

Treatment and Prevention of Coccidioidomycosis

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Acknowledgments

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TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS.....	ii
TABLE OF CONTENTS.....	iii
ABSTRACT.....	iv
CHAPTER 1: INTRODUCTION.....	1
CHAPTER 2: LITERATURE REVIEW.....	5
CHAPTER 3: METHODS.....	12
MATRIX.....	14
CHAPTER 4: RESULTS.....	16
CHAPTER 5: DISCUSSION.....	20

Abstract

Coccidioidomycosis (valley fever) is on the rise in the San Joaquin Valley. According to the California Department of Public Health (2018), the number of new cases reported by local health departments in California grew from 3,827 for the period January 1 through October 31, 2016, to 5,121 for the same period in 2017. This is an increase of 1,294 cases (Anderson, 2018). The literature shows a lack of awareness among primary care providers regarding the prevention and treatment of coccidioidomycosis. This deficiency supports the need to develop educational programs for nurse practitioners through continuing education in the endemic areas. An integrative literature review was conducted to identify the need for and investigate strategies that could be used to help prevent and treat coccidioidomycosis. The results of the research are synthesized and presented to improve awareness of coccidioidomycosis, thereby encouraging health promotion and wellness in the community.

Keywords: coccidioidomycosis, community-based strategies, health promotion, public health, San Joaquin Valley, statistics, health promotion, treatment, prevention

Chapter 1: Introduction

Coccidioidomycosis, also known as California fever, cocci, desert rheumatism, San Joaquin Valley fever, valley fever, and Posada's disease, is a non-contagious infection caused by the plant-based dimorphic fungi *Coccidioides immitis* and *Coccidioides posadasii* (Hector et al., 2011). Most *Coccidioides* infections are caused by the inhalation of spores that are present in the air when soil and dust are disturbed. The *Coccidioides* species grow as a mold a few inches below desert soil. It must rain first to start the growth cycle of the fungus underneath the soil. Over a prolonged dry period, the mycelia become very fragile and are easily split open by slight air turbulences into single-cell spores approximately 3 to 5 microns in size. The spores can remain suspended in the air for prolonged periods of time. Once the spores are inhaled, the incubation period for the infection is 1 to 4 weeks. The clinical appearance of the disease varies as it ranges from acute-pneumonia to disseminated disease, especially in immunosuppressed patients. In some cases, the infection may recur or become chronic (Saubolle, McKellar, & Sussland, 2007).

The geographic distribution of *Coccidioides* is dominant in certain lower deserts of the western hemisphere, including in Arizona, the southern and central valleys of California, New Mexico, and west Texas in the United States. *Coccidioides* are also found in parts of Mexico and Central and South America. People most at risk for infection with *Coccidioides* are those residing or traveling in or visiting the endemic areas and those whose occupations involve being outdoors in these areas, such as construction workers and farmers.

Common symptoms include fever, headache, dry cough, myalgia, and arthralgia, sometimes accompanied by a rash. A variety of different tests can be used to diagnose coccidioidal infection. Most ambulatory patients who are suspected of having cocci are

evaluated. Treatment ranges from close observation without medical treatment in mild cases to medical therapy, primarily with azole antifungals, in more severe episodes. Azole antifungal therapy is generally well tolerated with few adverse events; alternative treatments are rarely required.

Purpose

Coccidioidomycosis is often misdiagnosed as community-acquired pneumonia. Because there are many barriers to the prevention and treatment of coccidioidomycosis, the purpose of this project is to conduct a rigorous integrative review of the recent literature on the topic and present the results together with public health recommendations for effective strategies that facilitate prevention and treatment of this disease. The findings are synthesized into a systematic knowledge base for the purpose of improving patient outcomes.

Problem Statement

The clinical syndrome of coccidioidomycosis is very similar to that of other respiratory diseases and is difficult for both healthcare providers and the public to recognize. The diagnosis of coccidioidomycosis is often missed, thereby delaying appropriate treatment. Timely and accurate diagnosis is the foundation for the prevention and treatment of the illness. Prompt diagnosis and adherence to the clinical practice guidelines of the Infectious Diseases Society of America can lead to better outcomes for the community in the endemic areas (Galgiani et al., 2016). The underdiagnosis and misdiagnosis of coccidioidomycosis are public health concerns as patients with this disease often incur weeks to months of disability, consumed with debilitating fatigue and time away from work. Their illnesses utilize significant amounts of medical resources, including hospitalizations, resulting in a tremendous economic burden for the community as well as the patients. As a result, increased attention needs to be given to seeking

diagnosis early in patients with community-acquired pneumonia and endemic exposures to *Coccidioides* as recommended in current guidelines.

