VALLEY FEVER

2016 ANNUAL REPORT

ARIZONA DEPARTMENT OF HEALTH SERVICES

Photo credit: Michael Olbinski

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Executive Summary

Valley fever is an infection caused by a fungus that is found in the soil of the southwestern United States, and parts of Mexico, Central and South America. People become infected after inhaling fungal spores made airborne by disturbance of soil by natural or human activity. It is not contagious and cannot be transmitted from animals to humans. Sixty percent of infected persons experience no or mild symptoms. The remaining 40% experience a self-limited respiratory disease with symptoms such as fever, cough, fatigue, chest pain, shortness of breath, and rash. In less than 5% of people with symptoms, it can cause severe respiratory disease or disseminated disease outside of the lungs requiring treatment with antifungal medication. Treatment may need to be continued for many months or possibly for life. There is no vaccine or cure, and preventing infection is difficult.

Continued surveillance for valley fever by the Arizona Department of Health Services (ADHS) has demonstrated that:

- Nearly two-thirds of all cases reported nationwide reside in Arizona.
- Valley fever is one of the most commonly reported infectious diseases in Arizona.
- 94% of cases reported in Arizona reside in Maricopa, Pima, and Pinal Counties.
- In the last decade, the incidence* of reported valley fever in Arizona has increased from 74.9 per 100,000 population in 2007 to 89.3 per 100,000 population in 2016.**

An analysis of valley fever-associated hospitalizations from hospital discharge data noted that, in 2016:

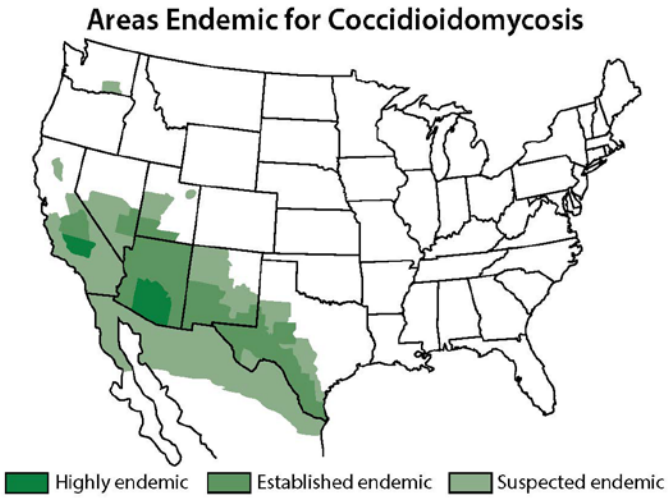
- There were 705 hospitalizations associated with a primary diagnosis of valley fever.
- Hospitalization charges for Arizona residents with a primary diagnosis of valley fever totaled $55 million.

*All incidence rate calculations included in this report are based on population denominators estimated by the ADHS Health Status and Vital Statistics Section using population projections obtained from the Arizona Department of Administration.

**Changes in reporting and testing practices at Laboratory A in 2009 and 2012 have significantly impacted the number of reported cases.

Introduction

Valley fever, also known as coccidioidomycosis, is an infection caused by the fungus *Coccidioides* spp. It has affected inhabitants of the southwestern desert of the U.S. for thousands of years.[1] The fungus is present in the top 2–8 inches of warm, dry soils at lower elevations of the American Southwest, especially Arizona and California, as well as parts of Mexico, Central and South America. The fungus has also recently been found in south-central Washington.[2]



When soil is disrupted (e.g. by wind, earthquakes, human activity, etc.), fungal spores become dispersed in the air. Susceptible individuals breathe in the spores resulting in infection. Infection causes mild or no symptoms in about 60% of cases. The remaining 40% experience a flu-like respiratory illness with symptoms including cough, fever, fatigue, chest pain, shortness of breath, headaches, rash, and joint and muscle aches. Symptoms generally begin 1–4 weeks after exposure and may last for several weeks, causing significant hardship including lost time at work and school. Most cases recover without treatment and become immune for life. However, less than 5% of people experience severe illness in the form of severe respiratory or disseminated disease.

Dissemination is the spread of the infection outside of the lungs. Although nearly any part of the body can become infected, the skin, bones, and central nervous system are the most common sites of dissemination. Risk factors for dissemination include weakening of the immune system due to underlying health conditions (e.g. HIV/AIDS, organ transplant), immunosuppressive medication (e.g. corticosteroids, chemotherapy, biopharmaceuticals for autoimmune diseases), African American or Filipino race, male sex, and pregnancy.

Disseminated disease can be deadly and requires treatment. Anti-fungal medications can be used to control the infection, but can have side effects. There is no cure or vaccine for valley fever.

Valley fever is a reportable communicable disease in Arizona. Arizona Administrative Code (A.A.C.) R9-6-202, 203, 204, and 205 describe the morbidities, test results, or prescriptions required to be reported by healthcare providers, administrators of healthcare facilities, clinical laboratory directors, institutions, schools, pharmacists, and others. Healthcare providers and laboratories are required to report a case of or positive test result for valley fever to ADHS within five working days. Arizona requires reporting by both healthcare providers and clinical laboratories as a dual surveillance measure to increase the sensitivity of the surveillance system and improve the completeness of reporting. Diseases are reported via secure electronic reporting systems, fax, mail, or telephone using the communicable disease report (CDR) form. More information about the current reporting requirements can be found on the Arizona Office of the Secretary of State's website.[3] Additional information on communicable disease reporting as well as reporting can be found on the ADHS Office of Infectious Disease Services website.[4]

Previously, ADHS received a legislative appropriation as well as funding from the Centers for Disease Control and Prevention (CDC) and the Arizona Biomedical Research Commission (ABRC) for valley fever prevention and control activities. Since 2012, ADHS has received funding through the CDC's Epidemiology and Laboratory Capacity for Infectious Diseases Cooperative Agreement to continue some of these activities.

Epidemiology in Arizona

The first reported case of valley fever in Arizona was described in 1938.[5] Since 1998, Arizona has accounted for over two-thirds of all valley fever cases reported nationwide[6] with thousands of cases reported to ADHS each year. However, public health surveillance only captures a fraction of infections. Most infected persons do not seek care or may not receive diagnostic testing when they do. Thus, the total number of infections in Arizona is likely several times higher than the number reported to ADHS.

