During 1999-2000, outbreaks of *Pseudomonas aeruginosa* dermatitis and otitis externa associated with swimming pool and hot tub use occurred in Colorado and Maine. This report summarizes these outbreaks and provides recommendations for swimming pool and hot tub operation and maintenance, particularly when using off-site monitoring of water disinfectant and pH levels or when cyanuric acid is added to pools as a chlorine stabilizer.

**Colorado**

In February 1999, the Colorado Department of Public Health and Environment (CDPHE) was notified of approximately 15 persons with folliculitis after they had used a hotel pool and hot tub. The cases occurred among children and adults attending two birthday parties at the hotel and among community residents who entered the pool on a pay-to-swim basis. The patients were treated for suspected *Pseudomonas* skin infections; one patient tested positive for *Pseudomonas* sp. by culture of a skin lesion.

Twenty-five community residents who used the pool and/or hot tub during February 5-7 were identified through discussions with area physicians, hotel management, and other swimmers. These community residents were interviewed by CDPHE using a telephone questionnaire. Case-patients were defined as persons who developed dermatitis/folliculitis, with or without other symptoms, within 3 days of using either the pool or hot tub at the hotel during February 5-7. Questionnaires were completed for 22 (88%) of the 25 persons identified. Of the 20 persons who used the hot tub, 19 developed a rash and met the case definition. Fourteen (74%) of the 19 case-patients had more severe illness (rash ≥ 2 weeks or rash and one other symptom), some lasting > 6 weeks.

Specimens collected during the environmental inspection in May from the hot tub filter and hand rail base were positive for *Pseudomonas aeruginosa* and other *Pseudomonas* species. The pool and hot tub used separate filtration systems; each had an automated chlorination system that relied on an onsite probe to measure free chlorine and pH levels and deliver set levels of chlorine using calcium hypochlorite tablets and muriatic acid for pH control. A printout of the hourly free chlorine and pH levels in the pool and hot tub revealed that free chlorine levels dropped below state-required levels (1 mg/L) on the evening of February 4 and remained below recommended levels for approximately 69 hours. The decline in pool chlorine levels was the result of a faulty chlorine pellet dispenser. Hotel staff did not perform routine onsite water testing for the pool or hot tub.

**Maine**

The Maine Bureau of Health (MBOH) was notified of several cases of dermatitis/folliculitis among persons who had stayed at Hotel A in Bangor, Maine, during February 18-27, 2000. To characterize the illness and determine exposures associated with illness, MBOH conducted a case-control study among persons connected with a high school basketball tournament who stayed at hotels with swimming pools and/or hot tubs in Bangor during the outbreak. Case-patients had a rash for ≤ 7 days or draining otitis externa with onset during February 18–March 3. Case-patients were matched by age and high school with healthy controls. Results from two (12.5%) schools were available for analysis. Nine persons were identified with rash, including one with otitis externa. Onset of symptoms occurred during February 20–March 1. Four of the nine persons were seen by a health-care provider. Case-patients ranged in age from 6-18 years (median age: 15 years); five were female.

The nine case-patients stayed at hotel A and spent time in either the hot tub or pool; seven spent time in both. Case-patients were more likely than controls to have spent time in the hot tub (odds ratio [OR] = 8.9; p = 0.04) or to have used the pool (OR = 7.4; p = 0.06).

The indoor pool and hot tub were located within 5 feet of each other and had separate filtration systems. Pool disinfectant and pH levels were monitored by an off-site contractor. The pool had an automated chlorination system that relied on an on-site probe to measure chloride and pH levels and to deliver a set level of chlorine using calcium hypochlorite tablets and muriatic acid for pH control. Chlorine and pH levels were maintained manually in the hot tub. To stabilize chlorine levels, 40-60 mg/L cyanurates were used. During the outbreak, free chlorine levels were tested daily and repeatedly registered < 1.0 mg/L, less than the state-required level of 1-3 mg/L, in the pool and hot tub. The pool and hot tub were crowded during the outbreak, and free chlorine levels were very low to zero after the February 25-26 weekend; no measurements were recorded over the weekend.

