Topics: Recent topics in public health in Japan 2023

＜ Review ＞

Recent water quality incidents and a methemoglobinemia outbreak in infants due to inadequate plumbing of a university hospital's private water supply

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Abstract

Water supply facilities that supply water to more than 100 residents or supply more than 20 m^3 of water per day are called specified privately owned water supply systems (SPOWs). SPOWs and small water systems require proper maintenance and management at their facilities, especially small water systems including private drinking water wells, where many water quality incidents involving health hazards have occurred. Most water quality incidents in SPOWs occurred in facilities where the groundwater was used as raw water, requiring thorough water quality management by those who install SPOWs. In addition to recent water quality incidents associated with microbial contamination in drinking water storage tanks, the incident at a building of university hospital is introduced. In October 2021, methemoglobinemia developed in 10 of 17 infants in the neonatal intensive care unit of the university hospital. It was found that these infants had been fed milk that had been prepared in the kitchen within the building of university hospital. It was finally proved that the water was contaminated with nitrite contained in the anticorrosion agent used in the air-conditioning system due to cross-connection.

Abbreviations

DWQSs, drinking water quality standards
MHLW, Ministry of Health, Labour and Welfare
SPOWs, specified privately owned water supply systems

keywords: drinking water supply; risk management; waterborne infectious disease; methemoglobinemia; building design

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I. Frequent incidents in specified privately owned water supply systems (SPOWs)

SPOWs are water supply facilities that supply water to more than 100 residents or supply more than 20 m^3 of water per day. As of March 31, 2021, there were 8,228 SPOWs for approximately 370,000 people in Japan. [1] (see Figure 1). Although some facilities are supplied only by a public water supply service, the number of SPOWs is increasing every year. The main reasons for this increase are some hospitals and other facilities use their own wells to save costs of public water supply or to prepare as a backup for emergency events like an earthquake.

As a rule, for new facilities or remodeling work under the category of SPOWs, it is necessary to consult with the public health center in advance (at the time of planning) before doing any work related to SPOWs. The right side of Figure 1 illustrates an explanation of a slightly complicated definition of SPOWs and the public notice, especially for small water systems.

Water supply systems require proper maintenance and management at their facilities, especially small-scale fa-

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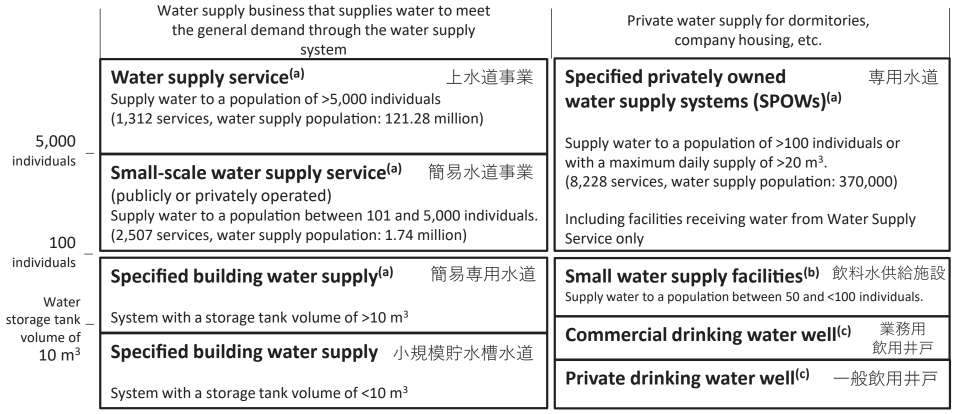

Figure 1 Categories of drinking water supply (modified by the authors from [1]**).**

In addition to those shown in this Figure 1, the Water Supply Act is applied to “wholesale water supply service.” Facilities covered by the Act on Maintenance of Sanitation in Buildings (applicable to specified buildings), inns, public bathhouses, and food-related businesses are not included in “potable wells, etc.”
(a) Designated by the Water Supply Act, (b) designated by some local governments, and (c) designated by the official notes for hygiene management of drinking water wells.

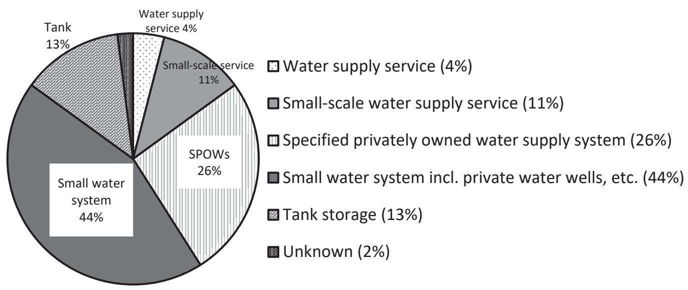

Figure 2 Percentage of water supply types in the water quality incidents with health hazard between 1983 and 2012 (adopted from Kishida et al., 2015 [2]**).**

cilities such as SPOWs and private drinking water wells, where many water quality incidents involving health hazards have occurred (see Figure 2; Kishida et al. [2]). Many water quality incidents in SPOWs occur in facilities where individual groundwater is used as raw water, requiring thorough water quality management by those who install SPOWs and appropriate guidance by the government.

