

EVALUATING BOIL WATER ADVISORY POLICIES AND PRACTICES: HEALTH OUTCOMES IN HONG KONG

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ABSTRACT

Boiling water (BW) is a common global practice, especially in Asia, for ensuring safe drinking water, though it does not remove chemical contaminants. The World Health Organisation recommends BW as an emergency measure against microbial contamination. In Hong Kong, the Water Supplies Department ensures water quality through strict regulations and extensive monitoring. Comparisons with Norway and Canada reveal effective practices such as water safety planning and risk-based advisories. Norway mandates water safety planning and uses messaging notifications for water advisories, ensuring high compliance, while Canada issues site-specific BW advisories based on risk assessments.

Hong Kong faces unique challenges, such as a warm climate and complex building infrastructure, which impact water quality. Many buildings lack proper maintenance, leading to potential health risks and necessitating regular maintenance. Health management, public health education and expert guidance are essential for promoting efficient practices and ensuring safe drinking water.

KEYWORDS

boiling water, boil water advisor, public health, drinking water, sustainability, climate change

BACKGROUND AND REASONS FOR BOIL WATER ADVISORY

Boiling water (BW) has historically been a norm in everyday life since Pasteur discovered that heat could kill microorganisms. In a study from 67 national surveys and reports, 33% of households or an estimated population of 1.1 billion people report the practice of household water treatment and of which BW is the most common [1]. The practice is particularly prevalent in Asian nations, with virtually universal daily practice in Uzbekistan (99%), Mongolia (95%), Vietnam (91%) and Indonesia (91%) [1].

As defined in the Guidelines for Drinking-water Quality by the World Health Organisation [2], safe drinking water should not pose any significant health risk across a lifetime of consumption, considering various degrees of vulnerabilities at different life stages including infancy, childhood, and elderly. The guidelines recommend BW as a travel advisory and emergency measure. The surveillance agency detects microbial contamination threatening public health. When evaluating various drinking-water disinfection methods for use by travellers, BW ensures that all pathogens are killed but failed to remove

turbidity and does not offer chemical disinfectant, as compared to chlorine, to remove the contamination. Cohen and colleagues performed a meta-analysis to examine the link between boiling drinking water and health outcomes, instead of water quality [3]. The study indicated that the effectiveness of removing pathogens and organisms, as well as the outcome of pathogen inactivation below 100 degrees Celsius, depends on factors such as temperature, duration, and the type of organism involved [3]. Inadequate access to water increases the likelihood of infection with soil-transmitted helminth species through ingestion [4]. Although water is not the only possible transmission route of protozoal infection, BW is generally a protective practice against multiple protozoa, particularly in less developed regions.

GOVERNMENT POLICY AND PRACTICE IN HONG KONG

In Hong Kong, the Water Supplies Department (WSD) have five principal functions and services: to plan and manage water resources and water supply systems; to design and construct waterworks projects; to operate and maintain water supply and distribution systems; to control the quality of water supply to customers; and to provide customer services and to enforce the Waterworks Ordinance [5].

In the 1960s, a water supply restriction was put in place due to the local rain yield being unable to satisfy the surging population resulting from the mass migration from mainland China. During the worst period, household taps only offered water for four hours every four days [6]. People had to learn how to conserve water and adjust their lifestyles to a bare minimal water supply. Then, in 1963, the Dongjiang-Shenzhen Water Supply Scheme was established through a consensus between the Governments of Guangdong Province and Hong Kong. Since 1982, Hong Kong citizens have been enjoying a stable and around-the-clock water supply.

The water supply issue soon faded away from the everyday conversation but then resurfaced in the news headline in 2015 following the elevated lead level found in the drinking water sample collected in public housing estates and education institutions [7]. The Development Bureau, WSD-led Task Force on Investigation of Excessive Lead Content in Drinking Water, Housing Authority, Commission of Inquiry and International Expert Panel on Drinking Water Safety jointly ascertained the causes of excess lead, reviewed

and evaluated the adequacy of the existing regulatory standard, and more importantly, formulated recommendations on safe drinking water in general. This is perhaps an example of a contaminant that the water boiling advisory (WBA) cannot eliminate and should prompt public reflection on its limitations. Since September 2017, the WSD has adopted the provisional guideline values described in the World Health Organisation Guidelines for Drinking-water Quality as the local Hong Kong Drinking Water Standards (HKDWS) by referencing international practices and an expert panel, in which the Drinking Water Safety Advisory Committee, constituted by experts from academia and the medical sector, has deliberated and agreed on these standards [8,9].

Since December 2017, the WSD has been implementing an enhanced territory-wide water quality monitoring programme. This includes collecting random daytime samples at consumer taps, based on the population of respective supply areas [10]. For the year 2021/2022, the WSD collected over 170,000 samples for water quality control. Of those, 35,551 and 3,210 were bacteriological and biological samples, respectively [11]. The WSD initiated testing residual chlorine and *E. coli* in May 2021 from consumer taps under the enhanced programme [12]. In line with the HKDWS, the concentration of *E. coli* should not exceed 0 cfu/100ml. Chlorine has been effective in killing most pathogenic bacteria [13], and some viruses and parasites slowly [14]. A small amount of residual chlorine in the water pipe system is sufficient to keep the concentration of *E. coli* at a minimum. In other words, the safety and quality of drinking water can be maintained even if WBA is not practised.

