Operating Public Swimming Pools

Preventing Recreational Water Illnesses (RWIs) is a multifaceted issue that requires participation from pool staff, swimmers and health departments. Poor maintenance can result in low disinfectant levels that can allow the spread of a variety of germs that cause diarrhea as well as skin and respiratory RWIs. Although pool staff alone cannot completely stop these complex problems, they play a key role in assuring the health of pool visitors. By following a few simple steps, aquatic managers and staff can lead the way.

- Obtain state or local authority-recommended operator training. Suggested national training courses are listed at http://www.cdc.gov/healthyswimming/courses.htm.
- Ensure availability of trained operation staff during the weekends when pools are most heavily used.
- Maintain free chlorine levels continuously between 1-3 parts per million.
- Maintain the pH level of the water at 7.2-7.8.
- Test pH and disinfectant levels at least twice per day (hourly when in heavy use).
- Maintain accurate daily records of disinfectant and pH measurements.
- Maintain filtration and recirculation systems according to manufacturer recommendations.
- Scrub pool surfaces, particularly tile, to remove any slime layer.
- Provide disinfection guidelines for fecal accidents and body fluid spills.
- Ensure adequate numbers of easily found, clean, close, and safe restrooms and diaper changing areas.
- Implement large group orientations, particularly for young children, and bathroom break policies to promote healthy swimming.
- Educate pool users and parents about RWIs and appropriate pool use (i.e., no swimming when ill with diarrhea).

For more details on preventing RWIs at your aquatics facility, see
http://www.cdc.gov/healthyswimming/twelvesteps.htm

Your Disinfection Team: Chlorine & pH

Protection Against Recreational Water Illnesses (RWIs)

Protecting swimmers and their families from RWIs is the reason that pool staff regularly check both chlorine and pH levels. Chlorine and pH, your disinfection team, are the first defense against germs that can make swimmers sick.

Water Quality	pH
Poor Chlorine Disinfection Eye Irritation Skin Irritation	> 8.0
Most Ideal for Eye Comfort and Disinfection	7.8
	7.6
	7.2
Eye Irritation Skin Irritation Pipe Corrosion	< 7.0

What does chlorine do?

Chlorine kills germs in pools--but it takes time to work. Therefore, it's important to make sure chlorine levels are always at the levels recommended by the health department (usually between 1.0 - 3.0 ppm).

Why does chlorine need to be tested regularly?

All sorts of things can reduce chlorine levels in pool water. Some examples are sunlight, dirt, debris, skin, and fecal matter from swimmer's bodies. That's why chlorine levels must be routinely measured. However, the time it takes for chlorine to work is also affected by the other member of the disinfection team, pH.

Why is pH important?

Two reasons. First, the germ-killing power of chlorine varies with pH level. As pH goes up, the ability of chlorine to kill germs goes down. Second, a swimmer's body has a pH between 7.2 and 7.8, so if the pool water isn't kept in this range then swimmers will start to feel irritation of their eyes and skin. Keeping the pH in this range will balance chlorine's germ-killing power while minimizing skin and eye irritation.

What else can be done to promote Healthy Swimming?

The best way to kill germs is by routinely measuring and adjusting both chlorine and pH levels. Since a few germs can survive for long periods in even the best-maintained pools, it is also important that swimmers become aware of Healthy Swimming behaviors (don't swim when ill with diarrhea, don't swallow pool water, take frequent bathroom breaks, and practice good hygiene). Combining Healthy Swimming behaviors with good chlorine and pH control will reduce the spread of RWIs.

For more information about pool disinfection, go to http://www.cdc.gov/healthyswimming/fecal_response.htm

Vomit and Blood Contamination of Pool Water

Protection Against Recreational Water Illnesses (RWIs)

Check for existing guidelines from your local or state regulatory agency before use.
Healthy Swimming recommendations do not replace existing state or local regulations or guidelines.

The most common germs spread through recreational water are germs that cause diarrheal illnesses and skin rashes. These are spread by swallowing water contaminated with feces or by skin exposure to contaminated water. Coming in contact with blood in pool water is unlikely to spread illness.

