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Efficacy of boil water notices on consumers

**Information prepared for
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Request from C. Bergin

A number of drinking water suppliers on the West Coast use the option of permanent boil water notices as a long term solution to addressing public health concerns. Whilst this is likely to change (due to legislative intervention) compelling evidence that provides insight into the limitation or otherwise of boil water notices can be helpful in assisting councils with their Health Impact Assessment (HIA) during the creation of Public Health Risk Management Plans (PHRMPs) and the Assessment of Water and Sanitary Services (AWSS).

Background

Availability of safe drinking water for all New Zealanders is a fundamental requirement for public health. The Health Act 1956 was amended by the Health (Drinking Water) Amendment Act in October 2007 (commenced 1st July, 2008) and aims to protect public health by improving the quality of drinking-water (reticulated and tank water) provided to communities (MOH, 2008).

Suppliers above a certain size¹ are obliged by the Act to:

- Take all practicable steps to comply with the (previously voluntary) New Zealand Drinking Water Standards.
- Introduce and implement public health risk management plans (PHRMPs) for the water supply (if serving more than 500 people).
- Provide for the appropriate management of drinking-water emergencies.

New Zealand had been unusual among developed countries in that it had relied mostly on voluntary mechanisms for supply of safe drinking water. To ensure a quality assurance approach there is a requirement for drinking water suppliers to develop Public Health Risk Management Plans. These plans assist in demonstrating whether all practical steps have been taken to try to comply with standards.

The World Health Organisation (WHO) states that water intended for human consumption must be free from harmful organisms and hazardous chemical substances. Generally the greatest microbial risks are associated with ingestion of water contaminated with human, bird or animal faeces which can be a source of pathogenic bacterial viruses, protozoa and helminths (WHO, 2006a). When micro-organisms such as those indicating faecal contamination are found in drinking water, water suppliers may be required to issue 'boil water notices'. Boiling is a simple method of killing any bacteria, viruses, ova and cysts that may be present in contaminated water. Water should be heated until it comes to a "rolling boil" (where large bubbles continuously come to the surface of the water) for one minute (WHO,

¹ Those that serve: 25 or more people for 60 or more days per year; or if there are fewer than 25 people, but 6000 or more "person/days" (that is the number of people multiplied by the number of days they receive water from the supply).

1997). After boiling, the water should be allowed to cool down on its own without the addition of ice. This procedure is effective at all altitudes and with turbid water (WHO, 2006b). A water *avoidance* notice is less common and is applied when the cause of water contamination is primarily chemical and not susceptible to boiling.

Public notification informs consumers of a health threat so they can make informed decisions. It should also detail what is being done by the authorities to deal with the problem, and importantly what they as consumers can do to reduce their individual risk. The value of boil water notices lies in their effectiveness in promoting behavioural change (Harding, 2000).

When water sampling fails to meet standards a boil water notice is issued instructing consumers to boil water for domestic use until the contamination has been dealt with, and the notice has been lifted. Notices are intended to be a precautionary measure but as some have become permanent, they are apparently being used as a substitute for treatment of contaminated water. When boil water notices are in place, consumers cannot rely on the safety of their drinking water.

In most cases, boil water advisories are issued:

a) On evidence of conditions such as:

- Significant deterioration in source water quality;
- Equipment malfunction during treatment or distribution;
- Inadequate disinfection or disinfectant residuals;
- Unacceptable microbiological quality;
- Unacceptable turbidity or particle counts;
- Situations where operation of the system would compromise public health; or

b) Where epidemiological evidence indicates that the drinking water is or may be responsible for an outbreak of illness.

Notices are usually rescinded:

a) As soon as the microbiological quality, turbidity, particle counts or disinfectant residual of the treated water in at least two consecutive sets of samples has returned to an acceptable level; or

b) When the treatment, distribution or operational malfunction has been corrected and sufficient water displacement has occurred in the distribution system to eliminate any remaining contaminated water.

(Taken from FPTC, 2001).

A boil water notice recommends that consumers boil all tap water intended for ingestion. This includes water for drinking, preparing food and infant formula, juices, ice cubes, cleaning teeth or washing wounds. Unless heavily contaminated, tap water will generally be safe for bathing/showering (providing no water is swallowed). Tap water can still be used for washing clothes, general household purposes and toilet flushing without being boiled (WHO, 2006b).

