

Blastomycosis Diagnosed in a Nonhyperendemic Area

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ABSTRACT

Introduction: Blastomycosis, caused by the dimorphic fungus *Blastomyces dermatitidis*, is hyperendemic in northern Wisconsin and is unevenly distributed in the rest of the state and contiguous Minnesota. Clinical presentation of this illness has been characterized by localized outbreaks and sporadic cases in endemic areas.

Methods: Using ICD-9 CPT codes, we queried our electronic health record system to identify cases of blastomycosis diagnosed at Gundersen Health System over a 32-year period. Gundersen serves a region outside the hyperendemic area of Wisconsin. Records so identified were reviewed for demographic and clinical features. We attempted to interview patients with a blastomycosis diagnosis from 2002 through 2006. Blastomycosis data also were collected from the states of Wisconsin and Minnesota from 2002 through 2006 and assessed for trends.

Results: Thirty-six patients had blastomycosis diagnoses at Gundersen Health System during the study period, as identified by ICD-9 code. Of these, 10 were excluded from further review because they were either miscoded or the code indicated a previous diagnosis. The remaining 26 patients were included in the study. Premorbid conditions included diabetes (38%) and smoking (62%). The mean time from onset of symptoms to the first laboratory specimen positive for *B dermatitidis* was 51 days. Notably, 73% of these patients were treated initially for bacterial pneumonia. The incidence of blastomycosis in Wisconsin in the review period was 2.0 per 100,000, and the rate in Minnesota was 0.5 per 100,000. Based on the census data in Gundersen Health System's 19-county service area, the incidence of blastomycosis is 0.17 cases per 100,000.

Conclusion: In this review of blastomycosis cases diagnosed outside the hyperendemic area of northern Wisconsin, diagnosis was often delayed, and 4 patients whose infections might have been treatable died. Although uncommon, blastomycosis needs to be considered in the differential diagnosis in areas outside the hyperendemic area.

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INTRODUCTION

Blastomycosis, first described from the Chicago area, is caused by the dimorphic fungus *Blastomyces dermatitidis* (mold growth at 21°C and yeast at 32°C).¹ Blastomycosis is a potentially fatal infection in humans, dogs, and other mammals.² The organism usually enters the host through the lungs, where it can cause an asymptomatic infection, a localized pneumonia, or severe acute respiratory distress syndrome (ARDS);³ thereafter, it can disseminate to other tissues, such as bones, central nervous system (CNS), liver, spleen, bone marrow, genitourinary tract, and skin.⁴ This fungus often is acquired along riparian environments, which in part explains its endemicity in wetter areas of the eastern woodlands of North America. In both Wisconsin and Minnesota, *B dermatitidis* has produced both localized outbreaks following point-source infections and sporadic infection.⁵

In hyperendemic counties in northern Wisconsin, health care providers maintain an index of suspicion for blastomycosis,

