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Compliance With Best-Practice Water-Sanitation Policies by Pool Organizations

Paola Paez and Catherine Strohbehn

Outbreaks of illness from recreational waters underscore the need for knowledge about proper water treatment. A survey was sent to pool operators in one state (*N* = 829; responses = 219) requesting information about the person in charge and presence of operational policies and maintenance practices related to water quality and sanitation. Policies were in existence, yet significant differences were found between public and privately owned, as well as indoor and outdoor, pools. Most facilities (95%) had a certified pool operator employed onsite. Findings showed that current methods of disseminating information about water quality and sanitation to pool operators were effective. A need was noted, however, to emphasize potential water contamination from fecal matter and unhygienic practices of swimmers. Model operational policies could be a useful guide for pool administrators.

***Key Words**:* water-sanitation practices, swimming pools, swimming pool maintenance, water safety, CPO

Swimming is a popular activity in the United States, with the Centers for Disease Control and Prevention (CDC) citing approximately 360 million annual visits to recreational water venues (CDC, 2003). One trend for lodging facilities is an investment in water-park types of swimming pools. This trend also is seen in municipal pools, with many adding wave pools and water slides to existing facilities (Buchholz, 2005; Clayworth, 2005). In addition to recreation, swimming is used as a form of exercise, with aquatic therapy widely recommended for those with special injuries or for people who cannot perform exercises on land (Inverarity, 2006). As the population of the United States ages (U.S. Bureau of Census, 2000), it is expected that the need and demand for aquatic therapy will increase. The popularity of swimming, current trends in pool design, and the effectiveness of aquatic therapy highlight the importance of water quality and sanitation in swimming pools. Administrators of organizations that operate swimming pools should be aware that recreational-water illnesses (RWI) are a concern, because 23 states reported a total of 65 RWI associated with pools (Yoder et al., 2004).

The number of pool-associated RWIs underscores the need for proper water treatment and practices. There is public health oversight through government inspections of pools, but resources generally allow only one to three annual inspections.

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Thus, there is a critical need for operational procedures to ensure water sanitation and daily monitoring by local aquatic organizational and facility staff.

It is important for aquatic professionals to know risks from poor sanitation practices in swimming pools. The literature shows that knowledge is a primary basis for changes in behavior (Finch, 2005). Food-safety education, provided through university and college coursework or through industry training programs such as ServSafe by the National Restaurant Association Educational Foundation (2006) and the National Environmental Health Association have been instrumental in reducing outbreaks of food-borne illnesses (Nash, 2004). Food-service establishments also receive one or two annual inspections from the government agency charged with regulatory oversight, but because food is prepared and served daily, it is incumbent on the individuals in charge to demonstrate proper knowledge about food safety and sanitation to protect patrons. Swimmers, like diners in a food-service establishment, depend on organizational management to establish policies and procedures to ensure that water-sanitation standards are met.

The National Swimming Pool Foundation recommends oversight by a certified pool operator (CPO) at every pool facility (Ford, 2005). Pool operators who earn CPO certification should understand proper handling and storage of chemicals used in water treatment and procedures to minimize water contamination. Some states require the employment of a CPO or a contracted arrangement that provides services to the pool. With few public health inspections, establishment of aquatic facility policies to maintain water quality and proper sanitation are recommended. Pool operators are responsible for maintaining water quality and ensuring proper water sanitation. Policies to prevent pool users from creating risks or operational practices to prevent contamination should be in effect. Procedures to ensure compliance with these operational practices should be established.

Policies such as locked gates and controlled access protect the facility for liability purposes, as well as limit opportunity for intentional sabotage or mischief. Other policies should address pool-water sanitation, such as a requirement that young children wear swim diapers or prohibition of those with infectious diseases from entering the pool.

In Iowa in 2001, an outbreak occurred in an unchlorinated fill-and-drain wading pool. The pool contained municipal water with no subsequent chlorination. Inadequate disinfection of the pool combined with heavy use by diapered and toddler-age children created a favorable environment for transmission of bacteria (CDC, 2001b). In a review of RWI from treated recreational waters, Yoder et al. (2004) concluded that "frequent reporting of low chlorine levels in outbreaks indicates lack of awareness among pool operators concerning the role of chlorine and pH control as a protective barrier against infectious disease transmissions in pools" (p. 8). Fecal matter in the pool was thought to be the cause of an *E. coli 0157:H7* outbreak at a water park in Atlanta, likely caused by children who were not toilet trained swimming without protection (CDC, 2000). The use of swim diapers will reduce the risk of fecal matter leaking into the pool water. Some research has investigated the protective effectiveness of various brands of swim diapers (Maas, Patch, Berkowitz, & Johnson, 2004).