The facilities had been cleaned thoroughly before the environmental investigation in March. *Pseudomonas aeruginosa* was isolated from the top of the pool filter and from the draining ear of a child aged 6 years who used the pool. Although the pulsed field gel electrophoresis patterns of the two isolates did not match, the pool isolate was...
obtained after the facilities had been cleaned and may not have reflected the bacterial environment of the pool during the outbreak.

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CDC Editorial Note: Pseudomonas aeruginosa, a gram negative rod, is ubiquitous and can cause various mild to severe symptoms.1 Pseudomonas dermatitis and otitis externa outbreaks associated with swimming pool and hot tub use are well described2,3; at least 75 cases during six outbreaks occurred during 1997-1998.4 Dermatitis outbreaks usually occur as a result of low disinfectant levels,2,3 a condition that also increases the risk for transmission of other chlorine-sensitive pathogens (e.g., Escherichia coli O157:H7 and Shigella sonnei) that may cause severe health consequences.

In this report, factors that may have resulted in inadequate disinfectant levels included the use of an off-site contractor who could monitor and alert pool staff to low free chlorine or pH levels but could not change free chlorine or pH levels, and hotel employees with a minimal understanding of the offsite monitoring and alert system, pool maintenance, and the link between inadequate water disinfection and disease transmission. In addition, pools and hot tubs were not monitored routinely onsite to adjust to high bather loads that can lower free chlorine levels. In Maine, cyanuric acid was added to the indoor pool and hot tub. However, cyanuric acid, which is used to reduce chlorine loss as a result of ultraviolet light exposure, is not recommended for indoor pools or hot tubs5,6 and is prohibited in two states7; adding this chemical reduces the antimicrobial capacity of free chlorine.8

To reduce the risk for Pseudomonas dermatitis and the transmission of other waterborne pathogens, pool and hot tub operators should (1) adhere to pool and hot tub recommendations and regulatory requirements for pH and disinfectant levels6,9,10; (2) have a thorough knowledge of basic aquatic facility operation; (3) provide training for pool staff on system capabilities, maintenance, and emergency alert procedures of remote monitoring systems; (4) closely monitor pool and hot tub free chlorine measurements during periods of heavy bather loading; (5) monitor hot tub disinfectant levels closely because the higher temperatures maintained serve to dissipate chlorine rapidly; and (6) understand appropriate use and effects of cyanurates on disinfection and testing. In addition, remote-monitoring companies should be timely in notifying swimming-facility staff about low disinfectant levels. Swimmers should be educated about the potential for waterborne disease transmission in pools and hot tubs, which could increase advocacy for improved maintenance and monitoring by pool operators.

REFERENCES

Human Rabies—California, Georgia, Minnesota, New York, and Wisconsin, 2000

MMWR. 2000;49:1111-1115

1 table omitted

ON SEPTEMBER 20, OCTOBER 9, 10, 25, and November 1, 2000, persons who resided in California, New York, Georgia, Minnesota, and Wisconsin, respectively, died of rabies. This report summarizes the case investigations.

California

On September 15, a 49-year-old man visited a neurologist with 2 days of increasing right arm pain and paresthesias. The neurologist diagnosed atypical neuropathy. The symptoms increased and were accompanied by hand spasms and sweating on the right side of the face and trunk. The patient was discharged twice from an emergency department but symptoms worsened. After developing dysphagia, hypersalivation, agitation, and generalized muscle twitching, the patient was admitted to a local hospital on September 16. Vital signs and blood tests were normal, but within hours he became confused. The consulting neurologist suspected rabies. Rabies immune globulin, vaccine, and acyclovir were administered. On September 17, the patient was placed on mechanical ventilation and rabies tests returned positive. Renal failure developed and the patient died on September 20. The patient did not report contact with a bat, although his wife reported that in June or July a bat had flown into their house and the patient had removed it.

New York

On September 22, a 54-year-old man who had resided in Ghana arrived in the
On October 3, a 26-year-old man developed intractable vomiting and hematemesis. At a local hospital, he was treated with antiemetic suppositories; that evening he became disoriented, combative, and had difficulty breathing. On October 4, he became hypotensive and hypoxic and was transferred to a referral hospital for ventilatory support. Examination revealed a temperature of 104 F (40 C), anisocoria, copious oral secretions, scattered bilateral pulmonary crackles, and a white blood cell count (WBC) of 46.6 cells x 10^9/L (normal: 5-10 x 10^9/L); a chest radiograph revealed bilateral diffuse alveolar densities. Broad spectrum antibiotics, including acyclovir, were initiated.

