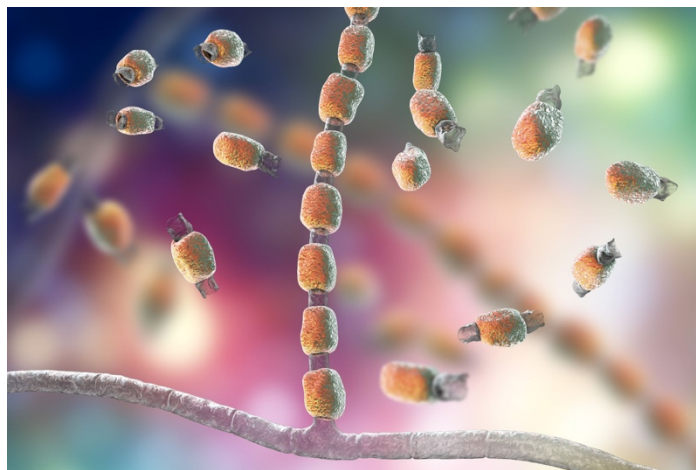


**THE COST OF VALLEY FEVER IN ARIZONA:  
*Summary of Results***



**Dr. Kent Hill and Haley Klundt  
L. William Seidman Research Institute  
W. P. Carey School of Business  
Arizona State University**

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This report provides estimates of the lifetime cost burden of new cases of coccidioidomycosis (Valley fever) infection in Arizona in the year 2019. The direct costs of infection are the health care treatment costs the patient is expected to incur over his or her lifetime—doctors' visits, chest X-rays, antifungal medications, episodes of hospitalization, etc. The indirect costs of infection are conservatively represented by the value of earnings lost during the initial period of treatment and earnings lost because of premature mortality. All costs are measured in 2019 dollars, and future costs are discounted to the present at a real rate of interest equal to 3 percent. Following Wilson, et al. (2019)<sup>1</sup>, cost estimates are made for each of five types of disease manifestation: (1) uncomplicated pneumonia, (2) chronic pneumonia without dissemination, (3) chronic pneumonia with dissemination, including meningitis, (4) other changes in chest, pulmonary nodule and (5) other changes in chest, pulmonary cavity.

Using the disease frequency distribution in Wilson, et al., 85 percent of symptomatic (reported) cases of Valley fever are assumed to consist of uncomplicated pneumonia. The estimated average per person lifetime direct costs in this case are \$29,900. Patients with this disease manifestation have normal life expectancy. The indirect costs of the disease are simply the value of workdays lost during the initial period of treatment, estimated on average to be \$1,300 per person.

Five percent of symptomatic cases are assumed to develop chronic pneumonia, with half of these having no dissemination and the other half with dissemination. Patients with chronic pneumonia but no dissemination are likely to require hospitalization during the first two years after diagnosis and are administered medications for each of the first three years. The lifetime direct costs for these patients are estimated to be \$162,700 per person. Health care treatment costs are very high for those with dissemination. These patients will require both medication and periods of hospitalization throughout their lives. The lifetime direct costs for cases with dissemination are estimated to be \$1.13 million per person.

Patients with Valley fever who develop chronic pneumonia suffer a significant number of lost workdays during their initial period of treatment (3-4 months). They also have higher rates of mortality. In particular, for patients with dissemination, the marginal mortality rate associated with the disease is assumed to be 15% in the first five years and 1% each year thereafter. Adding together both the value of workdays lost and the costs of premature mortality, indirect costs are estimated to be \$41,100 per person for those without dissemination and \$137,400 for those with dissemination.

In the disease classification of Wilson, et al., 10 percent of Valley fever patients experience “Other changes in chest.” These patients require expensive diagnostic work-up for possible lung cancer. The direct costs estimated for these cases are \$119,400 per person for pulmonary nodule and \$127,800 per person for pulmonary cavity. Patients in these disease categories are assumed to lose 7 days of work during their initial period of treatment and suffer mortality rates that are 0.2% higher each year for the remainder of their lives. The implied indirect costs of the disease are \$7,500 per person.