It is the responsibility of operations to ensure compliance with state-imposed policies. For example, some states stipulate that swimming pool users have access

to showers, dressing rooms, and sanitary facilities that are clean and free of debris and that soap be available at each lavatory. Facility practices with regard to pool cleaning can also affect the effectiveness of chemicals used for sanitation purposes. Water contaminants such as suntan lotion or sunscreen, debris such as leaves, and sunlight can all break down chlorine levels in pool water. Thus, an outdoor pool might require more frequent vacuuming of the water and higher levels of chlorine treatment than an indoor pool. Algae growth on tiles can be curtailed with cleaning on a regular basis on a schedule appropriate for the pool location's climate (Ford, 2005).

Surveillance data for swimming pool inspections across the United States in 2003 indicated the need for increased training and monitoring by pool operators to ensure high-quality swimming pool water that is safe for use by the public (Yoder et al., 2004). Inspections demonstrated that many pool operators did not have appropriate or current certification, even when such training was required. From an organizational perspective, training presents challenges because of high personnel turnover, part-time operators, and the seasonal nature of many employment situations. Even so, organizational decision makers need to be aware that inadequate disinfection in a pool and certain practices, or lack of standard operational practices, can contribute to increased risk of RWI (CDC, 2001a), which can lead to increased risk for the organization.

There is limited published research about water-quality and -sanitation practices at swimming pools in the United States. With support from the National Swimming Pool Foundation, an assessment of operation and sanitation policies and best practices that can help prevent RWI at public and privately owned (lodging facilities and country clubs) swimming pools in one Midwestern state was conducted. The purpose was to determine whether operators' credentials and characteristics of the aquatic facility affected existing policies and practices that contribute to RWI. Although limited to a survey of one state, this is one of the few efforts to document current practices and the impact of pool operators' credentials. This information should be useful to all involved in ensuring the safety of those who enjoy recreation at treated waters and provide guidance in assessing critical training needs.

Method

The state's Department of Public Health, the government body that provides oversight for inspection of aquatic facilities, provided a database of inspected swimming pools. Researchers sent a mail survey in late August 2005 to all operators of public and privately owned pools (lodging facilities and country clubs; N = 829). Health-club, apartment-complex, and therapeutic pools were not included as participants in this study. The three-page survey requested information about type of organization, the presence of and compliance with operational best-practice policies, frequency of best-practice maintenance procedures, characteristics of the pool, and some demographic information about the person in charge of the pool's water quality and sanitation. Return postage was paid. Researchers mailed a follow-up survey shortly after the requested response deadline to those who had not yet returned the completed survey. A response rate of 29% was achieved with 219 usable surveys returned and analyzed.

Frequencies were calculated for each survey item. Cross-tab procedures were run to determine whether characteristics such as ownership (public or private) and location of facility (indoor or outdoor) resulted in significantly different operational policies and the extent to which there was perceived compliance with them.

Results and Discussion

Findings from this study are presented in four categories: characteristics of swimming pools, profile of respondents, sanitation policies and practices in effect, and practices related to water quality and facility sanitation.

Characteristics of Swimming Pools

Most swimming pool organizations that participated in the study were classified as publicly owned (68%). Of the privately owned operations that returned the survey, lodging facilities accounted for about 27% and private country clubs represented 5% of all respondents. There was an even distribution of outdoor and indoor swimming pools represented. Many of the swimming pool operators (54%) reported the presence of multiple types of activities in their pools, such as a lap, recreational, or wading pool, and three sites were identified as water parks. Respondents indicated that average daily attendance at each pool ranged from fewer than 25 (26%) to more than 150 (21%).

Over 95% of respondents indicated that they employed at least a part-time CPO. Nine operations reported, however, either that CPO services were provided by a consultant ($n = 2$) or that there was no CPO ($n = 7$). Table 1 lists characteristics of the operations. Chlorine was the most common method of disinfection used by the facilities (90%); just 10% of them used bromine. Table 1 also shows that most of the facilities that reported using chlorine as the disinfectant met the recommended sanitation levels (72%) and pH (91%). For bromine, 39% reported that the sanitation levels were met. Chlorine is recommended to be maintained at 2.0–4.0 ppm, the same as bromine, and the recommended pH range for swimming pools and spas is 7.4–7.6 (Ford, 2005). Most of the swimming pools used liquid (45%) or solid (42%) chemicals as the form of disinfectant.

Profile of Respondents

Of the respondents, 68% were male, with 61% reporting an age between 41 and 60 years. Only 1 respondent reported an age less than 20 years. Almost half the respondents reported their titles as directors or managers of the operation (46%) and had 5 or fewer years (38%) or more than 15 years (28%) working with the organization. A high percentage of the respondents described themselves as active CPOs (86%). Table 2 shows frequencies and percentages of the responses to the demographic questions included on the survey. There were no significant differences found when responses were compared between men and women.

