

## *Pseudomonas aeruginosa* Skin Infections in Persons Using a Whirlpool in Vermont

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Four guests at a ski resort in Vermont reported contracting a characteristic papular, pustular, or vesicular rash after using the resort's whirlpool. *Pseudomonas aeruginosa* serotype 1, bacteriophage type 86, was isolated from a pustule on one patient, water within the whirlpool, and the whirlpool diatomaceous earth filter. This appears to be the first outbreak of dermatitis associated with *P. aeruginosa* serotype 1. Previous reports of whirlpool-associated dermatitis outbreaks have identified serotype 9 and 11 isolates of *P. aeruginosa* as the causative agents.

On Monday, 7 January 1980, the Vermont Department of Health received a report from a physician in Connecticut that two of his patients had developed a rash after a visit to a ski resort in Vermont. *Pseudomonas aeruginosa* was isolated from a skin lesion on one of the patients. The rashes developed 24 to 48 h after both patients had used a whirlpool at the resort. An investigation was initiated to determine whether an outbreak of whirlpool-associated dermatitis had occurred. The resort whirlpool was open from 20 December 1979 until the water was changed on 5 January 1980 in response to a call from one of the patients in Connecticut.

### CASE REPORT

A 27-year-old woman went to the emergency room of a local hospital after returning home with a rash from a skiing trip to Vermont. She stayed at a Vermont inn between 2 and 4 January 1980. Previously, she had been in excellent health and had no history of dermatological problems. She had used a ski lodge whirlpool and sauna on 2 and 3 January, approximately 48 h before the onset of her rash. She complained of tender, nonpruritic papules on her trunk. She had no fever or systemic symptoms and had no genitourinary or gastrointestinal complaints. She denied having insect bites or having been exposed to medications or new clothing.

During a physical examination she was afebrile and in no acute distress. A macular and pustular skin rash was on her chest, abdomen, and back. The rash on her back was in a V-shaped pattern. This rash was most severe in the areas that had been covered by a bathing suit she had worn in the whirlpool (Fig. 1). One of the pustular lesions on her back was cultured. *P. aeruginosa* was isolated from the pustule.

The patient was reassured and treated symptomatically on her first visit. One week later the lesions had resolved except for some hyperpigmentation and des-

quamation. No active ulceration, pustules, or vesicles remained. She did not require any further treatment.

### MATERIALS AND METHODS

**Epidemiological studies.** The Office of Epidemiology mailed a questionnaire to hotel guests who had stayed at the resort during the 16 days that the whirlpool was open, and they were queried for demographic information, history of rashes, and possible risk factors associated with the acquisition of a *Pseudomonas* skin infection. Persons who did not respond to the questionnaire and individuals reporting a rash of any kind were contacted and interviewed by telephone. A case was defined as an acute development of an erythematous vesicular, papular, or pustular body rash (which is the same type of rash that has been previously reported with *Pseudomonas* dermatitis [15]) on any person at the resort any time from 20 December 1979 to 5 January 1980. Chronic or recurrent rashes that had begun before 20 December were excluded. Persons meeting the case definition were recontacted 3 to 4 weeks after the onset of their illnesses to determine the nature of their rashes at that time.

**Laboratory and environmental studies.** The ski resort was inspected for possible environmental causes of the rash. Because there was no swimming pool at this resort, the examination focused on the whirlpool and sauna, which had been used by many of the guests. Information was obtained from the hotel manager regarding the maintenance of the whirlpool, and an inspection of the filtration system was conducted by the Environmental Health Division of the Vermont Department of Health on 8 January 1980. Water samples from the whirlpool were collected in sterile bottles containing sodium thiosulfate to neutralize residual chlorine. Swab cultures were obtained from the surface of the sauna, the whirlpool, and a shower in the same area. A sample of used diatomaceous earth was taken from the whirlpool filter. Control environmental samples were obtained from the whirlpool of a nearby resort. All samples were sent to the Vermont State Laboratory and directly inoculated onto blood agar and MacConkey agar for bacteriological isolation and

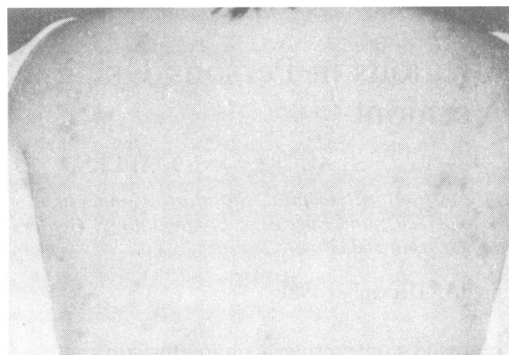


FIG. 1. *Pseudomonas* dermatitis in the reported case. The papular rash was most prominent in areas that were covered by the patient's bathing suit.

identification. All isolates of *P. aeruginosa* were forwarded to the Idaho State Laboratory for serotyping (3) and bacteriophage typing (2).

### RESULTS

**Epidemiological studies.** The questionnaire was mailed to all 213 guests who had been at the resort between 20 December 1979 and 5 January 1980. Completed questionnaires were obtained either by mail or telephone inquiries from 187 (84%) of the guests.

