NATIONAL
Aquatics
JOURNAL

VOLUME 9, ISSUE 3

FALL 1993

IN THIS ISSUE

Bloodborne pathogens and contagion risks • Lifeguard competitions • First class swimming pool • Confidence building in scuba • Osteoporosis • Pseudomonas aeruginosa in pools •

COUNCIL FOR NATIONAL COOPERATION IN AQUATICS

Warm Water Pool & Spa Problems

Alison Osinski

San Diego State University

Running Head: WARM WATER PROBLEMS

Warm Water Pool & Spa Problems

Benefits of soaking in warm water have been recognized for centuries. Relaxation, stress reduction, improved circulation, lowering of heart rate and blood pressure, and alleviating pain of sore muscles and chronic arthritis are both real and perceived benefits of immersing oneself in warm water. Spas often increase property values, and may be considered a medical tax deduction if used to treat a specific illness or condition. There has been a recent increase in popularity, and dramatic increase in ownership and use of spas by the general public. Today, about 200,00 spas are sold per year in the U. S. (Gabrielsen, 1987). Unfortunately, this proliferation of warm water pools and spas being operated by individuals with little or no knowledge of water chemistry or pool maintenance and operation procedures, has brought about potential public health concerns.

According to the Centers for Disease Control (1985), the primary health and safety problems experienced in public spas and hot tubs fall into three categories: high water temperature in combination with the use of various drugs and alcohol; injuries resulting from either suction entrapment, or from slipping on entry into or exit from the spas; and sanitation problems due to improper maintenance of safe disinfection levels. Most whirlpool related deaths from drownings are due to either falls or electrocution. Electrocutions often occur when radios, hair blow dryers, or electrical extension cords are dropped into the spa.

Excessively warm water may cause burns or scalding. Most public health regulations prohibit water in public spas from exceeding 104 degrees Fahrenheit. Private home spas are exempt from most regulation, and not all public pools and spas maintain standards up to code. Few problems exist when water is kept at or below 98 degrees, which is normal body core temperature. At 104 degrees F, exposure should be limited to twenty minutes. Hyperthermia may result from prolonged exposure to water in excess of 98.6 degrees. As body temperature increases, chances of developing heat stroke also increase.

There are four populations at high risk from warm water exposure: pregnant women, small children, individuals with cardiac problems, and bathers who are intoxicated.

Pregnant women are particularly at risk. There is a danger of bacterial contamination to the fetus if the water is not properly maintained and contaminant free. In addition, hyperthermia or overheating can decrease blood flow to the fetus.

Dr. Alison Osinski
Aquatic Consulting Services
3833 Lamont Street 4C
San Diego, CA 92109

Small children can drown or be seriously injured in spas, especially in situations where there is a lack of adult supervision. Suction created by the high turnover of recirculating water may cause long hair to become entrapped or tangled in the drain on the spa floor. Children should be reminded to keep their heads above the surface of the water at all times. Another somewhat uncommon injury occurs when a child sits on the drain grate. Suction can causes the intestines to be pulled out of body through anus. Installation of antivortex drain grates will help prevent this tragedy. Fences, self latching gates, and pool alarms may help prevent accidents involving small children, but should not relied upon entirely. There is no substitute for constant and uninterrupted adult supervision.

Use of warm water facilities by persons with cardiac problems or high blood pressure should be discouraged. Lengthy warm water exposure might cause congestive heart failure or disrhythmias.

Drinking alcohol while soaking in warm water causes vasodilation, increased blood flow to the skin, and dehydration. Alcohol acts as a diuretic, sweating increases, there is a loss of trace minerals, and since the percentage of alcohol to body water weight increases, the heart must work harder. Intoxication also causes impaired judgement. Both the alcohol and warm water increase muscle relaxation and act as sedatives which may result in loss of consciousness while in the pool, and ultimately drowning.

Of more concern to the general public is the spread of disease or skin infections through use of spas. Spread of disease is of course possible if the spa is not properly maintained, but usually this is an unfounded fear.

Body pores open at high temperatures so an individual is more susceptible to infection. Pathogens may be introduced into the pool, but because of dilution and the addition of a bactericide, it is not possible for most diseases to be transmitted to another individual. However, dilute bacteria may be a health risk to individuals with already weakened immune systems.

