A Large Histoplasmosis Outbreak Among High School Students in Indiana, 2001

Shadi Chamany, MD, MPH, Sara A. Mirza, MPH,† John W. Fleming, MD, PhD,‡ James F. Howell, DVM, MPH,§ Steven W. Lenhart, CIH,¶ Vincent D. Mortimer, PE,¶ Maureen A. Phelan, MS,† Mark D. Lindsley, PhD,† Naureen J. Iqbal, BA,† L. Joseph Wheat, MD,‖ Mary E. Brandt, PhD,† David W. Warnock, PhD,† and Rana A. Hajjeh, MD†*

Background: A histoplasmosis outbreak occurred in an Indiana high school in November–December 2001.

Methods: To describe the risk factors for this outbreak, we conducted a cohort study of all available students and staff (N = 682) and an environmental investigation.

Results: Of the 523 (77%) persons who displayed serologic evidence of recent *Histoplasma capsulatum* infection, 355 (68%) developed symptoms consistent with acute pulmonary histoplasmosis. Rototilling of soil in a school courtyard known to be a bird roosting site had been performed during school hours on November 12, 2001, 14 days before both the peak of the onset of illness and a rise in student absenteeism. Being a student (odds ratio, 3.3; 95% confidence interval, 2.2–5.0) and being a student in a classroom near the courtyard during the rototilling (odds ratio, 3.1; 95% confidence interval, 1.8–5.2) were independently associated with infection and symptomatic illness. *H. capsulatum* was isolated from environmental samples, including soil from the courtyard and dust collected from a filter of a heating, ventilating and air-conditioning system.

Conclusions: Soil-disrupting activities within a school courtyard caused the largest outbreak to date of histoplasmosis among adolescents. Improved efforts are needed to educate the community in endemic areas about histoplasmosis to prevent the occurrence of such outbreaks in the future. In addition, increased awareness among health care providers of this disease would facilitate appropriate diagnosis and treatment.

Key Words: histoplasmosis, outbreak, high school

(*Pediatr Infect Dis J* 2004;23: 909–914)

Histoplasmosis is a systemic infection caused by the dimorphic fungus *Histoplasma capsulatum*. Outbreaks have been previously reported in the United States in endemic areas located along the Mississippi and Ohio River valleys[1–5] and have usually occurred after airborne exposures to fungal spores, known to proliferate in soil that has been contaminated by bird or bat droppings. Infection can be asymptomatic or cause clinical illness. Symptoms usually appear 10–14 days after infection, and clinical manifestations range from acute pulmonary histoplasmosis to disseminated histoplasmosis. High attack rates of clinical illness ranging between 40 and 50% have been described during outbreaks,[1,2,5,6] with acute pulmonary histoplasmosis being the most common manifestation. Until now, the largest known outbreak among adolescents followed cleaning (ie, raking and sweeping) for Earth Day at a middle school in Ohio in 1970; almost 400 persons, primarily students, were infected.[1]

During the week of November 26, 2001, school officials at a high school in Indiana (school A) noted an increase in the student absenteeism rate from a baseline of 5% to 29%. Two weeks later, 2 local physicians reported 2 cases of laboratory-confirmed histoplasmosis in school A students, as well as several suspected cases of histoplasmosis in school A students, whose clinical and radiographic findings suggested histoplasmosis. Because cases were limited to students and employees of school A, an investigation of the school was initiated to identify recent activities that could have contributed to this outbreak. Preliminary investigation revealed rototilling activities earlier in November in a school courtyard known to be a bird roosting site for many years. The rototilling of the soil in the courtyard was identified as a potential source of infection.

Accepted for publication May 19, 2004.

From the *Epidemic Intelligence Service, Division of Applied Public Health Training, Epidemiology Program Office, and the †Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, GA; ‡Shelby County Health Department, Shelbyville, IN; §Indiana State Department of Health and ‖MiraVista Diagnostics, Indianapolis, IN; and the ¶National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, OH

Address for reprints: Mycotic Diseases Branch, Division of Bacterial and Mycotic Diseases, 1600 Clifton Road, MS C09, Atlanta, GA 30333. E-mail jtm7@cdc.gov.