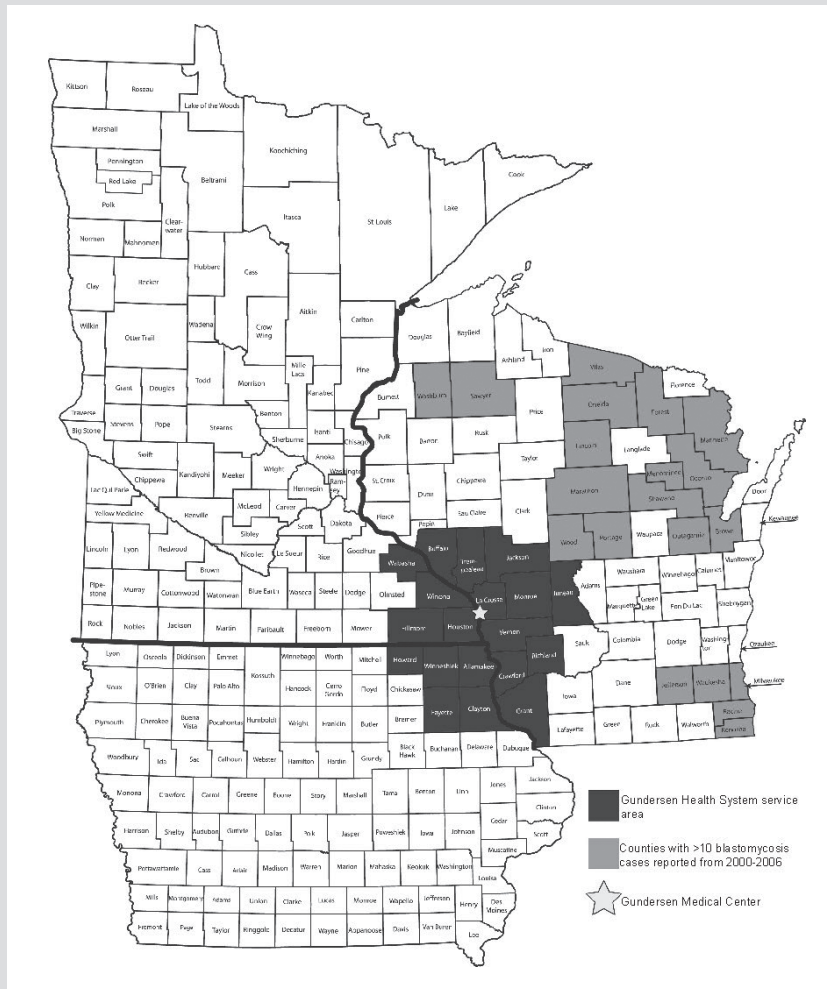
allowing recognition in the initial pulmonary disease phase. A recent evaluation using case vignettes found that primary care providers in Wisconsin counties with a low incidence failed to include blastomycosis in their differential diagnosis, while diagnosis was more likely to be listed if the physician practiced in a higher incidence county.⁶ However, even in hyperendemic counties, the diagnosis may be missed or delayed.

Since 1985, north central Wisconsin counties have reported an incidence of 10.4 to 41.9 per 100,000 persons; from 2000 through 2006, many of these counties reported more than 10 cases of blastomycosis (Figure 1).⁷ It is unclear whether the increasing prevalence is due to an increase in recognition of

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CME available. See page 19 for more information.

Figure 1. Prevalence of Blastomycosis



This map illustrates the Gundersen Health System service area and hyperendemic counties in Wisconsin with more than 10 cases of blastomycosis reported from 2000 to 2006. No county in the Gundersen service area had more than 4 cases of blastomycosis reported in the same time period.⁷

the illness, to humans entering previously undisturbed areas, or to a warmer and more humid climate.⁸ Forty-four percent of Wisconsin cases were identified in residents of 10 counties in the northern part of the state that have numerous wooded waterways. This hyperendemic area has been the location of several single point-source outbreaks.⁹ Over an 11-year period (November 1979-December 1990) Vilas County, a north central Wisconsin county with a population of just under 18,000, had an estimated mean annual incidence rate of 40.4 cases per 100,000 persons, with 101.3 cases per 100,000 persons in Eagle River, the county's largest town. Approximately 73% of this county is forested, and it has approximately 2300 miles of shoreline. There is an association between cases of blastomycosis and the presence of scrub and mature pine habitat in this area. This association has led to a hypothesis that after a period of measurable precipitation, a dormant natural reservoir is maintained in the acid decay of conifers.

With 77% of cases presenting with pulmonary symptoms, physicians in this area appear to have a high level of suspicion for pneumonic blastomycosis and to test for it early in respiratory infections.¹⁰

In this retrospective blastomycosis case series, we evaluated the incidence, epidemiologic exposures, clinical features, diagnosis, and initial treatments of patients cared for in a large health system located in southwestern Wisconsin, well outside the northern Wisconsin hyperendemic area.

METHODS

A Health Insurance Portability and Accountability Act (HIPAA) waiver was approved by the Gundersen Clinic Human Subjects Committee/Institutional Review Board (IRB) prior to initiation of any research. Cases diagnosed at Gundersen Medical Center, located on the Mississippi River in southwestern Wisconsin, were identified using the ICD-9 CPT code 116; data were retrieved for cases from 1981 through 2012.