Pseudomonas aeruginosa, a gram negative bacterium, is present in the environment and is passed into the water from the human skin and gastrointestinal tract. Pseudomonas aeruginosa has been cultured from warm, moist environments (CDC, 1981; Rose, 1983; and Salmen, et al., 1983), particularly when turbulent or aerated. The bacteria grows rapidly under these favorable conditions (Van Rossen, 1983). Whirlpool associated folliculitis, skin rashes and urinary tract infections from pseudomonas aeruginosa can be prevented by taking a hot water soapy shower after leaving the spa.

Spa associated kerititus, which results in serious damage to the eye, particularly the cornea, and, legionella, which can cause Pontiac fever or the more serious Legionnaires disease, as well as numerous other viruses have been isolated in spa water (Mangione, et al., 1985 and Samples, 1984). Although present in the water, actual contracting of disease is extremely rare.

There is widespread belief due to well publicized misinformation, that sexually transmitted diseases, particularly herpes simplex II and AIDS can be acquired in spas (Nerurka, et al., 1983). This is possible only if sexual activity is taking place in the pool or spa. There is no logical reason to prohibit high risk group individuals from using the pool or spa for fear that they will pass on the virus through the water.

Many problems that develop in warm water pool/spa environments can be eliminated through education of facility operators and instituting of proper maintenance procedures. Most problems develop due to high water temperature, high organic nutrient content, and high bather load to water volume ratio.

Gonaver (1985), and as reported by Griffith (1985), collected and analyzed water samples from fifty apartment and condominium, health and spa clubs, and hotel and motel whirlpools in San Diego County. Sixty percent of the water samples did not even meet minimum health code standards. In many cases, the water quality was poorer than that taken from samples of water discharged into the Pacific ocean near the city's sewer discharge line.

If spa facility owners and operators paid a little more attention to the following four factors related to water chemistry and pool/spa operation, most of the aforementioned problems would not exist.

Adequate chlorine or other halogen concentration levels need to be maintained. The free available chlorine (FAC) levels, as well as oxidation reduction potential (ORP), are kept too low in most spas. At 84 degrees F and up, more than twice the amount of chlorine is needed to oxidize organic material and maintain a minimum residual than at 74 degrees F. Warm water is an ideal environment for the growth of bacteria and algae. Chlorine dissipates at an even faster rate as temperature increases, and bubblers or jets installed on most spas may blow away undissolved chemicals. For these reasons, use of an isocyanurate such as granular sodium dichloro-s-triazinetrione, the addition of cyanuric acid to an unstabilized or unconditioned pool, or a switch to a bromine/chlorine mixture or alternative sanitizing method is recommended (Sinnes, 1982; Osinski, 1986). A minimum three to five parts per million of FAC should be present at all times the spa is in use.

In the U. S. most state bathing codes require that spas be capable of turning over every thirty minutes. Turnover is the process of passing the entire capacity of the spa through the filter system. In contrast, the British Swimming Pool and Allied Trades Association (SPATA) requires six turnovers per hour for light use spas, and ten turnovers when the spa is heavily used. West Germany requires ten minute turnovers for public spas (Tiersten, 1986). It is not uncommon to see commercial spas in which the circulation system is put on a timer. Commercial spas need to circulate constantly, twenty-four hours per day, and spas with heavy bather loads, need to turn over more rapidly.

Saturation Index (SI) should be calculated on a regular basis, and water balance adjusted. Water temperature, pH, calcium hardness and total alkalinity work together to prevent corrosion or calcification related problems. If water is not balanced, bathers will be uncomfortable, experience eye and mucus membrane irritation, and complain of dry, itchy skin. Metal components of the recirculation system, particularly the heater will rust rapidly if the water is corrosive. Or conversely, experience an increased likelihood of calcification and scaling problems, best described as a "hardening of the arteries of recirculation pipes". Flow will be reduced and pressure will increase.

