PROTOCOL

for Minimising the Risk of

Cryptosporidium Contamination

in Public Swimming Pools and Spa Pools

Better Health Good Health Care

NSW HEALTH

NSW HEALTH DEPARTMENT

State Health Publication No: (EH) 990227
ISBN: 0 7347 3 1256

For further copies please contact:

Better Health Centre
Locked Mail Bag 5003
Gladesville, NSW 2111
Ph: (02) 9816 0452
Fax: (02) 9816 0492

A full copy of this report and others in this series can be downloaded from the NSW HealthWeb site:
http://www.health.nsw.gov.au

December 1999

1. INTRODUCTION

This paper outlines the *NSW Health Department policy for minimising the risk of Cryptosporidium contamination in public swimming pools and spa pools*. It is intended as a supplement to the *NSW Health Department Public Swimming Pool and Spa Pool Guidelines* (the Guidelines). The purpose of this protocol is to provide minimum standards and best practice measures by which pools should operate to reduce the public health risk associated with *Cryptosporidium*. The protocol also has relevance to other similar disinfectant resistant microorganisms, of which *Cryptosporidium* appears to be the most resistant.

Cryptosporidium parvum is the parasite responsible for cryptosporidiosis, a diarrhoeal illness in humans, but it can also occur in a variety of animals such as cattle and sheep. In an infected person, the parasite invades and multiplies in the gastro-intestinal tract, causing illness and producing oocysts, the infective form of the parasite. Oocysts pass out in the faeces to the environment where they can survive for a long time, including in water. As oocysts are resistant to standard levels of chemicals, such as chlorine and bromine used for pool disinfection, *Cryptosporidium* transmission in public swimming pools and spas is a real public health risk.

Cryptosporidiosis transmission is faecal-oral, including person to person, animal to person, waterborne and foodborne transmission. Animal droppings and human faeces containing oocysts contaminate hands because of poor hygiene practices, but oocysts are also deposited in soil, water and food.

Outbreaks of cryptosporidiosis have been reported around the world. The most famous was in Milwaukee (USA) in 1993 when about 403,000 cases were linked to the contamination of drinking water supplies. Contaminated public swimming pools and recreational water facilities have also been related to several cryptosporidiosis outbreaks worldwide, including in Australia with reports of such outbreaks in 1998 in NSW, ACT and Queensland. In NSW, about 1,000 cases were notified between December 1997 and April 1998 and investigations implicated a number of pools around the State. These outbreaks highlight the need for public education about cryptosporidiosis and the development of appropriate pool risk management procedures with respect to *Cryptosporidium*.

Definitions of technical terms used in this protocol can be found in Appendix 3.

2. LEGISLATION

In December 1996, the Public Health Act 1991 was amended making cryptosporidiosis a notifiable disease. Laboratories that detect *Cryptosporidium* in a faecal sample must notify NSW Health Department who may then carry out further investigations if needed.

The Public Health Regulation 1991 (Part 4) makes provision for the operation of public swimming pools and spa pools and states:

Clause 14: The occupier of a swimming pool or spa pool to which the Part applies must not allow a person to use the water in the pool unless the water in the pool is disinfected in such a way as to prevent the transmission of scheduled medical conditions to the user of the pool.

Clause 17: It is a defence to a prosecution for an offence against this Part if the defendant satisfies the court that the act or omission constituting the offence was done in compliance with the Guidelines for Disinfecting Public Swimming Pools and Spa Pools published by the Department.

Additional legislative powers are prescribed allowing Environmental Health Officers to inspect and to close public swimming pools and spa pools and where it is believed, on reasonable grounds, that the public pool is a risk to public health. The closure notice must be displayed at the entrance to the pool until the closing notice is revoked.

3. RISK MANAGEMENT

The risk of a pool contaminated with *Cryptosporidium* is directly related to the organism's characteristics, its transmission and the epidemiology of disease (see Appendix 1). Briefly, infective oocysts are resistant to standard levels of chemicals used in pool disinfection and may not be adequately removed by the pool filtration system because of their small size. The more likely source of *Cryptosporidium* contamination in pools and spas comes directly from infected faecal material excreted by swimmers rather than from a contaminated water supply.

To reduce the risk of *Cryptosporidium* entering a pool it is recommended that operators prepare strategies to prevent the introduction of *Cryptosporidium* into pools and institute measures to ensure the elimination of *Cryptosporidium* if introduced into the pool/spa.

