UNDERSTANDING SWIMMING POOLS & SPAS

Good management of public swimming pools and public spa pools is essential for the health of everyone that uses them. Climate conditions can play a large part, and the effects of sun and rain in particular can adversely affect the water quality. Swimming pools and spas(Jacuzzis) that contain insufficient or reduced levels of disinfectant have the potential for rapid growth in microorganisms.

All swimming pools and spas should be equipped with an effective water circulation system with proper filtration and a continuous disinfectant dosing control system. A continuous dosing system is one that uses a metering device to feed the chemical/s at a controlled rate or can manufacture or generate chlorine to maintain a satisfactory residual to disinfect the water.

Separate to any statutory requirements, operators of pools, especially those that are used for commercial purposes, need to be aware of their Duty of Care obligations to provide a safe swimming environment.

Disinfection of swimming and spa pools focuses on the need to provide a safe water environment for public activities. The water in the pools should be safe and not cause harm to the public, have a residual of disinfectant to cater for shock loads of microorganisms and organic matter and the pool should be able to be operated in a continuous manner with no risk to the public.

What is recommended to ensure the success of any pool centre, and is extremely important, is that the person in charge should be adequately experienced and knowledgeable in all aspects of pool operation and management.

With the use of various pool and spa facilities by such a broad range of our community there is ample opportunity for the introduction of a wide range of organisms which can to the susceptible cause anything from a small annoying infection all the way up to life threatening disease. And, it should be understood and recognised that there is a susceptibility to infection for all persons who use public swimming pools and spas.

Disease causing organisms that affect bathers may be introduced into a pool or spa on the bather's skin, in their saliva, urine or faeces. Bird droppings, dust, water make-up, dirt and soil on the feet of bathers can also contribute and cause contamination. If pool water is not properly treated and maintained then disease causing organisms are not killed and may actually grow and proliferate. The fast and effective kill of all disease causing organisms is essential for proper control.

Spa pools should be drained at least once per month to enable cleaning procedures to be undertaken. There can be a build up of acid in the spa pool and this requires an exchange of water to reduce the level. Thorough cleaning includes removal of lint and foreign matter, and soaking overnight in 10 ppm chlorine or similar disinfectant.

Where spa pools are heated, the temperature must never exceed 40^{O}C and exposures at greater than body temperature should not exceed 20 minutes for a healthy adult.
Signs should be displayed around spa pools restricting bathing to 20 minutes. The temperature of the spa should be regularly checked. Temperature has an adverse effect on

the killing power of disinfectants, such as chlorine, in that the disinfectant dissipates rapidly. Warmer temperatures favour bacterial growth, such as *Legionella* in filter media, which may be transmitted by aerosols in spa pools. *Pseudomonas aeruginosa* survival and growth is enhanced at temperatures exceeding $26^{O}C$.

In swimming and spa pools bacterial count is controlled by the addition of a disinfecting agent. When chlorine is added to contaminated water, it begins to react with organic matter and ammonia-like compounds, and is gradually expended. Bathers mostly introduce the ammonia-like compounds from urine contamination. The ammonia like compounds reaction with chlorine forms chloramines. When all the chlorine in the water exists as chloramines this is called marginal chlorination of chloramines. The chlorine in combination as chloramines is available for disinfection and is called combined chlorination, but the speed of its disinfection is much slower than that of chlorine in a free or un-combined form.

However, if sufficient chlorine is added so that some of the chlorine exists in the free form, this is known as free residual chlorination and the disinfection can be up to 50 times more effective than marginal chlorination. Adding sufficient chlorine can destroy the chloramines compounds present in the water.

Chlorine demand is best described as the difference between the amount of chlorine applied to the water and the chlorine residual. Super-chlorination is the process of adding chlorine to the water beyond the level needed to produce an initial residual.

