with most of the increase occurring among people over 60 years of age [5]. A similar increase in listeriosis among people over 60 years of age occurred in England and Wales from 2001-2004 [6].

In France and Finland, routine serotyping and molecular subtyping by pulsed-field gel electrophoresis (PFGE) resulted in the detection of several case clusters and common-source foodborne outbreaks. However, few isolates in Germany were serotpyed or subtyped by PFGE, and no foodborne outbreaks were identified. The importance of routine molecular typing of *Listeria* isolates for outbreak detection and investigation was further highlighted by the two outbreaks reported in this issue from Switzerland, where the incidence of listeriosis has been stable but relatively high, and the United Kingdom, where incidence has been increasing [7,8]. Although both were identified because of a regional clustering of cases, rapid characterisation of an outbreak strain facilitated both investigations. Ultimately, isolation of the outbreak strains from implicated food items confirmed the source of the contamination [8].

The national experiences with listeriosis surveillance summarised in this issue suggest that across much of Europe, rates of listeriosis may be increasing or remaining stable at relatively high levels. In Germany, the increasing proportion of highly susceptible persons in the population was cited as a contributing factor to the increased incidence of listeriosis [5]. Indeed, across Europe the population is aging and the prevalence of cancer increased by 40% between 1992 to 2002 [9,10]. However, a growing at-risk population should not inevitably increase the public health burden of listeriosis. Where rates of listeriosis are declining, such as in France, this appears to be the result of extensive surveillance efforts to define the scope of the problem, followed by active collaboration between public health officials, food regulatory officials and food producers to reduce the levels of contamination in the food supply [3].

European food safety standards will help establish consistent approaches to the control of *Listeria* in ready-to-eat foods. However, implementation of these standards will still require extensive collaborations at the national level. Reliable surveillance data on listeriosis are a foundation upon which effective collaborations are built. Strengthening surveillance in individual countries by harmonising microbiological methods and providing epidemiologic tools for investigations will be a key step in reducing the public health burden of listeriosis, even as the population at risk grows. Thus, the need for a European surveillance network for *Listeria* has never been greater.

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EDITORIAL

INFECTION RISKS FROM WATER IN NATURAL AND MAN-MADE ENVIRONMENTS

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People can catch diarrhoeal diseases from contamination of both natural and man-made environments with human or animal faeces. Young children are more likely to be susceptible to the agents and to be exposed. While some diarrhoeal diseases acquired in childhood can be relatively mild and give some protection as an adult, others are more severe. The two papers presented in this issue of Eurosurveillance describe, on the face of it, unremarkable small outbreaks; one, from Chikwe Ihekweazu et al, linked to exposure to a stream contaminated with *Escherichia coli* from animal faeces [1]; the other, from Melanie Jones et al, to exposure to a water feature contaminated with *Cryptosporidium parvum* from either animal or human faeces [2].

Rivers, lakes and streams are known to harbour enteric and other pathogens derived from sewers, animal waste, the environment or through contamination by the bathers themselves. Outbreaks associated with recreational activity in these environments have been reported in developed countries [3-6]. However, the burden of illness associated with these sources as most disease is assumed to be acquired in a sporadic fashion. The source of contamination can sometimes be determined by tracking the specific pathogen type causing the illness to an upstream host. In the absence of such evidence, source tracking methods using indicator organisms or other markers [7-9] remain unreliable. While risk assessment can be used to reduce exposure to contamination in some situations it cannot prevent all disease. Although what we would like to have is good prevention of most disease, in practice assessing risks from recreational waters is both complicated and beset by local difficulties. The World Health Organisation has produced guidelines [10] that provide appropriate approaches to controlling infectious diseases and other risks. Epidemiological studies have used bathing trials to examine the relationship between microbiological indicators of water quality and diaries of symptoms kept by the participating volunteers [11]. Bathers at a number of sites were exposed to swimming in the sea or not and then followed up symptomatically, and the symptoms compared to microbiological measurements of faecal contamination of the water. Such studies have showed is a relationship between exposure to faecal pollution in general and faecal enterococci in particular and the burden of reported gastrointestinal symptoms. Retrospective cohort studies have also been used to examine the risks from recreational bathing with similar results [12].