Risk assessment applied to the contamination of pools and spas by *Cryptosporidium* identifies four key risk management areas:

(i) Swimmer hygiene practices
(ii) Education
(iii) Operational control and maintenance
(iv) Sampling

3.1. Swimmer Hygiene Practices

The single most effective method to prevent the transmission of *Cryptosporidium* in swimming pools is to stop oocysts from entering the pools by improving swimmer practices. There are two priority areas: personal hygiene and non toilet-trained infants.

3.1.1 Personal Hygiene

NOTE: People who have had diarrhoea within the previous week should be advised not to swim in a public swimming pool or spa pool.

All patrons should be encouraged to:

- Use the toilet if necessary.
- Shower thoroughly with soap and rinse well before entering the pool.
- If it is necessary to visit the toilet to defecate, re-shower before entering the pool.
- Pool water should not be drunk intentionally, nor should it be used for hand washing.
- Swimmers should avoid deliberately putting pool water in their mouths.

NOTE: In order to promote good personal hygiene practice, pool operators should install soap dispensers next to the showers and hand basins as well as installing hand-dryers or disposable hand towels dispensers. Nappy changing facilities and bins for soiled nappies should be provided in the change rooms.

3.1.2 Non-Toilet Trained Infants

The pool attendant should be notified immediately of any faecal accident.

- Non-toilet trained children should have their water activities restricted to the toddler pool if possible.
- No children should be allowed to enter the water naked.
- Non-toilet trained infants should wear swimmers with waterproof tight fitting pants over them.
- Under no circumstances should nappies be worn while swimming.
- Nappies should be changed in change rooms and not at the poolside. The child should be washed thoroughly and the changer should wash their hands immediately afterward. Soiled nappies should be disposed of in the bins provided.
- Non-toilet trained children should be taken to the toilet frequently.

3.2. Education

Education of both the public and pool staff is essential in preventing the transmission of cryptosporidiosis and fulfils part of the pool management's "duty of care" to their patrons. Because there is growing community awareness of *Cryptosporidium* it is important to reinforce this with information about proper personal hygiene. The local Public Health Unit or the Local Council may be able to assist with educational material.

The following educational strategies are recommended as part of good pool management procedures:

- Ensure all pool staff are fully trained in pool/spa operational procedures.
- Ensure that all pool staff are empowered to act immediately on incidents and behaviour which may cause contamination (eg infants with unsuitable swimmers, or patrons who may present a risk such as those who are incontinent or indicate they have had a diarrhoeal illness).
- Ensure patrons are aware that management will reserve the right to prevent patrons from swimming if there is reason to believe that they may cause a risk to other swimmers.
- Provide public information about the risks of spreading cryptosporidiosis. Methods for providing information could include information on noticeboards and pamphlets for those entering the pool.

- Provide suitable signs in the entry foyer and in amenities areas to promote showering. The following wording is suggested.
- Signs could also be placed behind toilet doors requesting customers to wash hands thoroughly and to shower after using the toilet.
- Display all results of water quality pool testing together with recommended standards in a suitable public area for customer information and confidence.

For The Health and Safety of Others

- Do not use this pool if you have had diarrhoea in the past week.
- Before entering the pool, use the toilet and then shower (using soap).
- All swimmers should wear a swimming costume and non-toilet trained children should wear waterproof tight-fitting pants over swimmers.
- Children who are not toilet trained should use the wading pool.
- Avoid swallowing or putting pool water in your mouth.

NOTE: When pools are being upgraded, consideration should be given to designing amenities so that all patrons have no choice but to walk through a shower area before gaining access to the pool. Because patrons tend to avoid cold showers, warm showers with temperature control devices to prevent scalding would be preferable.

3.3. Operational Control and Management (see Appendix 2 for more details)

These are the practices and procedures that management and staff should follow to ensure optimal swimming pool and spa pool water quality at all times. Additional strategies and policies on pool management should be developed to suit individual pools and these should be consistent with the operational procedures in the *NSW Health Department Public Swimming Pool and Spa Pool Guidelines*.

The following should specifically be considered:

- Circulation and filter systems should be maintained to provide maximum filtration efficiency and run 24 hours a day.

- Pool water disinfectant levels should be maintained in anticipation of swimmer numbers such that disinfectant concentrations always remain above the minimum recommended levels specified in the Guidelines.
- Pool water should be superchlorinated overnight at least fortnightly and where possible weekly (refer to the section on disinfection in Appendix 2.2).
- All pools should be regularly water suctioned.
- Regularly test pool water quality on-site (section 7.1 of the Guidelines) and submit monthly bacteriological samples to a National Association of Testing Authority (NATA) accredited laboratory for bacteriological testing (see section 7.1 & 7.2 and Appendix A of the Guidelines).