A total of 10,359 new Valley fever cases were recorded in Arizona in 2019. Assuming the percentage distribution of these cases by disease manifestation was the same as in Wilson, et al., the total lifetime direct cost of these new cases is \$724 million. The total lifetime indirect cost is \$65 million. Thus, the total cost burden borne by Arizona residents who were diagnosed with Valley fever in 2019 is \$789 million.

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<sup>1</sup> Leslie Wilson, et al. “The Rise of Valley Fever: Prevalence and Cost Burden of Coccidioidomycosis Infection in California,” *Int. J. Environ. Res. Public Health* **2019**, 16, 1113.

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**Table 1: Direct Lifetime Costs per Person by CM Disease Manifestation (Estimates for Arizona circa 2019)**

| DISEASE AND COST TYPE           | ITEM                            | UTILIZATION   | AVERAGE PER PERSON LIFETIME COST | SOURCE           |
|---------------------------------|---------------------------------|---|----------------------------------|------------------|
| <b>UNCOMPLICATED PNEUMONIA</b>  |                                 |   |                                  |                  |
| <i><b>Pre-CM Diagnosis</b></i>  |                                 |   |                                  |                  |
| Physician visit                 |                                 | 100% had 3 physician visits                           | \$584                            | Wilson escalated |
| ER visit                        |                                 | 23% first sought care in ER                           | \$20                             | Wilson escalated |
| Medication                      | Azithromycin/Levaquin           | 100% (50% require second course)                      | \$106                            | Wilson, Nix      |
| <i><b>Diagnosis</b></i>         |                                 |   |                                  |                  |
|                                 | Immunodiffusion and titer       | 100% (25% require repeat testing)                     | \$386                            | Wilson escalated |
|                                 | Chest X-ray                     | 100%  |                                  |                  |
|                                 | Chest CT                        | 25%   |                                  |                  |
|                                 | Others, HIV testing             | 100%  |                                  |                  |
| <i><b>Post-CM Diagnosis</b></i> |                                 |   |                                  |                  |
| Hospitalization                 | Requiring hospitalization       | 40%   | \$21,218                         | Wilson, Pu       |
|                                 | 1 lifetime hospitalization      | 90%   |                                  |                  |
|                                 | 2 lifetime hospitalizations     | 7%  |                                  |                  |
|                                 | >2 lifetime hospitalizations    | 3%  |                                  |                  |
| Medication                      | Fluconazole (400 mg/day)        | 90% (6 months)  | \$6,134                          | Wilson, Nix      |
|                                 | Itraconazole (200 mg twice/day) | 3% (6 months)   |                                  |                  |
|                                 | Amphotericin B (5 mg/kg/day)    | 2% (for pregnant women, 6 months)                     |                                  |                  |
|                                 | Voriconazole (200 mg twice/day) | 5% (after failing fluconazole/voriconazole, 6 months) |                                  |                  |
| Follow-up                       | Immunodiffusion and titer       | 100% every 3 months for 12 months                     | \$1,417                          | Wilson escalated |
|                                 | Chest X-ray                     |   |                                  |                  |
| Home care/nursing home          |                                 | None  | \$0                              |                  |
| <b>TOTAL</b>                    |                                 |   | <b>\$29,865</b>                  |                  |

| DISEASE AND COST TYPE                                  | ITEM                            | UTILIZATION                                   | AVERAGE PER PERSON LIFETIME COST | SOURCE           |
|--|---------------------------------|---|----------------------------------|------------------|
| <b>DIFFUSE/CHRONIC PNEUMONIA WITHOUT DISSEMINATION</b> |                                 |   |                                  |                  |
| <b>Pre-CM Diagnosis</b>                                |                                 | Same as CM-associated uncomplicated pneumonia | \$710                            |                  |
| Other medication                                       | 4-drug regimen for tuberculosis |   | \$20                             | Wilson escalated |
| <b>Diagnosis</b>                                       | Immunodiffusion and titer       | 100% (25% require repeat testing)             | \$385                            | Wilson escalated |
|  | Chest X-ray                     | 50% have 2 X-rays/year outside of hospital    |                                  |                  |
|  | Chest CT                        | 30% have chest CT outside of hospital         |                                  |                  |
| <b>Post-CM Diagnosis</b>                               |                                 |   |                                  |                  |
| Hospitalization  | 1st hospitalization in year 1   | 75%   | \$105,033                        | Wilson, Pu       |
|  | 2nd hospitalization in year 1   | 65% (of those with 1st hospitalization)       |                                  |                  |
|  | Hospitalization in year 2       | 100%  |                                  |                  |
| Medication   | Fluconazole (800 mg/day)        | 75% (36 months)                               | \$47,443                         | Wilson, Nix      |
|  | Itraconazole (200 mg twice/day) | 25% (36 months)                               |                                  |                  |
| Follow-up  | Immunodiffusion and titer       | 100% every 3 months for 12 months             | \$1,879                          | Wilson escalated |
|  | Chest X-ray                     |   |                                  |                  |
|  | Chest CT                        | 100% at discharge                             |                                  |                  |
| Home care  |                                 | 100% (3 days a week for 3 months)             | \$2,940                          | Wilson escalated |
| Rehabilitation facility                                |                                 | 100% (30 days)                                | \$4,319                          | Wilson escalated |
| <b>TOTAL</b>   |                                 |   | <b>\$162,730</b>                 |                  |