A review of the literature demonstrates a lack of attention on coccidioidomycosis in California's Central Valley as compared to other diseases. Although the cumulative total of illnesses and death for coccidioidomycosis is higher annually than for hantavirus, whooping cough, and salmonella poisoning combined, the disease historically has received comparatively little in research dollars or federal funding (Centers for Disease Control and Prevention [CDC], 2016). Epidemiology and preclinical animal studies that date back to the 1940s and '50s, have established that persons who recover from *Coccidioidal* infection have durable immunity to re-infection that is, in the absence of profound immune suppression, life-long (Pappagians, 2001). A large body of clinical and preclinical data that followed solidified this finding, supporting the possibility that a preventive vaccine could be created, which, if utilized, could impact the incidence and/or the severity of disease and the associated public health burden and economic consequences (Pappagians, 2001).

Research Question

The question addressed in this research was: What community-based strategies are effective in facilitating prevention and treatment of cocci infection? Many coccidioidal infections are not identified since the symptoms, signs, and routine laboratory results are nonspecific and clinicians do not always consider the diagnosis. Some practitioners consider the failure to diagnose early coccidioidal infections an insignificant problem because some infections resolve without specific therapy. This research project presents information on the need for earlier diagnosis of the disease and improved diagnostic tests, reviews current and future therapeutics for the treatment of this disease, identifies the advance nurse practitioner's

role in prevention and treatment, and discusses the possibility of developing a preventive vaccine for coccidioidomycosis.

Chapter 2: Literature Review

The purpose of this literature review was to critically appraise full-text research articles from peer-reviewed journals using the CASP study tool. Electronic database searched included PubMed and Google Scholar. Key words and phrases used in the detailed search strategy were: coccidioidomycosis, pathophysiology, rural population, Central Valley of California, education, treatment, diagnosis, evidence-based medicine and preventative strategies. The search was limited to articles in the English language published within the past 10 years. My PICO research question was: What community-based strategies are effective in helping prevent and treat cocci infection?

Critical Appraisal of the Literature

The California Department of Industrial Relations (2017) published research findings regarding the risk and prevention of coccidioidomycosis. The data were derived from epidemiological and microbiological studies, based on quality scientific data. This research is relevant and contains high quality findings. The results include prevention strategies that are helpful for avoiding the cocci infection. However, the validity of the information is in question because the prevention measures provided have not been proven to prevent coccidioidomycosis.

In response to the re-emergence of coccidioidomycosis, the University of California, Davis, Medical Center (2016) published an article with information about tactics that would help prevent cocci infection. The authors noted the difficulty in avoiding exposure to areas where coccidioidomycosis is common. They suggested that people with weak immune systems or who are otherwise at substantial risk reduce their exposure to the fungus by limiting activities such as digging or excavating in areas where the fungus lives. The article highlighted the importance of awareness as a preventive measure and suggested the general public as well as primary care

providers need to be aware of the risks. Awareness is a subject that is applicable to my research question as methods of promoting awareness are strategies that are useful for preventing cocci infection. The validity of this article is unreliable as it is grey literature, lacking an author and offering no scientific discoveries.

Guevara, Motala, and Tarashita (2015) investigated the epidemiology of coccidioidomycosis in Los Angeles County (LA), California. The researchers examined the population-based surveillance data of 1973-2011 to describe demographics, medical history, exposure history, and geographic case characteristics. Results showed that of the 24 health districts of LA County, 19 had an increase in the number of cases of 100% to 1500% between 2000-2003 and 2008-2011. Most of the cases (68%) were in the northern part of LA County. In 2004 the male-to-female case ratio was 1.4-2.2. White and Hispanic cases became more numerous than Asian and Black cases after 2003. The researchers assumed these changes were related to demographic changes and migration of new residents and workers with the construction boom that started in 2003-2004.