NOTE: Bacteriological testing does not include testing for *Cryptosporidium;* however, the presence of thermotolerant coliforms is an indicator of possible faecal contamination. Note that Cryptosporidia have been known to occur in the absence of bacterial indicators. All test details should be logged as recommended in the Guidelines in Section B.

Faecal Contamination Accidents

- If faecal or vomiting accidents occur follow the emergency decontamination procedures in section 6.4 of the Guidelines.
- In the case of a diarrhoeal faecal incident (not a solid stool), it is recommended that the pool or pools using the same circulation system **be closed immediately** while decontamination procedures are carried out. Patrons should not be permitted to re-enter the pool until the next day when all procedures have been completed.
- Any wastes from suctioning faecal matter from the pool should be discharged into the sewer and neither into the pool filtration system nor the stormwater system.
- Log details of all known faecal incidents and corrective actions taken.

NOTE: Wading or toddler pools are best served by their own pool water circulation system. Where separate circulation systems are used avoid cross contamination and do not feed bulk water from one system to the other through balance tanks. If pools are not on separate systems consideration should be given to separating pool circulation systems when upgraded.

3.4. Water sampling for Cryptosporidium

Routine pool water sampling for *Cryptosporidium* is not recommended.

Test methodologies, currently based on a 100 litre water sample, are available to detect and enumerate *Cryptosporidium* oocysts but only represent the status of the water at the time of testing. Negative results may give a false sense of security because sampling does not represent all of the pool water and a faecal accident may occur after sampling (as for any microbe including coliforms). Testing for the parasite is expensive and there is a time delay before results are received. The primary tests do not determine whether the oocysts are alive or whether they are able to cause infections. Further, as the dose of organisms needed to cause an infection is unknown the concentration of oocysts detected has little meaning. The test involves large sample volumes, is expensive and does not provide the necessary information for making operating decisions.

3.5. Outbreaks of Cryptosporidiosis

In the event of an outbreak or a cluster of cases of cryptosporidiosis and where a public swimming pool is implicated in the subsequent investigation, consideration may be given to the temporary closure of the relevant pool(s).

3.6. Further advice and information

Additional advice and information for the managers and operators of swimming pools and spa pools is available from the your local Public Health Unit and / or Local Council.

Appendices

Appendix1 - Epidemiology

Although there are several species of *Cryptosporidium*, only *Cryptosporidium* parvum is currently known to cause infection in humans. The first symptoms of cryptosporidiosis may appear 1 to 12 days after a person ingests the infective oocysts. Symptoms of the disease usually include profuse watery diarrhoea, abdominal cramps, fever, nausea, and vomiting. These symptoms may lead to weight loss and dehydration. Some infected people may not have symptoms, yet excrete oocysts in their faeces. **There is no specific treatment for cryptosporidiosis.**

People with healthy immune systems usually have symptoms for one to two weeks and then recover fully. After symptoms subside, they may still continue to pass *Cryptosporidium* oocysts in their faeces for several days and therefore may still spread the disease to others.

Those with a weakened immune system, may have cryptosporidiosis for a longer period of time; in some cases the illness can be serious or even life threatening. People with compromised immune systems should discuss with their doctor their risk of catching cryptosporidiosis, including swimming at public pools and spas, and the need to take precautionary measures. Examples of people with weakened immunity include people with HIV/AIDS, cancer and transplant patients on immunosuppressive drugs and people with inherited diseases affecting the immune system.

Appendix 2 - Barriers used in pool operations

Barriers are mechanisms used to prevent transmission of any disease from its source to a susceptible host. Barriers can include source control, cleaning and disinfection, pool closure and any other way to prevent exposure to the public to an infective microorganism. Two main barriers are used in normal operating practices to minimise the transmission of microorganisms to swimmers: these are filtration and disinfection.

A 2.1 Filters

In swimming pools and spa pools the water is continuously circulated through filters to remove solids and other impurities. The amount of water being filtered is usually about 1/4 of the pool volume every hour for Olympic sized pools to twice the pool volume every hour for spa pools. Most pool filters, depending on the type of filter, reliably remove particles to about 10 microns in size (1 hundredth of a millimetre). It should be noted that it takes time to remove particles from a pool because not all of the water is treated with each pass through a filter. The filtered water continuously dilutes the pool water as it returns to the pool and gradually reduces the level of contaminants over time, assuming that no more contaminants are added to the pool.