Patients who met a case definition of laboratory-confirmed blastomycosis were included in the study. Patients who reported a past history of blastomycosis were excluded from further review. In addition to epidemiologic and demographic data, clinical features, radiology, laboratory findings, and therapy were reviewed. Review of

La Crosse area cases included an evaluation of the suspected exposure for each patient. We attempted to interview patients who had been diagnosed from 2002 through 2006. Because the medical records were comprehensive, interviews did not add additional information and were not conducted for the remaining cases.

Regional patient data were evaluated for clinical features. Trends identified included pneumonia diagnosis, current or former smoking, lung disease, cancer, obesity, and incidence of diabetes. We compared data from our sample (N=26) with that of the general population of Wisconsin (N=5,581,839) for a representative year (2005) using SAS, Version 9.3 (SAS Institute Inc., Cary, NC).¹¹⁻¹³ The analysis included χ^2 tests and, when each cell contained less than 20.7% of the data, Fisher exact tests. *P* value was reported from the tests to detect any significant relationship between our sample and the overall population of Wisconsin.

Although not reported on a national level, blastomycosis is reported to the Wisconsin Division of Health and the Minnesota Department of Health. Demographic data on reported cases from 2002 through 2006 were obtained from the state epidemiologists assigned to blastomycosis in both states and entered into a Microsoft Excel spreadsheet for comparison with Gundersen Health System data.

RESULTS

Demographics

Thirty-six cases were identified by ICD-9 CPT codes over 32 years from 1981 through 2012 at Gundersen Health System. All cases were reviewed, with 26 meeting our inclusion criteria. The 10 cases eliminated were either miscoded or represented a past history of inactive blastomycosis. Seventy-three percent of patients (19/26) were men, and at least 92% (24/26) were white (race information was unavailable for 2 cases). Patients had a mean age of 53.9 years (range 22-82 years), with 60% (16/26) over the age of 50 years. Age ranges are reflective of those of the general populations of Minnesota and Wisconsin. Preexisting conditions were identified in 62% (16/26) of cases. The conditions included diabetes (10/26), cancer (4/26), asthma (2/26), chronic obstructive pulmonary disease (2/26), and splenectomy (1/26).

Clinical Features

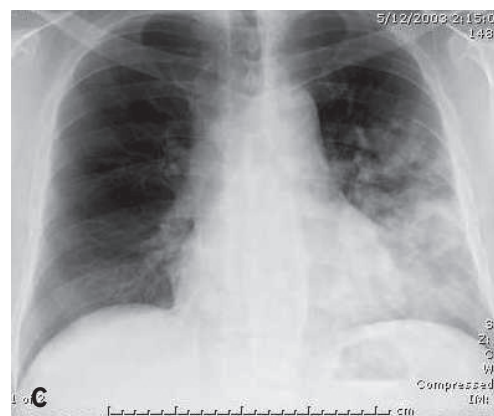
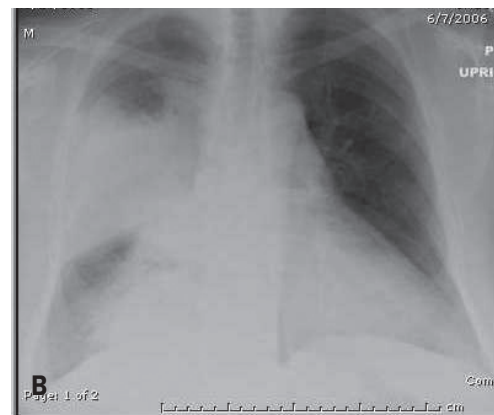
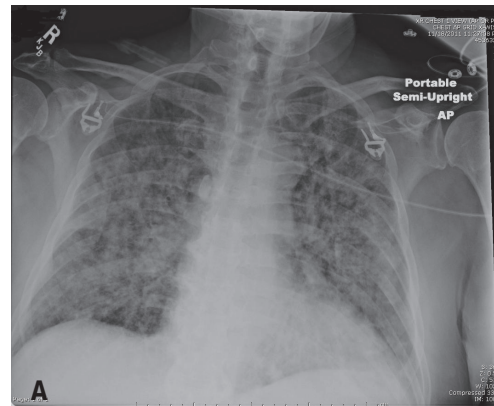
The most common symptoms were cough, chest pain, fever, chills, night sweats, and weight loss. Patients presented with an array of backgrounds at risk for lung disease: 1 patient had a long history of asbestos exposure in the workplace, and 16 (62%) were current or former smokers. Pulmonary involvement was noted in 85% (22/26). Two of the patients with pulmonary disease also had extrapulmonary symptoms. Twenty-seven percent (7/26) had extrapulmonary disease, as follows: skin (5/7), joint (2/7), bone (1/7), abdominal cavity (1/7), vertebral (1/7), and CNS (1/7).