On October 9, the patient developed cardiac arrhythmia, hypotension, and became combative, necessitating sedative and paralytic agent therapies. He developed respiratory and renal failure and died on October 10. Since July, the patient had been renting a room on the upper floor of an old house. He had reported to co-workers that bats from the attic had entered his living quarters and landed on him while he slept. Investigation of the house occupied by the patient since July revealed a colony of approximately 200 Mexican free-tailed bats in the attic and openings between the attic and the patient’s bedroom, bathroom, closet, and kitchen.

Minnesota
On October 14, a 47-year-old man visited a local clinic with 6 days of worsening right arm pain and paraesthesias. Two days later he developed decreased right finger movement. Nerve conduction studies were consistent with carpal tunnel syndrome. On October 19, while travelling in North Dakota, the patient was admitted to a North Dakota hospital with a temperature of 103 F (39.4 C), flaccid paralysis and sensory loss in the right upper extremity, sensory loss in the mid-thoracic area, hypopnea and hyporeflexia in the left upper extremity, and anisocoria. Laboratory findings were normal except a WBC count of 13.8 x 10^9/L. The patient was placed on broad spectrum antibiotics. On October 20, the patient developed acute respiratory failure and was intubated. Magnetic resonance imaging was consistent with myelitis and ganciclovir was added to antibiotic coverage. He died on October 25. Three days earlier, a friend told the family that during August 11-19, the patient had been bitten in Ghana on his thumb and leg by his unvaccinated puppy in May.

Georgia
On October 3, a 26-year-old man developed intractable vomiting and hematemesis. At a local hospital, he was treated with antiemetic suppositories; that evening he became disoriented, combative, and had difficulty breathing. On October 4, he became hypotensive and hypoxic and was transferred to a referral hospital for ventilatory support. Examination revealed a temperature of 104 F (40 C), anisocoria, copious oral secretions, scattered bilateral pulmonary crackles, and a white blood cell count (WBC) of 46.6 cells x 10^9/L (normal: 5-10 x 10^9/L); a chest radiograph revealed bilateral diffuse alveolar densities. Broad spectrum antibiotics, including acyclovir, were initiated.

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CDC Editorial Note: These five cases of human rabies are the first diagnosed in the United States since De-
december 1998, and underscore that rabies should be considered in any patient with progressive encephalitis. The initial presentations of rabies can be diverse and a history of animal contact is rarely obtained. Because the immune response to rabies may not occur until late in the disease, if rabies is suspected, an antemortem examination should include a nuchal skin biopsy, saliva, and cerebral spinal fluid or a postmortem examination of central nervous system tissue.1

In the United States since 1990, infection with indigenous rabies virus variants associated with insectivorous bats and infection with foreign canine rabies virus variants have accounted for 30 of the 32 human cases. Although 24 (74%) of the 32 cases since 1990 have been attributed to bat-associated variants of the virus, a history of a bite was established in only two cases. Contact with bats occurred in approximately half of the other cases. These cases represent various bat-contact histories: a bat bite, direct contact with bats with multiple opportunities to be bitten, and possible direct contact with a bat. Canine rabies is prevalent in Africa, Asia, and Latin America. Worldwide estimates of human rabies deaths exceed 50,000 cases each year, and >95% of reported cases occur in regions where canine rabies is endemic.2

Although rabies usually is transmitted by a bite, persons may minimize the medical implications of a bat bite. Unlike bites from larger animals, the trauma of a bat bite is unlikely to warrant seeking medical care. Unless the potential for rabies exposure is known to the patient, rabies postexposure prophylaxis (PEP) will not be received. Although bat rabies virus variants can be transmitted secondarily from terrestrial mammals, the lack of other animal-bite histories and the rarity of bat rabies virus variants found in terrestrial mammals suggest that this means of transmission is rare.3

