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Under the microscope: pool management practice found wanting

A unique study of pool management practices has provided hard evidence of critical shortcomings. Robbie Phillips reports on the findings of the report and argues that it should be read as a major wake-up call for the industry.

Since 2001 swimming pools have been the most common setting for outbreaks of waterborne infectious intestinal disease in England and Wales, with cryptosporidium being the leading cause. In response the public protection team at the City of Cardiff council conducted a study in 2013, the first of its kind, with a number of aims: to help raise awareness with pool operators; assess management of cryptosporidium in swimming pools across Wales; and to gather information about swimming facilities which could be utilised in the event of an outbreak.

The first phase of the study involved the development and application of health promotional information, with phase two comprising pool visits and analysis of the results. All 22 local authorities in Wales participated, including commercial pools under local authority health and safety enforcement, and pools run by local authorities and health boards. Announced visits were made by environment health practitioners (EHP) to a standard protocol that considered all areas of pool management and operations critical to the effective prevention and control of cryptosporidium. To ensure consistency in approach all officers undertaking the visits had previously attended a training workshop.

At the time of the study a total of 522 pools were reported to be in operation in Wales and of these 426 were visited (82%). Of these 426 pools 267 (67%) were privately owned and 140 (33%) were under public ownership (local authority or health board). Of the publicly owned pools, 83 (59%) were in leisure centres, 36 (26%) in schools and 15 (11%) were paddling pools. Of those pools under private ownership 126 (44%) were in holiday parks, 81 (28%) in hotels and 29 (10%) in holiday accommodation.

The headline results of the study show that 19 (4.5%) pools were found to be in unacceptable or unsatisfactory condition, 215 (46.5%) were satisfactory (with minor shortcomings or were 'patchy') and 208 (49%) were found to be of a high or good standard. However, the study also revealed a very interesting picture of other aspects of swimming pool provision, including areas such as management competency, expertise associated with pool plant, installers' knowledge of design, and levels of training both generic and site-specific.

By way of introduction to the findings of the study it is worth reminding ourselves of what cryptosporidium is, how it can be managed, and why it is such a threat to public health.

Cryptosporidium outbreaks are associated with pools because, unlike most other pathogens, the oocysts are resistant to normal free chlorine levels used for pool disinfection. Oocysts can survive for months in moist environments with ambient temperature. They will therefore survive in pool water and present an infection risk unless removed. If cryptosporidium oocysts are introduced into the pool water, the optimum method of removing these is by medium-rate filtration. Filtration relies on good circulation and turnover, and should be undertaken with continual dosing of coagulant/flocculant. Without coagulation, oocyst

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removal has been estimated to be substantially less than 90%. With high-rate filtration, super-chlorination is the only viable way of oocyst neutralisation.

Factors that have been found to contribute to swimming pool outbreaks include: inadequate pool design and construction, including water features; sewage cross-connection; faecal release or contamination from bathers; excessive bather loads; inappropriate handling and disposal of stools; inappropriate response to faecal accidents; inadequate pool water circulation, coagulation and filtration; filter backwashing problems; inappropriate backwashing procedures; ozone or UV treatment not working properly.

However, defending a pool against cryptosporidium involves the application of some basic but highly effective protocols. Educating pool users and providing adequate pre-pool hygiene facilities will keep cryptosporidium out of the pool. Good pool management requires that any contamination is dealt with promptly and appropriately. Pool water circulation, coagulation and filtration needs to be sufficient to remove contamination. Good filter backwashing practice and procedures are essential, as is proper pool design and construction to prevent cross-connections and spread of contamination. In ideal circumstances the circulation, filtration and treatment for learner pools is separate from the main pool.

A schematic diagram forms a fundamental part of effective pool water management. They are needed to support and demonstrate a clear understanding of the specific pool water circulation, filtration and treatment system for the pool in question. This document is critical and should include a schematic of the filtration and water treatment system, which should include the filters, pumps, dosing equipment, tanks, valves, samples points, routing of the pipes and origin of the water supply. A clear, concise schematic is a fundamental document as a part of an effective outbreak investigation. However, the study found that 257 (60%) pools did not have adequate schematic diagrams, with holiday accommodation (including 87 holiday parks and one cottage) the most common type of business not to have this information.

The turnover period is the time taken for the entire volume of pool water to pass through the water treatment plant and back to the pool. This information is critical when establishing remedial action to be taken in the event of a liquid faecal accident. The study found that 56 pool water operators (37%) did not know the turnover period of their pool. Again, the most common type of premises to be lacking this information was holiday accommodation (including 69 parks and cottages [44%], 40 hotels [26%] and 19 schools [12%]). The management of 29 pools (6.8%) were found to be either not up to task or ambivalent to health and safety. Only 40 pools (9.5%) showed good practice.

It was also interesting – and alarming – to find some confusion regarding chemical terms. The perception in some pools that some chemicals – including bromide, calcium chloride, chlorine, chlorine briquette, chlorine HTC, chlorine hypochlorite H₂O, sodium hypochlorite and sodium carbonate -- were disinfectants raises serious questions regarding knowledge and training. It is worrying that the operators in certain cases do not know the correct name of the chemicals being used or that some are not disinfectants. The implications for health and safety regimes could be disastrous.