The West Coast currently issues boil water notices, which vary in content depending on the supplier, via:

- A simple public notice in the newspaper/radio and/or
- A note in the rates demand generally done for permanent boil water notices and /or
- A mail out – this is sometimes to all residents on the rates file for the community, sometimes just to business owners e.g. food premises

(Personal communication from C. Bergin, Health Protection Officer/Drinking Water Assessor, Community and Public Health, West Coast).

These notices may be missed by residents who do not receive a newspaper, listen to the radio or who are tenants of a property where the landlord may have received notification but they have not.

Risk communication and boil water notices – international evidence.

In a paper by **Parkin** (2003) on communicating water-related health risks, important challenges facing risk communicators were identified which are important to consider:

- Experts and laypeople do not always use the same language when dealing with risk issues
- Some people are cynical and do not trust officials and experts. Social, cultural, gender and socioeconomic status are factors which all contribute to people's perspective on risk.
- There can be unintended consequences of risk information. Some information can result in harm or ill-advised behaviours.
- Consumers are not a homogeneous group, they come from a range of backgrounds, may interpret risk differently and have differing levels of literacy.
- The role and effects of the mass media need to be considered.

Experts cannot assume what people know, even at the most basic level. An instruction to “boil your water” is not detailed enough for some consumers. There will be people who will require specific instructions, either written and/or graphic, to show how to actually go about this. Consumers can be confused about appropriate

action to take if the notice is ambiguous. The precise wording of the notice is important so as to avoid mixed messages and misunderstandings which could lead to risk behaviour.

Rundblad (2008) conducted a study with a hypothetical “do not drink” water notice. The aim was to show that the actual wording of a risk message is important and can be misinterpreted. A survey of 107 undergraduate students in the UK found that when asked the question: “Your water company tells you not to drink tap water. What would you still do?”, 87.9% responded they would buy and drink bottled water and 12.1% would not. However, 60.7% would not boil the tap water before drinking it ($p < 0.05$). What may appear to be a clear, concise message such as ‘*do not drink*’ or ‘*boil water*’ will, according to Rundblad, result in a variety of behaviours and not all will be desirable

A well designed study by **Harding** (2000) surveyed residents of four Oregon communities about their responses to public notification of a water problem. Participants were randomly selected using stratified random-sampling techniques and the overall sample size was determined to be adequate to provide a representative sample of the target population. The telephone survey was well designed and pilot-tested and the overall response rate was 69%. The survey found that residents were more likely to respond to short-term boil water notices than to long-term. The majority of respondents in both towns chose to drink *bottled* water despite the boil water notice and even though the notices did not specify it, reflecting the easy accessibility and convenience of bottled water. Nearly two thirds of residents in a town which had a long-term problem requiring periodic notification over the past three years, did not boil their water in response to notification (although they were more aware that the notification had been issued). The proportion of residents who consumed bottled water over this time was also less in the town with the long-term problem. The authors commented that the difference could be attributable to differences in the notices’ content. The notice issued to the town with the long-term problem outlined the problem, and the possible health effects, but did not include instructions on how to boil water. In contrast, the notification distributed to the town with the short-term problem detailed how to reduce the risk (by boiling water or drinking water supplied by the fire department). The study concluded that consumers are more likely to take risk-reduction measures when the notice is for the short-term, from a credible source, provides adequate explanation of the problem and provides specific advice as what course of action to take (e.g. drinking boiled water or bottled water).

O’Donnell (2000) studied the effect of a boil water notice on consumer behaviour in the management of a water contamination incident. In 1998, the water supply of 878 households in Wigan, England, was affected by possible sewage contamination. A postal questionnaire was sent to 350 randomly selected households asking about the issued boil water notices, risk behaviour and changes in their drinking water consumption habits. Questionnaires were returned from 69% of those households. Out of those households, 81% engaged in behaviour likely to increase the risk of infection, including forgetting to boil the water (20%), brushing teeth with unboiled water (54%), and preparing food with unboiled water (17%). At least 62% of

households who received and read the notice put their health at risk by using unboiled water.