Such studies suffer from a variety of methodological criticisms. There is scepticism about the relationship between reported diarrhoeal symptoms and the acute diarrhoeal diseases that are diagnosed by laboratory detection of causative agents. Most human gastrointestinal pathogens exhibit a seasonal distribution. The human and animal faecal inputs are likely to exhibit a different distribution. Because of this the relationships between pathogen and indicator when measured throughout the year are likely to vary by orders of magnitude. As an example Norovirus is the commonest cause of human gastrointestinal disease but is not thought to derive from animals. There will therefore be some relationship between human faecal contamination and norovirus infection whereas there will not be with animal contamination. As with disease burden studies related to drinking water [13] this approach has to generalise from the conditions within the local environment of the study to a general assessment. Despite this, there is a need to set new standards and the levels established from bathing studies have provided a useful basis for this.

A new EU Directive [14], was published by the European Union on 4 March 2006 and entered into force 20 days later on 24 March. Under the Directive the tests for bathing waters are simplified to *E. coli* and intestinal enterococci, instead of 19 different tests used previously. It will classify beaches as either 'excellent', 'good', 'sufficient' or 'poor'. The extra classification of 'sufficient' quality comes below 'excellent' and 'good' but still allows a beach to qualify as a bathing water and the standards have been raised so that the estimated health risk to bathers is reduced. There will be more tests carried out more frequently when a beach is classified as 'poor' or only 'sufficient'. Information on water quality will be provided on the internet in a timely fashion. New standard signs will be used on all bathing beaches to show the quality of recent tests. Under this new regime it is hoped that infections linked to recreational activity will be reduced. MEPs voted on 18 January 2006 to allow the new standards to replace the existing 1976 Directive. This bathing water management programme will be introduced over a 13 year period, starting in 2008.

Increasing evidence of outbreaks linked to both recreational waters and decorative water features

There is a difference between recreational water activity in natural and man-made environments. In recent years there has been an increase in outbreaks of infectious diseases associated with public water features of various types [15-21]. It seems that there are factors in the design of many of these features that increase the risks of people, particularly children, being infected. Outbreaks in other countries have involved *Shigella sonnei* [20], norovirus [19], legionnaires disease [17] and Pontiac fever [18]. The microbiology of such water features and the treatment of the water within them have received little attention. There have been a number of recent outbreaks linked to recreational water features in England and Wales caused by cryptosporidium. There was also a large outbreak of cryptosporidiosis at the Seneca State Park sprayground (an interactive water feature) in New York State, USA, in August 2005 which affected an estimated 3000 people. Cryptosporidium was found in two water storage tanks that supplied water to a water spray attraction.

A variety of private and municipal water features are being developed that allow people, particularly young children, to play in them. These may present risks to the populations using them if they are not designed and operated correctly. These features differ from swimming pools in potentially having a greater burden and variety of environmental contamination and requiring a high water turnover that puts a burden on any treatment processes.

Interactive water features are usually located outdoors and include fountains, shallow pools, vertical pressure jets, overhead sprays and showers. Children can run around in and easily drink the water. The area is usually designed to collect the water from the feature and return it to an underground holding tank. The water jets are operated by pumps that draw their water from a holding tank. The features are often fitted with control valves that enable operation to be varied either manually or via an automatic programme. The holding tank should be sized to ensure that there is adequate water available to operate the feature and there should be a separate system for water treatment. These features pose a high risk of microbiological contamination and transmission of infection to children. The filtration systems need to be well designed and managed to remove cryptosporidium oocysts that can enter from the environment and from childrens' shoes and bodies. Additionally, the disinfection should be sufficient to inactivate bacterial and viral pathogens. The microbiological quality of water at the feature's spouts of the feature should be to the same standard as swimming pool water and should be checked at least monthly (BS PAS 39:2003). Water should ideally be mains water that is not re-circulated. In all cases the UK Water Supply (Water Fittings) Regulations 1999 apply. Where re-circulation is required treatment should involve filtration and disinfection as occurs with swimming pools. With interactive water features the risk of cryptosporidium infection may be the same as, or greater than, that from swimming pools. The use of UV treatment to reduce the risk of cryptosporidiosis is recommended. There should be clear signs indicating that the water is not fit for drinking, and alternative sources of safe drinking water should be readily available.