| DISEASE AND COST TYPE                      | ITEM                                   | UTILIZATION  | AVERAGE PER PERSON LIFETIME COST | SOURCE            |
|--|--|--|----------------------------------|-------------------|
| <b>DISSEMINATION, INCLUDING MENINGITIS</b> |  |  |                                  |                   |
| <b>Pre-CM Diagnosis</b>                    |  | Same as CM-associated uncomplicated pneumonia            | \$710                            |                   |
|  |  | 40% first sought care in ER                              |                                  |                   |
| <b>Diagnosis</b>                           |  |  |                                  |                   |
| Immunodiffusion/titer/chest                |  | Same as CM-associated diffuse/chronic pneumonia          | \$884                            | Wilson escalated  |
| X-ray/chest CT                             |  | without dissemination                                    |                                  |                   |
| Lumbar puncture                            |  | 50%  |                                  |                   |
| MRI  |  | 15-20%   |                                  |                   |
| Aspirates of joint effusions               |  | 10%  |                                  |                   |
| Skin biopsy                                |  | 10%  |                                  |                   |
| Bone marrow biopsy                         |  | 5%   |                                  |                   |
| Lung biopsy                                |  | 20%  |                                  |                   |
| Lymph node biopsy                          |  | 20%  |                                  |                   |
| Liver biopsy                               |  | 5%   |                                  |                   |
|  |  |  |                                  |                   |
| <b>Post-CM Diagnosis</b>                   |  |  |                                  |                   |
| Hospitalization                            | 1st hospitalization in year 1          | 100%   | \$775,751                        | Wilson, Pu, Hill  |
|  | 2nd hospitalization in year 1          | 65% (of those with 1st hospitalization)                  |                                  |                   |
|  | Hospitalization in year 2              | 100% hospitalized once a year for life                   |                                  |                   |
| Medication                                 | Fluconazole (800 mg/day)               | 98% (lifelong)   | \$315,975                        | Wilson, Nix, Hill |
|  | Amphotericin B (5 mg/kg/day)           | 2% (lifelong)  |                                  |                   |
| Other treatment considerations             | Ventriculoperitoneal shunt placement   | 15% of those with meningitis                             | \$9,229                          | Wilson escalated  |
|  | Ventriculoperitoneal shunt replacement | 100% of shunts replaced once in lifetime                 |                                  |                   |
| Follow-up                                  | Immunodiffusion and titer              |  | \$20,252                         | Wilson escalated  |
|  | Chest X-ray                            |  |                                  |                   |
|  | Chest CT                               | 100% (every 3 months in year 1, every 6 months for life; |                                  |                   |
|  | Liver function test                    | MRI every 6 months for life; lumbar puncture 2 times in  |                                  |                   |
|  | Renal function test                    | year 1, 5 times in lifetime; expected compliance         |                                  |                   |
|  | MRI                                    | 50-80%)  |                                  |                   |
|  | Lumbar puncture                        |  |                                  |                   |
| Home care                                  |  | 100% (3 days a week for 3 months)                        | \$2,940                          | Wilson escalated  |
| Nursing home                               | Temporary stay                         | 10% (2 months)   | \$874                            | Wilson escalated  |
|  |  |  |                                  |                   |
| <b>TOTAL</b>                               |  |  | <b>\$1,126,616</b>               |                   |