Of the 187 respondents, 8 reported that they had developed a rash after their stay in Vermont. Three of the eight reported scaly rashes localized on one area of the body. One other rash was scaly and macular and diagnosed by a physician as pityriasis rosea. None of these four rashes was vesicular, papular, or pustular and, therefore, did not meet the case definition and was excluded from analysis.

Four persons met the case definition. Their rashes were located on the legs and buttocks (100% of the cases); back, arms, and thighs (75%); armpits and abdomen (50%); and chest, neck, and head (25%). Three were female; one was male. Their ages were 15, 27, 39, and 50 years. The four reported no other symptoms besides the rashes.

Five guests used both whirlpool and sauna on at least 1 day between 2 and 4 January 1980. Four of these five guests contracted the characteristic rash. The rates of rashes developed by dates of whirlpool and sauna use are shown in Table 1. Twenty-two other guests responded that they had stayed at the inn during 2 to 4 January. None of them used either the sauna or whirlpool, and none developed a rash. The history of use of either whirlpool or sauna was statistically associated with the rash (Fisher exact test:  $P = 0.00029$ ). Since all five exposed individuals used both whirlpool and sauna, it is statistically impossible to separate these two.

The onset of rashes occurred for two persons on 3 January, one person on 4 January, and one person on 5 January. Since all four persons had used the sauna and the whirlpool on 2 and 3 January, the most likely time that exposure occurred would have been on these dates. These exposures occurred during a time of relatively low use of the whirlpool and sauna facilities. The greatest use of these facilities was 2 to 6 days before the probable exposure period (Table 1).

Persons identified as cases had spent an average of 15 min in the whirlpool. A similar average time had been spent in the sauna. Two had worn swimsuits in the whirlpool and two had not. Two used a shower after using the whirlpool, and two

TABLE 1. Rash rates by date of whirlpool and sauna use between 20 December 1979 and 5 January 1980

Date	No. of individuals with rashes who used whirlpool and sauna <sup>a</sup>	Total no. of individuals using sauna (rash rate %)	Total no. of individuals using whirlpool (rash rate %)
December 20	0	0	0
21	0	0	0
22	0	3 (0)	3 (0)
23	0	5 (0)	5 (0)
24	0	8 (0)	8 (0)
25	0	6 (0)	6 (0)
26	0	11 (0)	11 (0)
27	0	18 (0)	19 (0)
28	0	20 (0)	21 (0)
29	0	19 (0)	17 (0)
30	0	14 (0)	10 (0)
31	0	10 (0)	11 (0)
January 1	0	4 (0)	7 (0)
2	4	5 (80)	5 (80)
3	4	5 (80)	5 (80)
4	2	3 (67)	3 (67)
5	0	4 (0)	4 (0)

<sup>a</sup> All four individuals with rashes reported using both the whirlpool and sauna.

did not. None had used lotions after using these facilities.

The individual who did not develop a rash but had used the whirlpool between 2 and 4 January 1980 reported that he had used a swimsuit while he was in the whirlpool and had showered after using it. He reported having used lotions after using the whirlpool and also reported having used the whirlpool for the same duration as those who had developed rashes.

None of the four persons who had rashes reported a history of acne, eczema, or allergic skin rashes. When the persons with cases were recontacted by telephone 3 to 4 weeks after the onset of their symptoms, all rashes had resolved. None received systemic or topical antibiotic therapy.

**Lab and environmental studies.** The whirlpool was located in a room that had shag carpeting. A sauna and shower were located in a room adjacent to the whirlpool. The whirlpool had a capacity of approximately 500 gallons (1,892.50 liters), and water was circulated through a diatomaceous earth filter. A flow meter was not installed with this whirlpool, so the water circulation time is unknown. It is estimated that the water was circulated and filtered every 10 to 15 min. The water heater was turned on daily at 8 to 9 a.m. and off at 11 p.m. by the manager on duty, and the water temperature was maintained at approximately 110°F (43.33°C). The water in the whirlpool was reportedly tested by the manager when the heater was turned on in the morning; however, no records of water temperature, free chlorine levels, or the amounts of chlorine added were maintained. The whirlpool water was tested with Guardex Four-In-One test kit (Purex Corp., Pool Products Div., La Puente, Calif.), which tests for free chlorine residual, pH, acid demand, and total alkalinity. Granular chlorine was reported to be manually added to the whirlpool water every day if the free chlorine residual dropped below 0.6 ppm ( $\mu\text{g}/\text{ml}$ ). Sodium trichloro-*s*-triazinetrione dihydrate was used which has 56% available chlorine. The pH of the pool was maintained at approximately 7.4 by the addition of sodium bisulfate or sodium bicarbonate to the water. When the filter pressure rose to 25 lb/in<sup>2</sup> (1.76 kg/cm<sup>2</sup>), the whirlpool was backwashed, and the diatomaceous earth filter was changed. This occurred approximately every 2 to 3 weeks.