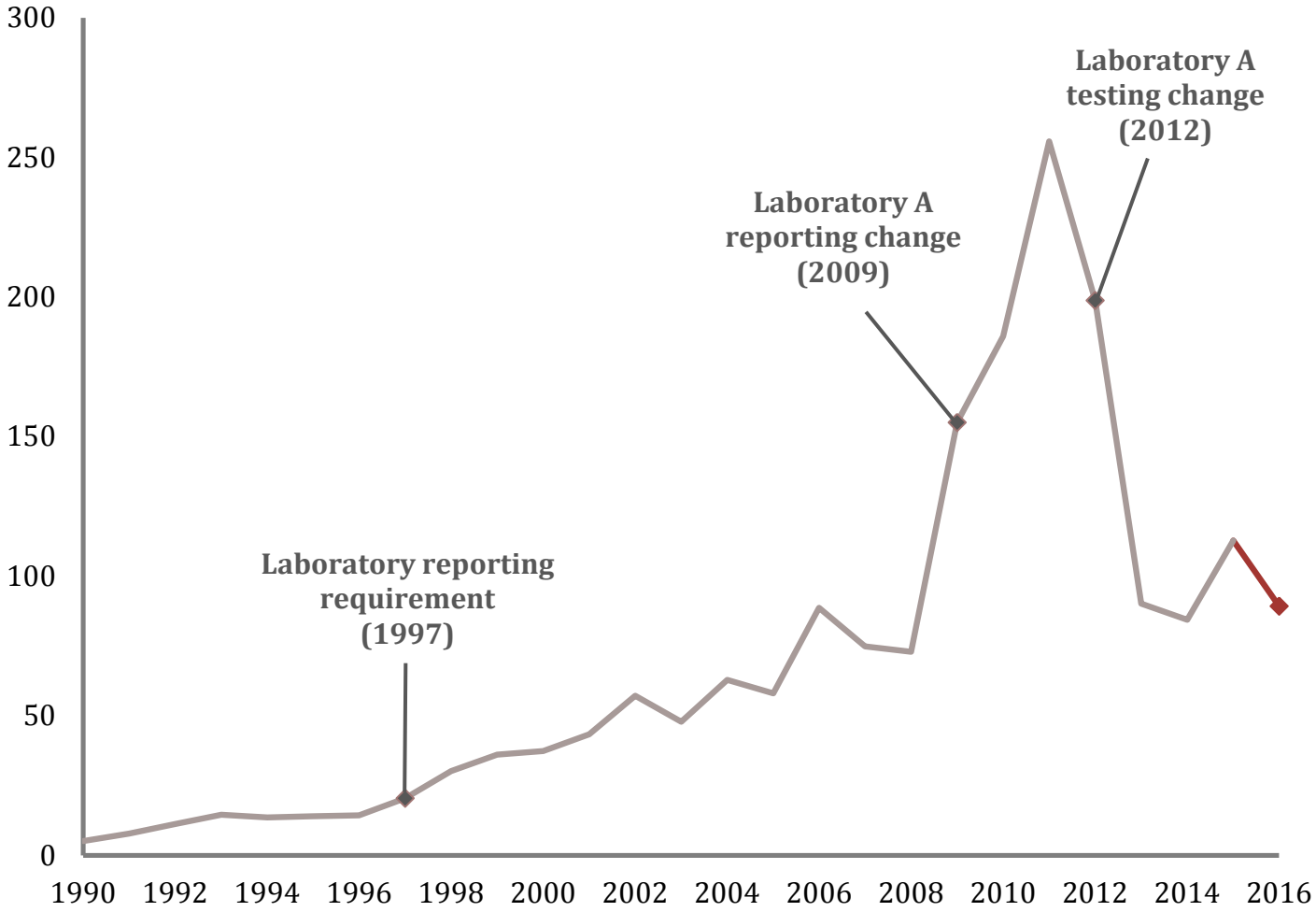
Cases of valley fever have been reported to ADHS for decades. Laboratory reporting of valley fever was mandated in 1997. Since then, reports of valley fever have increased dramatically. In 2009, a major commercial laboratory (Lab A) altered its reporting practices for valley fever, after consultation with ADHS, to include reporting of enzyme immunoassay (EIA) results, greatly increasing the total number of reported cases. In 2012, a change in testing methods at Lab A contributed to a substantial decline in the number of cases reported in late 2012 and 2013.

In 2016, 6,101 cases of valley fever were reported to ADHS. This is a decrease of 1,521 cases (20%) compared to 2015. This is in stark contrast to California which reported 5,372 cases in 2016[7]—roughly a 70% increase compared to 2015. The causes of variability in reported case counts remains poorly understood. Contributing factors may include:

- Migration of susceptible people to the highly endemic counties in Arizona.
- Increased recognition and testing by healthcare providers.
- Increased awareness and care-seeking among the general public.
- An increase in the number of people with weakened immune systems due to aging, immunosuppressive medications, or underlying health conditions.
- Changes in precipitation, dust storms, and other weather-related phenomena that may affect fungal growth, spore formation, and dispersal.
- Increased construction or desert soil disturbance in areas where the fungus is present.

See Table 1 in the Appendix for more information.

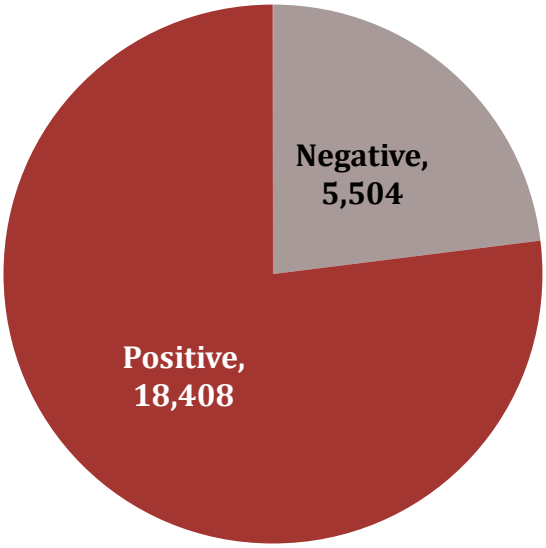
The rate* declined substantially from 112.8 in 2015 to 89.3 in 2016. There were 6,101 reported cases in 2016.