Missing data limited the validity of the results of the Guevara et al. (2015) study. Also, passive surveillance carries problems of both underreporting and overreporting. The mixed-methods study design was used in order to gain a greater understanding of epidemiologic changes. The findings are applicable and useful for my research as they support the importance of raising awareness, informing government, and increasing community planning efforts to the prevention of coccidioidomycosis morbidity and mortality. Also, the researchers reiterated the need for effective education and awareness efforts for the prevention of coccidioidomycosis. Engaging local community organizations and local government agencies to collaborate in

endemic areas and areas of low or unrecognized endemicity that have a history of cases is a progressive step towards better public health.

The Centers for Disease Control and Prevention Information, 2017 a federal agency identified a need for a uniform set of recommendations to prevent exposure to coccidioidomycosis. On June 13, 2013, the Occupational Health Branch of the California Department of Public Health, now called the California Department of Industrial Relations, released its recommendations. The department recognized that no vaccine is currently available that prevents cocci infection, and it pointed out that there are actions that can minimize the risk. The recommended actions may be useful in the prevention of the cocci infection, but California has no effective strategy for either primary or secondary prevention of coccidioidomycosis in the general population. A study done by University of CA Davis, 2016 concluded that limiting or modifying outdoor activities may not substantially reduce cocci infection. The information presented by Cal/OSHA followed a statistical model and therefore lacks high validity. Although there a number of guidelines for preventing coccidioidomycosis, there is limited evidence regarding the effectiveness of these efforts. This information is pertinent and useful for my research question, as it tackles the strategies for preventing coccidioidomycosis.

Chen et al. (2011) published a qualitative study assessing knowledge and attitudes of physicians and nurse practitioners regarding the treatment of coccidioidomycosis. Of the 9,248 surveys mailed in October 2007, a total of 755 (8%) were completed and 1,640 (18%) were returned uncompleted. Survey questions evaluated recognition of symptoms, testing practices, and treatment regimens of healthcare providers. The study was limited to healthcare providers in Arizona and therefore results may differ from results from California. Descriptive analyses examined the frequency distribution for each variable and the internal consistency of data. For

continuous variables, the study compared the mean and range for each variable at a 95% confidence interval (CI). Measurements of results appear accurate and survey questions were related to coccidioidomycosis knowledge and attitudes of healthcare providers. The study had good validity in its content. Outcomes emphasized the critical gap in healthcare providers' knowledge of the treatment of coccidioidomycosis, a topic is related to my research.

Chu, Feudtner, Heydon, Walsh, and Zaoutis (2006) concluded from observational data that antifungal therapy does not benefit those with a mild form of coccidioidomycosis. The researchers evaluated the role of treatment in an observational study of 105 patients diagnosed with primary coccidioidomycosis; 54 patients were treated and 51 were not. They found no difference between the groups with respect to overall rates of improvement. However, of the 54 who received treatment, 8 had a relapse of cocci infection upon discontinuation of therapy. These results did not provide support for the treatment of cocci infection, but instead emphasized the importance of follow-up care and therefore produced relevant findings. The validity of this study was, adequate and data analysis accurate. This study was not proven to be harmful to any of the participants.

The 2016 Clinical Practice Guideline for the Treatment of Coccidioidomycosis of the Infectious Diseases Society of America was written by a multidisciplinary committee led by infectious disease specialists. The guideline included a large section titled "Recommendations for Management of Coccidioidomycosis in Patients Without Overt Immunosuppressing Conditions" (Galgiani et al., 2016). Although guidelines cannot always account for individual variation among patients and their geographic locations, the guideline development process was appropriate. The recommendations were clearly stated and appeared applicable to the guideline's stated purpose. Overall, the guideline raised no major concerns and can be

considered valid. Recommendations are applicable to the research on treatment of coccidioidomycosis. The recommendations were clearly stated regarding the use of appropriate antifungal treatments, patient education, and supportive measures.