In this study, the authors would like to generally introduce the water quality incidents especially related to buildings. In addition to recent water quality incidents associated with microbial contamination in drinking water storage tanks, the incident at a university hospital building is introduced.

II. Water quality incidents caused by malfunctioning facilities and devices

The Ministry of Health, Labour and Welfare (MHLW) requests local governments and water suppliers to report the water quality incidents that excessively do not follow the drinking quality standards (DWQSs) or those that could lead to health hazards [3]. On the basis of the information reported to the MHLW [4], major water quality incidents caused by malfunctions of facilities and equipment within the last 4 years are shown in Table 1. Unexpected backflow through an overflow tube to the drinking water storage tank and cross-connection were the most common causes of reported water quality incidents. On the basis of the knowledge learned from these incidents, we should continuously pay attention to the water supply building facilities or equipment to prevent inadequate piping and malfunction especially during disinfectant injection.

III. A norovirus outbreak in a commercial building

Three incidents of gastroenteritis or diarrheal diseases occurred because of microbial contamination in drinking water storage tanks between 2019 and 2022 (Table 1). The two incidents with the contamination in concrete drinking water storage tanks installed in the basement of buildings happened in Hyogo Prefecture and Tokyo in 2019 and 2022, respectively. A total of 35 gastroenteritis cases were identified in three restaurants in a commercial building (built in 1970) in Kobe City, Hyogo Prefecture, in February 2019. On the basis of the outbreak investigation by the local public health center, norovirus GI.2 and GII.4 Sydney 2012 were detected in stool samples collected from five patients and water samples from restaurants' tap and a groundwater collection tank [5].

The water storage tank stored water from a public water supply, and the stored water was pumped up to a water tank on the roof, before being distributed to each floor (Figure 3). Water infiltrates in buildings are collected in groundwater collection tanks, and there was an overflow tube from the water storage tank to the groundwater collection tank. A water pipe above the groundwater collection tank was broken, and unfortunately, the drainage pump was out of order. Groundwater flowed into the water storage tank through the overflow tube, and drinking water was contaminated by the groundwater. It is not known why noroviruses were contained in the groundwater, but the building is located in the downtown area of Kobe City and the groundwater surrounding the building could be contaminated by untreated sewage [6]. Noroviruses have been detected in groundwater samples collected in private wells [7], and pathogen contamination in groundwater is one of the major causes of waterborne outbreaks in Japan.

Similar waterborne outbreaks due to contamination of drinking water storage tank at the basement of buildings have been reported for *Cryptosporidium* in Hiratsuka, Kanagawa Prefecture, in 1994 [8]; *Giardia* in Chiba Prefecture in 2010 [9]; norovirus GI and *Campylobacter jejuni* in Osaka in 2013 [10]; and norovirus GI in Tokyo in 2022. In 1977, the Building Standards Act was revised and the use of a water storage tank with all surfaces that can be checked visually has become mandatory. Buildings constructed before 1977 still exist, in fact, and their owners are obligated to operate and maintain the water supply facilities properly. In Japan, if a building complies with the standards at the time of construction, it will not be deemed nonconforming even if the standards are subsequently revised (so-called existing nonconformity).

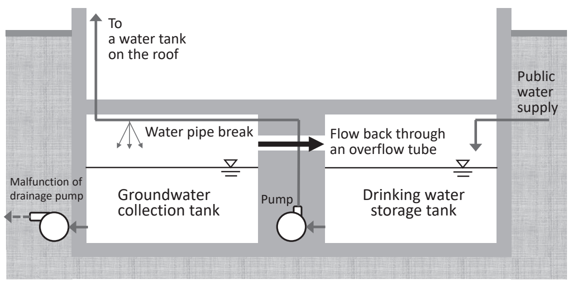

Figure 3 The water supply system in the commercial building. The drinking water storage and groundwater collection tanks were made of concrete and placed at the basement as part of the building.

IV. Outbreak of methemoglobinemia in a hospital

A chemical incident occurred because of a cross-connection in a building. On October 19, 2021, methemoglobinemia developed in 10 of 17 infants in the neonatal intensive care unit of Gunma University Hospital, Maebashi, Gunma, Japan [11]. It was found that these infants had been fed milk that had been prepared in the kitchen on the first floor of the same hospital building, and it was suspected that the event was caused by nitrite in the water used to prepare the milk. Treatment was immediately initiated, and fortunately, the incident did not become more serious, but normal operations of the hospital had to be suspended because water was supposedly contaminated.

In methemoglobinemia, the hemoglobin in red blood cells changes to abnormal methemoglobin, causing the skin and mucous membranes to turn blue. It is also called a blue baby syndrome because the whole body turns blue. These symptoms are caused by the ingestion of nitrite or nitrate. Many cases of methemoglobinemia have been reported worldwide for a long time [12], mainly in European countries and the United States. In 1996, a serious case of cyanosis in a newborn baby due to nitrite of 36.2 mgN/L (as nitrogen concentration) in the well water used for preparing bottles of infant milk formula at home was also reported in the north Kanto area in Japan [13].

