The Mysterious Fungus Infecting the American Southwest

By Madeleine Thomas, The Atlantic - Friday, August 8, 2014

Last fall, Kirt Emery was on his motorcycle, cruising up the 99 freeway over the mountains from Santa Barbara to Bakersfield, California, when he saw the dust storm materializing in front of him. Visibility was low, but he wanted to get through it as quickly as he could, so he held his breath and hammered his bike up to 100 miles per hour.

As the head of epidemiology for the Bakersfield Public Health Services Department, Emery has spent the past two decades studying dust like this—and avoiding it at all costs. He knows all too well what could happen to him if he got sick: the expensive medications with their nasty side affects, the uncertainty of whether he could be ill for the rest of his life.

It's been more than 20 years since he moved to Bakersfield, and so far, he's still healthy. That makes him one of the lucky ones. For many people living in places like Bakersfield, and throughout much of California's Central Valley, dust can be deadly.

Coccidioidomycosis, also known as cocci, or valley fever, is a fungal disease endemic to the soils of the Southwest, in places like Arizona, Nevada, New Mexico, Texas and Utah. In California, it's rampant across the Central Valley, an area just slightly smaller than West Virginia that grows about a third of the country's produce. About 30 percent of all valley fever cases nationwide occur in the Central Valley each year.

Valley fever has perplexed doctors and patients alike for more than a century. Symptoms range from mild fatigue to incapacitating, flesh-eating infections, and despite decades of research, advances in treatment and pushes to develop a vaccine have been painfully slow. There's virtually no way to guard against inhaling the spores that cause valley fever, as most masks can't filter out the microscopic dust particles that carry the spores through the air and into the lungs. Getting infected with valley fever can be as simple as driving through Bakersfield with the windows down—or in Emery's case, on a motorcycle.

For reasons still unclear, rates of valley fever are rising nationwide. Between 1998 and 2011, documented cases across the country increased steadily by about 15 percent annually, from just 2,000 infections in 1998 to more than 22,000 in 2011. In areas where the fungus is widespread, like Kern County, it's statistically more probable to develop valley fever than hepatitis or chickenpox.

Kern County, where Bakersfield is located, is the world's number one supplier of carrots and grows some of the largest amounts of almonds and pistachios in California, but its soils also have some of the highest levels of cocci fungus in the state. Between 2009 and 2011, valley fever rates tripled there. Researchers blame a population boom that has led to increased construction—which kicks infected soils up into the atmosphere—and unusual weather patterns. As rainy and dry seasons become more erratic due to climate change, rates of valley fever could continue to rise. Unusually wet years lead to massive cocci blooms in the soil, while subsequent dry spells kick up the spores and render them airborne. Bakersfield is a city covered in dust, fine brown grime kicked up from neighboring farmlands. It streaks windshields and gathers on dashboards, engulfs cars and collects in piles on sidewalks. It's everywhere, and if you live there, it's inescapable.

"You just have to inhale one spore," says George Rutherford, head of the division of preventive medicine and public health at the University of California San Francisco. "The risks of getting a face full of this stuff all depends on where you are, what the climate is."

As valley fever escalates in Kern County, getting the rest of the state to notice, and act, falls heavily on Emery's shoulders. "When you look at how we report cases of cocci here in Kern

County and if you ask me what's being done about it, well, there's my secretary out there and there's me. That's it," he says. "The joke when my secretary retired was that 50 percent of the cocci program went away. Does Kern County invest in cocci? No, they don't."

Symptoms of valley fever range from outwardly nonexistent in some infected people to fatal in others. Unpredictably, valley fever can spread to the bones, lung, or brain, or it can cause nothing more than a phlegmy cough. Save for the gastrointestinal tract, cocci has been found in nearly every organ of the body.

Most people never even know they've been exposed. Although once introduced cocci never truly leaves the body, about 60 percent of infections present no symptoms. Even then, however, there's no guarantee of immunity. An infected patient will test positive for it for the rest of their lives, even if they never get sick. And severe stresses on the immune system, like cancer treatment or organ transplants, can cause symptoms to flare up decades after exposure.