*Reported cases per 100,000 population

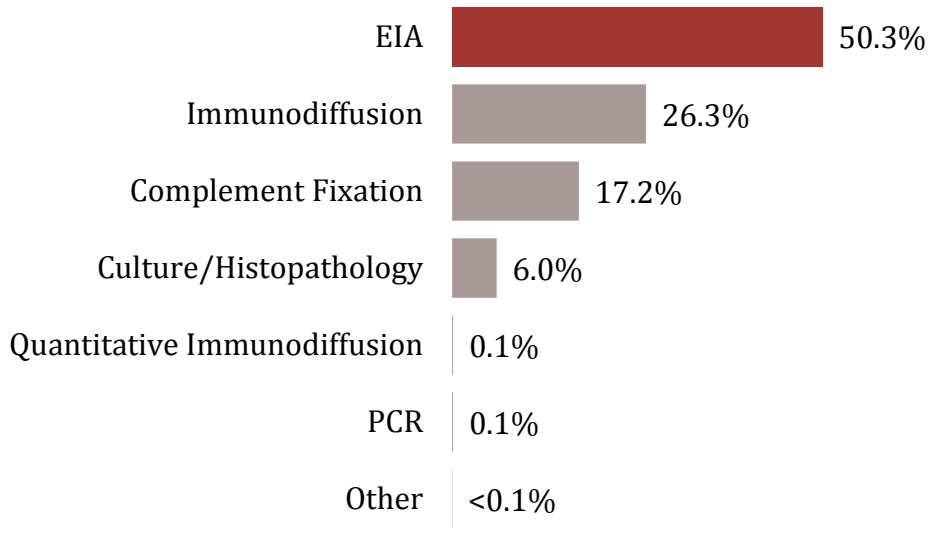
Laboratory Data

There were 23,912 laboratory tests* for valley fever reported** to ADHS in 2016, of which, 77% were positive.



*Multiple tests were reported per patient.
**97% of reported tests were able to be classified, and over 99% of cases were reported by laboratories in 2016.

Of the 18,408 positive valley fever tests in 2016, the majority (50.3%) were performed using an Enzyme Immunoassay (EIA).

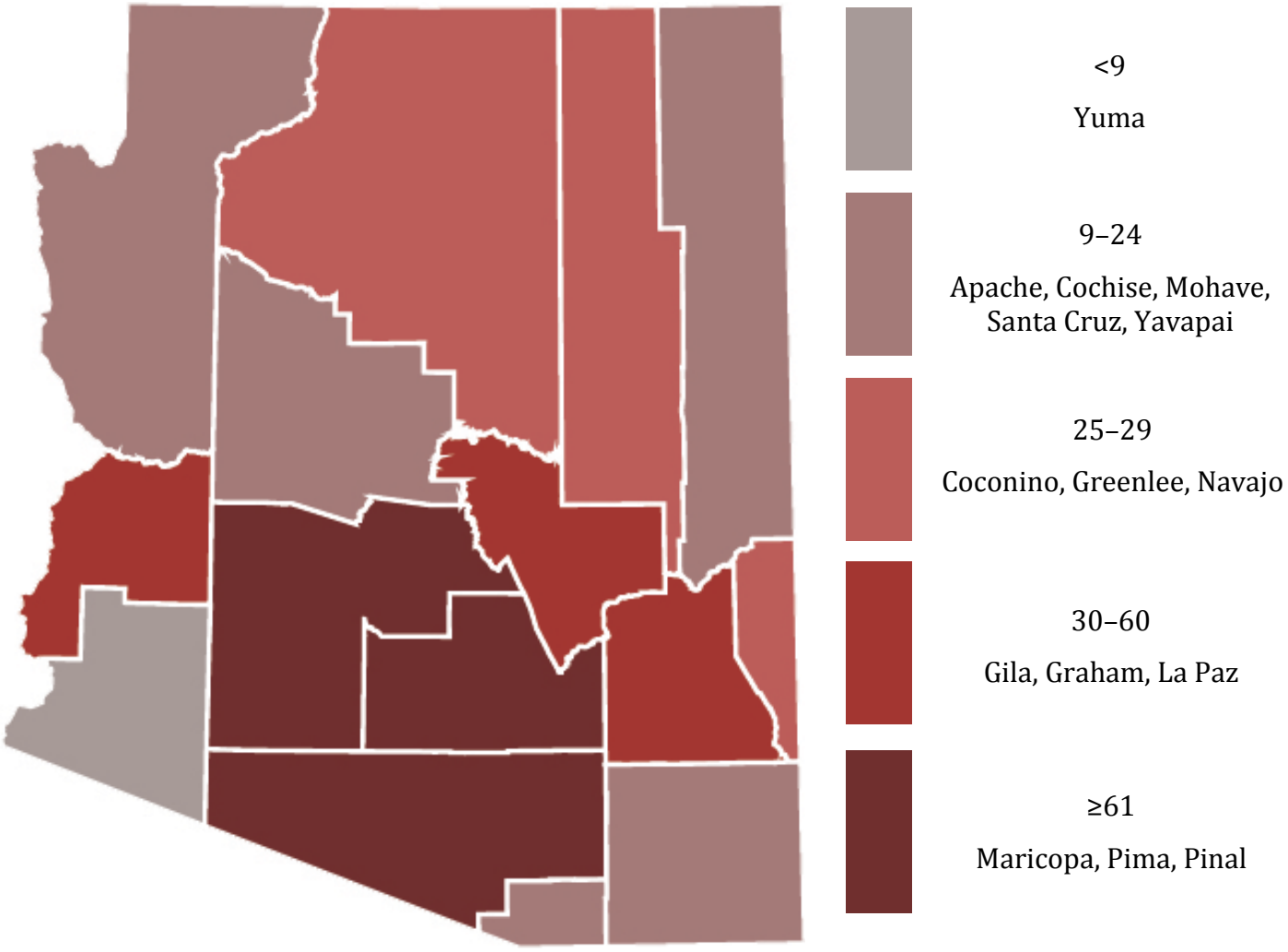


See Table 2 and Reporting Sources and Changes in Laboratory Reporting Practices in the Appendix for more information.

Geographic Distribution

Cases were reported from every county in Arizona in 2016. Rates of reported valley fever were highest in Maricopa, Pima, and Pinal Counties, which is consistent with prior years. *See Table 3 in the Appendix for more information*.