Vomit in Pool Water

Vomiting while swimming appears to be a common event. Often, vomiting is a result of swallowing too much water and, therefore, the vomit is probably not infectious. However, if the full contents of the stomach is vomited, follow the guidance in these Q & As:

Q: **What germs are likely to be spread by vomit?**
A: Noroviruses (also known as Norwalk-like viruses).

Q: **Assuming that norovirus is in the vomit, what should I do?**
A: Respond to the vomit accident as you would respond to a formed fecal accident, using CDC's recommendations (http://www.cdc.gov/healthyswimming/fecal_response.htm). The time and chlorine level combinations needed to kill noroviruses and *Giardia* are similar. Since killing *Giardia* is the basis of CDC's formed fecal accident response recommendations, this protocol should be adequate for disinfecting a potentially infectious vomit accident.

Blood in Pool Water

Germs (e.g., Hepatitis B virus or HIV) found in blood are spread when infected blood or certain body fluids get into the body and bloodstream (e.g., by sharing needles and by sexual contact). CDC is not aware of any of these germs being transmitted to swimmers from a blood spill in a pool.

Q: **Does chlorine kill the germs in blood?**
A: Yes. These germs do not survive long when diluted into properly chlorinated pool water.

Q: **Swimmers want something to be done after a blood spill. Should the pool be closed for a short period of time?**
A: There is no public health reason to recommend closing the pool after a blood spill. However, some pool staff choose to do so temporarily to satisfy patrons.

Cleaning Up Body Fluid Spills on Pool Surfaces

Protection Against Recreational Water Illnesses (RWIs)

Body fluids, including blood, feces, and vomit are all considered potentially contaminated with bloodborne or other germs. Therefore, spills of these fluids on the pool deck should be cleaned up and the contaminated surfaces disinfected immediately.

Appropriate Disinfectants

Bleach

One of the most commonly used chemicals for disinfection is a homemade solution of household bleach and water. Since a solution of bleach and water loses its strength quickly, a fresh mixture should be made before each clean-up to make sure it is effective.

Recipe for Bleach Disinfecting Solution

9 parts cool water

1 part household bleach

Add the household bleach to the water. Gently mix the solution .

Other Disinfectants

A listing of other approved commercial disinfectants can be found at www.epa.gov/oppad001/chemregindex.htm and http://www.fda.gov/cdrh/ode/germlab.html. These disinfectants are effective when used according to the manufacturer's instructions.

Clean-up Procedure Using Bleach Solution

1. Block off the area of the spill from patrons until clean-up and disinfection is complete.
2. Put on disposable latex gloves to prevent contamination of hands.
3. Wipe up the spill using paper towels or absorbent material and place in plastic garbage bag.
4. Gently pour bleach solution onto all contaminated areas of the surface.
5. Let the bleach solution remain on the contaminated area for 20 minutes.
6. Wipe up the remaining bleach solution.
7. All non-disposable cleaning materials used such as mops and scrub brushes should be disinfected by saturating with bleach solution and air dried.
8. Remove gloves and place in plastic garbage bags with all soiled cleaning materials.
9. Double-bag and securely tie-up plastic garbage bags and discard.
10. Thoroughly wash hands with soap and water.

Healthy Swimming

Fecal Accident Response Recommendations for Pool Staff*

What do you do when you find poop in the pool?

*Check for existing guidelines from your local or state regulatory agency before use. CDC recommendations do not replace existing state or local regulations or guidelines.

- These recommendations are for responding to fecal accidents in chlorinated recreational water venues.
- Improper handling of chlorine-based disinfectants could cause injury. Follow proper occupational safety and health requirements when following these recommendations.

Important background info...

WHAT ARE RECREATIONAL WATER ILLNESSES (RWIs)?

What is the first thing that pops into your head when you think about water safety? Drowning? Slipping? Lightning? All good answers, and all are very important. But, did you know that germs can contaminate swimming water? These germs cause RWIs that have made many people sick.

RWIs are caused by waterborne germs such as "Crypto" (KRIP-toe), short for *Cryptosporidium*, *Giardia* (gee-ARE-dee-uh), *E. coli* 0157:H7, and *Shigella* (Shi-GEL-uh).

HOW ARE RWIs SPREAD?

RWIs are spread by accidentally swallowing pool water that has been contaminated with germs that cause diarrhea. How? If someone has diarrhea, that person can easily contaminate the pool. Think about it. Pool water is shared by every swimmer and is not sterile.