Screening questions per CASP cohort study, the population studied consisted of patients with coccidioidal pneumonia who were not immunosuppressed. The cohort that was recruited represented a defined population consisting of 354 patients with valley fever (primary pulmonary coccidioidomycosis). Subjects were classified into exposure groups of no antifungal treatment and amphotericin b treatment. (Ampel, 2015)The study examined the role of antifungal therapy in primary pulmonary disease. The patients with primary pulmonary disease were either prescribed antifungal therapy or not based on a non-random clinical decision (Ampel, 2015). Among the patients who were not given antifungal therapy, there were no adverse events after a median follow-up of 297 days. Among the patients who continued on antifungal therapy, only two developed disseminated disease after therapy was discontinued (Ampel, 2015). There was no difference in the rate of improvement between those receiving antifungal therapy and those not.

According to the Valley Fever Fact Sheet published by the California Department of Public Health (2016), coccidioidomycosis is caused by the dimorphic fungi of the genus *Coccidioides*; most infections are caused by inhalation of spores. The species predominantly in California is the *C. immitis* isolate. It grows as mold a few inches below the surface of desert soil and is easily formed into spores in dry conditions. It is endemic to lower deserts of the western hemisphere including the Central Valley of California.

It is estimated that less than 50% of all infections are reported and receive medical attention because the illness does not have early signs or symptoms. When clinical signs are

substantial, the primary infection is obvious and is often diagnosed a community-acquired pneumonia 7 to 21 day after exposure (Ganlgiani, 2016).

Diagnosis usually relies on serologic testing. When treatment is indicated, the recommendations are fluconazole or Itraconazole. Amphotericin B should be used as initial therapy for the most severe cases. It is important that patients with coccidioidal infection be followed for a year or longer to monitor for complications. Some patients may develop fatigue and lethargy without evidence of complications. Studies show that these patients should be on a structured physical rehabilitation program to maximize reconditioning (Saubolle, 2007).

Wilkin et al. (2015) studied 3,572 workers constructing two solar power-generating facilities in San Luis Obispo County, California. The research was conducted because of the likelihood that as construction in *Coccidioides*-endemic areas increases, workers will be exposed and possibly infected unless awareness and preventative measures are put in place. The cohort was recruited through employer records and comparison of rosters to California Department of Public Health coccidioidomycosis reports. The most common job titles of participants were electrician (33%) and heavy equipment operator (26%). The data collected in the study was mainly objective, although some subjective data were gathered through interviews of the cohort.

A small number of participants reported prior chronic medical conditions, none reported corticosteroid use, and one reported an immunocompromised condition (Wilkins et al., 2015). The researchers recommended implementing measures that have been shown to be effective in reducing exposure, such as limiting dust generation and providing respiratory protection. The investigation had limitations. The researchers assumed San Luis Obispo County had a stable population, but some workers could not be traced by employers. Case-finding was complicated

because a substantial number of employees lived outside San Luis Obispo County and outside California.

Chapter 3: Methods

Coccidioidomycosis is a growing problem in the western hemisphere. Although it has reached epidemic proportions in some regions, there continues to be a lack of attention to the prevention and treatment of cocci infections compared to other diseases. Therefore, this integrative review was conducted to identify community-based strategies that help prevent and treat cocci infections. The review followed Whittmore and Knalf's (2005) five-stage integrative review process: (a) problem identification, (b) literature search, (c) data evaluation, (d) data analysis, and (e) presentation.

Problem Identification

Coccidioidomycosis is frequently misdiagnosed and therefore not treated. The underdiagnosis of the disease is a serious public health concern as the incidence of cocci infections in both endemic and non-endemic areas is increasing. Coccidioidomycosis can be both prevented and treated, but only if healthcare workers and the general public are aware of the risks and prevention strategies.

Literature Search

The databases PubMed and Google Scholar were searched to identify relevant evidence-based material published in professional journals. The search focused on articles related to the prevention and control of coccidioidomycosis, cocci infection therapies, and community-based strategies for preventing and treating coccidioidomycosis. Initially all article types were included and then search was limited to articles published in the last 5 years. Additional search was carried out, adding filters for the study/publication types and broadening the time frame to articles published from 2000 on. The filters were: systematic review, meta-analysis, guideline, practice guideline, from 2000/01/01 to 2017/17/31, humans, English. With the help of a librarian

the development of a comprehensive search strategy was put into place to find studies that covered the main subject areas of this integrative review.

