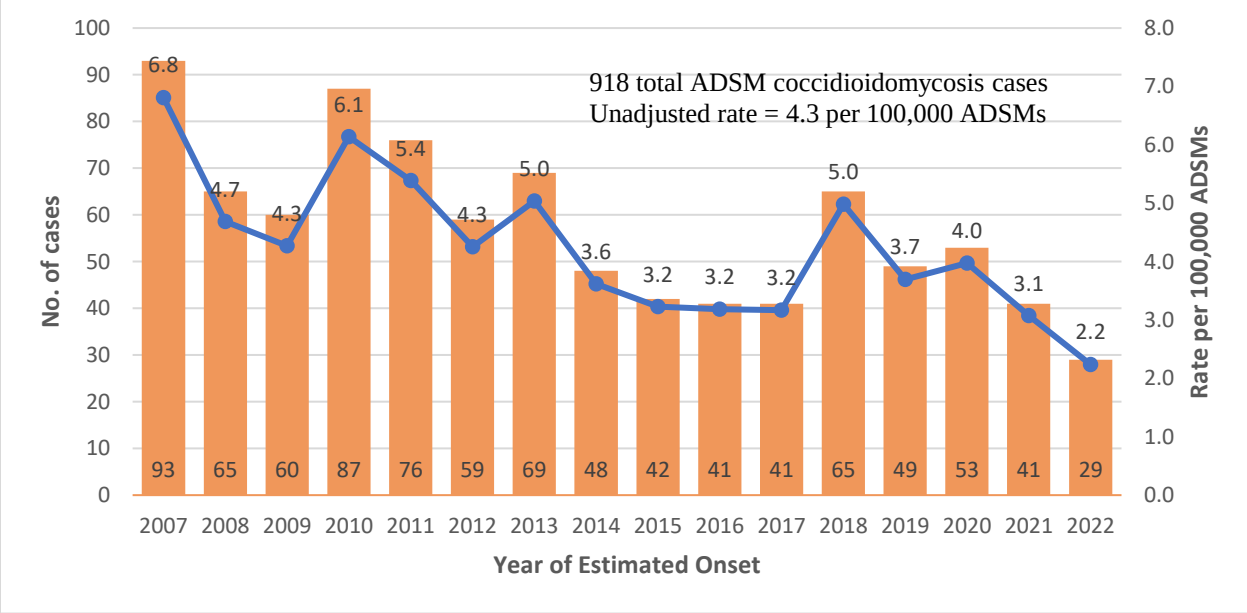
ADSMs diagnosed with coccidioidomycosis are issued physical and duty restrictions to facilitate treatment and recovery. Although these restrictions are usually temporary (less than 6 months),

permanent restrictions may be placed on those ADSMs who develop long-term functional impairments to ensure they are assigned to duties appropriate for their physical and mental capabilities. Some ADSMs require medical separation from the military if they no longer meet retention standards due to functional impairments acquired due to a coccidioidomycosis complication.

(7) The Relative Trend in Overall Case Numbers Over the Past 20 Years

Figure 6 depicts the annual incidence rates of coccidioidomycosis for ADSMs between 2007 and 2022. The overall unadjusted incidence rate of coccidioidomycosis cases was 4.3 cases per 100,000 ADSMs during the reporting period. The rates fluctuated annually with peaks in 2007 and 2010 (6.8 and 6.1 cases per 100,000 ADSMs, respectively), with rates falling below the overall unadjusted incidence rate (4.3 cases per 100,000 ADSMs) in 2014-2017 and 2019-2022.

Figure 6. Incident diagnoses and annual incidence rates of coccidioidomycosis, ADSMs, U.S. Armed Forces, 2007 – 2022



(8) Any Information the Department Has Regarding Air Sampling

Air monitoring for fungi of any specific type, including the fungus *Coccidioides*, is not performed due to the challenges associated with air samples containing diverse varieties of fungi. Fungi are ubiquitous in the outdoor environment; they consist of numerous genera and highly variable air concentrations. No EPA regulations or standards for airborne fungi are currently available.

(9) Gaps in the Department's Understanding of Risks Associated with the Condition or Expanded Region with Risk of Exposure

There are two main gaps in the understanding of health risks from exposure to *Coccidioides*: 1) a lack of health-based exposure guidelines for a minimum infectious dose and doses that result in predictable illness of known severities; and 2) quantitative measurement of environmental sources and levels of *Coccidioides*. Though some information regarding infectious dose and environmental prevalence is available, the majority of information is either speculative or relies on a limited number of experimental studies prior to 1970 (Castleberry et al. 1965; Castleberry et al. 1962; Converse et al. 1962; Converse and Reed 1966; Egeberg and Ely 1956; Elconin et al. 1957; Smith and Beard 1946; Smith et al. 1961; Swatek and Omieczynski 1970).