A survey to assess understanding of the advice, compliance and adverse events associated with a boil water notice was undertaken in the North Thames region of the UK (**Willocks**, 2000). All employees at a hospital within the boil water area, where 300 000 households were advised to boil tap water during a large outbreak of cryptosporidiosis, were surveyed by questionnaire about compliance and adverse events. While the boil water notice was in place 85% of the 479 respondents (34% response rate) said that they used boiled water, 72% used bottled water (although not stated it is presumed most people used both) and 12% used unboiled tap water because they 'forgot or could not be bothered'. While 73% boiled all water for the duration of the boil water notice (16 days), 19% boiled the water initially but did not continue to do so. Willocks concluded that this was due to forgetfulness or a belief that it was not important to comply. Thirteen respondents said that they, or members of their households, had received a scald or burn as a result of the boil water notice. The author recommended clear advice must be available to the public including a printed notice, follow up letters with more detailed information, as well as notices in the local news media. The limitations of this study include the potential for bias due to hospital employees not being representative of the general population. They may be more compliant with or complacent about public health advice and be more knowledgeable about cryptosporidiosis. The age and gender of hospital employees would not be representative of the community although the study attempted to address the age bias by asking if any member of their household had received burns from the boiling water. The response rate (34%) is low and no explanation for this was given, but it may reduce the validity of these findings.

The effectiveness of a boil water notice was also examined in a study (of good methodological design) by **Angulo et al** (1997) following a community waterborne outbreak of salmonellosis in the United States. They describe a waterborne outbreak of *Salmonella typhimurium* which caused 650 cases of diarrhoea, 15 hospitalisations and 7 deaths (rest home residents) in Anderson Township, Missouri in 1993-1994. Contamination entered the unchlorinated water system through a water storage tower which could be accessed by wild birds. A systematic random sample of 150 (from 548) households was drawn and of these, 22 were excluded due to being out of the study zone. A total of 120 households (329 people, 18 years of age or older) participated in the study (two households declined) and were interviewed, via telephone or in person, by trained interviewers. They were questioned about diarrhoeal illness, water consumption and compliance with the order to boil water. Persons in 31% of households continued to drink unboiled water after a boil water notice had been issued including 14 residents who subsequently became ill. The most common reasons for non compliance were "forgetting" (44%), not believing the initial notification (25%), and not understanding that the water used for ice-making required boiling also (17%). This study concluded that the reasons for the lack of compliance were that the population did not appreciate the serious nature of the situation and that the initial boil water order gave no reason for its requiring to be issued nor of the possible illness that could result if not heeded. An improvement in compliance with the notice was evident only once information sheets, explaining the rationale and procedure for boiling water and that ice should be made from boiled water, were

delivered to all residents. This paper recommends water supply operators, public health officials and local governments ensure all residents are adequately informed about the health risks and consequences of non-compliance.

The **World Health Organisation** (2006b) guidelines for drinking water quality recommend protocols be in place for communication of boil water notices. The chosen method should provide assurances that all consumers who will be affected by the boil water notice are notified as soon as possible. This includes residents, workers and travellers. Depending on the nature of the supply and the size of the community affected, these could include:

- Media releases through television, radio and newspapers;
- Telephone, e-mail and fax contact of specific facilities, community groups and local authorities;
- Posting of notices in conspicuous locations;
- Personal delivery; and
- Mail delivery.

(Taken from WHO, 2006b).

Notices require easy-to-understand instructions about the actual process of boiling the water. Door-to-door delivery of notices in small towns with limited media outlets should begin as soon as possible after contamination of the water supply has occurred (Angulo, 1997). Detailed instructions should also be provided to health care institutions, dialysis centres, doctors offices, dental clinics, schools, day care centres and kindergartens, caterers, food manufacturers, restaurants, hotels, public pools, spas, supermarkets and other public facilities (FPTC, 2001; WHO, 2006b).

Pontius (1996) states that deciding when to lift a boil-water notice is as important as when to issue one. Authorities should consider the following factors when rescinding a boil water notice:

- Source water quality indicators have returned to baseline or acceptable levels or period of stormy weather or other abnormal event has ceased.
- The treatment deficiency has been corrected.
- Total coliform, faecal coliform, *E.coli*, and turbidity levels are within regulatory limits.
- Sufficient finished water displacement has occurred in the distribution system to eliminate contaminated water.
- Epidemiological evidence that an outbreak has concluded, if available.
- Other relevant site-specific factors, circumstances, and criteria.

Public health advantages and disadvantages of boil water notices.