The original search identified 100 references, it was narrowed to 41 after eliminating duplicate studies. The titles and abstracts of the 41 articles were read. No specific evaluation criteria was employed when conducting an integrative review using diverse empirical sources; one approach is to evaluate methodological quality and informational value (Whittemore & Knafl, 2005). After defining the inclusion criteria, the 10 studies included in the integrative review met the following criteria: English language, full articles addressing community-based strategies to help prevent and treat cocci infection and indexed in the above-mentioned databases in the last 10 years. The main exclusion criteria were: editorials, opinions, discussions, or textbooks.

Data Evaluation and Analysis

The studies were arranged in this literature review in a matrix. The following headings in the matrix describe the features recorded for each study: citation (author and year, variables (independent and dependent), study design, sample size/characteristics, methods (sampling and data collection), analysis and results, and evidence level (I-VII).

Presentation

The findings from the literature are presented in the matrix below.

Matrix Table 1

Author (Year)	Variables IV/DV	Study Design	Sample Size & Characteristics	Methods	Analysis & Results	Evidence Level
California Department of Industrial Relations (2017)	IV: Prevention strategies DV: Cocci infection	Health studies, surveillance	NA	Data collection	Prevention tactics: avoid dusty outdoor places, wear N95 respirator, indoor air filtration, clean skin injuries, preventive antifungal medications	V
University of California, Davis, Medical Center (2016)	IV: People with weak immune systems DV: Reduction of exposure	Report	816 reported cases in 2000 in CA; 4000 reported cases in 2012	Data from CA Department of Health	People with weak immune systems should limit exposure to activities such as digging; awareness important for prevention & seeking medical treatment	VII
Guevara, Motala, & Tarashita (2015)	IV: Coccidioidomycosis endemic vs nonendemic areas DV: No. cases and case characteristics	Mixed-methods	LA County & 57 other CA counties	Electronic passive surveillance data	100-1500% rise in no. cases from 2000-2003 to 2008-2011; mortality greater in nonendemic areas (14%) than endemic (9%); multi-agency and community partnerships recommended to develop prevention strategies	III
California Department of Industrial Relations (2013)	IV: Prevention of cocci infection DV: Steps for limiting risk	Case reports, recommendations	Confirmed cases of cocci infection at CA Valley Solar Ranch at Santa Margarita	Retrospective review of case reports	Recommendation: if in endemic area, adopt site plans & work practices that reduce exposure: minimize area of soil disturbed, use water-appropriate soil stabilizers &/or revegetation to reduce airborne dust, etc.	IV

Chen et al. (2011)	IV: Management of cocci infection DV: Knowledge of healthcare providers	Qualitative	Survey mailed to 7,608 healthcare providers	Cross-sectional survey	Results highlighted need & value of accurate cocci infection education for healthcare providers	IV
Flaherman, Hector, & Rutherford (2007)	IV: Pregnancy status, age, immune status DV: Known endemic areas of CA	Analytic cohort study	7,457 inpatients with diagnosis of coccidioidomycosis in nonfederal institutions	Quantitative, descriptive analysis, bivariate relative risks	High risks with subgroups: endemic areas, pregnancy, older, HIV infection; need for cocci vaccine	III
Short et al. (2017)	IV: Do patients use integrative medicine strategies with coccidioidomycosis? DV: Patients use integrative strategies such as massage, breathing techniques	Qualitative	Survey of 100 patients with or under evaluation for coccidioidomycosis	Descriptive	64% had used at least one integrative modality, 53% had used two or more. Awareness of patient's goals & preferences important in shared clinical decision making	V
Azadeh et al. (2013)	IV: Immunocompetent patients with cocci infection DV: Received corticosteroid	Cohort study, medical chart review	74 patients received systemic corticosteroids for relief of cocci-related symptoms	Retrospective review	No adverse effects of short-term corticosteroid therapy for early symptomatic treatment of acute pulmonary coccidioidomycosis	III
Galgiani et al. (2016)	IV: Cocci treatment and symptom relief DV: Azoles antifungal medications	Systematic review	Public surveillance reports	Observational	IDSA Clinical Practice Guideline for treatment of coccidioidomycosis	I
IDSA (2016)	IV: Tx of cocci at risk groups. DV: Rapid antifungal medication.	Systematic review	Public surveillance reports	Panel of experts	IDSA expert guidelines	VII