Eighty-one percent (21/26) of patients were hospitalized for at least 1 day due to their blastomycosis. Findings from chest radiographs were highly variable—from normal, to localized infiltrate, to ARDS (Figure 2). In 73% (19/26) of cases, symptoms and signs suggestive of bacterial pneumonia were treated with various antibacterials prior to the diagnosis of blastomycosis. In the 5 patients not hospitalized, pneumonia was not considered as an initial diagnosis because the patients first were evaluated for blastomycosis skin lesions. One patient initially was given multiple courses of antibiotic treatment and underwent surgical excision due to persistent dermatitis.

Outcomes for all cases were evaluated. At the time of review, 69% of patients (18/26) were still living, 15% (4/26) had died due to blastomycosis, 8% (2/26) had died of other causes, and the outcomes for 8% (2/26) were unknown.

Time from onset of illness to the collection date for the first

Figure 2. Sample Chest Radiographs



(A) Severe acute respiratory distress syndrome; (B) Severe pneumonia, right lung; (C) Localized pneumonia, left lung with cavitation.

positive laboratory sample was available in 25 of 26 cases (mean 51 days; median 35 days; range 157 days) (Table). Infection was confirmed using KOH microscopy (5/26), culture (20/26), and histopathology, predominantly by Gomori methenamine silver (GMS) stain showing large broad-based budding yeast (12/26).

Table. Southwest Wisconsin Blastomycosis: Selected Epidemiology and Clinical Features

Clinical Feature	Age/Sex	Days from Symptoms to Positive Laboratory Result	Significant Epidemiology (if Noted)	Diabetes	Smoking	Died Due to Blastomycosis	Testing Methodology
Acute Pulmonary	53/M	15	None	+	-	Yes	Bronchoalveolar lavage, culture, histopathology
	22/M	14	None	+	-	Yes	Histopathology lung tissue
	75/M	22	None	+	+	Yes	Bronchoalveolar lavage
	72/M	4	Cabin in Washburn County, Wisconsin	+	-	Yes	Sputum culture
Chronic Pulmonary	42/M	136	Cutting rotten trees	-	+	No	Sputum culture, lung biopsy, negative complement fixation
	59/F	161	Excavation of cellar 4 months prior	-	+	No	Bronchial wash, culture, histopathology, negative complement fixation, immunodiffusion positive
	66/M	69	None	+	+	No	Lung brushings, biopsy, culture, histopathology
	46/M	70	rabbit hunting	-	+	No	Bronchial wash, lung needle biopsy, culture, histopathology
	40/F	25	None	-	+	No	Bronchoalveolar lavage, culture, histopathology
	45/M	27	None	-	+	No	Bronchial brushing, lung biopsy
	52/M	n/a	Works for dredge team US Army Corps of Engineers	+	+	No	Culture
	52/M	16	Cabin in Stevens Point, Wisconsin; ill dog	-	+	No	Bronchial wash
	56/M	55	None	+	-	No	Bronchial wash, culture, DNA probe confirm, negative complement fixation
	69/M	68	Lived in Washburn County, Wisconsin	+	+	No	Bronchial wash, culture positive, positive complement fixation
	72/M	70	Clearing brush near stream	-	+	No	Lung resection, histopathology, negative complement fixation
	61/F	60	None	-	-	No	Bronchoalveolar lavage, culture
	50/F	7	Polk County, Wisconsin; canoes on Platte River	-	+	No	Lung biopsy, culture
	49/M	7	None	-	-	No	Bronchial lavage, culture
	45/F	70	None	+	+	No	Culture lung tissue
	Mixed Pulmonary and Extrapulmonary	37/M	56	Northern Wisconsin travel	-	-	No
53/F		33	None	-	+	No	Bronchoalveolar lavage
65/F		16	None	+	-	No	skin biopsy, abdomen
Extrapulmonary	37/M	154	Vilas & Oneida County, Wisconsin; ill dog	-	-	No	Histopathology skin
	29/M	35	None	-	+	No	Skin biopsy, nose lesion, culture, histopathology
	82/M	20	None	-	+	No	Leg wound culture, histopathology, negative serology
	54/M	59	None	-	-	No	Paraspinal muscle tissue culture, histopathology