The manager reported that there were no differences in the treatment of the whirlpool facilities before the outbreak of skin rashes. At 4 p.m. on 8 January, the Vermont Department of Health recorded a free chlorine residual of 0.3 ppm, a total chlorine of 0.7 ppm, and a whirlpool water pH of 7.5 by using the *N,N*-diethyl-*p*-phenylenediamine colorimetric method of analysis.

The isolates from the skin rashes, whirlpool filter, and one of the water samples were positive for *P. aeruginosa* serotype 1, bacteriophage type 86. The remaining isolates from the whirlpool were serotype 6 but were of two different bacteriophage types, 83 and 55. Two surface swab samples taken from the carpet surrounding the whirlpool, one surface swab sample from the shower area, one surface swab sample from the sauna area, and four water and surface swab samples from a whirlpool at another resort did not yield *P. aeruginosa*.

## DISCUSSION

The epidemiological data support the theory that both whirlpool and sauna use are associated with *Pseudomonas* dermatitis. However, the environmental samples of the sauna were negative, and those of the whirlpool were positive for *P. aeruginosa* serotype 1. Thus, the outbreak was probably related to *Pseudomonas* in the whirlpool water.

This outbreak is one of a growing number of reports of *Pseudomonas* outbreaks associated with whirlpools (5-7, 10, 14, 15). Previous reports have identified outbreaks of *P. aeruginosa* serotypes 9 and 11; this is the first reported instance of a serotype 1 outbreak.

*P. aeruginosa* is not part of the normal skin flora (8, 9) but is often present in low concentrations in water used for bathing or swimming (11, 13, 15). *P. aeruginosa* serotype 1 has been identified in random water and fecal specimens (12) and in approximately 11% of endemic hospital isolates (3). Several factors may also contribute to the development of *Pseudomonas* dermatitis in people using whirlpools. *Pseudomonas* that is picked up on bathers' feet from carpet surrounding the whirlpools may inoculate the water. The water in whirlpools is usually maintained at temperatures between 104 and 108°F (40 and 42.22°C) and is aerated. The high temperature of the water promotes sweating, and the turbulence of the water promotes skin desquamation. This contributes to the organic, nutritive compounds in the water which probably provide substrates for *Pseudomonas* growth. Heavy use of whirlpools will also reduce the chlorine content and consequently the bactericidal treatment of the whirlpool water. All of these factors are very conducive to the presence or multiplication of *P. aeruginosa*. The heat from the whirlpool water and sauna could dilate pores in the skin. A rash characterized as folliculitis may then develop, with invasion of the skin by large numbers of *Pseudomonas*.

Although only four cases were identified, the attack rate for persons who responded to the questionnaires and used the whirlpool during the days when it was most likely contaminated was

high (80%). The other documented reports of whirlpool-associated outbreaks have had attack rates from 7 to 85% (5, 7, 10). It is not known why attack rates have such a wide range. Host factors, the quantity of *Pseudomonas* in the water, and the time spent in the whirlpools may all be factors. In this outbreak, exposure to *Pseudomonas* organisms probably occurred during periods of infrequent use of the whirlpool, which is in contrast to other reports of outbreaks that occurred with frequent use (5, 7). The frequent use that occurred 2 to 6 days before the probable exposure may have contributed to the water contamination and subsequent development of rashes in this outbreak.

Topical occlusive lotions, oils, or creams did not seem to be related to the development of rashes in this outbreak. None of the four persons with rashes routinely used lotions after whirlpool use. Occlusion has previously been identified as a factor that promotes *Pseudomonas* skin infections (9). The patient discussed earlier in this report had a rash more prominent in areas underneath the bathing suit she had worn in the sauna and whirlpool. We think the bathing suit may have acted as an occlusion for the pores that had been inoculated with *Pseudomonas* organisms.

There is little information on the medical treatment of *Pseudomonas* dermatitis associated with whirlpool use. Most cases of this dermatitis are mild and resolve after a few days or a week (4). Sausker et al. reported two cases of dermatitis that were uncomplicated and required no antibiotic therapy. He also described a patient who had developed an abscess that was culture positive for longer than 3 months (14). However, complications seem to be rare with this dermatitis in immunocompetent hosts. All four cases in the Vermont outbreak had resolution within 3 to 4 weeks without topical or systemic antimicrobial therapy.

There are several published lists of recommendations designed to prevent the occurrence of this problem (1, 15). The Vermont Health Department made the following recommendations to the owner of the resort. (i) Maintain continuous filtration of the water in the whirlpool. (ii) Drain and wash the whirlpool at least once a month to remove particulate matter. The whirlpool should be cleaned more frequently with heavy use. (iii) Install automatic disinfection equipment, such as an automatic chlorinator, to facilitate the maintenance of disinfectant

levels. (iv) Frequently monitor the free chlorine levels in the whirlpool, especially during heavy use. Measurements of free chlorine residuals should be taken with the *N,N*-diethyl-*p*-phenylenediamine free-chlorine method. Free chlorine residuals should be kept between 0.4 and 0.6 mg/liter with a water pH between 7.2 and 7.6. (v) Maintain daily records of pH and free chlorine residuals of the whirlpool water.

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