Dosing of disinfectant and pH control chemicals should be fully automated to ensure that constant levels of residual disinfectant at the correct pH are maintained and the risk of infection is minimised. Where hazardous manual dosing is used it must be backed up with good management of operation, monitoring and record-keeping. The study found 121 pools (28%) were manually dosing disinfectant.

Filtration relies on good circulation and turnover, with filtration efficiency generally reducing as the filtration rate increases. Medium-rate filters are more desirable, particularly in public pools, and high-rate filters are only suitable for small domestic pools with a low bather load. The study shows 202 pools (47%) reported using medium-rate filters, 123 (29%) had high-rate filters and 101 (24%) pools did not know the flow rate of their filter. Holiday accommodation and hotels were the most common types of premise in which the flow rate was unknown. It is a key point is that operators should know their filtration type because the type – medium or high – dictates the type of treatment applied to eradicate cryptosporidium oocysts.

With regard to recording and reaction logs, 49 pools (12%) did not keep a water treatment log and of these five did not understand the required corrective actions. Of the 377 that kept a water treatment log 12 did not understand the required corrective actions. Monthly sampling for bacteriological quality is recommended by the Pool Water Treatment Advisory Group (PWTAG) and the Health and Safety Executive (HSE) to monitor for the presence of micro-organisms. Bacteriological results help to confirm effective pool water management but 142 (33%) pools did not have a regular microbiological sampling programme.

Keeping cryptosporidium out of the pool is the most important method of prevention and this can be achieved by good pool management, which would include the introduction and application of procedures for managing cryptosporidium. These procedures would in turn include managing faecal contamination promptly and appropriately, effective nappy policies and educating pool users by providing them with information on diarrhoea and cryptosporidium. However, this study showed that 140 pools (33%) did not have a procedure for managing cryptosporidium; 254 (60%) did not provide information to pool users on diarrhoea and cryptosporidium; 94 (22%) did not have an adequate procedure for faecal contamination; 79 (19%) did not have a procedures for different stools; 193 (45%) did not apply any nappy policy; 11 (2.6%) did not have clean and adequate changing facilities; 61 (14.3%) did not have any facilities (the latter comprised primarily holiday parks, accommodation and paddling pools).

Analysis of the study's finding confirms the value of trained pool plant operators in the effective management of cryptosporidium in swimming pools. Swimming pools with suitably trained pool water operators were four times more likely to have an adequate schematic diagram, three times more likely to know the turnover period of the pool, three times more likely to have a procedure for managing cryptosporidium and twice as likely to undertake regular sampling for microbiological analysis. Pool management and staff need to be suitably trained to ensure they understand the functioning of the site pool water system but 92 pools (22%) did not have suitably trained operators.

To prevent the potential infection by cryptosporidium pool operators should be aware that the best defence against infections is good hygiene and filtration. This can be summarised as:

- Advertise that people with diarrhoea must not swim for 48 hours afterwards. Those who have been diagnosed with cryptosporidiosis must not swim for 14 days after diarrhoea has stopped.
- Encourage bathers to wash and shower before swimming.
- The operator should be able to identify the difference between medium- and high-rate filtration; or any other type (diatomaceous earth, etc).
- Continuous low-level dosing of a coagulant is recommended for all pools to improve the filtration efficiency with medium-rate

filtration.

- Correct backwashing protocol is critical; backwashing must not take place when the pool is being used.
- Backwashing of filters should be done at least once a week or more frequently as the filter pressure differential dictates and according to the manufacturer's literature for the filters installed.
- Backwashing should not take place during bathing and should allow the filters to recompact before any use, normally last thing at night. Only one filter should be backwashed at a time.
- Ensure there is an appropriate emergency action plan (EAP) for a loose, runny stool; also appropriate documentation and awareness.
- With high-rate filters there should be volumes of chemicals present to attain the super-chlorination and dechlorination, together with flocculant/coagulant to administer.
- Ensure there is an effective disinfectant residual, and an appropriate pH, at all times.

The City of Cardiff's public protection team should be applauded for proactively raising awareness of these important issues via this detailed two-year study and report. As an industry we can no longer brush the problem of cryptosporidium under the carpet. We now have hard evidence of the critical issues and together we must take decisive action. This report should be a major wake-up call for the industry and it serves to illustrate that by investing in training we can manage cryptosporidium in swimming pools effectively. It is very pleasing to see that the research has already having a positive impact on pool plant training, with rising numbers of pool plant qualifications being awarded.

Robbie Phillips is the STA's pool plant expert and is a regular contributor to the Leisure Review.

This two-year project evolved from the investigation of an outbreak of swimming pool-associated cryptosporidium and elevated numbers of sporadic cryptosporidium in south-east Wales in 2009, and a follow up national study into sporadic swimming pool associated cryptosporidium in 2010. The members of the project working group are: Dr Sarah Jones City of Cardiff Council; Kelly Lee, Newport City Council; Samantha Hancock, Pembrokeshire Count Council. The STA assisted the study with the pro-forma questionnaire, training and assisting the EHPs.

The Leisure Review, November 2014

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