| DISEASE AND COST TYPE                           | ITEM                               | UTILIZATION   | AVERAGE PER PERSON LIFETIME COST | SOURCE           |
|---|------------------------------------|---|----------------------------------|------------------|
| <b>OTHER CHANGES IN CHEST, PULMONARY NODULE</b> |                                    |   |                                  |                  |
| <i>Pre-CM Diagnosis</i>                         |                                    | Same as CM-associated uncomplicated pneumonia                     | \$710                            |                  |
| <i>Diagnosis</i>                                | Immunodiffusion and titer          | 100% (25% require repeat testing)                                 | \$91,957                         | Wilson escalated |
|   | Chest X-ray                        | 100%  |                                  |                  |
|   | Chest CT                           | 25%   |                                  |                  |
|   | Diagnostic work-up for lung cancer | 90%   |                                  |                  |
| <i>Post-CM Diagnosis</i>                        |                                    |   |                                  |                  |
| Hospitalization                                 |                                    | Same as CM-associated uncomplicated pneumonia                     | \$21,218                         |                  |
| Medication                                      | Requiring medication               | 25%   | \$1,198                          | Wilson, Nix      |
|   | Fluconazole (400 mg/day)           | 90% (6 months)  |                                  |                  |
|   | Itraconazole (200 mg twice/day)    | 5% (6 months)   |                                  |                  |
|   | Voriconazole (200 mg twice/day)    | 5% (after failing fluconazole/voriconazole, 6 months)             |                                  |                  |
| Follow-up                                       | Immunodiffusion and titer          | 100% every 3 months for 12 months, then every 6 months for 1 year | \$4,274                          | Wilson escalated |
|   | Chest X-ray                        |   |                                  |                  |
| Home care/nursing home                          |                                    | None  | \$0                              |                  |
| <b>TOTAL</b>                                    |                                    |   | <b>\$119,358</b>                 |                  |



| DISEASE AND COST TYPE                           | ITEM | UTILIZATION                            | AVERAGE PER PERSON LIFETIME COST | SOURCE     |
|---|------|--|----------------------------------|------------|
| <b>OTHER CHANGES IN CHEST, PULMONARY CAVITY</b> |      |  |                                  |            |
| <i>Pre-CM Diagnosis</i>                         |      |  |                                  |            |
| <i>Diagnosis</i>                                |      | Same as CM-associated pulmonary nodule | \$119,358                        |            |
| <i>Post-CM Diagnosis</i>                        |      |  |                                  |            |
|   |      |  |                                  |            |
| <b>Additional Hospitalization</b>               |      |  |                                  |            |
| Cavity complications                            |      | 5%                                     | \$4,933                          | Wilson, Pu |
| Hemoptysis/chest pain                           |      | 5-10%                                  | \$3,521                          | Wilson, Pu |
| Home care/nursing home                          |      | None                                   | \$0                              |            |
|   |      |  |                                  |            |
| <b>TOTAL</b>                                    |      |  | <b>\$127,811</b>                 |            |

**Notes:**

- Costs per hospital stay are from Pu, et al. "Clinician Practice Patterns that Result in the Diagnosis of Coccidioidomycosis Before and During Hospitalization," Table 2. Two rates were used: (1) the mean costs per stay for those requiring neither ICU nor a procedure, \$28.4 mill/605 = \$46,942; and (2) the mean costs per stay for those requiring a procedure but not ICU, \$58.5 mill/593 = \$98,651.
- Escalation of selected costs from Wilson, et al. (2019) made using the percentage change in U.S. health care costs from 2012-2019 as measured by the Medical Care component of the Consumer Price Index for All Urban Consumers, Bureau of Labor Statistics.