ISSN: 0891-3668/04/2310-0909

DOI: 10.1097/01.inf.0000141738.60845.da

We report here the largest outbreak of histoplasmosis among adolescents to date and describe its characteristics, source and risk factors for infection.

MATERIALS AND METHODS

Case Definitions. The study period was defined as November 12, 2001 through December 20, 2001. A school A attendee was defined as any person who attended classes at the school or who worked at or visited the school at least 2 times per week during the study period.

A laboratory-confirmed case of histoplasmosis was defined as the presence of H and/or M bands on immunodiffusion (ID) or a complement fixation (CF) titer of $\geq$ 1/32 in serum collected from a school A attendee. Because the earliest symptom onset after infection is 3 days, a clinical case was further defined as the development of any 2 of the following symptoms, fever, cough, chest pain, shortness of breath or headache, on or after November 15, 2001, in a school A attendee with laboratory-confirmed histoplasmosis.

Case Finding. Announcements regarding the outbreak were made in various local media venues (television, newspaper) to inform the community of the outbreak and the investigation. To alert physicians about the outbreak, the county health department sent out a memo to local physicians via an E-mail list-serve, requesting that these physicians report potential histoplasmosis cases. These physicians were also asked to report any cultures or histopathology specimens demonstrating the presence of *H. capsulatum*. In addition, medical records at the local hospital were reviewed to identify persons who underwent serologic evaluation for histoplasmosis.

Cohort Study. To identify additional cases, an announcement was made in the local newspaper asking all school A attendees to participate in a cohort study. After informed consent, each person completed a self-administered questionnaire asking about illness in the previous month including information about symptoms, physician visits, diagnostic tests and treatment. In addition, information was obtained about participation in certain outdoor activities such as cave exploration and construction, which have previously been associated with increased risk of developing acute histoplasmosis. Responses were dichotomized into 2 groups: (1) ever having participated in these outdoor activities; and (2) never having participated in these outdoor activities. Class schedules and absentee lists were reviewed to determine the location of students on specific days; absentee information on adults was incomplete and was not included in the analysis. A student was considered "nearby" the rototilling if s/he had class in the wing adjacent to the courtyard during the afternoon of the rototilling and was present in school that day. Participants also voluntarily provided a single serum sample for *H. capsulatum* testing. Individuals who had serologic testing performed at their physicians' offices between December 15, 2001 and December 21, 2001 (the week before the cohort study) were not asked to provide an additional serum sample.

Environmental Evaluation. Students and staff were questioned about school activities and community events that could have resulted in exposures to *H. capsulatum*. In addition, the school grounds; heating, ventilating and air-conditioning (HVAC) systems; and classrooms were inspected to identify all possible sources of *H. capsulatum.*

Twenty soil samples from the school courtyard were collected. In addition, samples of dusty material were collected from filters of the HVAC systems supplying the wing of the school adjacent to the courtyard.

Laboratory Evaluation. Serum specimens collected from cohort study participants were tested at the Centers for Disease Control and Prevention for the presence of *H. capsulatum*-specific antibodies using both ID and CF methods.[7] Sera from the small subset of participants previously tested by their physicians underwent ID and CF testing at ARUP laboratories (Salt Lake City, UT). All environmental samples were tested using intraperitoneal mouse inoculation.[8]

Statistical Analysis. Data were analyzed using SAS version 8.2 (SAS Institute, Cary, NC). Categoric variables were compared with the χ^2 test. Because the relationship between the student status (student versus nonstudent) and age was collinear, we chose to use student status in the risk factor analysis as a marker for age. Univariate analysis was initially conducted to calculate relative risks with 95% confidence intervals (CI). Variables found to be significant on univariate analysis at $P \leq 0.15$ were included in the multivariable analysis. The SAS logistic regression procedure with backwards elimination was used to calculate adjusted odds ratios (aOR) with CIs.

RESULTS

Descriptive Characteristics. Of the 1207 school A attendees, 682 (57%) participated in the cohort study: 532 high school students (53% of all students); 147 employees (74% of all employees); and 3 elementary/junior high school students who attended swim practice at the high school in the evenings.