Pool construction and design are another area that should be reviewed regularly especially when building or upgrading facilities. It cannot be impressed enough, the importance of good circulation and the need for a safe, easy clean functional pool capable of satisfying all anticipated bather loads. Important to note here is that pools which are patronised by non-toilet trained toddlers should have their own separate circulation system, especially in light of the various outbreaks of Cryptosporidium which is introduced through accidental faecal contamination. Cryptosporidium cysts range in size between 4-6 microns and because of their size are not totally removed by filtration as most filters will only remove particulates greater than 10-15 microns. Although flocculation and coagulation agents assist in the removal of cysts which pass through the filter they are not normally successful in the remaining body of pool water. (Cryptosporidium can cause severe diarrhoea).

Eventually, with constant filtration there will be a reduction in the number of cysts and if there is no animal host they will not multiply. But, as with most things prevention has to be better than cure. To help prevent the contamination of pool and spa waters by bathers, they should all be encouraged to perform toileting prior to bathing by locating such areas within dressing and change rooms close to the pool entry. Urine is the most polluting material to enter a pool or spa. Adequate numbers of showers should also be located in the dressing/change room areas and patrons should be encouraged to pre-shower before swimming. Signage should be erected to help encourage showering and soap provided. Where persons are detected with wounds, sores and rashes, infected eyes, or wearing bandages it should be requested that they not swim in the pool. Pool contamination through nose blowing, spitting and sprouting of water should be actively discouraged.

Each pool facility should determine its own attitude towards the control or possible exclusion of incontinent persons who might use the pool. Disinfection systems for pools are not designed to accept or disinfect faecal material. However, a suitable management plan may

need to be devised for specific pools, such as hydrotherapy pools frequented by special groups such as incontinent and/or immuno-compromised persons. Suitable signs should be erected near the main entrance.

Emergency contamination management should also be addressed to cover three essential areas which will affect pool operations.

1. Substantial amount of loose runny stool(diarrhoea) introduced into the pool, clear people from the immediate vicinity of the faecal accident, thoroughly remove as able, all faecal matter using a fine mesh and check the disinfectant levels in the pool vicinity and if below required levels close the pool immediately, add a coagulant and filter for at least one turnover before allowing patrons to use the pool, superchlorinate overnight, thoroughly vacuum the pool, backwash the filter and enter all relevant details on the pool log sheet.

2. When a solid stool is introduced into the pool, immediately vacate that vicinity. The stool should be removed as quickly as possible and a check made of disinfectant levels within that area. Where the disinfectant concentration is low the pool should be closed for one pool turnover, if levels are satisfactory, allow swimming to continue.

3. Where blood or vomit is introduced into a pool it should be temporarily cleared and the contamination dispersed until there is no further trace. Tests for disinfectant levels should be satisfactory before allowing people to swim. Blood spillage on the poolside should not be washed into pool side drains. It should be neutralised with a 1% chorine solution for two minutes before being washed away.

Testing of pools and spas, and the frequency of such testing is an integral part of ensuring the overall safety of a pool or spa. Depending on the method you use for the dosing of disinfectant, and the product/s used, will determine how often and when to carry out the necessary tests. **Bacteriological testing** should be included alongside that for chemical testing and this **should be performed every month** of continuous operation by a properly accredited laboratory. Immediate re-sampling for bacteriological analysis should be performed when unsatisfactory results are obtained. It should also be realised that the results of a single sample do not give an indication of overall pool management. Because there is a delay of some days before the results of a bacteriological analysis is known, the chemical quality of the swimming pool water will provide a measure of its “on the spot” ability to combat infection as it is introduced into a pool or spa.

The chemical and microbiological analysis results should be entered into a database or similar recording system so that baseline data is gathered on the pool management performance especially when it is compared to bathing loads at the times of such sampling.