The good news is that germs causing RWIs are killed by chlorine. However, chlorine doesn't work right away. It takes time to kill germs and some germs like Crypto can live in pools for days. Even the best maintained pools can spread illness.

SHOULD ALL FECAL ACCIDENTS BE TREATED THE SAME?

No.

A diarrheal fecal accident is a higher risk event than a formed stool accident. With most diarrheal illnesses, the number of infectious germs found in each bowel movement decreases as the diarrhea stops and the person's bowel movements return to normal. Therefore, a formed stool is probably less of a risk than a diarrheal accident that you may not see.

A formed stool may contain no germs, a few, or many that can cause illness. You won't know. The germs that may be present are less likely to be released into the pool because they are mostly contained within the stool. However, formed stool also protects germs inside from being exposed to the chlorine in the pool so prompt removal is necessary.

Germ Inactivation Time for Chlorinated Water*

Germ	Time
E. coli O157:H7 Bacterium	Less than 1 minute
Hepatitis A Virus	about 16 minutes
Giardia Parasite	about 45 minutes
Cryptosporidium Parasite	about 9600 minutes (6.7 days)

***1ppm (1mg/L) chlorine at pH 7.5 and 77°F (25°C)**

SHOULD YOU TREAT A FORMED FECAL ACCIDENT AS IF IT CONTAINS CRYPTO?

No. In 1999, pool staff volunteers from across the country collected almost 300 samples from fecal accidents that occurred at waterparks and pools. CDC then tested them for Crypto and *Giardia*. None of the sampled fecal accidents tested positive for Crypto but *Giardia* was found in 4.4% of the samples collected. These results suggest that formed fecal accidents pose only a very small Crypto threat, but should be treated as a risk for spreading other germs (such as *Giardia*). Remember a diarrheal fecal accident is considered to be a higher risk event than a formed stool fecal accident.

What do I do about...

formed stool in the pool?

Formed stools can act as a container for germs. If the fecal matter is solid, removing the feces from the pool without breaking it apart will decrease the likelihood of pool contamination. In addition, RWIs are more likely to be spread when someone who is ill with diarrhea has a fecal accident in the pool.

diarrhea in the pool?

Those who swim when ill with diarrhea place other swimmers at a significant risk for getting sick. Diarrheal accidents are much more likely than formed stool to contain germs. Therefore, it is important that all pool managers stress to patrons that swimming when ill with diarrhea is an unhealthy pool behavior.

1. For both formed stool and diarrhea, direct everyone to leave the pool. If you have multiple pools that use the same filter—all pools will have to be shut down. Do not allow anyone to enter the contaminated pool(s) until all decontamination procedures are completed.

2. For both formed stool and diarrhea, remove as much of the fecal material as possible using a net or scoop and dispose of it in a sanitary manner. Clean and disinfect the net or scoop (e.g., after cleaning, leave the net or scoop immersed in the pool during disinfection).

VACUUMING STOOL FROM THE POOL IS NOT RECOMMENDED.

3. Raise the chlorine to 2 ppm (if less than 2ppm), and ensure the pH is between 7.2 - 7.5. This chlorine concentration was selected to keep the pool closure time to approximately 30 minutes. Other concentrations or closure times can be used as long as the CT inactivation value[†] is kept constant (see back page).

4. Maintain the chlorine concentration at 2.0 ppm, pH 7.2 - 7.5, for at least 25 minutes before reopening the pool. State or local regulators may require higher chlorine levels in the presence of chlorine stabilizers such as chlorinated isocyanurates. Ensure that the filtration system is operating while the pool reaches and maintains the proper free available chlorine concentration during the disinfection process.

3. Raise the free available chlorine concentration to 20 ppm[¶] (mg/L) and maintain the pH between 7.2 and 7.5. This chlorine and pH level should be sufficient to inactivate *Cryptosporidium* and should be maintained for at least 8 hours, equivalent to a CT inactivation value of 9600.

4. Ensure that the filtration system is operating while the pool reaches and maintains the proper chlorine level during disinfection. If necessary, consult an aquatics professional to determine and identify the feasibility, practical methods, and safety considerations before attempting the hyperchlorination of any pool.