The remaining 40 percent of infections resemble the flu, or result in painful boils that typically clear up following a few months of treatment. But for reasons still mysterious to doctors, a very small percentage of valley fever infections become brutal lifelong illnesses. There's little understanding of why cocci targets some people more harshly than others, but the amount of spores inhaled, the strength of the patient's immune system, and genetic predisposition all play a role. "It means something to the Central Valley," Emery says, "but it's an orphan disease."

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Fungi are nature's great garbage disposals. Some species of fungi are saprophytes—Sapros in Greek means rotten—so they thrive off of dead or rotting materials, like wood or mammals. Cocci, a particularly virulent saprophyte, lives just as well in the soil as it does in humans, where the lung seems to be a favorite habitat.

Cocci's life cycle begins in the dirt. Its spores break apart easily when airborne, and when carried on the breeze, either settle in new soils to reproduce, or, if a human happens to breathe them in, in the warm, moist environments of our lungs. When inhaled, the spores head straight to the tiny, hollow sacs located at the ends of the air passageways where they start to multiply, feeding off the body's flesh.

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Adan Barragan was just 17 when he left his home in Colima, a beach town on Mexico's Pacific coast, for California. He settled in Delano, Kern County's second-largest city after Bakersfield, as a farmworker. Now 29, he lives in a modest home with his wife and four young children, and works for a local grower, digging irrigation lines and spraying pesticides. He's often in the fields six days a week, working 10- to 12-hour shifts.

Last October, Barragan noticed a tiny bump in the middle of his chest. It looked like a pimple, he says, so he didn't think much of it at first. Before long, it was the size of a bright red baseball, hard to the touch and oozing pus. The bigger it grew, the harder it became for him to breathe, and to lift and carry the heavy machinery he operates in the fields. His wife, Alma Ramos, worried it was cancerous, urged Barragan to seek medical attention at Kern Medical Center. He was diagnosed immediately with valley fever.

Barragan's extensive exposure to the soil as a farmworker puts him at a higher risk of developing valley fever, but Ramos says they had never heard of the disease before.

"If we knew more about it, he probably would have been more careful," Ramos says, translating for Barragan, who only speaks Spanish. "I hear 'valley fever' and all I think is 'fever.' So I'm thinking a cold. He probably had symptoms before and we didn't know." Barragan still works as a farm laborer, but his health scare was enough to convince him to start considering other work. "He's learning English," Ramos says. "He's going to get a high school diploma, because he

doesn't want to be out in the fields anymore."

While hospitalized, Barragan underwent a strict regimen of the antifungal fluconazole, delivered intravenously three days a week for three months. The medicine gave him seizures, and caused him to shed weight, about 50 pounds over the course of his stay. Because antifungals are rarely administered directly to the infection site—with the exception of shunts that convey them directly into the brain to combat meningitis—the hope is that enough can be pumped throughout the body to target wherever the fungus has spread. Sustained use of antifungals, whether orally or intravenously, can cause permanent kidney damage, however. "With the oral medications, why it gets scary is that they see how much the patient can tolerate," Emery says. "It's not like with other drugs when they say, 'OK, we know this body weight and we give them this specific amount of medication.'"

Barragan's symptoms eventually cleared, but he is still supposed to take up to 10 pills of fluconazole daily for the next three years. He's wary of experiencing any more side effects, like the fatigue that put him out of work for four months, but he considers himself fortunate—of the 10 other patients also in treatment for valley fever during his stay in the hospital, four of them died from "disseminated" disease, he says.

Disseminated valley fever might be one of the greatest conundrums surrounding the disease. It only occurs in 1 percent or less of infections, but if a patient is black or Filipino, the risk of developing valley fever is much higher. Its damage to the skeletal system, joints, lungs or meninges—the delicate membranes that enclose the brain and spinal cord—is vicious, as the fungus can decompose the vertebrae, skull, long bones, like the femur and tibia, or the joints of the knees, wrists, ankles, and elbows. Meningitis, the most serious manifestation of disseminated cocci, happens if the fungus manages reach the protective membranes of the brain and spinal cord. To keep a patient alive, treatment must last a lifetime.