Serology using complement fixation or immunodiffusion was used to evaluate only 8 of the cases. Only 1 patient had a positive complement fixation test at 1:16, and another patient had a positive immunodiffusion test, resulting in a sensitivity for all immunologic testing of only 29%.

Treatment and Outcomes

Treatment regimens did not vary greatly and mirrored the Infectious Diseases Society of America Practice Guidelines.¹⁴ Itraconazole was the most common treatment and was used in 58% (15/26) of cases. Amphotericin B (4/26), ketoconazole (2/26), fluconazole (3/26), and voriconazole (3/26) were the other

treatment choices. Changes in therapy were made for 5 patients. The first of these patients initially was treated with itraconazole. After no improvement and the patient developed bloody stools, a switch was made to amphotericin B, then to comfort measures only before he died due to blastomycosis. The second patient was changed to fluconazole when limited improvement was noted with itraconazole. The third patient was started on amphotericin B and then placed on ketoconazole as an outpatient. The only patient with a recurrence of infection had non-Hodgkin lymphoma. He had been treated initially with fluconazole; he relapsed with blastomycosis and was treated with voriconazole 4.1 years after the initial diagnosis. The final patient was started on voriconazole, and the regimen was changed to itraconazole due to its lower cost and better record of efficacy.

Outcomes/Misdiagnosis

Delay in diagnosis played a key role in the death of those patients who died due to blastomycosis. One case diagnosed in March 1988 was treated with various antibacterials for 2 weeks before clinical consideration of blastomycosis. Another case was diagnosed with pneumonitis in the urgent care department; the patient declined a chest radiograph at the time and was sent home with antibacterials. Within 2 days, admission to the intensive care unit was necessary; with further clinical decline, a belated sputum for KOH was obtained. Results were compatible with blastomycosis. The patient was returned to intensive care, where amphotericin was started on day 5 of the hospitalization, but the patient died that day. Another death occurred in an individual with end-stage renal disease who had an initial diagnosis of bacterial pneumonia in mid-February of 2005. This individual eventually was referred for evaluation of worsening lung nodules, and blastomycosis was not considered until day 4 of the hospitalization. On day 6 the patient developed hypoxemia and died on hospital day 16. The final death in this series occurred in an individual admitted with confusion and hyperglycemia. An infectious disease consult led to adjustment to Zosyn, doxycycline, and voriconazole on hospital day 3, but the patient went into multisystem organ failure and his prognosis was poor. He died on hospital day 6.

There was also misdiagnosis among the patients who survived their illness. In 6 patients, treatment for bacterial pneumonia was initiated before the diagnosis. Of these, 1 was placed on cefadroxil, azithromycin, and steroids for presumed pneumonia, with a diagnosis of blastomycosis delayed for 2 months. The other patients were treated with a variety of antibacterial agents. One patient whose blastomycosis initially was misdiagnosed as a bacterial infection had been ill for 6 months following a hunting trip to northern Wisconsin. The patient had a skin lesion that was treated as bacterial cellulitis, later believed to be a lipoma. The patient underwent surgical excision of the wound with histopathology before a diagnosis of subcutaneous blastomycosis was made.

Outdoor Exposure and Epidemiology

Individual cases with epidemiologic clues to the diagnosis of blastomycosis included 1 patient who reported weed whacking brush along a stream on his property. Another patient reported a musty odor when chain sawing some dead elm trees. A third patient, who had an illness onset in November, recalled excavation of a kitchen cellar the previous summer. One patient, an avid outdoorsman, recently had been rabbit hunting.