The *Cryptosporidium* oocysts are about 4-6 microns in size and are capable of passing through the filter unless they adhere to larger particles or are coagulated and captured. Some will be trapped but again it takes time to pass water through filters and may take as long as seven filter turnovers (28 hours for an Olympic sized pool) to remove most of the oocysts, although the removal of all oocysts is not assured. **Finally, pools have "dead spots" where not all water is guaranteed to be circulated through the filters.** Filters therefore should not be relied upon as a treatment barrier to removing oocysts but as an adjunct to oocyst control (see A 2.2. Disinfection).

Filter backwash water may be heavily contaminated with (i) bacteria, viruses and parasites; (ii) physical components such as dirt, lint, cosmetics, oils and greases; and (iii) chemicals such as sodium. Backwash water should never be reused without adequate treatment.

Where pools are being upgraded, consideration should be given to the following:

- Separate circulation systems for wading and toddler pools,
- Where backwash waste disposal is being re-engineered (often due to Environment Protection Authority requirements) this type of wastewater is not to be recycled to pool facilities.

A 2.2 Disinfection

Public swimming pools and spa pools must have an effective means of continuous disinfection. This is where a disinfectant is continuously added to the circulation system by a metering device. The aim of disinfection is to kill the disease causing bacteria, viruses and parasites introduced by swimmers, make-up water or wind blown spores as well as to control algae. It is essential that the minimum residual of disinfectant is maintained in the pool itself because pathogenic microorganisms need to be killed as soon as possible after being introduced into the pool.

Determining the type and level of disinfection required is complex as there is no ideal disinfectant that will completely oxidise organic foreign matter and leave a residual to continue disinfection. There are numerous recommended disinfectants and the *NSW Health Department Public Swimming Pool and Spa Pool Guidelines* contain more information on this subject.

Routine disinfection procedures, on their own, are not sufficient to quickly destroy *Cryptosporidium* oocysts unless superchlorination is regularly practised (see below). While chlorine and bromine at the recommended levels will eventually kill the oocysts over many days or even weeks, assuming no further contamination, the time lag is insufficient to protect swimmers from infection.

Superchlorination is strongly recommended. Weekly or fortnightly superchlorination maintaining 10mg/L free chlorine should be performed when swimmers are not present (usually overnight) for an eight hour period minimum.

Superchlorination:

- Allows the pool to catch up on disinfection while there is no contamination entering the pool.
- Is much more effective at killing *Cryptosporidium* oocysts.
- Allows extra oxidation of organic contaminants and aids filtration, clarification and polishing of the pool water.
- Destroys biofilms that may develop on the inside of pipes. Biofilms may harbour *Cryptosporidium* oocysts.

NOTE: Where it is suspected that an outbreak of cryptosporidiosis is related to a contaminated swimming pool or spa pool, a CT value (free chlorine concentration (mg/L) x time (minutes)) of at least 8,400 must be achieved in order to inactivate 99.9% of the oocysts. That is, the concentration (in mg/L) multiplied by the time (in minutes) must exceed 8,400. This equates to 10mg/L free chlorine for 14 hours or 20mg/L for 7 hours. This regime should be monitored.

Liquid, stabilised chlorine dioxide has recently been introduced into the market for use as a shock dose similar to superchlorination and claiming superior inactivation of oocysts than free chlorine. From research data it appears that a CT value of about 100 will inactivate 99.9% of oocysts.

Appendix 3 – Glossary

Biofilm	A complex of microorganisms held in a slime layer often covering the inner surface of pipes.
Cryptosporidiosis	A gastrointestinal illness caused by *Cryptosporidium* parvum.
Disinfection	Killing of infectious agents outside the body by direct exposure to chemical or physical agents.
Epidemiology	The study of factors determining and influencing the frequency and distribution of disease, injury, and other health-related events and their causes in a defined human population, for establishing programs to prevent and control disease development and spread.
Faecal-oral transmission	Transmission of a communicable (infectious) disease through the ingestion of faecally contaminated material.
Host	A person or other living animal or plant that harbours or nourishes another organism (parasite).
Oocyst	Encapsulated egg that is the infective form of the parasite.
Outbreak	Two or more cases of a communicable (infectious) disease in the same place and time and with a common exposure; cluster has a similar meaning but usually refers to smaller numbers.
Parasite	An organism that uses the body of another organism to support its growth and reproduction.
Standard level of chemicals	"SLOC" a chemical regime used in a swimming pool or spa which satisfies Guidelines requirements.
Thermotolerant coliforms	Bacteria that originate from the gut of warm blooded animals and are used as indicators of faecal contamination.

(Sources: A Benenson. Control of Communicable Diseases Manual. 1995 Dorland's Illustrated Medical Dictionary, 28th Edition, 1994)