Persons who are bitten or scratched by any animal should wash wounds thoroughly and seek immediate medical attention to evaluate the need for PEP. In all cases where bat-human contact has occurred or is suspected, the bat should be collected and tested for rabies. If the bat is unavailable, the need for PEP should be assessed by public health officials. PEP should be considered after direct contact between a human and a bat, unless the exposed person can be certain a bite, scratch, or mucous membrane exposure did not occur. PEP may be considered for persons who were in the same room as a bat and who might be unaware that a bite or direct contact had occurred (e.g., when a sleeping person wakes to find a bat in the room or an adult witnesses a bat in the room with an unattended child, mentally disabled person, or intoxicated person). PEP is not warranted when direct contact between a human and a bat did not occur. Seeing a bat or being in the vicinity of bats does not constitute an exposure.4

REFERENCES

Human Rabies—Quebec, Canada, 2000

MMWR. 2000;49:1115

On September 22, 2000, a 9-year-old boy awoke with a fever and complained of pain in his upper left arm. The pain persisted, and he developed insomnia and tremors in his left arm and hand. He was admitted to a local hospital on September 27. That evening, he had mild dysphagia, pruritus of his upper chest and back, and a transient macular rash. On September 28, he developed tremors and myoclonic jerks in both arms, had become agitated, and had hydrophobia, aerophobia, dysarthria, and visual hallucinations. The next day hypersalivation was observed and the tremors and myoclonus had spread to his lower extremities. He became very anxious, indicated that he was suffocating, and underwent endotracheal intubation. A diagnosis of rabies was considered and he was transferred to a children’s hospital. Laboratory findings were normal except a mildly elevated cerebral spinal fluid protein. An electroencephalogram indicated no epileptiform activity. Head magnetic resonance imaging was normal. On September 29, the results of the rabies tests were positive, and rabies immune globulin and vaccine were administered to the patient. His neurologic and hemodynamic status deteriorated, and he died on October 6.

A nuchal skin biopsy tested positive by direct fluorescent antibody test. Rabies virus was isolated from the saliva, and saliva, tears, and skin biopsy were positive for rabies by reverse transcriptase-polymerase chain reaction. Molecular analysis of the virus revealed a rabies variant associated with silver-haired (Lasionycteris noctivagans) and eastern pipistrelle (Pipistrellus subflavus) bats.

During August, the patient visited a zoo and went to a day camp where he observed bats that had been captive for many years. No history of substantial exposure to bats or other animals occurred in these places. On August 28, while the patient and his brother were sleeping in a rural cottage, his parents found a bat in the kitchen. The same evening, the patient’s brother went into the bathroom and observed a bat that seemed to have difficulty flying. He alerted his father who removed it from the cottage with his bare hands. Approximately 3 days later, the patient showed his mother a 0.8-inch (2 cm) erythematous lesion with a small central laceration on his upper left arm. No action was taken. After the diagnosis was made, rabies postexposure prophylaxis was offered to the patient’s parents and brother. Prophylaxis also was
Progress Toward Poliomyelitis Eradication—Eastern Mediterranean Region, 1999-September 2000

MMWR. 2000;49:1024-1028

1 table, 1 figure omitted

IN 1988, THE REGIONAL COMMITTEE FOR the Eastern Mediterranean Region* (EMR) of the World Health Organization (WHO) adopted a resolution to eradicate poliomyelitis from the region by 2000. Since then, substantial progress has been made in vaccination and surveillance and, by the end of the year, 19 of the 23 EMR countries are expected to have interrupted poliovirus transmission. This report summarizes progress toward this goal from January 1999 through September 2000.

Routine vaccination coverage. In 1999, the regional reported coverage with at least three doses of oral poliovirus vaccine (OPV3) by age 1 year was 83% (range: 18%-100%), compared with 82% in 1998. OPV3 coverage of ≥90% was reported from 14 countries. Coverage levels of ≥80% were reported from Afghanistan (32%), Djibouti (27%), Pakistan (80%), Somalia (18%), only northern regions reporting), Sudan (77%), and Yemen (72%). These countries represent more than half of the total regional population. Compared with reported administrative data, surveys in some of these countries have identified lower coverage rates.