Potential occupational exposures were reported in 2 cases. The first individual owned a construction company that builds homes in the region; he also was a hunter. Another patient was a member of the dredge team for the Army Corps of Engineers.

Two patients indicated their dogs were ill just before they were diagnosed with blastomycosis. A third patient mentioned having to euthanize a dog for "lung cancer" (not histologically proven) just before being diagnosed with blastomycosis.

Twenty-four patients lived within the Gundersen Health System tristate service area. One patient lived in eastern Wisconsin. The final patient had stayed at a cabin in Washburn County, within the known hyperendemic area, just before his diagnosis. Six patients had travelled to, or lived in, the northern hyperendemic area of blastomycosis (Wisconsin counties of Vilas, Washburn, and Polk, and a cabin in northern Wisconsin).

Wisconsin and Minnesota Statewide Data

The Wisconsin and Minnesota state data include only individuals with both symptoms of blastomycosis and laboratory-confirmed infection. Demographic data collected included sex, race, and age. The rate of blastomycosis per 100,000 persons was calculated using population data for each state.^{10,14} Overall in the 5-year period, Wisconsin had a higher incidence of the infection, with a rate of 2.0 per 100,000, while Minnesota had a rate of 0.5 per 100,000. The overall incidence rate of blastomycosis in combining both states was 1.3 cases per 100,000. Of note, in 2006 Wisconsin experienced an outbreak in the hyperendemic area along the upper Wisconsin River, affecting the significance of the increase in that state in 2006.¹⁵ Based on census data in Gundersen's 19-county service area, our rate is 0.17 cases per 100,000.¹⁶ To calculate this figure, the 26 cases in our study were combined with 5 cases reported by the only other large regional hospital (Mayo Clinic Health System Franciscan Healthcare in La Crosse, oral communication, June 2013) and a population estimation for the 19-county region was obtained. The majority of patients in the 19-county region obtain their care at 1 of the 2 hospitals.

Patients in our series were significantly more likely to have diabetes than were individuals in Wisconsin's general population (38% vs 15%, respectively; $P = .003$, Fisher exact test). They were also significantly more likely than Wisconsin's general population to be current or former smokers (62% vs 40%, respectively; $P = .024$, χ^2 test).

Patient Interviews

Five patients met the criteria for interview in 2007. Two of the 5 did not return a consent form or could not be located. During the 3 patient interviews we conducted, patients had difficulty recalling details of their illness, even though one had been diagnosed only 3 months earlier. Because the health system has a comprehensive medical record that crosses from the hospital to clinic, the patient interviews added little information and were discontinued. In the future, detailed questionnaires with targeted questions to be completed at the time of diagnosis may provide additional clues about where individuals might have been infected with the fungus. Furthermore, environmental sampling may be more productive with prompt data collection.

DISCUSSION

The blastomycosis incidence from the statewide data indicated an increase from previous reports. A rate of 0.32 and 0.72 cases per 100,000 was reported in Wisconsin between 1973 and 1982. Between the years of 1986 and 1995, a rate of 1.4 cases per 100,000 persons was reported.⁷ This evaluation of Wisconsin data from 2002 through 2006 yielded a rate of 2.0 per 100,000 persons. This number was somewhat inflated by the 2006 outbreak in Lincoln County, although outbreaks also were reported during the previous data sets.¹⁷⁻¹⁹ Incidence should continue to be evaluated to determine whether this increase continues, perhaps due to climatic factors, or with greater human encroachment into riparian areas of Wisconsin.

This southwestern Wisconsin regional data indicated only a slight variation from statewide trends in Minnesota and Wisconsin. Although 73% of local cases were men, men represented 65% in the combined state data. This varies from a reported trend towards a more balanced ratio of men and women (27/47 female) in cases from Vilas County, Wisconsin from 1991-1996.²⁰ The male predominance in this case series may be due to more occupational and vocational risk among men outside of the hyperendemic area.