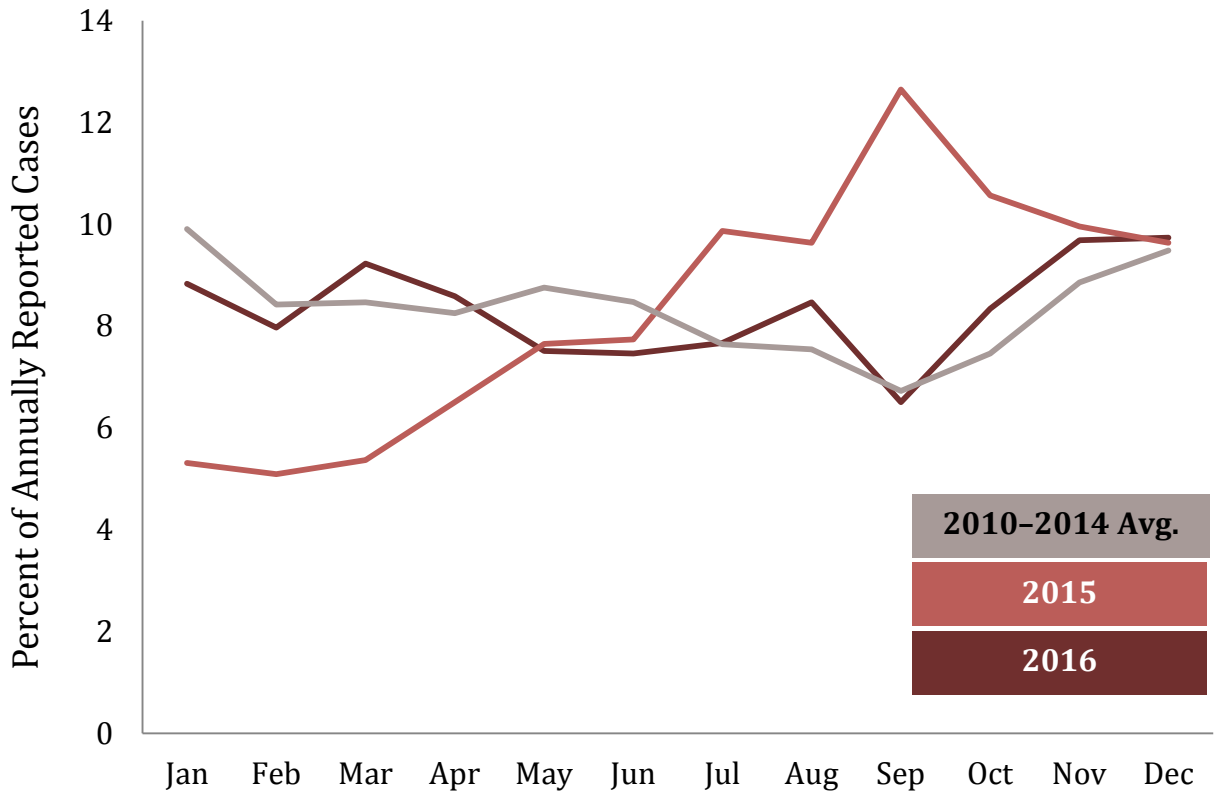
Pinal County had the highest rate* in 2016.



*Reported cases per 100,000 population

Seasonality

The proportion of cases reported each month in 2016 resembled the 2010–2014 average, while 2015 cases did not follow this pattern.



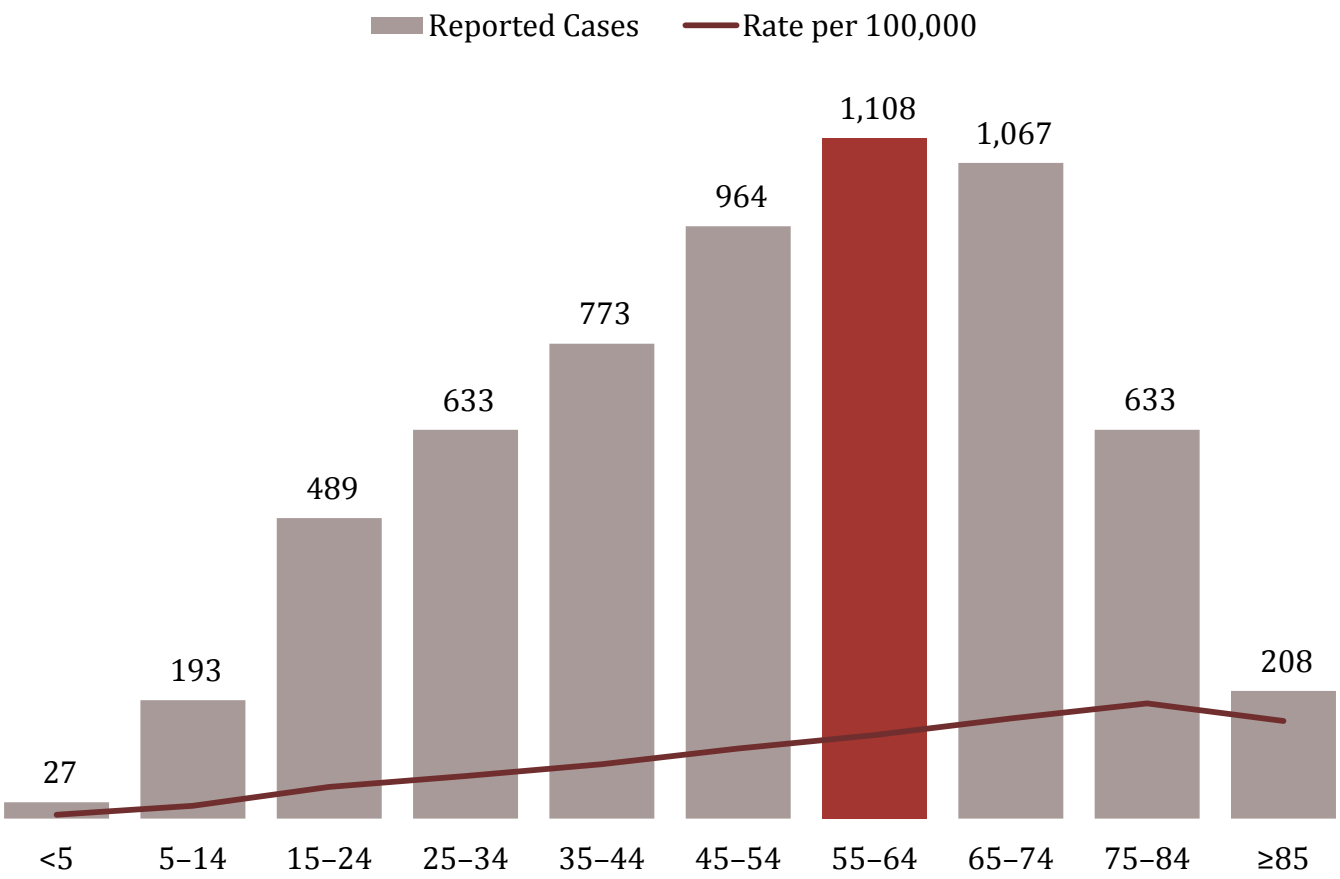
Seasonal variation in valley fever reports has been consistently noted in past years: numbers of reported cases increase in the spring and the winter. It is unclear why the proportion of 2015 cases by month does not resemble the pattern followed by other years. These data do not correspond to month of exposure to fungal spores or onset of symptoms. Possible causes of delay between exposure and reporting include the 1–4 week incubation period between exposure and symptom onset, delays before seeing a healthcare provider for the illness, delays in being tested for valley fever, time associated with processing and testing laboratory specimens, and time associated with reporting by a laboratory or healthcare provider to the health department. A previous ADHS investigation found that the median time between symptom onset and diagnosis was 55 days.[8]