Of the 678 people who provided serum samples, 523 (77%) met the laboratory-confirmed case definition. Of the laboratory-confirmed cases, 355 (68%) also met the clinical case definition. The median age of the laboratory-confirmed case patients was 16 years (range, 8–80); 247 (47%) were male and 439 (84%) were students. The median age of the clinical case patients was also 16 years (range, 8–68); 161 (45%) were male and 308 (87%) were students. Of all case patients, 72% met the laboratory case definition because of a CF titer $\geq$1/32 and a positive ID, 12% because of a CF titer of $\geq$1/32 alone and 16% because of a positive ID alone. There were no reports of histopathology or other specimens

positive for *H. capsulatum* by culture. Fifty-five additional laboratory-confirmed cases (all but 1 were either students or school employees) were identified through case finding, but these cases were not included in the cohort study because the medical records of these case patients were incomplete. The school grade and sex distributions of the case patients were similar to those of the entire school and cohort study populations. Seventeen percent of students and 48% of employees had heard of histoplasmosis before this outbreak, and 2 adults had been previously diagnosed with histoplasmosis.

Clinical Characteristics. The earliest date of symptom onset was November 15, 2001, and the latest date of symptom onset was December 20, 2001, with a peak on November 26, 2001, 14 days after the rototilling activities (Fig. 1). Greater than 80% of clinical case patients had 5 or more symptoms. The distribution of symptoms is shown in Table 1, with the most common symptoms being headache in 95%, fatigue in 79%, fever in 79%, cough in 73% and myalgias in 71%. The relationship between the number of symptoms and the magnitude of the CF titer is shown in Figure 2. Among the 437 laboratory-confirmed case patients with a positive CF titer, 27 (37%) of 73 without symptoms had a high titer (CF $\geq$ 1/128), 22 (49%) of 45 with 1–2 symptoms had a high titer, 47 (55%) of 85 with 3–5 symptoms had a high titer and 179 (77%) of 234 with >5 symptoms had a high titer (χ^2 for trend, $P < 0.0001$).

Within the cohort, 69 people (10%) were smokers and 98 (14%) had an underlying illness: 80 had asthma; 13 had diabetes; 3 had cancer; and 4 individuals were receiving immunocompromising medications for various medical conditions. Three of these 4 were receiving newly introduced immune therapy for rheumatologic disorders, and 1 was taking oral steroids for a nonrheumatologic condition. Three (75%) of the 4 met both the laboratory-confirmed and clinical case definitions, 1 of whom developed disseminated histoplasmosis.

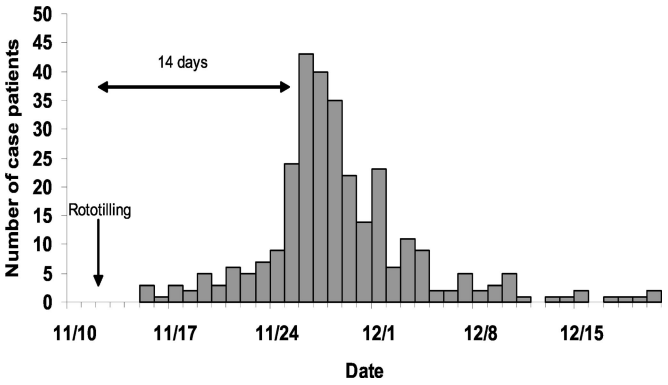

FIGURE 1. Distribution of date of symptom onset among persons with acute pulmonary histoplasmosis, school A, histoplasmosis outbreak, Shelby County, Indiana, November–December 2001 (N = 300)

TABLE 1. Distribution of Symptoms Among Persons With Acute Pulmonary Histoplasmosis, School A, Histoplasmosis Outbreak, Shelby County, Indiana, November–December 2001 (N = 355)

Symptom	No.	%
Headache	337	95
Fatigue	280	79
Fever	279	79
Cough	258	73
Myalgias	251	71
Chills	239	67
Chest pain	235	66
Arthralgias	183	52
Shortness of breath	157	44
Night sweats	157	44
Rash	33	9

Clinical care was sought by 170 persons (48% of clinical case patients); 71 (42%) of these clinical cases received a chest radiograph and 85 (50%) were given an antibiotic. Of these 85, 78 received an antibacterial agent (41 a macrolide antibiotic, 28 a β-lactam antibiotic), and 13 received an antifungal agent (fluconazole, itraconazole, ketoconazole and/or amphotericin B). Nine individuals from the cohort were hospitalized, 3 of whom were immunocompromised, and there were no deaths.