Supplementary vaccination activities. During 1999, National Immunization Days (NIDs)† were conducted in 20 of the 23 countries of the region. Iran and Tunisia conducted targeted subnational campaigns in provinces at risk for poliovirus importation and/or with suboptimal vaccination coverage, and NIDs have not been considered necessary in Cyprus. In 2000, several countries that have been polio-free have scaled down the scope of supplementary vaccination activities from NIDs to subnational or local campaigns. During 1999-2000, NIDs and other supplementary vaccination activities have been intensified in countries with persistent poliovirus circulation (Afghanistan, Egypt, Iraq, Pakistan, Somalia, and Sudan). In 1999, each of these countries either conducted two pairs (four rounds) of NIDs (Afghanistan, Egypt, and Iraq) or one pair of NIDs and one pair of large-scale subnational campaigns (Pakistan, Somalia, and Sudan). During 2000, each of these six countries will conduct two pairs of NIDs and additional mopping up or subnational campaigns. The quality of campaigns in these remaining countries where polio is endemic has been improved substantially through house-to-house vaccination, greater emphasis on high-risk areas, improved planning and supervision, additional financial resources, and increased technical consultation.

Campaigns are coordinated among groups of contiguous countries within EMR. Coordination with the European region has led to elimination of the poliovirus reservoir in the border areas of Iran, Iraq, Syria, and Turkey. Cross-border coordination will continue between Afghanistan, Pakistan, and Iran. Increasing attention is being focused on collaboration with the regional office of WHO for Africa to coordinate eradication activities among countries of the Horn of Africa and countries that border western and southern Sudan.

Surveillance. All member countries have established acute flaccid paralysis (AFP) surveillance. Fifteen countries (Bahrain, Egypt, Iran, Iraq, Jordan, Lebanon, Libya, Oman, Pakistan, Palestine, Qatar, Saudi Arabia, Syria, Tunisia, and Yemen) achieved or exceeded the WHO-established minimum AFP reporting rate indicative of a sensitive surveillance system (≥1 nonpolio AFP case per 100,000 children aged <15 years) during 1999. Among the eight remaining countries, the annualized nonpolio AFP reporting rates during 2000 have exceeded one in Afghanistan, Kuwait, Somalia, and Sudan. The regional average reporting rates for nonpolio AFP in 1999 and 2000 are 1.1 and 1.3 (annualized, respectively). During 1999 and 2000, two adequate stool samples were collected from 67% and 71% of the reported persons with AFP in EMR, respectively. During 1999, nine countries (Bahrain, Cyprus, Iraq, Jordan, Kuwait, Oman, Palestine, Syria, and Tunisia) achieved the WHO-recommended target of collecting two adequate stool specimens from at least 80% of persons with AFP. During 2000, an additional four countries (Egypt, Lebanon, Libya, and Saudi Arabia) achieved this target.

EMR laboratory network. The EMR laboratory network consists of 12 laboratories (eight national and four regional reference laboratories). All network laboratories have been fully or provisionally accredited by WHO. As of September 2000, the EMR laboratory network tested 4129 stool specimens obtained from 1947 (96%) of 2028 persons with reported AFP (or their contacts) from 21 EMR countries. Specimens from an additional 142 persons with AFP reported from Somalia and southern Sudan were tested in the laboratory network of the African region. Laboratory results were reported on time (within 28 days of receipt of specimen) for >80% of stool specimens during 1999-2000.
Genetic sequence analyses are performed routinely on all wild poliovirus isolates in the region. Recent sequence data have identified separate virus reservoirs shared between Pakistan and Afghanistan and between Chad and Sudan. With improvements in surveillance, independent and unique transmission chains of poliovirus types 1 and 3 have been identified in Afghanistan, Somalia, and Sudan. Communities with persistent foci of virus transmission have been better delineated in Egypt. Sequencing of a recent wild poliovirus isolate obtained in Syria confirmed that the strain was imported recently from southern Asia.