Chapter 4: Results

The fundamental problem addressed in this research is the nonexistence of educational programs for nurse practitioners that would ensure proper instruction on the prompt diagnosis and effective treatment of coccidioidomycosis. Addressing this problem is especially important in the endemic rural areas of the San Joaquin Valley of California. The literature on the prevention and treatment of coccidioidomycosis shows that multiple variables affect the prompt diagnosis and treatment of cocci infections. Rather than investigating these variables, most of the research on the topic has focused on superficial data regarding the prevention and treatment of cocci. This lack of depth in the research on the educational deficiencies among nurse practitioners practicing in endemic rural areas regarding the prevention and treatment of coccidioidomycosis indicated a need for additional information that would form the basis for designing an educational program. That need was the motivation for this research. Educating nurse practitioners about this infection should enable them to apply the knowledge they gain to preventative actions and prompt treatment of coccidioidomycosis.

Synthesis of the Literature

A total of 10 articles were reviewed in this project. They are summarized in Table 1. High-quality studies were reviewed to determine whether treating high-risk individuals with antifungal and short-term corticosteroids may prevent or reduce the incidence of disseminated coccidioidomycosis. Dissemination occurs when the infection spreads (disseminates) beyond the lungs to other parts of the body. Most often these parts include the skin, bones, liver, brain, heart, and the membranes that protect the brain and spinal cord (meninges) (University of California, 2016).

Although morbidity is substantial in people with coccidioidomycosis, mortality is very low; the mortality rate is approximately 0.07%. Death occurs most commonly in patients with disseminated disease, underlying risk factors, or immunosuppression (Anderson, 2018). The literature also demonstrated that people under the age of 5 and over the age of 50 with valley fever are more likely to have disseminated cases (Pappagianis 1988). These groups appear to be more vulnerable to the disease, as their immune systems are less resilient and less able to resist infection. Pappagianis (1988) reported a “disproportionate representation of certain ethnic groups” among the cases of disseminated valley fever. Studies have shown that Blacks, Asians, Mexicans, Filipinos, and Native Americans are more likely to experience a severe form of valley fever than Whites (CDC, 2017).

The articles examined prevention strategies and early treatment of coccidioidomycosis. The prevention tactics described in the literature are the following: avoid dusty outdoor spaces, wear an N95 respirator, practice indoor air filtration, clean skin injuries promptly, and use water to stabilize soil (California Department of Industrial Relations, 2017). Implementation of these strategies does not guarantee prevention; only a vaccine can prevent cocci infections (Pappagianis, 2001).

IDSA Recommendations

The articles that were researched evaluated early recognition of coccidioidomycosis and treatment recommendations from the Infectious Disease Society of America (IDSA). The recommendations met the criteria for good guidelines: validity, reliability, reproducibility, clinical applicability, clinical flexibility, clarity, multidisciplinary process, review of evidence, and documentation (Galgiani, 2016). The IDSA recommendations for the management of

coccidioidomycosis in patients without immunocompromised conditions are as follows

(Galgiani, 2016):

1. Patient education, close observation, and supportive measures such as reconditioning physical therapy for patients who appear to have mild or no debilitating symptoms should be provided.
2. Antifungal treatment should be initiated for patients who, at the time of diagnosis, have significantly debilitating illness.
3. For patients with extensive pulmonary involvement at the time of diagnosis, with concurrent diabetes, or who are otherwise frail because of age or comorbidities, antifungal treatment should be initiated. Some experts also include African or Filipino ancestry as indications for treatment.
4. If treatment is begun in nonpregnant adults, the treatment should be an orally absorbed azole antifungal (e.g., fluconazole) at a daily dose of ≥ 400 mg.

Summary

As the literature indicated, early diagnosis and prompt treatment of disseminated coccidioidomycosis decreases the mortality and morbidity associated with the disease. The literature showed that multiple variables affect the treatment of coccidioidomycosis. Education focusing on recognition of cocci in the early stages and immediate treatment decreases dissemination.