Environmental Investigation. Review of questionnaires and responses from personal interviews identified 4 possible sources of exposure to *H. capsulatum*. A bonfire with approximately 30 Latin class high school students in attendance took place on October 20, 2001. Given the known incubation period of *H. capsulatum* and that it does not exhibit person-to-person transmission, exposure at this event would have resulted in infection among only a small number of students, with onset of illness the first week of November. Football games during October–December 2001 and a Halloween "Haunted Barn" open to the community between October 18 and October 27, 2001 were also potential sources of exposure, but exposure to these sources would have resulted in illness among persons throughout the community, not just among students and school employees. Rototilling of soil in a school A courtyard during school hours took place on November 12, 2001 and would have resulted in the following: (1) a large population (>1000 persons) potentially being exposed; (2) symptom onset occurring between November 15 and November 26, 2001; and (3) exposure limited to school A attendees. Because this event could explain an outbreak of this magnitude limited to school A attendees at the end of November, the remainder of the environmental investigation focused on the rototilling activities.

During the last week of October, 5 trees within the school A courtyard were cut down. Birds had been roosting in these trees since the school was built in the 1960s. Two weeks later, on November 12, 2001, 1 student accompanied

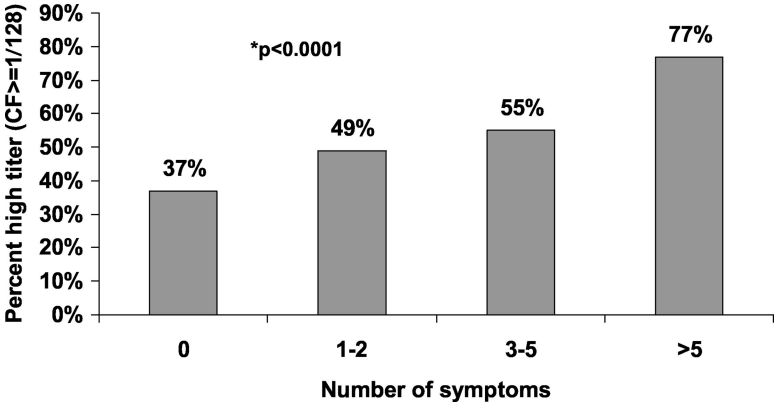

FIGURE 2. Proportion of cases with a high titer of *H. capsulatum* antibodies (CF $\geq$ 1/128) by number of symptoms, school A, histoplasmosis outbreak, Shelby County, Indiana, November–December 2001 (N = 437). $*$ indicates χ^2 for trend.

by 2 other students and 4 teachers rototilled a 10- $\times$ 45-foot area of soil, where the trees had previously stood, to plant flowers. The 50- $\times$ 100-foot courtyard where the rototilling took place is enclosed and surrounded by 2 floors of classrooms and student lockers. A hallway on the first floor connects these classrooms and lockers to the rest of the school and houses the only vending machine in the school (Fig. 3).

Three HVAC systems served the wing of the school that was near the courtyard. The fresh air intakes of all 3 systems were a few feet below the ground level of the courtyard. The ventilation systems for this wing of the school were separate from those serving the rest of the building. The filters of the HVAC systems were made of a material of low filtering efficiency and the filters fit imperfectly in their mounting frames.

Because the weather was unseasonably warm, the windows of the classrooms and the doors to the courtyard were open during the rototilling. Within several minutes of the beginning of the rototilling, students and faculty in the classrooms near the courtyard noticed an unusual odor which prompted the school to call the fire department. Because the odor was presumed to be coming from the courtyard activities, the rototilling was terminated. Five more students joined the others in the courtyard later that afternoon to continue planting.