NOTABLE OVERSEAS EXAMPLES AND PRECEDENT CASES

Norway and Canada have been selected as notable examples due to their strong public health systems and high human development index. By examining these two developed nations from Europe and America, researchers can compare how boiling water practices are integrated into public health recommendations and regulations. This comparative analysis is particularly relevant to Hong Kong, where boiling water is a common practice rooted in traditional Asian culture. Understanding these variations can enhance the appreciation and implementation of best practices, contributing to improved health outcomes in Hong Kong.

NORWAY

BWA is a tool to prevent waterborne illness in the instance of microbiological contamination [2]. In Norway, water safety planning is a legal requirement for water supplies [15]. In the event of a planned and unplanned water outage, the water supplier in the municipality of Bareum, Norway, issues precautionary BWA to residents via short messaging service (SMS) notifications. The SMS notification is moderately effective with 67% of local citizens reporting receipt of it [16]. Of those who remembered the receipt of the notification, 72% follows the guidance from the local water supplier [16]. The predominant reason for non-compliance was the perception that the water was safe to drink after flushing the tap until the water ran clear.

In August 2019, a routine water sample was collected from an elevated water reservoir in the Drammen municipality. The sample tested positive for intestinal enterococci resulting in an issuance of BWA to residents within the affected water supply area [17]. A study team examined the perception and compliance to BWA, revealing an effective compliance rate of 92% [17]. The primary reasons for non-compliance were the perceived minimal risk of getting sick and misconceptions about waterborne infections and their transmission.

CANADA

The Federal-Provincial-Territorial Committee on Drinking Water is responsible for establishing the guidelines for Drinking Water Quality in Canada. The BWA is in place to strengthen public health risk management and advise the public to treat the water prior to consumption.

If *E. coli* is detected in the drinking water sample, it may indicate potential human or faecal contamination, or even pathogenic microorganisms, and may trigger emergency BWA. On several occasions, after investigation and site-specific risk assessment, a precautionary BWA may be issued to mitigate risks that emerged with local maintenance or planned repairs, the persistent presence of total coliforms, minor equipment malfunction, unexpected changes in source water quality and any form of breach in system integrity. From 2010 to 2012, the predominant reasons for BWA concerning water quality were pressure loss in the distribution system (46%), the detection of total coliforms (15%) and suspected contamination (12%) [18].

THE CASE OF AND ADVICE TO HONG KONG

While Norway has a robust texting alert system, Canada employs risk assessed, site-specific BWA instead of longstanding, blanket advisories which Hong Kong can take a lesson from. However, we must consider the challenges of maintaining water quality in warm and humid climates. The cultural background and building structures differ significantly, with Hong Kong having a more convoluted pipeline system. Therefore, the WSD should develop its policy according to its local context and customary practices.

As of December 2023, there were approximately 3,100 buildings without owners' corporations or any form of residents' organisations, or engagement with property management companies [19]. The absence of property management will lead to potential risks of the environmental hygiene and maintenance of communal facilities falling short of standards. Poor or infrequent maintenance of the sanitary condition of water storage tanks may result in the accumulation of sediments or debris [12]. Besides, certain conditions such as temperature, humidity, stagnation of water and cross connection of potable pipes with non-potable pipes, may cause the ingress of contaminants [12]. Although the drinking water produced by the treatment works in Hong Kong is safe and comparable to that of many advanced countries and regions, the quality of tap water at the consumer end is affected by the condition of maintenance of inside service of the buildings. The tap water in a user's home is potable if the management company follows proper upkeep procedures [9]. This includes maintaining the interior pipes, regularly cleansing water storage tanks, and frequently monitoring water quality in line with the HKDWS [9]. With reference to the localised green building certification system, a similar system can be initiated by the joint force between WSD and professional bodies to highlight buildings with potable tap water supply.

Despite that BW is commonly used to ensure a clean water supply, it is not a bulletproof practice, as evident in incidents of excessive lead in water. The practice of BW may have arisen from previous generations being accustomed to contaminated and pathogen-rich water supplies, and it may have become an inherited routine in Chinese families. The key to untangling this perpetual cycle, however, lies with the government and its Advisory Committee on Water Supplies (ACWS), consisting of

department representatives, engineers, surveyors, and academics. Due to the complex nature of water quality standard setting, the ACWS upholds a compelling obligation to maintain close connections with professional bodies, property management companies, and stakeholders.

CONCLUSION

Public health and the integrity of the water supply system are sensitive topics necessitating continuous monitoring and surveillance. BWA is generally considered an emergency response to biological contamination. However, in the world of energy crisis and climate change, BWA should be perceived as a socio-economic issue that is worth re-thinking. If Hong Kong continues to practise BWA, it is not because of the pathogenic microorganisms in the water, but because of the psychological fear of not treating the water. The belief in BWA and its practice in the local community has been perpetual for generations and generations. Nonetheless, many Hong Kong residents have lived in Western countries where people drink water off the tap. Expert advice and public health education should work in tandem to correct stigmatised myths, deliver the correct message and encourage the next generation to reflect on the most efficient practice in the treatment and utilisation of household water supply in the pursuit of sustainable development goals for humankind.

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DECLARATION

The research has not been presented, published or posted online before, in whole or in part.

AUTHOR CONTRIBUTIONS

All authors contributed to the study's conception and design. Simpson S. C. Tam performed a literature review, material preparation and the first draft of the manuscript. Simpson S. C. Tam and Ben Y. F. Fong commented on the

first draft and worked on the final version of the manuscript. All authors have read and approved the final manuscript.

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