Advantages

- There is little available research about the health benefits associated with issuing boil water notices. Few researchers have focused on water risk issues and few studies have assessed compliance with a boil water notice.
- According to Pontius *et al* (2000) a boil water notice is the most comprehensive control measure at the point of use while acknowledging the disadvantages (causing public anxiety and domestic accidents).
- Public interest is not always best served by making disconnection or avoidance orders (Hunter, 2003). Turning off water supplies can have important economic consequences due to loss of production and disruption to businesses, institutions and households.
- The issuance of a boil water notice allows continued use of the water supply despite the inconvenience of having to boil water. If carefully planned practical procedures are in place in advance, then emergencies can be managed with the use of boil water notices. The World Health Organisation recommends that prior to issuing a notice, authorities should be clear about the criteria that will be used to lift the advice.
- There is the obvious advantage of boil water notices in that many people will heed the advice and boil water thus reducing the risk of illness. The cost of heating or buying water is less than the costs to the individual resulting from illness.
- Boiling water is a common recommendation in developing countries to improve the quality of the drinking water and decrease the incidence of diarrhoea in children.
- Although local communities may become acclimatised to the presence of micro-organisms that are regularly present in their water and develop resistance to them, visitors to the area may be affected. Boil water notices alert visitors to a region that the drinking water is not safe and must be boiled before use.

Disadvantages

- There are certain water quality problems that cannot be alleviated by boiling. Heat-stable cyanobacterial toxins and many disinfection by-products (DPBs) are not volatile and are not removed by boiling (FPTC, 2001). Therefore boiling is not recommended as a solution to the health risks related to these.
- It is difficult to provide information to hard to reach consumers such as those with special needs, poor literacy skills and children.

- It is necessary to question if a permanent notice is being issued for bureaucratic reasons (such as inadequate water sampling) or problems in the water treatment process or due to actual contamination of the water supply. A Canadian Medical Association Journal survey indicated that 1766 boil-water advisories were in place across Canada on March 31st 2008, meaning that affected residents could not rely on the safety of their drinking water (Eggertson, 2008). Eggertson commented that some boil water notices had been in place for at least 5 years in Canada, indicating that permanent notices are being used as a band-aid substitute for water treatment.
- Boil water notices can only reduce the risk of disease if they are issued while the drinking water is contaminated and if people act on the advice given to them. There is evidence that consumers do not comply or only partially comply with notices. Some studies show that over 50% of consumers either ignored the advice to boil water or engaged in risky behaviour. (Hunter, 2000; O'Donnell, 2000; Mayon-White, 1989; Pontius, 2000; Angulo, 1997).
- Boil water notices can result in adverse events and have potential negative effects on health (Mayon-White, 1989, WHO, 2006a,b). Burns and scalding can result from boiling water contacting the skin or by drinking the water before it has cooled. This can be an especially hazardous activity for the elderly and the visually impaired. Boil water notices can also result in inconvenience and costs to the consumer from either heating the water or purchasing bottled water. Boiling water can give it an unpleasant taste which may be unacceptable. It can also become re-contaminated once it has cooled (WHO, 1997).
- Some sectors of the population, who are at special risk from drinking contaminated water such as young children, pregnant women or people with immunodeficiency, require a clearly defined message. Following distribution of notices via the usual channels it is necessary to send letters to homes in the affected areas (Mayon-White, 1989). Hospitals, schools, rest homes, restaurants and other places of work need to be given special advice on how to manage boiling water on a large scale. It may be more cost-effective and safer to buy bottled water or have safe drinking water delivered. Mayon-White suggests that an advisory team be set up to assist this type of large scale consumer.
- Permanent boil water notices do not increase consumer confidence in the quality of the drinking water and can cause public anxiety. People may lose confidence in their water supply as a result of the inconvenience (heating water) and cost (bottled water).
- If boil water notices are issued frequently or are left in place for long periods, compliance will decrease (WHO, 2006b; Harding, 2000).

Conclusion

Water suppliers are required to notify customers to boil water when water samples indicate contamination or when conditions exist that make the water supply vulnerable to contamination. Waterborne diseases can cause serious illness.

However, boil water notices can reduce the risk of becoming ill from drinking tap water only if they are imposed *while* the water is contaminated and if people *act* on the advice contained in them. The evidence discussed in this report reveals that the majority of recipients of boil water notices have either ignored the advice or engaged in some risky behaviour making it difficult to determine the public health benefits of boil water notices. The goal of water incident communication is to ensure the public complies with any protective measures suggested.

Further research into notification procedures and compliance with boil water notices needs to be undertaken, in particular the possibility that compliance decreases with time. If this is an attrition effect rather than a result of the content of the notice, it suggests that boil water notices should not be used as a long-term measure.

The need for permanent notices questions the adequacy and reliability of the water supply. If advice to boil water is issued then the authorities must be certain there is an ongoing risk to health of drinking tap water, which outweighs any risk from the boil water notice itself.

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