During the environmental inspection in late December, the only bird droppings present in the courtyard were on and under a blue spruce tree located in the middle of the courtyard. *H. capsulatum* was recovered from 4 soil samples: 3 of the 10 samples collected from the rototilled area; and 1 of the 3 samples collected under the spruce tree. *H. capsulatum* was

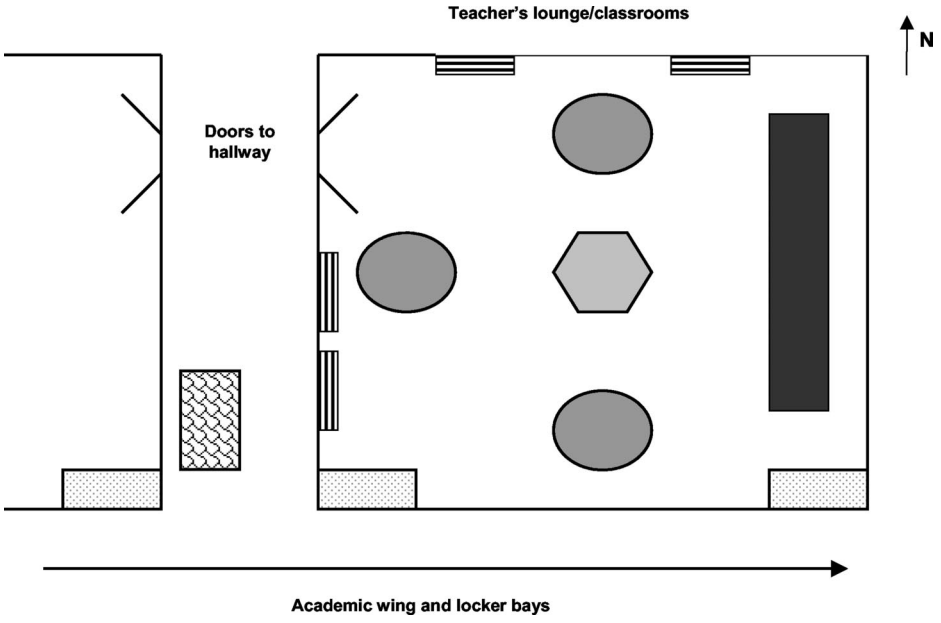

FIGURE 3. School courtyard and surrounding structures, school A, histoplasmosis outbreak, Shelby County, Indiana, November–December 2001. Black rectangle indicates area of rototilled soil; oval, shrub; hexagon, blue spruce tree; dotted rectangle, subgrade air intake for HVAC system; striped rectangle, air intake of univent; tiled rectangle, vending machine.

also isolated from the dust sample collected from the filter of the HVAC system with its fresh air intake immediately adjacent to the rototilled area.

Risk Factor Analysis. Patient characteristics, underlying conditions, student absenteeism and location in the school during the rototilling were evaluated as potential risk factors for infection and for clinical disease (Table 2). On multivariable analysis, being a student (aOR 3.3; CI 2.2–5.0; $P < 0.0001$) and being a student in a nearby classroom during the rototilling (aOR 3.1; CI 1.8–5.2; $P < 0.0001$) were associated with an increased risk of having a laboratory-confirmed case of histoplasmosis. Similar factors were associated with an increased risk of having a clinical case of histoplasmosis: (1) being a student (aOR 2.5; CI 1.7–3.7; $P < 0.0001$); and (2) being a student in a nearby classroom during the rototilling (aOR 2.4; CI 1.5–3.9; $P = 0.0003$). In addition, never having participated in outdoor activities (aOR 1.5; CI 1.1–2.1; $P = 0.01$) was associated with an increased risk of having symptomatic infection.

Comparison of Attack Rates. The overall attack rates for infection and symptomatic infection were 77 and 68%, respectively. Among students, these attack rates were 82 and 70%; among adults, these rates were 58 and 56%. We examined 2 populations of individuals who may have had different attack rates given their proximity, or lack thereof, to the rototilling activities: (1) individuals who participated in the rototilling and planting activities in the courtyard on November 12, 2001; and (2) students who were not in a nearby classroom during the rototilling activities and were absent from school the following days. Individuals who were present in the courtyard on November 12, 2001, had attack rates similar to those of the entire cohort population. Of the 88 students who were not in a nearby classroom during the rototilling activities, 74 were present in school that day but did not have class in a classroom near the courtyard and 14 were absent the entire day. The attack rate for infection among these students was 66% (58 of 88), and the attack rate for symptomatic infection was 60% (35 of 58). Of the 3 students who were absent during the rototilling activities and the following day, November 13, 2 (67%) became infected, and both (100%) were symptomatic. Two students were absent the entire week and did not meet either case definition.