To estimate health risk from exposure to *Coccidioides,* it is necessary to understand the likelihood that an exposure will result in known severity of adverse health effects. It is widely cited that 60 percent of those exposed to aerosolized *Coccidioides* remain asymptomatic (Brown et al. 2013; Crum 2022; Freedman et al. 2018; Smith and Beard 1946). This value is based on an early analysis of *Coccidioides* infection incidence among military trainees at four Army airfields in the San Joaquin Valley (Smith and Beard 1946). Historical dose-response data suggest that inhalation of as few as 1 to 10 spores is sufficient to cause an infection (Nicas and Hubbard 2002). Though these estimates have been reported in the last 20 years, these studies rely solely on dose-response data reported by researchers from Ft. Detrick, Maryland, in the 1960s (Converse et al. 1962; Converse and Reed 1966).

Between 1962 and 1966, small samples of non-human primates (NHPs) and canines were experimentally exposed to *Coccidioides* via aerosols or intratracheal inoculation of *Coccidioides* suspensions, or were naturally exposed to the ambient environment in an endemic area in southern Arizona (Converse et al. 1962). The authors reported that of the naturally exposed animals, 15 percent of NHPs and 58 percent of canines showed evidence of infection by serological conversion (Converse et al. 1962). Less than half of those that became infected exhibited signs of illness (Converse et al. 1962). No *Coccidioides* were recovered from environmental air samples, so exposure rates were unknown (Converse et al. 1962). Experimental exposures caused all animals to become infected, with increased mortality linked to higher doses (Converse et al. 1962). Limited data suggest that infectivity may be similar among NHPs, canines, and humans; however, NHPs may be more susceptible to coccidioidomycosis than humans (Castleberry et al. 1965; Converse and Reed 1966). Data suggest that the canine immune response may be more similar to human illness (Castleberry et al. 1965; Converse and Reed 1966).

Epidemiological data indicate the most likely source of exposure to *Coccidioides* is inhalation of arthrospores in the environment (Brown et al. 2013; Chiller et al. 2003; Crum 2022; Ericsson et al. 2002; Freedman et al. 2018; Hector and Laniado-Laborin 2005; Hernandez et al. 2019; Lauer et al. 2020; McCotter et al. 2019; Petersen et al. 2004; Williams and Chiller 2022). Natural and anthropogenic activities may be linked to an increased likelihood of exposure (Brown et al. 2013; Chiller et al. 2003; Crum 2022; Ericsson et al. 2002; Freedman et al. 2018; Hector and Laniado-Laborin 2005; Hernandez et al. 2019; Lauer et al. 2020; McCotter et al. 2019; Petersen et al. 2004; Williams and Chiller 2022). An outbreak of coccidioidomycosis occurred in

California following the Northridge earthquake in 1994 (Jibson 1994). The subsequent increase in airborne arthrospores was attributed to landslides which created large dust clouds that were carried into nearby valleys in Ventura County (Jibson 1994; Schneider et al. 1997).

Similarly, strong winds have been blamed for periodic increased incidences of coccidioidomycosis (Fisher et al. 2000). In 1977, strong winds up to 160 kilometers (km) per hour centered in Kern County, California transported arthrospores in dust clouds to Sacramento County, as far as 500 km away (Fisher et al. 2000). As many as 7,000 infections were estimated to have occurred in Sacramento County, where *Coccidioides* was not considered endemic (Fisher et al. 2000). Coccidioidomycosis outbreaks from anthropogenic activities such as construction projects and archeological excavations have also been reported (Ericsson et al. 2002; Ocak et al. 2004; Petersen et al. 2004). Despite these past records of outbreaks, no measured concentrations of viable *Coccidioides* in the air are available. Past investigators have unsuccessfully tried to detect *Coccidioides* in air samples (Converse and Reed 1966; Swatek and Omieczynski 1970). Similarly, studies attempting to map *Coccidioides* locations in soil reported successful detection in less than 10 percent of samples (Egeberg and Ely 1956; Greene et al. 2000; Lacy and Swatek 1974; Ocak et al. 2004).