Chapter 5: Discussion

The public health burden of coccidioidomycosis is substantial and has been increasing in recent years (Hector, 2011). Current prevention messages focus on common-sense methods to reduce exposure to soil or dust where coccidioides is common in the environment, such as wearing a dust mask, wetting soil before participating in soil-disturbing activities, or limiting these types of activities altogether, particularly among people at risk for severe disease. However, it is important to point out that few to no data exist that demonstrate the effectiveness of any of these measures. Wide-scale measures to reduce airborne dispersal of coccidioides such as watering construction sites, paving roads, planting grass, or other vegetation have also been proposed, but these methods are not likely to be overly effective because airborne cocci can travel for miles.

Determination of prior coccidioides exposure to evaluate the risk for disease represents a promising public health strategy. Measurement of coccidioidal cellular immunity using skin tests has been a valuable clinical and epidemiologic tool since the 1940s; however, coccidioides skin test reagents have not been commercially available in the USA for over a decade (Ampel, 2015). The return of widespread access to coccidioidal skin tests in endemic areas could help identify and thus better manage specific groups of people at risk for infection.

Because there are no proven methods to prevent coccidioidomycosis, additional research into strategies to reduce the associated morbidity is required. Continued efforts to promote awareness among the public may help to reduce delays in diagnosis and treatment, as evidence suggests that persons with coccidioidomycosis who knew about the disease before seeking healthcare were more likely to request testing and be diagnosed sooner than those who were unfamiliar with the disease (Short, 2017). Similarly, increased awareness among healthcare

providers about coccidioidomycosis diagnosis and treatment is needed, especially because the symptoms are often indistinguishable from those of other community-acquired respiratory infections. Admittedly, it is not definitively known whether earlier diagnosis and treatment can lead to improved outcomes, but other benefits of diagnosis, such as reduced anxiety or unnecessary medical treatment or procedures, make recognition of coccidioidomycosis essential.

Further research into the optimal antifungal treatment regimen for coccidioidomycosis is also warranted, particularly with regard to the role of antifungal treatment for primary pulmonary disease (Hector, 2011). Currently, guidelines from the Infectious Diseases Society of America recommend treatment of primary pulmonary disease in persons who are at risk for developing severe or disseminated disease (Galgiani, 2016). However, the role of antifungal medications in this clinical syndrome is controversial. Some experts recommend treatment of all persons with symptomatic respiratory disease, while others prefer to observe these patients closely. More research is needed to determine if existing or newly-developed antifungal agents can reduce the severity or duration of disease. Finally, efforts to create a preventive vaccine are ongoing; (Hector, 2011) and if developed, a vaccine could prove to be a cost-effective strategy to reduce the burden of disease among some at risk populations.

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ABSTRACT

- Coccidioidomycosis (valley fever) is on the rise in the San Joaquin Valley. Often referred to simply as “cocci,” in California’s soil, it is caused by one of the two fungal species that belong to the genus *Coccidioides*: *C. immitis*. The literature show a lack of awareness among primary care providers regarding the prevention and treatment of coccidioidomycosis. This deficiency supports the need to develop educational programs for nurse practitioners through continuing education in the endemic areas.

INTRODUCTION

- Coccidioidomycosis is recognized as a significant health concern that is often misdiagnosed causing a delay in appropriated treatment. Studies support the need to improve the timely diagnosis, prompt assessment, and appropriate management. Education of nurse practitioners and other health care providers in the endemic areas on the prevention and treatment of cocci is crucial.
- Coccidioidomycosis can be a severe illness and result in disability due to pulmonary involvement and disseminated disease; however, most infections are asymptomatic.
- The purpose of my research project is to analyze effective strategies for the prevention and treatment of coccidioidomycosis and propose the need for education of health care providers in the endemic areas.

ENDEMIC AREAS

Geographic Range of Valley Fever Current Understanding

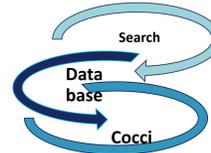


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- Coccidioidomycosis is caused by the inhalation of the fungus coccidioides, it grows on the top 2-8 inches of soil, and with dry conditions the mycelia become fragile and are easily split open into single-cell spores that can remain in the air for prolonged periods of time. It thrives in areas of low-rainfall, high summer temperatures, and moderate winters. The endemic areas of the United States are: California, Arizona, New Mexico, Texas, Nevada and Utah.