Total dissolved solids (TDS) build up faster. Warm water causes metabolism rate to increase, so people perspire more heavily. Spas using cartridge filters require less water replacement, therefore less dilution and a faster build-up of TDS. Spas have a very high bather load to water ratio as compared to pools. Sinnes (1982) estimates that three people in an average spa is equal to two hundred people in a twenty by forty foot backyard sized pool. Taylor Technologies of Sparks, Maryland makes an excellent TDS test kit for under $20.00. According to Murdock (as quoted in Blackburn, 19840), and Lowrey (1985), it is possible to calculate the frequency in number of days that you should empty the spa because of TDS build-up. Determine water volume, divide the volume by three, then divide by the average number of daily users. A home spa whose depth is four feet, whose diameter is eight feet, and whose volume is 1,507 gallons, with an average use by five people per day, would need to be emptied about once every one hundred days. However, a commercial spa of the same volume used by one hundred and fifty patrons per day, should be emptied because of TDS saturation every 3.3 days. According to Tiersten (1986), SPATA requires a water change "each time the number of bather entries has equaled one half of spa water capacity measured in gallons". To help control TDS build-up, dilute the spa water, and superchlorinate daily or when the combined available chlorines (CAC) exceed .3 ppm. Remember that phosphates and certain nitrates cannot be oxidized out through superchlorination, so TDS will still continue to build. Empty and refill the pool or spa when TDS approaches 1500 parts per million.

REFERENCES

Blackburn, L. (1984, July). Hot water chemistry seminar. Pool & Spa News, pp. 80, 82, 88.

Brody, J. (1987, February). Healthy spas and hot tubs often harbor unhealthy bacteria. San Diego Union, p. D-5.

Centers for Disease Control. (1981). Outbreak of pseudomonas aeruginosa serotype 0:9 associated with a whirlpool. Morbidity and Mortality Weekly Report, 30, 329-331.

Centers for Disease Control. (1985). Suggested health and safety guidelines for public spas and hot tubs. HHS Pub. No. (CDC) 99-960. Atlanta, GA: Author.

Favero, M. S. (1984). Whirlpool spa-associated infections: Are we really in hot water? American Journal of Public Health, 74, 653-655.

Gabrielsen, M. A. (Ed.). (1987). Swimming pools: A guide to their planning, design, and operation, 4th ed. Champaign, IL: Human Kinetics.

Gonaver, B. C. (1985). Occurrence of acanthamoeba spp., legionella spp., and pseudomonas aeruginosa in water samples collected from public whirlpool spas. Unpublished Master's thesis, San Diego State University, San Diego, CA.

Griffith, J. (1985, April). Public spas fail water tests. Pool & Spa News, pp. 8, 16.

Lowry, R. (1985, February). Water chemistry for spas & tubs. Pool & Spa News, p. 84.

Mangione, E. J., et al. (1985). An outbreak of pontiac fever related to whirlpool use, Michigan, 1982. JAMA, 253, 535-539.

Nerurka, L. S., et al. (1983). Survival of herpes simplex virus in water specimens collected from hot tubs in spa facilities and on plastic surfaces. JAMA, 250, 3081-3083.

Osinski, A. (1986). Bactericides for use in swimming pools and spas: A comparison. Unpublished manuscript.

Rose, H. D., et al. (1983). Pseudomonas pneumonia associated with use of a home whirlpool spa. JAMA, 250, 2027-2029.

Salmen, P., Dwyer, D. M., Vorse, H., and Kruse, W. (1983). Whirlpool associated pseudomonas aeruginosa urinary tract infections. JAMA, 250, 2025-2026.

Samples, J. R., et al. (1984). Acanthamoeba keratitis possibly acquired from a hot tub. Archives of Ophthalmology, 102, 707-710.

Sinnes, A. C. (1982). Spas & hot tubs: How to plan, install & enjoy. Tucson, AZ: HP Books, Inc.

Sunset Books (Ed.). (1979). Sunset ideas for hot tubs, spas & home saunas. Menlo Park, CA: Lane Publishing.

Tiersten, S. (1986, November). Public spa standards: Tough enough? Pool & Spa News, pp. 136-137, 158, 160.

Thomas, D. G. (1972). Swimming pool operators handbook. Washington, DC: National Swimming Pool Foundation.

Van Rossen, D. P. (1983). Pool/spa operators handbook. San Antonio, TX: National Swimming Pool Foundation.