Interactive water features may suffer from environmental contamination, including domestic and wild animals and birds, and people can occasional cause accidental fouling with vomit or faeces. In these instances the contaminated water should be diverted to drain and the pool cleaned. These features need to automatically make-up water lost by evaporation and filter backwashing. Some plant rooms may be located underground and these should be well designed for housing all equipment and ensuring the safe delivery and storage of chemicals. Water from these features should not be used to top up other pools as this could lead to contamination and an outbreak [22].

There are a variety of municipal water features including decorative pools and fountains, that have not been designed for bathing but which are used for this purpose in hot weather, often by children. These pools can involve the same problems as interactive water features and may also have inadequate filtration and disinfection. Such pools should be designed to make it difficult for children to use them as recreational play areas. Indoor features such as fountains have also been responsible for outbreaks of legionellosis, which probably reflects higher water temperatures, lack of sunlight and enclosure enhancing aerosol transmission.

Paddling or wading pools are shallow, usually open-air, pools that small children can play in and can include large local authority run pools and small domestic inflatable pools. Outbreaks have been linked to these pools [23-29]. Many of these result from inadequate disinfection of the water. Domestic paddling pools can be a focus for infection as disinfection of the water is uncommon. There may also be risks from *Pseudomonas aeruginosa* folliculitis if the pool is not emptied and stored dry. Municipal and other non-domestic paddling pools should have water treatment equivalent to public swimming pools, with similar filtration and disinfection. It is not generally appropriate to disinfect water in small domestic inflatable paddling pools; instead they can be better managed by washing after use and storing dry until next used.

Fountains have been popular public features for centuries and do not generally represent a significant infection risk. If the water becomes warm then it may become contaminated with legionella and could represent a risk, but no legionella outbreaks have yet been conclusively attributed to contaminated outdoor fountains. If untreated water from lakes, rivers or the sea is used, it may be subject to pollution from animal or human waste, then there is a potential risk of the transmission of enteric pathogens through the spray. The risks from this route are also thought to be low because the amount ingested is likely to be small. If fountains are placed in rivers or lakes, there are possible risks from inhaling cyanobacteria and their toxins present in aerosols. These risks are likely to be small, however, and no such adverse health effects have been associated with fountains. Studies that have looked at exposure to enteric pathogens in sewage workers indicate that although viruses and bacteria can be detected in aerosols, there is little evidence of disease resulting from this exposure.

Drinking water fountains have the potential to cause serious outbreaks [30-35]. Public drinking water fountains are less common than they were in the past. Their use outdoors is declining because people increasingly carry bottled water, and likewise, their use within buildings, because of the provision of water dispensers with disposable cups. The microbiological quality of water from public fountains is dependent on a secure water supply and hygienic use. All such supplies should be derived from a potable source that meets the EU Drinking Water Directive and national regulations. It is difficult to prevent users contaminating the spouts with oral and faecal organisms but this can be limited by designing the spout to enable regular cleaning and disinfection.

The principal public health measure for preventing infections and outbreaks associated with these devices is risk assessment and management. All such features should be formally assessed for microbiological risks, including legionella, during the design stage and ensure that treatment is adequate for minimising the risks to the public. Risk assessment should involve a public health microbiologist. The risk assessments should be reviewed at regular intervals and at least every two years. The principal microbiological risks are cryptosporidiosis resulting from inadequate filtration, legionellosis resulting from inadequate disinfection, and bacterial and viral infections also resulting from inadequate disinfection. In addition to infection risks there needs to be assessments of other risks such as slipping, drowning [36] and disembowelment [37,38]. Disinfection and filtration systems must be well maintained and monitored. Measures should be in place to minimise faecal contamination, especially from footwear, and to minimise potential for children to drink of the water. Recent outbreaks indicate that there is a risk of litigation if water features are found to be the cause of an outbreak. If an outbreak is associated with such a feature, consideration should be given to pool closure and drainage until the pool can be shown to be safe.

What should we conclude from these two papers about the risks of infection? There is increasing evidence of outbreaks linked to both recreational waters and decorative water features. While the source of contamination on bathing beaches may be contamination of the sea from rivers, the diffuse sources from small streams can be important in contributing to contamination and may be missed in an investigation. As for interactive water features, the design and use must be carefully managed to ensure that outbreaks resulting from children drinking water contaminated with cryptosporidium are avoided.

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