The management of swimming pools associated with Cryptosporidiosis or contaminated by *Cryptosporidium* oocysts

Pilot Guidance for the U.K. Federation of Tour Operators

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These notes have been prepared for guidance on the actions to be taken when cryptosporidium infection is associated with a swimming pool. They do not cover action for prevention of contamination such as a faecal accident policy. Many of the procedures recommended should only be undertaken by an operative with the appropriate training. The use of high chlorine levels is hazardous and the appropriate health and safety precautions must be followed.

1. I am unaware of any published procedure for the decontamination of a swimming pool contaminated with cryptosporidium oocysts. There are no published studies on the efficacy of any procedures on the disinfection of swimming pools against cryptosporidium although there is anecdotal evidence that certain actions have been associated with the cessation of further cases of cryptosporidiosis.

2. There are recommendations for a response to a faecal accident.
   a. US Centers for Disease Control and prevention in their weekly publication (MMWR) of 25 May 2001 includes in their advice for contamination by a liquid stool.

      3. Raise the free available chlorine concentration to 20 mg/L and maintain the pH between 7.2 and 7.5. Ensure this concentration is found throughout all co-circulating pools by sampling at least three widely spaced locations away from return water outlets. 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. A higher or lower free available chlorine level/inactivation time can be used as long as a CT inactivation value equalling 9600 is maintained for Cryptosporidium inactivation. State or local regulators may require higher free available chlorine levels in the presence of chlorine stabilizers such as chlorinated isocyanurates. If necessary, consult an aquatics professional to determine and identify the feasibility, practical methods, and safety considerations before attempting the hyperchlorination of any pool.

      4. Ensure that the filtration system is operating while the pool reaches and maintains the proper free available chlorine concentration during disinfection.

      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 into the pool after the required CT value has been achieved and the free available chlorine level has been returned to the normal operating range allowed by the state or local regulatory authority. Maintain the free available chlorine concentration and pH at standard operating levels based on state or local regulations. If necessary, consult state or local regulatory authorities for recommendations on bringing the free available chlorine levels back to an acceptable operating range.

      This guidance assumes a correctly installed and maintained water treatment system.

3. The UK Pool Water Treatment Advisory Group (PWTAG) Swimming Pool Water –treatment and Quality Standards (1999) following a faecal accident where there is a possibility of cryptosporidium contamination it states and recommends that:

The appropriate procedure relies on the fact that the cysts are, in principle, large enough to be filtered out.

- *The pool is cleared of people immediately.*
- *Disinfectant levels are maintained at the top of the recommended range.*
- *The pool is vacuumed and swept.*
- *Using a coagulant, the water is filtered for six turnover cycles (which could well take up to a day, and so might mean closing the pool until the next day).*
- *The filter is backwashed.*
- *The pool can then be reopened.*

Clearly this is a fairly drastic course of action that any pool operator would want to avoid if possible. But if there is a good reason to suspect that Cryptosporidium or Giardia is responsible (certainly if the person involved has had diarrhoea for some days), it would be the safest procedure. The local consultant in communicable disease control (CCDC) should be notified. A copy of such emergency measures can usefully be included in the operation and maintenance manual.

4. In the PWTAG technical guidance note of February 2001 on Cryptosporidium concentrates on coagulation and filtration but does not deal directly with decontamination of a known contaminated pool. They mention chlorine at a level of 30mg/L for 4 hours as being necessary to kill cryptosporidium oocysts but make no recommendations on the use of chlorine. Further detailed advice is given on the use of coagulants and filters.

5. In the UK there is concern on relying on high chlorine levels alone as a means of disinfection because

   a. There is no published data on the effect of chlorine on cryptosporidium oocysts in a swimming pool. It is understood that the studies that have been undertaken are in a laboratory setting.
   b. Chlorine is inactivated by organic material and there may be high levels of such material in parts of a pool and especially in filters.
   c. It would be necessary for the chlorine to be evenly distributed throughout the pool.
   d. For chlorine to be effective the pH must be carefully controlled (CDC recommend 7.2 – 7.5)
   e. Other chemicals may interfere with the action of the chlorine.