Sanitation Policies and Practices in Effect

Respondents indicated on the survey whether there were organizational policies in place related to water quality and sanitation and also indicated their perceptions of

Table 1 Characteristics of Responding Swimming Pool Operators (*N* = 219)

Characteristic	*n*	%
Owner/Operator		
lodging facility	60	27.4
city or county recreation department	107	48.9
private country club	11	5.0
YMCA/YWCA	14	6.4
other	25	11.4
missing	2	0.9
Location of pools		
indoor	100	45.7
outdoor	114	52.1
missing	5	2.3
Certified pool operator employed onsite		
one or more full-time	182	83.3
part-time	26	11.9
no certified pool operator on staff/consultant	9	4.0
missing	2	0.9
Facilities reporting meeting recommended sanitation levels		
chlorine	158	72.1
bromine	9	39.0
pH	199	90.9
Form of chemical application		
gas	18	8.2
liquid	99	45.2
solid	92	42.0
combination	6	2.8
missing	4	1.8

compliance with them. Table 3 shows some marked differences between the presence of a policy and perceived compliance. A few respondents noted difficulty of ensuring compliance with some of the policies. For example, they indicated that they have no way of knowing whether a swimmer entering the pool has an infectious disease, short of asking patrons for a doctor's notice. There were similar comments about a policy barring swimmers with open cuts or sores from entering the pool. The literature has noted the importance of compliance with these policies in reducing risk to swimmers (CDC, 2001a).

Over 90% of respondents reported that the following policies were in effect: provision of a restroom with hand-washing supplies (94%), locked gates (93%), no glass containers allowed on premises (92%), and posted pool hours (92%). Policies limiting unauthorized access to the pool could be driven by insurance companies and concerns that swimming pools present an "attractive nuisance."

Some of the reported findings were troubling. Even after reports of *E. coli 0157:h7* being transmitted through fecal matter in water areas (CDC, 2000), less than 78% of the responding pools indicated that swim-diaper policies were in place, and only 63% of the responding operations had a specific policy about swim-diaper requirements in their wading pools. Toddlers and young children, who are susceptible to illnesses because of their undeveloped immune systems, frequently play in

Table 2 Profile of Respondents (*N* = 219)

Characteristic	*n*	%
Age, years		
<20	1	0.5
20–30	33	15.1
31–40	33	15.1
41–50	77	35.2
51–60	56	25.6
>60	12	5.5
Gender		
male	148	67.6
female	66	30.1
Reported title		
director/manager of operations	101	46.1
pool supervisor/manager	45	20.5
director of maintenance	40	18.3
other	28	12.8
Years with organization		
≤5	74	37.9
6–10	42	21.9
11–15	31	10.0
>15	67	27.9
Active certified pool operator		
no	25	11.4
yes	189	86.3

wading pools. Because of this and the tendency of younger children to inadvertently ingest pool water, the potential for contamination from fecal matter is a concern. Perceived compliance with policies requiring swim diapers in pools was reported by all respondents as 63% for the general pool areas and about half (52%) in wading pools. Aquatic professionals need to understand the risk posed from fecal matter in swimming pools. This knowledge could influence policy development and staffing decisions. Only 16% of the responding pools reported having a hair-restraint policy in effect, and of these, only 11% reported compliance. Although not a risk factor in itself, hair will clog up filters and impair the effectiveness of chlorine or bromine sanitation.

There were significant differences found in presence and perceived compliance with some of the listed policies between public and privately owned pools and between recreational waters located indoors and outdoors. More policies were in effect with a significantly higher perception of compliance ($p \leq .05$ to .001) at publicly owned facilities. Publicly owned pools appeared to be more rigorous in policy establishment and enforcement for showering before entering the pool, locked gates, requirement of swim diapers in pools and wading pools for children not potty trained, restrooms with hand-washing supplies, and prohibition of glass containers on the premises. This higher degree of perceived enforcement of policies might be attributable to the fact that private organizations are more service oriented and do not wish to police their guests.

Table 3 Sanitation Policies in Effect and Respondents' Perceptions of Compliance (*N* = 219)

	Public/Private Ownership				Indoor/Outdoor			
	In Effect		In Compliance		In Effect		In Compliance	
Policy	*n*	%	*n*	%	*n*	%	*n*	%
Shower before entering the pool	170***	77.6	79*	36.1	170	77.6	79	36.1
Posted pool hours	201	91.8	176	80.4	201**	91.8	176	80.4
Locked gates	203***	92.7	175**	79.9	203*	92.7	175*	79.9
Hair restraints	16	7.3	11	5.0	16	7.3	11	5.0
Swim diapers required for children not toilet trained	169***	77.2	138***	63.0	169***	77.2	138*	63.0
Swim diapers required in wading pool	138**	63.0	114**	52.1	138*	63.0	114	52.1
Restroom with hand-washing supplies	207**	94.5	164*	74.9	207	94.5	164	74.9
Swimmers with open cuts and sores not allowed in water	167	76.3	125	57.1	167	76.3	125	57.1
Swimmers with infectious diseases not allowed in water	175	79.9	132	60.3	175	79.9	132	60.3
No glass containers allowed on premises	202	92.2	168***	76.7	202*	92.2	168**	76.7

*$p < .05$. **$p < .01$. ***$p < .001$.