Demographics

Age

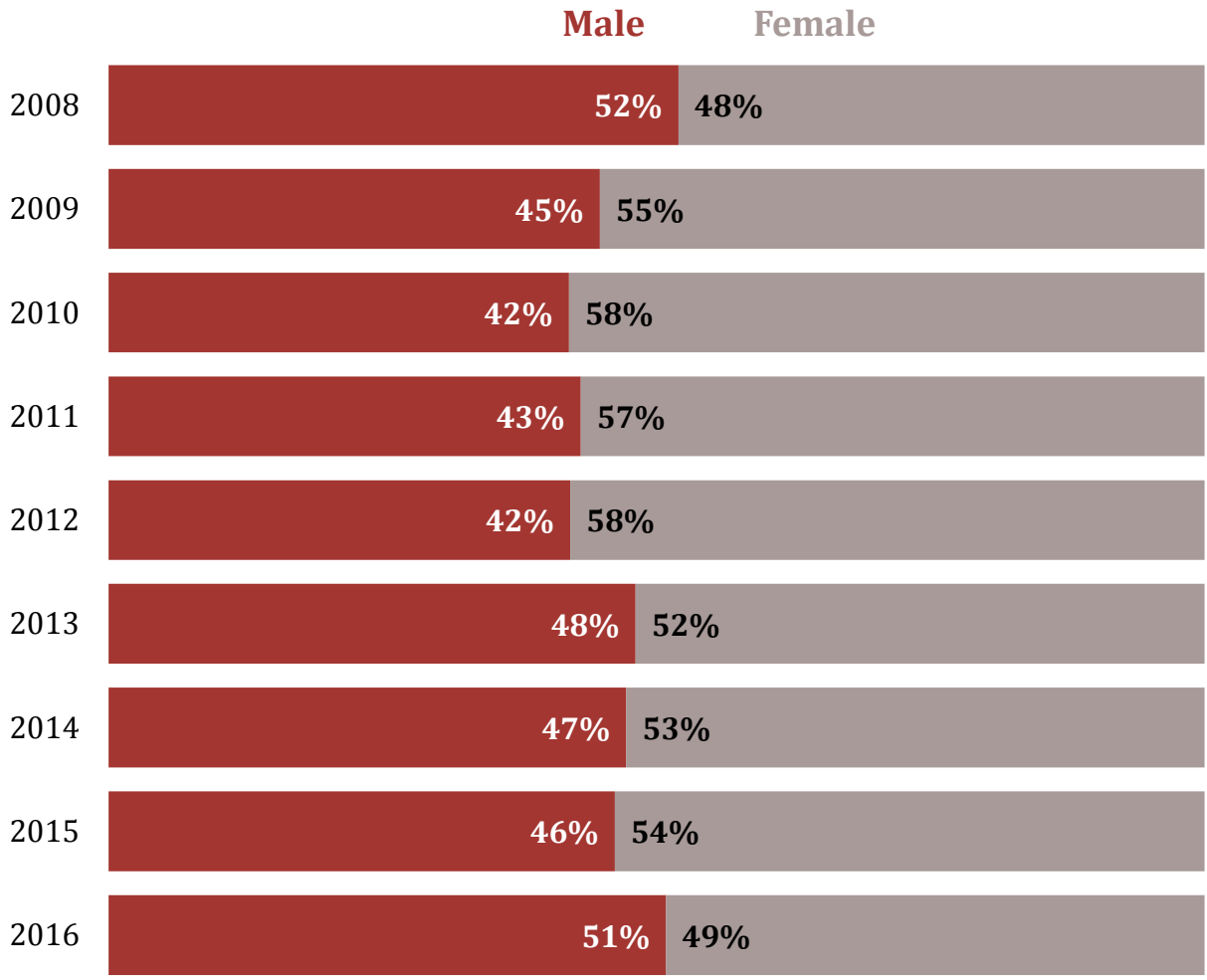
In 2016, the age of reported valley fever cases ranged from six months to 99 years old with a median age of 55 years. The highest rate of reported disease occurred among those 75–84 years old. Rates in this age group are more than twice those in the general population (187.7 vs. 89.3 reported cases per 100,000 population, respectively). Age could not be determined for six cases (approximately 0.1% of all cases). *See Table 4 in the Appendix for more information*.

The largest proportion of cases was 55–64 years old.



Sex

Males accounted for just over half of reported cases with known sex* in 2016. This has not occurred since 2008.