DISCUSSION

We have described here the largest outbreak of histoplasmosis among adolescents in an endemic area of the United States to date. The high density of individuals in close proximity to the rototilling activities, the open windows and doors to the courtyard and the majority of school A attendees being young susceptible individuals may account for the high attack rates in this outbreak, which are similar to those previously reported.[1,2,5,6] Furthermore the morbidity associated with the intense exposure that occurred in this outbreak emphasizes the need for increased awareness about the disease and preventive measures.

The high attack rates associated with this outbreak caused marked disruption to the community. Because a large number of students missed school, the school was forced to postpone final examinations and to close until the investigation was complete. Health care utilization was high among this cohort, with nearly one-half of the clinical case patients seeking health care during a 1-month period, adding to the burden of both physicians and other caretakers within the community. In addition, almost one-fourth of the clinical case patients unnecessarily received antibacterial agents.

Risk factors found in association with this outbreak are similar to those identified in previous outbreaks and include young age (being a student) and proximity to soil-disrupting activities.[1,5,9,10] Prior exposure to *H. capsulatum* is known to confer partial immunity and may occur through repeated lifetime exposures while living in an endemic area, during travel to an endemic area or by participating in activities associated with exposure (ie, cave spelunking). In this outbreak, the attack rates of both asymptomatic and symptomatic

TABLE 2. Risk Factors for Laboratory-Confirmed Cases Among Cohort Study Participants, Univariate Analysis, School A, Histoplasmosis Outbreak, Shelby County, Indiana, November–December 2001*

Risk Factor	No. of Cases/No. of Persons With Risk Factors Present	No. of Cases/No. of Persons With Risk Factors Absent	Relative Risk	*P*
Being a student	439/533 (82)†	84/145 (58)†	1.4 (1.2–1.6)‡	<0.0001
Having asthma	67/80 (84)	456/598 (76)	1.1 (1.0–1.2)	0.13
Being from an endemic area§	505/658 (77)	17/18 (94)	0.8 (0.7–0.9)	0.08
Never having participated in outdoor activities‖	286/352 (81)	221/304 (73)	1.1 (1.0–1.2)	0.009
Being a student in a nearby classroom during rototilling	379/442 (86)	58/88 (66)	1.3 (1.1–1.5)	<0.0001

*Similar risk factors identified for clinical cases.

†Numbers in parentheses, percent.

‡Numbers in parentheses, 95% CI.

§Defined as having lived as least half a lifetime in one of the following states: Alabama, Arkansas, Illinois, Iowa, Kansas, Kentucky, Louisiana, Mississippi, Missouri, Ohio, Oklahoma, Tennessee, Texas.

‖Outdoor activities include: construction work; tilling soil/gardening; hunting; tractor farming; cave exploring; debris removal.

infection were higher among students because they were less likely than adults to have had lifetime exposures and were subsequently more susceptible to *H. capsulatum.* The attack rates were similar among students who were in the courtyard during the rototilling and those who were not, most likely because of the heavy aerosolization of spores in the area surrounding this activity and the close proximity of the classrooms to the courtyard.

Presence in a classroom surrounding the courtyard where the rototilling activities occurred also contributed to the risk of infection, but it did not account for all cases of infection. Although we were able to determine particular student locations within classrooms during a specific time period, we were unable to track other activities, such as going to the locker bay, socializing with other students in the hallways or using the vending machine located in a hallway that borders the courtyard, that may have placed other individuals in that area during the same time period. In addition, a few individuals who were not in a nearby classroom during the rototilling activities and were absent from school the following day also became infected. This finding suggests that exposures to aerosolized spores through the open windows and doors may not have been limited to the day of the activities but perhaps continued for 1–2 additional days. It is also possible that some spores may have entered the classrooms through the HVAC systems because the filters of the HVAC systems had low efficiency and did not fit tightly. In the Earth Day outbreak, Brodsky et al[1] also observed that being absent on both the day when spore-contaminated dust was aerosolized and the day afterward did not appear to be fully protective.