Incidence of polio. Compared with the same period in 1999, the number of confirmed cases of polio reported through September 2000 in the EMR has decreased by approximately 50% (from 619 to 314) despite substantial improvements in AFP surveillance. Compared with 13 EMR countries in 1999, 16 have reported no cases during 2000. However, during 1996-2000, six countries (Afghanistan, Egypt, Iraq, Pakistan, Sudan, and Somalia) have reported cases with indigenous strains of wild poliovirus. In 1999, Iran and Syria reported cases associated with imported poliovirus strains. Intensive control measures composed of multiple NID rounds and mopping up campaigns have led to cessation of the polio outbreak in Iraq. The last virologically confirmed case—patient from this outbreak had paralysis onset in January 2000. Since late 1999, wild poliovirus transmission in Egypt has been localized to a few districts in four governorates. The latest person with virologically confirmed polio in Egypt had onset in late May 2000. Expansion of surveillance in southern and central Somalia has led to identification of an outbreak of polio caused by wild poliovirus types 1 and 3 in Mogadishu, where, since January 2000, 38 cases of virologically confirmed polio have been identified. During 1999-2000, Pakistan continued to report the largest number of cases and has contributed more than 60% of the total number of virologically confirmed cases in the region. However, from January through September 2000, the number of virologically confirmed cases has declined 46% in Pakistan compared with the same period in 1999.

The Regional Commission for Certification of Poliomyelitis Eradication has reviewed national documentation of polio-free status from nine countries with high-quality AFP surveillance that have not reported cases of polio for several years. The commission has favorably reviewed reports from Bahrain, Iran, Jordan, Kuwait, Oman, Saudi Arabia, Syria, and Tunisia.

**CDC Editorial Note**: Remarkable progress toward polio eradication has occurred in the member states of EMR since 1988. By the end of 2000, polio-virus transmission probably will be interrupted in all but four EMR countries. Improved local level planning and supervision, house-to-house vaccination, community mobilization, and heightened political commitment have enabled vaccination of an increasing number of children, especially among hard-to-reach and high-risk populations. These activities have necessitated the mobilization of financial and human resources and the development of local administrative capacity. AFP surveillance in the region is increasingly guiding planning, coordination, and targeting of vaccination activities and has identified virus reservoirs shared between countries or previously unknown foci of virus transmission. Despite the progress, gaps remain in the quality of supplementary vaccination activities and in geographic representation of AFP surveillance in areas of conflict. Countries with armed conflict and/or high population density, poor sanitation, low OPV3 coverage, and weak or absent health infrastructure have posed obstacles to interruption of virus transmission. In polio-free countries of the EMR, maintenance of high OPV3 coverage and targeted supplementary vaccination activities will be necessary to minimize the spread of any poliovirus that may be introduced through importation.

Polio eradication in the region has entered its final phase. High priority polio eradication activities planned for this phase include (1) rapid completion of program intensification and expansion in the remaining countries where polio is endemic to ensure interruption of poliovirus transmission in the region by the end of 2001 or soon after; (2) rapid geographic expansion of AFP surveillance in countries affected by conflict and difficult access to populations; (3) maintenance of high-quality surveillance in polio-free countries; (4) containment of poliovirus stocks and potentially infectious material in laboratories throughout the region; (5) documentation of polio-free status by each country for review by the regional commission and certification of polio eradication in the region by the end of 2004; and (6) an increased focus on strengthening routine vaccination programs and vaccine-preventable disease surveillance. Implementing these high priority activities to achieve polio eradication and its certification will require the continued support of national governments and partner agencies.

**REFERENCES**

- The 23 member countries are Djibouti, Egypt, Libya, Morocco, Somalia, Sudan, and Tunisia in northern and eastern Africa; Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates, and Yemen in the Arabian peninsula; Iraq, Jordan, Lebanon, Syria, and the Palestinian National Authority in the Middle East; Afghanistan, Iran, and Pakistan in Asia; and Cyprus.
- Mass campaigns over a short period (days to weeks) in which two doses of OPV are administered to all children in the target age group (usually age <5 years) regardless of previous vaccination history, with an interval of 4-6 weeks between doses.
- Support of polio eradication activities in EMR is provided mainly by governments of member states and by Rotary International, CDC, the government of the United Kingdom through the Department of Foreign and International Development, the government of Japan through the Japanese International Coordinating Agency, the government of Canada through the Canadian International Development Agency, the government of Denmark through Danish International Development Assistance, and the governments of Norway and Italy, the United Nations Foundation, and the U.S. Agency for International Development.