The following table provides bacteriological criteria applicable to all swimming pools and spas

. **Type of Organism**	**Maximum Count Allowable**

Total Plate Count	100 Colony Forming Units (CFU) per mL
Thermotolerant coliforms (Faecal Coliforms)	Nil per 100 mL
Pseudomonas aeruginosa	Nil per 100 mL

Health risks to susceptible people that can be attributed to poorly maintained swimming pools and spa pools may be from infections caused by a number of microorganisms some of which may be naturally present on our hair or skin or in our ears, mouths, noses, intestinal and uro-genital tracts. The infections may be transmitted by inadequately treated pool water, or surfaces such as shower floors which need to be cleaned and disinfected daily with at least weekly scrubbing to remove soap accumulation.

To help you to understand what all this means take time to review the list of bacterial pathogens, protozoan pathogens, viral pathogens, yeast and fungal pathogens that can and do invade our bodies if and when given the opportunity.

Bacterial Pathogens

Pseudomonas aeruginosa

is the most common disease causing agent associated with waterborne disease outbreaks. It is an opportunistic pathogen and has been identified as the causative agent of eye, ear and skin infections. Its normal habitats are water, soil and vegetation but may also be of human origin. Although relatively resistant to a range of disinfectants, chlorination of normal swimming pools should be sufficient to kill the bacterium. However, in environments which are peculiar to spas such as water turbulence, elevated temperature and heavy bather-loads, considerably greater care is needed to ensure their safe operation and the eradication of this organism.

Legionella spp.

causes a serious pneumonic disease known as Legionnaires' disease and a less debilitating disease called Pontiac fever. They are found in the natural environment, such as soil, rivers, lakes and creeks. The great majority of outbreaks have been associated with air conditioning cooling systems although spa pools have also been implicated. Legionellosis is caused through inhalation of contaminated aerosols.

Coagulase positive staphylococci

have been regularly isolated from swimming pools and spa pools as they are normal microflora of the skin, ear and nose. The micro-organisms can cause skin infections, such as boils, carbuncles and wound infections. They are fairly resistant to disinfection but have not been shown to be a public health problem in well maintained pools.

Mycobacterium marinum

causes chronic skin ulceration known as " swimming pool granuloma " which may last up to three years if untreated.

Shigella Salmonella and Campylobacter

have been implicated as causative agents of gastrointestinal disease but outbreaks as a result of swimming are uncommon.

Protozoan Pathogens

Cryptosporidium and Giardia

are protozoan single celled organisms which may be excreted by infected humans into swimming pools through faecal accidents and may cause outbreaks of diarrhoea.

Naegleria Fowler

is a pathogenic free-living amoeba which has been shown to cause a fatal disease called primary amoebic meningo - encephalitis. The disease is contracted by the invasion of the amoeba through the nose into the brain. In nature, the organism thrives in mineral springs, thermal bores, rivers and lakes. These waters are generally heated above 25° C, which assists the parasite in its metabolism and survival.

Viral Pathogens

Enteroviruses

are the major causative agents of swimming pool gastroenteritis. They are most frequently found in washing pools used by infants and young children where bather hygiene is poor and water volume is small.

Adenoviruses

types 3 & 4 cause pharyngo-conjunctival fever amongst bathers. The disease is characterised by sore throat, fever and conjunctivitis frequently associated with diarrhoea.

The Herpes, simplex virus

causes fever and an unwell feeling. It has been reported to be able to survive for long hours in warm, humid conditions and is spread by persons with cold sores.

Plantar warts

are caused by a papovavirus through contaminated floor surfaces.

Yeast and Fungal Pathogens

Large numbers of fungi can be found in indoor swimming pools. Athlete's foot or tinea pedis is caused by Trichophyton mentagrophytes which has been isolated from the wooden flooring of a shower stall.

The yeast, Candida albicans, causes urino-genital, skin and nail infections in individuals with normal immune defences as well as serious systemic infections in debilitated patients.

Chemical Conditions

While too little residual chlorine will allow bacteria to grow, too much chlorine, bromine or prolonged swimming, particularly in salt water can cause conjunctivitis(eye irritation) and dermatitis (skin allergy) and dry scaly skin. Bromine particularly in the form of BCDMH is believed to cause permanent skin sensitivity.