Outdoor facilities had significantly more ($p \leq .05$ to .001) policies in effect and/or greater perceived compliance with regard to posting of pool hours, locked gates, requirement of swim diapers in recreational and wading pools, and prohibition of glass containers. The greater prevalence of and compliance with policies related to locked gates and swim-diaper requirements might be a result of greater numbers of wading pools located outdoors. Indoor pools at lodging facilities might have a shallow end but typically do not have a separate wading pool.

Water Quality and Sanitation Practices

Poor maintenance practices can affect water quality and sanitation. Respondents identified their typical schedules for completion of tasks related to water quality and sanitation. Table 4 shows the results. Most of the operations reported that their pools were vacuumed at least daily (32%) or weekly (29%), yet 1 respondent indicated that this task was completed just once a year. Over 75% of respondents reported that they checked and recorded chlorine levels two to four times a day. Best practice is to document monitoring of disinfection practices because this provides a written record. Most operations reported that they checked and recorded pH levels two to four times a day. Some states require operations to keep records of chlorine and pH inspections.

It is recommended that a certified laboratory analyze a sample of pool water for total coliform levels each month (Ford, 2005). Almost all (96%) the responding organizations reported submitting a water sample to a certified laboratory monthly for analysis of total coliform levels.

Most of the responding organizations indicated that their pools were drained and refilled annually (65%). Because more than half the pools in this Midwestern state were located outside, annual draining and refilling of pools is logical. Over three fourths (78%) of respondents reported cleaning locker rooms and restrooms daily and, in most of these organizations, recording the cleaning at least daily (54%). We assumed that the cleaning process included replenishment of supplies such as hand soap. Because recreational swim outings often include snacks, proper hand-washing supplies are needed. CDC media releases encourage swimmers to practice good hygiene before swimming in a pool and after using the restroom and changing a diaper (CDC, 2001a).

Conclusion

Findings presented in this report cannot be generalized beyond the results associated with the respondents from the surveyed state. This study does provide a profile of characteristics of treated recreational water facilities and shows that current methods of disseminating information about water sanitation and safety to pool operators are somewhat effective. A need to emphasize potential water contamination from fecal matter and the importance of organizational policies, such as requiring swim diapers, is evident. The establishment of healthy standard practices, such as hand washing after using the restroom for patrons, can also help curtail risks from RWI.

With changing demographics and continued popularity of swimming for recreation, exercise, and therapy, the role of aquatic professionals with oversight of

Table 4 Water-Quality and Facility Sanitation Practices and Schedules for Completion as Reported by Swimming Pool Operators (*N* = 219)

Practice	*n*	%
Vacuum pool		
at least daily	69	31.5
2–4 times/week	45	20.5
weekly	64	29.2
biweekly	23	10.5
monthly	10	4.6
annually	1	0.5
Chlorine checked		
at least hourly	45	20.6
2–4 times/day	165	75.3
daily	6	2.7
Chlorine levels recorded		
at least hourly	34	15.5
2–4 times/day	174	79.5
daily	9	4.1
pH checked		
at least hourly	42	19.2
2–4 times/day	168	76.7
daily	7	3.2
pH recorded		
at least hourly	34	15.5
2–4 times/day	174	79.5
daily	9	4.1
weekly	1	0.5
Locker room/restroom cleaned		
2–4 times/day	20	9.1
daily	172	78.5
2–4 times/week	7	3.2
weekly	2	1.0
Cleaning locker room recorded		
at least daily	127	53.5
at least weekly	7	3.1
monthly	1	0.5
annually	2	0.9
Water sample submitted for lab analysis		
less than monthly	2	1.0
monthly	210	95.5
annually	3	1.5

pools and spas is very important. It is imperative that those with responsibility for recreational water facilities understand basic sanitation and safety. Information from this study could be used to develop model recreational water policies incorporating sanitation and safety best practices that operations could use as a guide. Policies could be modified depending on operation characteristics. These model policies could protect organizations from legal liabilities and resulting fiscal strain, as well as protecting their patrons. Continued education about sanitation of recreational waters and emerging threats is necessary to reduce the risk of RWI.

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