The majority of southwestern regional cases were white (92%), although whites represented only 73% of cases in the statewide data. However, race data are difficult to interpret statewide due to the large number of cases with unknown race (14%). Age data also varied from the state data, with 60% being over the age of 50 years in the southwestern regional data set compared with 39% in the statewide data. No pediatric cases were identified in the regional data during the study period; there is service for pediatric intensive care at the hospital, so it is unlikely the cases were referred outside of the community. The cases are more widely distributed in all ages in the statewide data than in the regional data, perhaps due to the small sample size in the regional data set, or maybe due to the environmental foci of blastomycosis occurring in locations, unlike the Northern hyperendemic area, where children unlikely frequent.

Only 23% of our patients reported travel to the hyperendemic counties in northern Wisconsin. This could indicate the intermittent presence of the organism in the tristate area served by the Gundersen Health System, or it could indicate limited reporting by the patients. Presenting symptoms and demographic data from our cases were compared with previously published data. Eleven years of blastomycosis cases from Vilas County, Wisconsin, were reviewed. Of these cases, 77% presented with pulmonary manifestation of disease. In our series, 19 of the 26 patients had pulmonary symptoms at some time during their illness. The age range of the patients in this study was 22 to 82 years, narrower than that published in other studies of 4 months to 95 years,⁹ and 6 months to 83 years,²¹ a difference likely due to our much smaller sample size.

A notable association was that 62% of patients in our series were current or former smokers. This was a statistical difference that indicated being a current or former smoker is a predisposition to infection with *B dermatitidis*. This association was evaluated by Baumgardner et al in an area of high endemicity and not identified as a factor in disease.¹⁰ Interestingly, both diabetes and smoking history have been associated with histoplasmosis and coccidioidomycosis.²²⁻²⁴ The most common premorbid condition in the patients in this review was diabetes (38%). Rates of the underlying prevalence of diabetes were obtained and artificially adjusted for the study years. There was a statistical difference between the general population and patients diagnosed with blastomycosis, indicating an epidemiologic predisposition to disease in this population. White cell dysfunction due to insulin resistance may be an underlying explanation for this observation.

Not surprising was the finding that 35% of our patients reported exposure to excavation or waterways. As in other reports, activities such as clearing brush, cutting trees, or hunting were noted. Six patients in this case series reported trips to counties with a hyperendemic incidence of blastomycosis. This review extends the association with soil and waterways, as predicted by Reed et al, to the upper Mississippi River valley.⁷

If Winston Churchill had been a microbiologist, he might have described blastomycosis as "a riddle, wrapped in a mystery, inside an enigma." The *riddle* is: What is the exact niche of blastomycosis? Only rarely and transiently has this fungus been identified from nature. Therefore, limited useful data are available to warn the public of specific exposure for infection. In hyperendemic counties, such as Vilas County, Wisconsin, health care providers keep this infection high in their differential for pneumonic illnesses. In areas such as the regional health care facility studied here in southwestern Wisconsin, well outside the hyperendemic area, the illness is often far lower on the differential.⁶

The *mystery* is how to get providers to include blastomycosis in their initial differential and to test for this treatable infection. This review indicates that some trends may be worth

further investigation. An alarming 73% of patients with acute pneumonia were treated for bacterial pneumonia before therapy for blastomycosis was initiated. This supports the report of Baumgardner et al, in which providers from low-incidence counties were less likely than those from high-incidence counties to include blastomycosis in the differential when given case presentations.⁶ Increasing the level of suspicion for blastomycosis could help shorten the duration from onset of illness to diagnosis of the infection. Although 13 of 26 (50%) patients in our retrospective review had prior epidemiologic features, such as activity in a riparian area, outdoor recreation, brushwork, travel to hyperendemic areas, or recent death of a pet dog due to pulmonary disease, the medical records of 8 of our cases contained no mention of an exposure factor that could have alerted providers to the diagnosis earlier. Raising suspicion for this uncommon illness may be challenging because the vast majority of cases of community-acquired pneumonia are due to more common infections.