There is a dearth of minimum infective exposure dose information to determine health risk due to *Coccidioides* exposure, and historical studies have extensive limitations impacting the utility of the results (Castleberry et al. 1962; Nicas and Hubbard 2002). Most available experimental exposure studies failed to include exposure doses at levels not resulting in illness, thus preventing identification of a minimum infectious dose (Castleberry et al. 1962; Nicas and Hubbard 2002). Furthermore, in most studies arthrospores were directly inoculated into the respiratory tract of animal subjects (Castleberry et al. 1962; Converse and Reed 1966). Since direct inoculation into the respiratory tract circumvents natural physiological and structural defense mechanisms meant to reduce particle infiltration to deeper regions of the lungs, the validity of available dose-response data is reduced.

The lack of arthrospore recovery from environmental samples does not mean that natural exposure doses were low. Evidence suggests that in the environment, specifically the soil, *Coccidioides* does not grow as evenly dispersed vegetative cells or mold mycelium but as focal points of concentrated colonies (Petersen et al. 2004; Smith et al. 1961). Thus, arthrospore dispersal does not occur as a constant, widespread release but as distinct, concentrated events (Egeberg and Ely 1956; Greene et al. 2000; Kolivras et al. 2001; Swatek and Omieczynski 1970). The uncertain arthrospore dispersal is believed to result in substantial variation in airborne arthrospore concentration over time and area (Ocak et al. 2004; Petersen et al. 2004; Swatek and Omieczynski 1970). Only when a relatively large disturbance of the soil occurs, such as strong winds or land-disturbing events, do airborne concentrations of arthrospores become widespread (Elconin et al. 1957; Ericsson et al. 2002; Fisher et al. 2000; Jibson 1994; Schneider et al. 1997; Smith et al. 1961). Recovery of airborne arthrospores under normal environmental conditions would be much less likely.

To better understand exposure to *Coccidioides,* it would be necessary to determine the minimum infective dose of aerosolized arthrospores. Performing properly devised dose-response studies using modern scientific processes would help to identify the full spectrum of health effects

resulting from known inhalation exposure to *Coccidioides* arthrospores. New technologies not available during the original exposure studies, such as polymerase chain reaction-based tests, may enable more accurate determination of soil and airborne concentrations of *Coccidioides* arthrospores. Such determinations would enable more accurate environmental monitoring and improved exposure estimates. The ability to estimate environmental exposure concentrations accurately, along with a better understanding of human dose-response, would provide increased confidence in conducting health risk assessments for *Coccidioides* infection.

IV: CONCLUSIONS

Coccidioidomycosis is a reportable medical condition for which ongoing DoD attention and resources are required to promote ADSM and provider awareness, as well as to identify cases early, so case management strategies can be employed. Nine-hundred and eighteen (918) incident cases of coccidioidomycosis were diagnosed in ADSMs between 2007 and 2022, of which 155 were hospitalized. In 2019–2022, the annual incidence rates were lower than the average incidence rate of 4.3 per 100,000 ADSMs over the reporting period (2007–2022); however, the annual rates have fluctuated greatly. Most reported cases did not require hospitalization; however, of those that did require hospitalization, about 28.3 percent were reported to have an extrapulmonary diagnosis, which tends to be more severe compared to an acute diagnosis. Cases primarily occurred in the disease-endemic areas associated with coccidioidomycosis, which feature semi-arid to arid environments. Though MWDs live and work in the same or similar endemic areas as ADSMs, only six total MWD cases of coccidioidomycosis were identified between January 1, 2014, and September 6, 2023. Of those cases, only one was identified after 2017. Although there have been no reported disruptions to training, deployment, or other activities in the military due to coccidiomycosis within the last 20 years, the DoD recognizes it's potential to negatively impact military readiness. Ongoing research and surveillance efforts into coccidiosis infections and environmental prevalence will improve risk mitigation and preventive measures.

V: APPENDIX A – TABLES SUPPORTING FIGURES

Table A1. Incident coccidioidomycosis cases, by installation, ADSMs, U.S. Armed Forces, 2007-2022