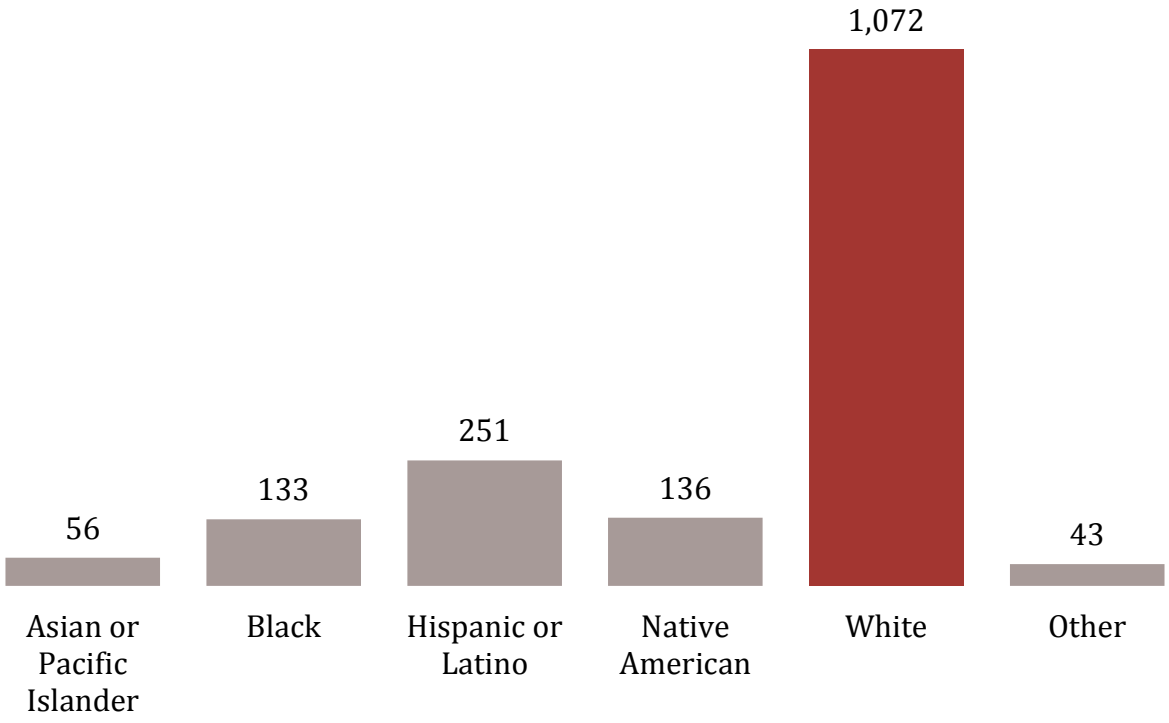
*Sex was not reported for 14 cases in 2016 (0.2% of all cases).

Prior to 2009, the majority of reported cases were male. 2016 was the first year since 2008 that males accounted for the majority of cases. It is not clear why, but reporting and testing changes may have caused this shift. *See Table 5 in the Appendix for more information.*

Race/Ethnicity

Of the 6,101 reported cases, 72.3% did not contain information about race or ethnicity. Thus, it was not possible to analyze incidence rates by race or ethnicity. *See Table 6 in the Appendix for more information*.

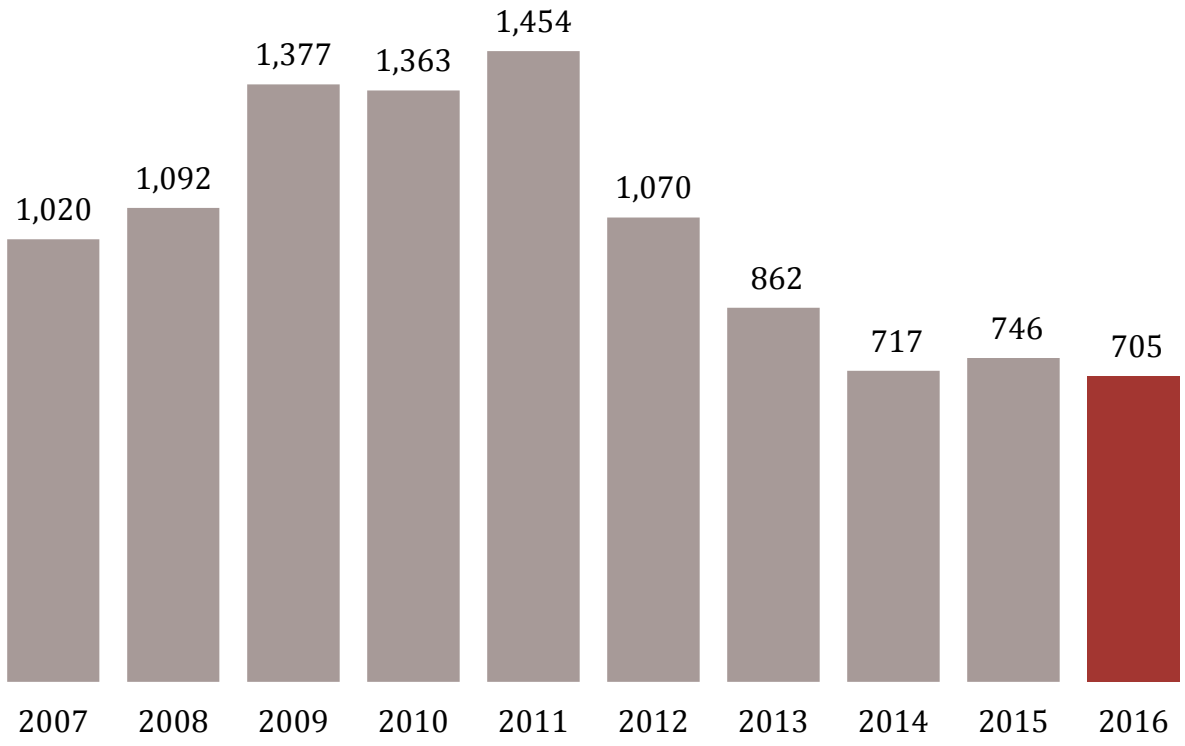
Whites accounted for **63.4%** of reported cases with known race or ethnicity.



Hospitalizations

A previous ADHS investigation noted that 40% of reported valley fever cases required hospitalization.[8] In 2016, there were 705 hospitalizations with a primary diagnosis of valley fever. The rate of hospitalizations with a primary diagnosis of valley fever increased from 15.9 hospitalizations per 100,000 population in 2007 to a high of 22.6 hospitalizations per 100,000 population in 2011, falling to 10.3 hospitalizations per 100,000 population in 2016. Graham and Pinal Counties had the highest rates of hospitalizations. The causes of this variability are unclear, but may reflect improved diagnosis and recognition by healthcare providers and changes in the incidence of disease. It should also be noted that the transition from ICD-9 to ICD-10 codes occurred in October 2015, but it is uncertain how this change affected the number of hospitalizations with a primary diagnosis of valley fever since that time. *See Table 7 in the Appendix for more information*.