"The fact of the matter is that [getting infected] is a game changer," Emery says. "Your life has to revolve around getting these drugs or you die. No one will take their patients off of medication believing that they'll survive. We've tried. Everything looks healthy, everything looks normal, and then we try taking them off the medication and they go back to disease state."

Kern County's first great epidemic of valley fever began in 1991 and lasted for three years, the result of a particularly rainy spring following a five-year drought. In just one year—from 1991 to 1992—cases jumped from 959 to more than 3,000. Counting asymptomatic patients, however, some doctors think up to 8,000 people may have been infected.

The surge was alarming, but Emery says interest and funding for the disease disappeared completely two years after the epidemic ended. "We put fire stations everywhere to protect you, but when it comes down to public health, you're fighting for everything. What we do doesn't necessarily get seen until something bad happens, like a big outbreak of cocci, H1N1, or bioterrorism," he says. "When something like that happens, all of a sudden we get funding, but it just seems like we continuously chase our tails."

A second valley fever epidemic hit Kern County in 2001 and remains ongoing. It led to the deaths of more than three dozen inmates since 2006 at two nearby state prisons, Avenal and Pleasant Valley, before Kern County's epidemic received the national attention Emery had been waiting for. Because the prisons house high concentrations of black and Filipino inmates, valley fever infection rates are astronomical there compared to the state average: 1,000 times higher at Pleasant Valley, where more than 1,000 inmates have contracted valley fever over the past five years, and 189 times higher at Avenal. Following a federal mandate to transfer more than 2,500 at-risk inmates out of Kern County in 2013, the National Institutes of Health and the Centers for Disease Control and Prevention announced plans to start a clinical trial in Bakersfield, in hopes

of understanding how early diagnosis affects the course of treatment, and developing a vaccine. In June, the FDA also announced plans to include cocci on its Generating Antibiotic Incentives Now (GAIN) program, a federal system intended to encourage the development of new antibacterial or antifungal drugs to treat what the government deems serious or life-threatening infections. Adding cocci to the list extends the period that valley fever antibiotics or vaccines can be sold without any generic-brand competition on the market by five years—a much-needed incentive for a pharmaceutical company to jump on board and manufacture a vaccine.

Even now, although it's been decades since research took off in the 1930s and 40s, and the first patient was diagnosed in 1892, the prospect for a vaccine still remains uncertain. Developing a vaccine would mean creating a financial incentive lucrative enough to draw Big Pharma into producing a product that only a relatively small portion of the entire country would ever use. There are only a handful of researchers nationwide working toward a vaccine, primarily in California, Texas, and Arizona, and Emery believes the effort needs another big infusion of money to push it over the top. It could be decades more before one is perfected in the lab.

Yet the question remains whether valley fever would still be as mysterious or overlooked if it didn’t affect some of California’s poorest residents. Kern County, the state’s disease epicenter, is a hub for farm laborers, not investment bankers or tech entrepreneurs. Agriculture in Kern might be a $6 billion enterprise, but the reality is that more than 22 percent of the county’s population lives incentive for a pharmaceutical company to jump on board and manufacture a vaccine.

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“Most of the other vaccines that we’re dealing with now were sort of a big full-court press government thing,” Rutherford says. “If you look at the AIDS vaccine efforts, you know, [their budgets] are astronomical. The amounts of money spent, and properly so, are very high. I can guarantee that this is true, that if this disease were happening in Washington, DC, the conversation would be [different].”

Emery, who will retire within the next decade, says he’s “scared to death” that when he leaves the Kern County’s public health department, so too will local pressure to confront valley fever. “It’s my disease. It’s Kern County’s disease,” he says, adding that his work will probably never be done in his lifetime. “This disease needs a voice. If I die tomorrow on my motorcycle, I’ll die with a smile. I got involved and I made a difference.”