The enigma is how to improve laboratory testing to rapidly diagnose blastomycosis with a sensitive and specific screening test. Chest radiograph results can be normal, or they can show a healed granuloma, a localized infiltrate, or a diffuse ARDS. While improved serologic testing may aid in more chronic cases or in blastomycetes epidemiology, immunologic tests based on adaptive immunity probably will remain insensitive in early, acute cases. There is a sensitive urine antigen test, though it does not differentiate histoplasmosis and blastomycosis. It is a rapid, noninvasive method that can speed diagnosis.²⁵ It is hoped that molecular testing to detect subclinical or mild infections due to this dimorphic fungus will aid in earlier diagnosis, as it has already led to data for epidemiologists investigating the occurrence and prevention of blastomycosis.²⁶

Evaluation of regional data indicates a low level of suspicion for blastomycosis among health care providers along the Mississippi River in Wisconsin. Most patients in this review were treated for bacterial pneumonia and bacterial skin infections, sometimes for several months, before the diagnosis of blastomycosis was made. No single factor was identified that consistently could help the provider with early clues to the diagnosis. Therefore, it is imperative that health care providers consider this serious, but difficult to diagnose, fungal infection.

Newer treatment regimens did develop at the end of this period. For instance, 1 case initially treated with amphotericin followed by ketoconazole suffered a relapse, whereupon voriconazole, with its CNS penetration, proved successful. Amphotericin B remains a standby treatment for more invasive disease, although 1 patient with disseminated disease was successfully treated with intravenous followed by oral, high-dose fluconazole.²⁷ In non-CNS cases, itraconazole was supported as a drug of choice. These newer treatment regimens are better tolerated and allow for less expensive outpatient therapy.

CONCLUSION

In summary, the complete ecology of blastomycosis in Wisconsin remains a mystery. Until the exact niche of the fungus is identified, it will remain difficult to warn the public about how to protect themselves—and difficult for providers to consider this unusual fungal infection. For the time being, the most important key is for the medical community to promptly screen for blastomycosis in patients with a history of soil or dead vegetative exposure, with an ill dog in the home, with unusual findings on a chest radiograph, extreme acute respiratory distress syndrome, or failure to respond promptly to initial antibacterial therapy.

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Quiz: Blastomycosis Diagnosed in a Nonhyperendemic Area

EDUCATIONAL OBJECTIVES

Upon completion of this activity, participants will be able to:

1. Understand the epidemiology of blastomycosis.
2. Recognize the varied presentations of patients presenting with blastomycosis.
3. Appreciate the appropriate evaluation and treatment of patients with blastomycosis.

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QUESTIONS

1. Which of the following statements concerning blastomycosis is false?
 - Blastomycosis is caused by the dimorphic fungus *Blastomyces dermatitidis* which is found in wet, forested areas near rivers and streams.
 - The organism usually enters the host through the lungs, where it can cause an asymptomatic infection, a localized pneumonia, or severe acute respiratory distress syndrome (ARDS); thereafter, it can disseminate to other tissues, such as bones, central nervous system, liver, spleen, bone marrow, genitourinary tract, and skin.
 - In hyperendemic counties in northern Wisconsin, health

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care providers maintain an index of suspicion for blastomycosis, allowing recognition in the initial pulmonary disease phase.

- Chest radiographs are highly characteristic for blastomycosis, generally showing a localized infiltrate.
2. The incidence rate for blastomycosis in Wisconsin varies from as low as 0.17 cases per 100,000 in the current study to as high as 101.3 cases per 100,000 in the hyperendemic area of Eagle River, Wisconsin.
 - True
 - False
 3. Which of the following statements concerning the findings in the present study is false?
 - Being a current or former smoker was a predisposition to infection with *Blastomyces dermatitidis*.
 - Although pulmonary involvement was noted in 85%, more than a quarter of patients had extrapulmonary disease as well.
 - Serological studies were the most useful method of making the diagnosis of blastomycosis.
 - In a majority of the cases, symptoms and signs suggestive of bacterial pneumonia were treated with various antibacterials prior to the diagnosis of blastomycosis.
 - Skin lesions were the most common manifestation of extrapulmonary disease.
 4. Maintaining a high level of suspicion for blastomycosis in patients presenting with pulmonary symptoms and signs with or without extrapulmonary manifestations is the key to making the diagnosis of this disorder and its prompt treatment.
 - True
 - False

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