5. Backwash the filter thoroughly after reaching the CT value. Be sure the effluent is discharged directly to waste and in accordance with state or local regulations. Do not return the backwash through the filter. Where appropriate, replace the filter media.

6. Swimmers may be allowed back into the pool after the required CT value has been achieved and the chlorine level has been returned to the normal operating range allowed by the state or local regulatory authority.

For both formed stool and diarrhea, establish a fecal accident log. Document each fecal accident by recording date and time of the event, note whether formed stool or diarrhea, and note the chlorine levels at the time or observation of the event. Before reopening the pool, record the pH, the procedures followed in response to the fecal accident (including the process used to increase chlorine levels if necessary), and the contact time.

[†] CT refers to concentration (C) of free available chlorine in ppm multiplied by time (T) in minutes. If pool operators want to use a different chlorine concentration or inactivation time, they need to ensure that CT values always remain the same (See Figure 1 for examples).

[¶] Many conventional test kits cannot measure free available chlorine levels this high. Use chlorine test strips that can measure free available chlorine in a range that includes 20ppm (such as those used in the food industry) or make dilutions for use in a standard DPD test kit using chlorine-free water.

For more information about the CDC Fecal Accident Recommendations, please go to www.cdc.gov/healthyswimming/fecal_response.htm

Pool Disinfection time...

How long does it take to disinfect the pool after a fecal accident? This depends on what type of fecal accident has occurred and at which chlorine levels you choose to disinfect the pool. If the fecal accident is formed stool, follow Figure 1, which displays the specific time and chlorine level needed to inactivate *Giardia*. If the fecal accident is diarrhea, follow Figure 2, which displays the specific time and chlorine levels needed to inactivate Crypto.

Figure 1-*Giardia* Inactivation for Formed Fecal Accident

Chlorine Levels (ppm)	Disinfection Time*
1.0	45 minutes
2.0	25 minutes
3.0	19 minutes

*These closure times are based on a 99.9% inactivation of *Giardia* cysts by chlorine, pH 7.5, 77° F (25°C). The closure times were derived from the Enviromental Protection Agency (EPA) Disinfection Profiling and Benchmarking Guidance Manual. These closure times do not take into account "dead spots" and other areas of poor pool water mixing.

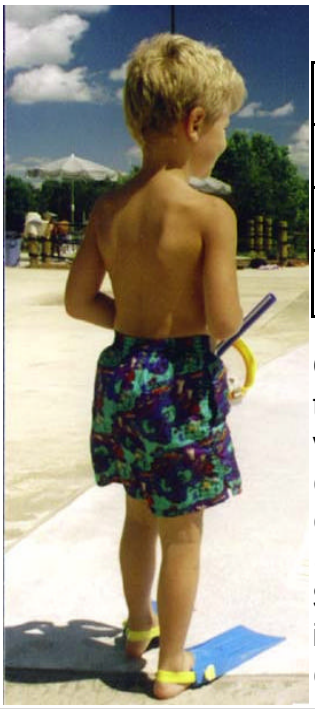

Figure 2-Crypto Inactivation Time for Diarrheal Accident

Chlorine Levels (ppm)	Disinfection Time*
1.0	6.7 days
10	16 hours
20	8 hours

CT value is the concentration (C) of free available chlorine in ppm multiplied by time (T) in minutes (CT value = C x T). The CT value for *Giardia* is 45 and the value for Crypto is 9600. If you choose to use a different chlorine concentration or inactivation time, you must ensure that the CT values remain the same. For example, to determine the length of time needed to disinfect a pool at 15 ppm after a diarrheal accident use the following formula: C x T = 9600.
Solve for time: T= 9,600 ÷ 15 ppm = 10.7 hours. It would take 10.7 hours to inactivate Crypto at 15 ppm. You can do the same for *Giardia* by using the CT of 45.

~ Pool Closures ~

Fecal accidents are a concern and an inconvenience to both pool operators and patrons. Pool operators should carefully explain to swimmers the need to close the pool in response to a fecal accident for their own health and safety. Understanding that pool closure is necessary for proper disinfection and protection of the health of swimmers is likely to promote support rather than frustration. Pool closures allow chlorine to do its job and protect your swimmers from RWIs.

For more information go to:

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