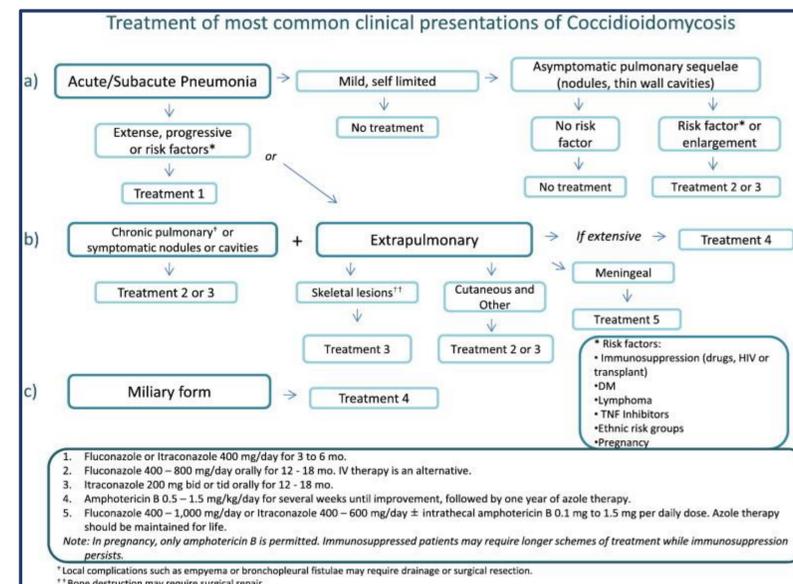
METHODS

- An Integrative review was performed as described by Whittemore and Knafelz (Whittemore, 2005).
- Data was collected utilizing a comprehensive computer-assisted search in CINAHL, Pub Med, and Google Scholar from 2001-2018 of full text, peer-reviewed, scholarly journal articles, published in English with key terms: coccidioidomycosis, community-based strategies, health promotion, public health, San Joaquin Valley, statistics, health promotion, treatment, prevention and Valley Fever.
- Inclusion criteria, studies must have been published in the last 5 years; included educational needs of the prevention and treatment of coccidioidomycosis.
- Exclusion criteria, study published more than 5 years ago, or study published in a language other than English.



RESULTS

- Early diagnosis and appropriate treatment of cocci can reduce dissemination in those with immunodeficiency leading to better patient outcomes.
- The main goal of treatment is to relieve clinical symptoms and reduce anticcoccidial antibodies and return organ function to normal. Preventing relapse is also a goal, but not always achievable.
- Prognosis is very good for most patients with pulmonary coccidioidomycosis. Many patients have a period of significant fatigue following resolution of acute pulmonary symptoms, but most patients recover completely and without sequelae.



CLINICAL IMPLICATIONS

- Coccidioidomycosis is difficult to diagnose solely based on signs and symptoms, it is usually vague and overlap with symptoms that occur in other illnesses. Definitive diagnosis depends on finding evidence of coccidioides organisms in tissue, blood, or other body secretions.
- There is no vaccine to prevent cocci, prevention strategies can reduce exposure to those individuals at risk. A multi-component strategy involving health education, improved dust control, avoiding areas of construction or evacuation sites, and air filtration, prove to help reduce the risk of exposure. Health education and community involvement have been highlighted as essential components in strategies to help prevent cocci infections.
- Implementation of the IDSA Cocci treatment guidelines of evidence-based treatment will improve patient outcomes.
- Education of nurse practitioners is critical for the early diagnosis and prompt treatment of coccidioidomycosis.

DISCUSSION

- Because there are no proven methods to prevent coccidioidomycosis, additional research is needed for a possible vaccine. Continued efforts to promote awareness among the public may help reduce delays in diagnosing and treatment, as evidence suggest that persons with cocci infection who knew about the disease before seeking healthcare were more likely to request testing and were diagnosed sooner than those who were unfamiliar with the disease. Similarly, increased awareness among healthcare providers about the diagnosis and treatment of coccidioidomycosis is needed.

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