No.	Installation	State	OCONUS/ CONUS	Country	Endemic Location
175	NAVAL BASE SAN DIEGO	CA	CONUS	US	ENDEMIC
142	NAS LEMOORE	CA	CONUS	US	ENDEMIC
104	LUKE AFB	AZ	CONUS	US	ENDEMIC
89	DAVIS-MONTHAN AFB	AZ	CONUS	US	ENDEMIC
80	FT HUACHUCA	AZ	CONUS	US	ENDEMIC
27	FT BLISS	TX	CONUS	US	ENDEMIC
23	WALTER REED NATIONAL MILITARY MEDICAL CENTER	MD	CONUS	US	NON-ENDEMIC
22	FT SHAFTER	HI	CONUS	US	NON-ENDEMIC
22	JB SAN ANTONIO	TX	CONUS	US	ENDEMIC
18	MCB CAMP PENDLETON	CA	CONUS	US	ENDEMIC
17	EDWARDS AFB	CA	CONUS	US	ENDEMIC
13	JB LEWIS-MCCHORD	WA	CONUS	US	ENDEMIC
10	OTHER - CA	CA	CONUS	US	ENDEMIC
9	FT IRWIN	CA	CONUS	US	ENDEMIC
9	NMC PORTSMOUTH	VA	CONUS	US	NON-ENDEMIC
8	FT EISENHOWER	GA	CONUS	US	NON-ENDEMIC
8	FT RILEY	KS	CONUS	US	NON-ENDEMIC
8	WRIGHT-PATTERSON AFB	OH	CONUS	US	NON-ENDEMIC
6	OTHER - AZ	AZ	CONUS	US	ENDEMIC

No.	Installation	State	OCONUS/ CONUS	Country	Endemic Location
6	FT CAVAZOS	TX	CONUS	US	ENDEMIC
6	RAMSTEIN AB	XX	OCONUS	GM	NON-ENDEMIC
5	TRAVIS AFB	CA	CONUS	US	ENDEMIC
5	FT CARSON	CO	CONUS	US	NON-ENDEMIC
5	OTHER - IL	IL	CONUS	US	NON-ENDEMIC
4	MCB CAMP LEJEUNE	NC	CONUS	US	NON-ENDEMIC
4	NELLIS AFB	NV	CONUS	US	ENDEMIC
4	NB OKINAWA	XX	OCONUS	JA	NON-ENDEMIC
3	PRESIDIO OF MONTEREY	CA	CONUS	US	ENDEMIC

Table A1. Incident coccidioidomycosis cases, by installation, ADSMs, U.S. Armed Forces, 2007-2022—Continued

3	**NAS PENSACOLA**	**FL**	**CONUS**	**US**	**NON-ENDEMIC**
3	SCHOFIELD BARRACKS	HI	CONUS	US	NON-ENDEMIC
3	FT LIBERTY	NC	CONUS	US	NON-ENDEMIC
3	HOLLOMAN AFB	NM	CONUS	US	ENDEMIC
3	JB CHARLESTON	SC	CONUS	US	NON-ENDEMIC
3	FT BELVOIR	VA	CONUS	US	NON-ENDEMIC
3	OTHER	XX	UNKNOWN		
3	YOKOTA AB	XX	OCONUS	JA	NON-ENDEMIC
2	JB ELMENDORF-RICHARDSON	AK	CONUS	US	NON-ENDEMIC
2	LOS ANGELES AFB	CA	CONUS	US	ENDEMIC
2	MCAS MIRAMAR	CA	CONUS	US	ENDEMIC
2	NAS POINT MUGU	CA	CONUS	US	ENDEMIC
2	EGLIN AFB	FL	CONUS	US	NON-ENDEMIC
2	PATRICK SFB	FL	CONUS	US	NON-ENDEMIC
2	FT MOORE	GA	CONUS	US	NON-ENDEMIC
2	FT KNOX	KY	CONUS	US	NON-ENDEMIC
2	FT JACKSON	SC	CONUS	US	NON-ENDEMIC
2	GOODFELLOW AFB	TX	CONUS	US	ENDEMIC
1	FT WAINWRIGHT	AK	CONUS	US	NON-ENDEMIC
1	FT RUCKER	AL	CONUS	US	NON-ENDEMIC

1	LITTLE ROCK AFB	AR	CONUS	US	NON-ENDEMIC
1	YUMA PROVING GROUND	AZ	CONUS	US	ENDEMIC
1	MCAGCC TWENTYNINE PALMS	CA	CONUS	US	ENDEMIC
1	VANDENBERG SFB	CA	CONUS	US	ENDEMIC
1	PETERSON SFB	CO	CONUS	US	NON-ENDEMIC
1	USAF ACADEMY	CO	CONUS	US	NON-ENDEMIC

Table A1. Incident coccidioidomycosis cases, by installation, ADSMs, U.S. Armed Forces, 2007-2022—Continued