**Table 2: Indirect Lifetime Costs per Person by CM Disease Manifestation (Estimates for Arizona circa 2019)**

| DISEASE AND COST TYPE                                  | DURATION OF LOSS  | AVERAGE PER PERSON LIFETIME COST | SOURCE         |
|--|---|----------------------------------|----------------|
| <b>UNCOMPLICATED PNEUMONIA</b>                         |   |                                  |                |
| Work loss  | 7 days  | \$1,299                          | Wilson, Hill   |
| Mortality  | Normal life expectancy  | \$0                              | Wilson         |
| <b>TOTAL</b>   |   | <b>\$1,299</b>                   |                |
| <b>DIFFUSE/CHRONIC PNEUMONIA WITHOUT DISSEMINATION</b> |   |                                  |                |
| Work loss  | 90 days   | \$16,703                         | Wilson, Hill   |
| Mortality  | 2% in first year, 0.2% each year thereafter   | \$24,410                         | Galgiani, Hill |
| <b>TOTAL</b>   |   | <b>\$41,113</b>                  |                |
| <b>DISSEMINATION, INCLUDING MENINGITIS</b>             |   |                                  |                |
| Work loss  | 120 days  | \$22,270                         | Wilson, Hill   |
| Mortality  | 5% in year 1, 4% in year 2, 3% in year 3, 2% in year 4, and 1% each year thereafter | \$115,109                        | Galgiani, Hill |
| <b>TOTAL</b>   |   | <b>\$137,379</b>                 |                |
| <b>OTHER CHANGES IN CHEST, PULMONARY NODULE</b>        |   |                                  |                |
| Work loss  | 7 days  | \$1,299                          | Wilson, Hill   |
| Mortality  | 0.2% each year  | \$6,172                          | Galgiani, Hill |
| <b>TOTAL</b>   |   | <b>\$7,471</b>                   |                |
| <b>OTHER CHANGES IN CHEST, PULMONARY CAVITY</b>        |   |                                  |                |
| Work loss  | 7 days  | \$1,299                          | Wilson, Hill   |
| Mortality  | 0.2% each year  | \$6,172                          | Galgiani, Hill |
| <b>TOTAL</b>   |   | <b>\$7,471</b>                   |                |

**Note:**

- Mortality rates from John Galgiani, M.D., Director, Valley Fever Center for Excellence, College of Medicine Tucson, University of Arizona Health Sciences.

**Table 3: Total Direct and Indirect Lifetime Costs for New CM Cases in Arizona in 2019**

| DISEASE AND COST TYPE                           | NUMBER<br>(n= 10,359) | AVERAGE PER PERSON<br>LIFETIME COST | TOTAL LIFETIME<br>COST FOR<br>ARIZONA |
|---|-----------------------|-------------------------------------|---------------------------------------|
| <b>DIRECT COSTS</b>                             |                       |                                     |                                       |
| Uncomplicated pneumonia                         | 8,805                 | \$29,865                            | \$262,965,805                         |
| Diffuse/chronic pneumonia without dissemination | 259                   | \$162,730                           | \$42,143,002                          |
| Dissemination, including meningitis             | 259                   | \$1,126,616                         | \$291,765,495                         |
| Other changes in chest, pulmonary nodule        | 725                   | \$119,358                           | \$86,550,067                          |
| Other changes in chest, pulmonary cavity        | 311                   | \$127,811                           | \$39,719,824                          |
|   |                       |                                     |                                       |
| <b>INDIRECT COSTS</b>                           |                       |                                     |                                       |
| Uncomplicated pneumonia                         | 8,805                 | \$1,299                             | \$11,437,890                          |
| Diffuse/chronic pneumonia without dissemination | 259                   | \$41,113                            | \$10,647,198                          |
| Dissemination, including meningitis             | 259                   | \$137,379                           | \$35,577,694                          |
| Other changes in chest, pulmonary nodule        | 725                   | \$7,471                             | \$5,417,535                           |
| Other changes in chest, pulmonary cavity        | 311                   | \$7,471                             | \$2,321,801                           |
|   |                       |                                     |                                       |
| <b>TOTAL COSTS OF CM</b>                        |                       |                                     |                                       |
| Direct costs                                    |                       |                                     | \$723,144,193                         |
| Indirect costs:                                 |                       |                                     | \$65,402,119                          |
| Work loss                                       |                       |                                     | \$22,876,440                          |
| Mortality                                       |                       |                                     | \$42,525,679                          |
| Total direct plus indirect costs                |                       |                                     | \$788,546,311                         |



**Arizona State University**

**Seidman Research Institute**

660 S MILL AVENUE, SUITE 300  
TEMPE  
AZ 85281

Tel: (480) 965 5362

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