There were 705 hospitalizations with a primary diagnosis of valley fever in 2016.



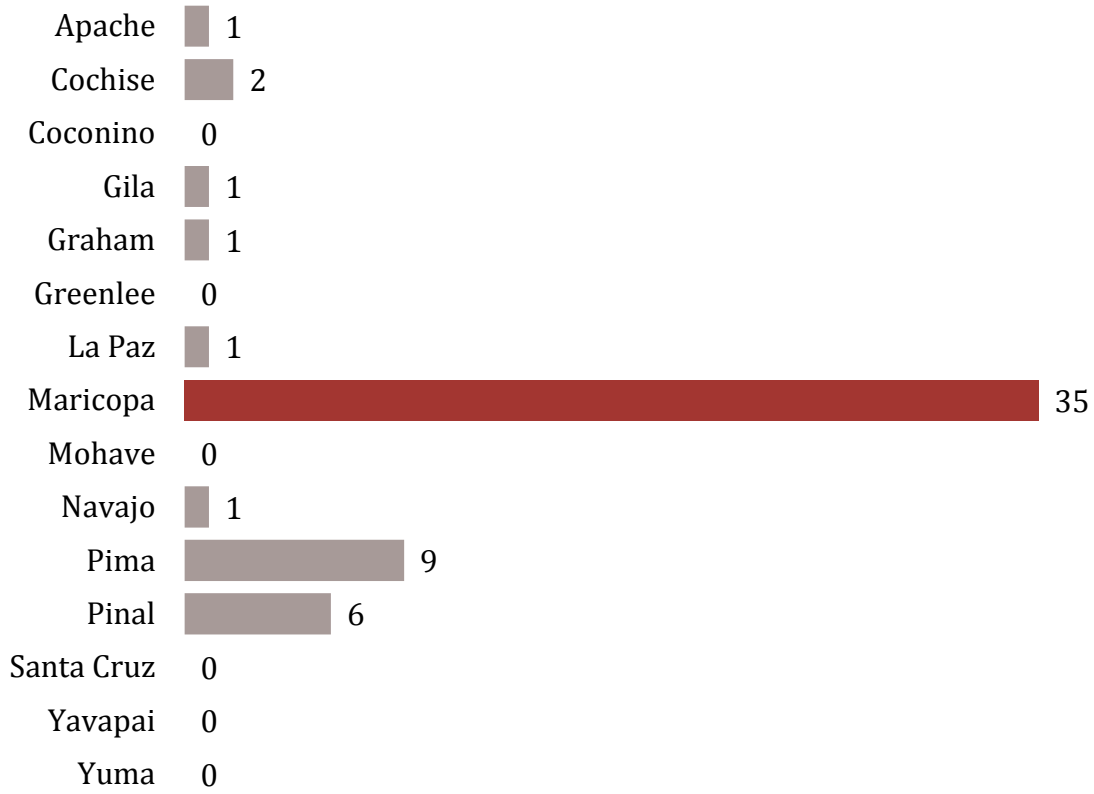
Valley fever continues to be a costly disease. A previous investigation noted that total charges, which do not reflect actual payments, for Arizona residents hospitalized with a primary or secondary diagnosis of valley fever at non-federal facilities in Arizona were $86 million in 2007.[8] In 2016, hospitalization charges for Arizona residents with a primary diagnosis totaled $55 million with a median of $47,212 in total charges per hospitalization. Medicare was the most frequently listed expected source of payment (28.2%), followed by the Arizona Health Care Cost Containment System (AHCCCS) (25.4%), Health Maintenance Organizations (HMO) (19.7%), Preferred Provider Organizations (PPO) (8.8%), Medicare Risk (8.7%), Indemnity (4.7%), and self-pay (2.1%). Total charges associated with hospitalizations for which Medicare and AHCCCS were listed as sources of payment were $14.9 million and $16.2 million, respectively. The total healthcare costs attributable to valley fever are greater due to the exclusion of the cost of outpatient care and other forms of inpatient care in these figures.

Males accounted for 51% of reported cases in 2016; however, 57.2% of hospitalizations involved a male patient. The age distribution of hospitalized patients was as follows: 10.1% <25 years old, 24.3% 25–44 years old, 36.2% 45–64 years old, 27.1% 65–84 years old, and 2.4% 85 years or older. The median age was 55 years. Approximately 43.1% of hospitalizations involved an intensive care unit (ICU) admission. The median length of stay was 5 days. Twenty percent of patients were readmitted to the hospital with a primary diagnosis of valley fever. Thirteen patients (1.8%) died during a hospitalization.

Deaths

Valley fever is rarely lethal. However, infection in persons who are severely immunosuppressed, due to HIV/AIDS for example, may lead or contribute to death. Based on causes of death listed on death certificates from 2016, valley fever was a primary or contributing cause of death in 57 deaths in Arizona. A recent public health investigation found that death certificates might underreport valley fever as a cause of death. The estimated number of deaths attributable to valley fever derived from death certificates and hospital discharge data was seven-fold higher than the estimate calculated from death certificates alone.[9] Thus, these data are likely an underestimate of the true number of deaths attributable to valley fever.

Maricopa County accounted for 61% of the deaths attributable to valley fever among Arizonans in 2016.



Acknowledgements

Case reporting by providers and laboratories is the key to Arizona's infectious disease surveillance system. All staff within the ADHS Office of Infectious Disease Services and local health departments are acknowledged for their contributions to data collection, data entry, and data analysis. Funds and technical assistance from the CDC and the University of Arizona Valley Fever Center for Excellence (VFCE) supported this work. The contents of this report are solely the responsibility of the authors and do not represent the official views of the CDC or the VFCE.

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Appendix

Table 1. Reported cases and rates of valley fever, 1990–2016.