6. Concerns with filtration include

   a. The need for the filters to be operated at the correct pressure and water flow. The optimum operating conditions should be provided by the filter suppliers
   b. The use of sand of the correct particle size in the filters.
   c. Proper maintenance and back washing of the filters.
   d. The time taken for all the pool water to be filtered. Water equivalent to the pool volume may pass through in a given time but the structure of the pool may be such that all the water has not passed through. That is there may be areas of poor circulation in the pool

7. Water can be tested for the presence of cryptosporidium oocysts. Normally 10L grab samples are tested but larger volumes can be examined by the use of a cartridge filter. The volume of water and collection method should be discussed with the test laboratory. Before considering the appropriate action an understanding of the water test results is necessary so that misunderstandings do not occur.

    a. Cryptosporidium oocysts are not evenly distributed in the water therefore the numbers demonstrated in a sample does not on it's own have any significance. If oocysts are present that water is contaminated and poses a potential risk to bathers.
    b. The absence of oocysts in a sample does not mean that there are no oocysts elsewhere in the pool that could be a hazard to bathers.
    c. All laboratory tests should be undertaken in a laboratory with accreditation for cryptosporidium testing in water. The test method should be based on the US EPA Analytical Method 1662 "Cryptosporidium in Water by Filtraion/IMS/FA"
    d. The tests undertaken do not distinguish between live and dead oocysts. As a rule of thumb they should all be regarded as alive and potentially infectious.
    e. If a suspect pool has negative test results for oocysts further samples including a backwash and a sample of sand from the top 30cm of the filter should be examined.
    f. It is also be worth considering examining the deposit from the pump strainer.

8. The following scenarios are being met associated with hotel pools.
    a. 3 or more cases of cryptosporidiosis from different families using a swimming pool. This may be accompanied by an increase in illnesses with diarrhoea, and no other obvious cause, among other pool users. Pool water samples containing cryptosporidium oocysts
    b. As for (a) with no oocysts demonstrated in water samples.
    c. Oocysts demonstrated in pool water samples but no associated cases of unexplained diarrhoea.

9. Scenario

    3 or more cases of cryptosporidiosis from different families using a swimming pool. This may be accompanied by an increase in illnesses with diarrhoea, and no other obvious cause, among other pool users. Oocysts found in water tests

    a. Empty the pool
    b. Thoroughly clean all pipe work and associated tanks
    c. Replace the sand in the filters
    d. Refill the pool and chlorinate to 20 mg/L at pH 7.2 – 7.5 for 8 hours

10. Scenario

    3 or more cases of cryptosporidiosis from different families using a swimming pool. This may be accompanied by an increase in illnesses with diarrhoea, and no other obvious cause, among other pool users. No oocysts found in water tests

    a. Test further water samples and especially backwash samples. Test samples of sand taken from the top 30 cm of the sand filters. If negative and further cases do not occur no further action need be taken and another source of infection should be sought.
    b. Look for non-pool source(s) of infection. This should involve the local public health authorities and the Water Company or companies.

c. If further cases occur and the pool is the probable source of infection follow the scenario below even if oocyst are not found in the pool water tests.

11. Scenario

Oocysts demonstrated in pool water samples but no associated cases of unexplained diarrhoea

a. Take further samples including sand from the filters.
b. Close the pool - and any other pools whose water treatment is linked to the fouled pool.
c. Maintaining disinfectant levels at the top of the operating range, vacuum and sweep the pool.
d. Using optimised coagulation, filter for six turnover cycles (which may mean closing the pool for a day). This assumes good hydraulics and filters that have been correctly installed and maintained.
e. Backwash the filters individually NOT through other filters.
f. Check free chlorine residuals and pH and if they are satisfactory reopen the pool.

12. General Considerations in all scenarios

a. Ensure that any water used to fill or top up the pool is free from Cryptosporidium
b. Ensure that the pool operation is in accordance with sound water treatment principles as for example in the PWTAG Swimming Pool Water –Treatment and Quality Standards (1999)
c. Consider other pools or water features that may be contaminated.
d. Do not move guests from a pool with a contaminated pool to another hotel. This may spread any infection.
e. Ensure that all test results are made available to the local public health authorities

References:

CDC Guidelines

www.cdc.gov/mmwr/preview/mmwrhtml/mm5020a7.htm

PWTAG
www.pwtag.org

SWIMMING POOL WATER - Treatment and Quality Standards (ISBN 0 951 7007 6 6).
Obtainable through **www.ghpbooks.com**

See also Institute of Sport and Recreation Management
www.isrm.co.uk/information/216_cryptosporidium.pdf

These pilot guidelines have been discussed with other workers in the U.K. who have experince in the management of swimming pool outbreaks and there is a general agreement on the contents.

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