1	**HURLBURT AFB**	**FL**	**CONUS**	**US**	**NON-ENDEMIC**
1	OTHER - FL	FL	CONUS	US	NON-ENDEMIC
1	TYNDALL AFB	FL	CONUS	US	NON-ENDEMIC
1	ROBINS AFB	GA	CONUS	US	NON-ENDEMIC
1	JB PEARL HARBOR-HICKAM	HI	CONUS	US	NON-ENDEMIC
1	MCAS KANEOHE BAY	HI	CONUS	US	NON-ENDEMIC
1	SCOTT AFB	IL	CONUS	US	NON-ENDEMIC
1	MCCONNEL L AFB	KS	CONUS	US	NON-ENDEMIC
1	BARKSDALE AFB	LA	CONUS	US	NON-ENDEMIC
1	OTHER - LA	LA	CONUS	US	NON-ENDEMIC
1	FT LEONARD WOOD	MO	CONUS	US	NON-ENDEMIC
1	MALMSTRO M AFB	MT	CONUS	US	NON-ENDEMIC
1	NB OKINAWA	NC	OCONUS	JA	NON-ENDEMIC
1	NMRTC CHERRY POINT	NC	CONUS	US	NON-ENDEMIC
1	CANNON AFB	NM	CONUS	US	ENDEMIC
1	FT DRUM	NY	CONUS	US	NON-ENDEMIC
1	WEST POINT	NY	CONUS	US	NON-ENDEMIC
1	ALTUS AFB	OK	CONUS	US	NON-ENDEMIC
1	FT SILL	OK	CONUS	US	NON-ENDEMIC
1	OTHER - PA	PA	CONUS	US	NON-ENDEMIC
1	NAVSTA NEWPORT	RI	CONUS	US	NON-ENDEMIC

1	OTHER - TN	TN	CONUS	US	NON-ENDEMIC
1	DYESS AFB	TX	CONUS	US	ENDEMIC
1	LAUGHLIN AFB	TX	CONUS	US	ENDEMIC

Table A1. Incident coccidioidomycosis cases, by installation, ADSMs, U.S. Armed Forces, 2007-2022—Continued

1	OTHER - TX	TX	CONUS	US	ENDEMIC
1	JB LANGLEY-EUSTIS	VA	CONUS	US	NON-ENDEMIC
1	NAVSTA NORFOLK	VA	CONUS	US	NON-ENDEMIC
1	FAIRCHILD AFB	WA	CONUS	US	ENDEMIC
1	NB KITSAP	WA	CONUS	US	ENDEMIC
1	AHC LIVORNO	XX	OCONUS	IT	NON-ENDEMIC
1	AL DHAFRA AB	XX	OCONUS	AE	NON-ENDEMIC
1	AVIANO AB	XX	OCONUS	IT	NON-ENDEMIC
1	FA YOKOSUKA	XX	OCONUS	JA	NON-ENDEMIC
1	NH NAPLES	XX	OCONUS	IT	NON-ENDEMIC

Table A2. Location of coccidioidomycosis laboratory tests, by State, ADSMs, U.S. Armed Forces, 2007-2022

State	Incident Positive	Incident Test	Percent Positive	Total Labs
AK	2	32	6.3	100
AL	1	8	12.5	15
AR	0	4	0.0	8
AZ	205	2165	9.5	6360
CA	336	3636	9.2	12309
CO	4	52	7.7	146
CT	0	3	0.0	4
DC	6	57	10.5	113
DE	0	1	0.0	1
FL	5	115	4.3	164
GA	6	71	8.5	135
HI	27	144	18.8	381
ID	0	3	0.0	9
IL	5	96	5.2	236
KS	6	83	7.2	134
KY	0	65	0.0	79
LA	1	3	33.3	11
MD	13	241	5.4	651
MO	1	17	5.9	21

Table A2. Location of coccidioidomycosis laboratory tests, by State, ADSMs, U.S. Armed Forces, 2007-2022—Continued

MS	**0**	**32**	**0.0**	**52**
MT	1	1	100.0	2
NC	5	94	5.3	179
ND	0	2	0.0	4
NE	0	5	0.0	6
NH	0	1	0.0	1
NJ	0	5	0.0	10
NM	4	22	18.2	52
NV	4	65	6.2	166
NY	1	7	14.3	8
OH	7	30	23.3	109
OK	2	23	8.7	50
RI	1	1	100.0	6
SC	4	33	12.1	74
SD	0	1	0.0	2
TX	46	902	5.1	2072
UT	0	1	0.0	2
VA	11	348	3.2	550
WA	10	108	9.3	264

VI: APPENDIX B – REFERENCES

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