Year	Reported cases	Rates*
1990	191	5.2
1991	287	7.8
1992	437	11.3
1993	592	14.6
1994	580	13.6
1995	626	14.1
1996	655	14.4
1997	869	20.5
1998	1,556	30.2
1999	1,813	36.1
2000	1,922	37.4
2001	2,302	43.4
2002	3,118	57.2
2003	2,695	47.9
2004	3,665	62.9
2005	3,515	58.1
2006	5,535	88.7
2007	4,832	74.9
2008	4,768	73.0
2009	10,233	155.1
2010	11,888	185.9
2011	16,472	255.8
2012	12,920	198.8
2013	5,861	90.2
2014	5,624	84.4
2015	7,622	112.8
2016	**6,101**	**89.3**

*Reported cases per 100,000 population

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Table 2. Positive valley fever laboratory tests, 2016.

Test Type	Frequency	Percent
EIA	9,253	50.3%
Immunodiffusion	4,844	26.3%
Complement Fixation	3,163	17.2%
Culture/Histopathology	1,107	6.1%
Quantitative Immunodiffusion	19	0.1%
PCR	18	0.1%
Other, not valley fever	4	<0.1%
Total	**18,408**	**100%**

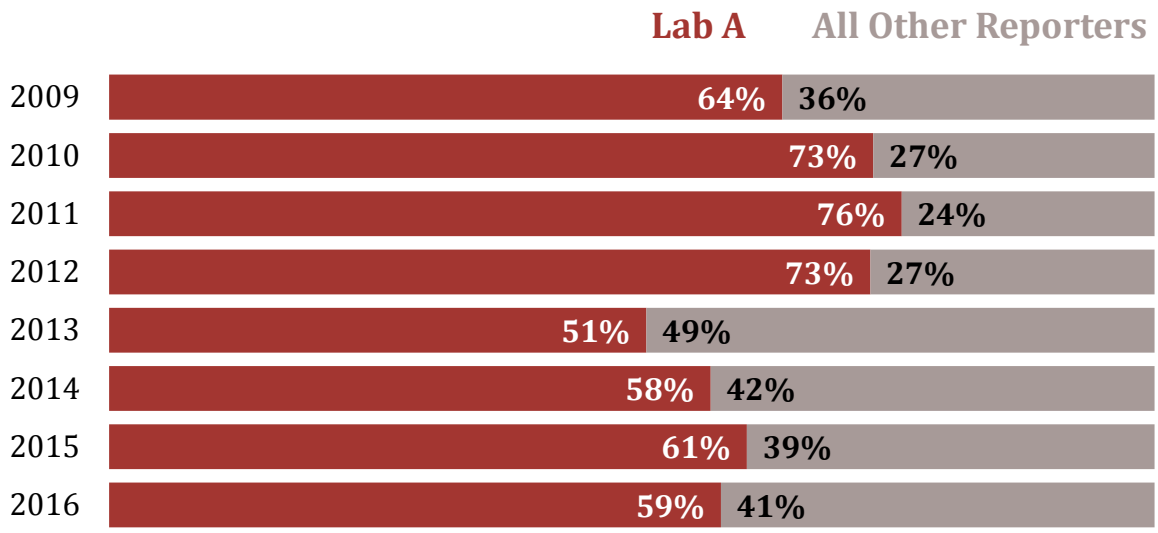
Back to Report: Laboratory Data

Reporting Sources and Changes in Laboratory Reporting Practices

Ninety-nine percent of cases were reported by laboratories in 2016. The proportion of cases reported by a single major commercial laboratory (Lab A) increased from 2009–2011. In mid-2009, Lab A altered its reporting practices for valley fever after consultation with ADHS, to include reporting of enzyme immunoassay (EIA) results, greatly increasing the total number of reported cases. In late 2012, the same laboratory changed the testing platform used for EIAs, and in 2013 the number of cases reported statewide declined 55% compared to 2012.

Back to Report: Laboratory Data

The proportion of cases reported by Lab A declined after 2012.



Back to Report: Laboratory Data

Table 3. Reported cases and rates by county, 2016.

County	Cases	2016 Rates*	2011–2015 Avg. Rates*
Apache	16	22.2	23.6
Cochise	31	24.2	44.9
Coconino	42	29.5	27.4
Gila	33	60.7	82.4
Graham	17	44.4	60.8
Greenlee	3	28.8	24.1
La Paz	12	56.5	109.0
Maricopa	4,392	106.2	188.5
Mohave	48	23.3	41.8
Navajo	33	29.9	41.3
Pima	895	88.3	126.6
Pinal	496	120.0	158.5
Santa Cruz	10	19.8	35.1
Yavapai	55	25.0	24.1
Yuma	18	8.3	14.7
Arizona	**6,101**	**89.3**	**148.2**

*Reported cases per 100,000 population

Back to Report: Geographic Distribution

Table 4. Reported cases and rates by age groups, 2016.

Age Group* (years)	Cases	Rates**
<5	27	6.3
5–14	193	21.0
15–24	489	51.5
25–34	633	69.2
35–44	773	88.8
45–54	964	114.2
55–64	1,108	136.0
65–74	1,067	163.1
75–84	633	187.7
≥85	208	158.8

*Age could not be ascertained for 6 cases (approximately 0.1% of all cases).
**Reported cases per 100,000 population

Back to Report: Age

Table 5. Cases and rates by sex, 2016.

Sex	Cases	Percent of total	Rates*
Female	2,990	49.0%	86.9
Male	3,097	50.8%	91.2
Unknown	14	0.2%	---

*Reported cases per 100,000 population

Back to Report: Sex

Table 6. Race or ethnicity of reported cases, 2016.

Race or ethnicity	Cases	Percent of total	Percent of cases with known race or ethnicity
Asian or Pacific Islander	56	0.9%	3.3%
Black	133	2.2%	7.9%
Hispanic or Latino	251	4.1%	14.8%
Native American	136	2.2%	8.0%
White	1,072	17.6%	63.4%
Other	43	0.7%	2.7%
Unknown	4,410	72.3%	---

Back to Report: Race/Ethnicity

Table 7. County rates of hospitalization with a primary diagnosis of valley fever, 2016.

County	Hospitalization Rates*
Apache	4.2
Cochise	2.3
Coconino	4.2
Gila	12.9
Graham	20.9
Greenlee	9.6
La Paz	4.7
Maricopa	11.8
Mohave	4.4
Navajo	8.2
Pima	7.9
Pinal	18.9
Santa Cruz	0.0
Yavapai	3.2
Yuma	2.8
Arizona	**10.3**

*Reported cases per 100,000 population

Back to Report: Hospitalizations