One of the interesting clinical findings in our study was the significant association between CF antibody titer and the severity of illness, as measured by the number of symptoms. We chose to look at this correlation within our cohort based on the findings of a previous histoplasmosis outbreak investigation by Larrabee et al[9] In this 1975 outbreak among military personnel in Panama, the investigators showed that as the severity of illness (measured by the duration of illness and/or hospitalization) increased, so did the proportion of individuals with a positive CF titer.

Previous studies have shown that persons with immunocompromising conditions have an increased risk of developing disseminated histoplasmosis.[11] In this outbreak, the only known disseminated case was in an immunocompromised individual. In light of new advances in immune therapy for medical conditions, particularly rheumatologic disorders, this finding emphasizes the need for increased awareness of the risk that these therapies may pose for individuals in histoplasmosis-endemic areas. Physicians in endemic areas treating these patients should have a heightened index of suspicion when these patients, particularly young patients, present with symptoms compatible with histoplasmosis.

This outbreak demonstrates that even in endemic areas, large outbreaks of histoplasmosis can occur after intense exposure to *H. capsulatum* spores aerosolized during activities disrupting contaminated soil. Therefore it is essential for persons living and working in histoplasmosis-endemic areas to be educated about histoplasmosis, activities with potential for exposure to *H. capsulatum* and ways to protect themselves and others by minimizing exposures. Guidelines for the prevention of occupational histoplasmosis have been developed[12] and should be used when such exposures are anticipated. In addition, efforts should be taken to minimize exposure of susceptible individuals during these activities. Because histoplasmosis mimics other respiratory illnesses, health care providers in endemic areas must be aware of the clinical presentation of histoplasmosis, its diagnosis and treatment.

ACKNOWLEDGMENTS

We thank the staff and volunteers of Major Hospital, the Shelby County Health Department and the school who assisted us with this investigation.

REFERENCES

1. Brodsky AL, Gregg MB, Loewenstein MS, Kaufman L, Mallison GF. Outbreak of histoplasmosis associated with the 1970 Earth Day activities. *Am J Med*. 1973;54:333–342.
2. Wheat LJ, Slama TG, Eitzen HE, Kohler RB, French ML, Biesecker JL. A large urban outbreak of histoplasmosis: clinical features. *Ann Intern Med*. 1981;94:331–337.
3. D'Alessio DJ, Heeren RH, Hendricks SL, Ogilvie P, Furcolow ML. A starling roost as the source of urban epidemic histoplasmosis in an area of low incidence. *Am Rev Respir Dis*. 1965;92:725–731.
4. Ward JI, Weeks M, Allen D, et al. Acute histoplasmosis: clinical, epidemiologic and serologic findings of an outbreak associated with exposure to a fallen tree. *Am J Med*. 1979;66:587–595.
5. CDC. Histoplasmosis: Kentucky, 1995. *MMWR*. 1995;44:701–703.
6. Morgan J, Cano MV, Feikin DR, et al. A large outbreak of histoplasmosis among American travelers associated with a hotel in Acapulco, Mexico, spring 2001. *Am J Trop Med Hyg*. 2003;69:663–669.
7. Reiss E, Kaufman L, Kovacs JA, Lindsley MD. Clinical immunomycology. In: Rose NR, Hamilton RG, Detrick B, eds. *Manual of Clinical Laboratory Immunology.* 6th ed. Washington, DC: ASM Press; 2002: 559–583.
8. Allejo L, Weeks RJ. Soil decontamination and other control measures. In: DiSalvo AF, ed. *Occupational Mycoses*. Philadelphia, PA: Lea & Febiger, 1983:229–238.
9. Larrabee WF, Ajello L, Kaufman L. An epidemic of histoplasmosis on the Isthmus of Panama. *Am J Trop Med Hyg*. 1978;27:281–285.
10. Furcolow ML. Test of immunity in histoplasmosis. *N Engl J Med*. 1963;268:357–361.
11. Wheat LJ, Slama TG, Norton JA, et al. Risk factors for disseminated or fatal histoplasmosis: analysis of a large urban outbreak. *Ann Intern Med*. 1982;96:159–163.
12. Lenhart SW, Schafer MP, Singal M, Hajjeh RA. Histoplasmosis: protecting workers at risk. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 97-146; 1997. Available at http://www.cdc.gov/niosh/97-146.html. Accessed November 20, 2003.