The hospital conducted a water quality survey and found that the nitrite concentration was abnormally high, up to 490 mgN/L [14] exceeding the DWQS by more than 10,000 times higher in some points. Because of the abnormal water quality, the water was supposed to be from the exclusive water supply system of the university hospital (hereinafter referred to as "tap water," which is produced by treating groundwater within the facility). The city health department and hospital conducted a water quality survey and found that the water quality abnormality was limited to the tap water in the north building. The north building includes outpatient and inpatient areas, a dialysis room, and a kitchen, where milk for the newborn room was prepared. The hospital organized an investigation committee, in which the author was asked to participate as an external expert.

V. Accidents caused by incorrect plumbing in the building

The committee investigated the route of drinking water, route of water for air conditioning in the hospital facility, and operation status of switching water for air conditioning before and after the onset of the accident. Additionally, temporal changes in water quality abnormalities and spatial distribution of nitrite in the hospital were investigated, and analysis of substances in the drinking water and bacteriological tests were conducted. As a result, it was found that there was a connection point between the tap water and hot/cold water pipe for air conditioning via a check valve, which allows water to flow only from tap water piping to the air-conditioning system with a simple structure. Although reverse flow from the air-conditioning system to the tap water piping could be effectively restricted by the function of the check valve, complete sealing by check valves may not be generally guaranteed because of unexpected erroneous motions of the valve or deformation as a result of corrosion even when the valves are installed properly.

An anticorrosion agent was injected into the hot water pipes for air conditioning every day using an injection pump controlled by a timer to prevent rust, and the anticorrosion agent contained nitrite and other substances. Generally, benzotriazole or other substances are used as additives for the anticorrosion. Nitrite and other substances contained in the anticorrosion agent were detected in the tap water (for drinking) collected from the hospital at the moment of this chemical incident. Because there was no other equipment from which these components were injected, it was concluded that the check valve was not working properly and the air-conditioning water containing the anticorrosion agent flowed back, mixed with the water, and contaminated one side of the building through the piping of the upper water on the top floor. A daily volume of 13 L of chemical (6.4 kg as nitrite) was injected into a chilled water generator; the generator was shut down for 6 days from October 13 to 18. The amount of chemical injected during this period corresponds to 38.4 kg nitrate (7.8 kg of nitrite-nitrogen (NO_2-N)). It was suspected this high-concentration portion may have unexpectedly flowed into the water in the air-conditioning system because of the malfunctioning valve on October 18. Water for the air-conditioning system was circulated through the facility, including other buildings in the area of the medical department, supplied by a pump installed in the central machine room. Additionally, the anticorrosion agent of the hot water system of the north building (water volume 11 m^3) entered the water supply system at the highest nitrite concentration of 4,800 mg/L (corresponds to 370 mgN/L), based on the calculation.

After disconnecting the water supply system and cleaning the air-conditioning pipe system and the water and hot water piping system, nitrite was no longer detected in the water supply and hot water. Therefore, it was concluded that the nitrite in the drinking water was due to contamination of the anticorrosion agent contained in the hot water in an air-conditioning system and that the methemoglobinemia in the infants was due to the nitrite contained in the water for air conditioning and in the drinking water.

VI. Hospital "private water supply" and water supply service

The "tap water" in this case was not supplied by the water service run by the local city but by a SPOW that pumped groundwater from the university grounds, which the hospital independently purified and disinfected. The hospital had a contract with the city's water supply service for a short time. However, for the most part, the SPOW treated only its own groundwater and supplied it via rooftop water tanks installed in each building.

In response to this incident, the city health department, which has jurisdiction over the facility, conducted on-site investigations, water quality tests. It immediately issued a directive requesting the suspension of water supply in the hospital wards and an investigation into the cause, to prevent secondary accidents, whereas the hospital's investigation committee examined the cause of water contamination and measures to prevent recurrence.

Meanwhile, Maebashi City's Waterworks Bureau received an urgent request for an emergency water supply, and two water trucks were dispatched every day over a period of approximately 10 days, as the hospital is the core facility in the area with a high degree of urgency.

VII. Recovery phase

Investigation of the cause revealed that the water piping equipped in air conditioning system and the water piping used in the water supply system had been directly connected by a check valve with a simple structure (Figure 4 [15]) since the construction of the ward approximately 20 years ago. In the piping shown in Figure 5 [15], this connection is not capable of completely preventing backflow from the air-conditioning water piping to that of the water supply system (Figure 6 [15]). On the basis of the results of the investigation, the hospital disconnected the water piping for air conditioning from that for the water supply system as a measure to prevent recurrence. Afterwards, the hospital implemented intensive cleaning of the water supply system piping and confirmed that nitrite was no longer detected.

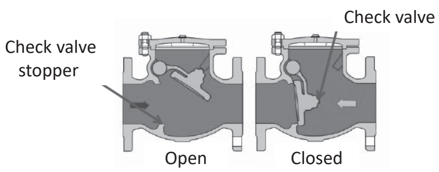

Figure 4 Structural drawing (vertical cross section) of a check valve. The valve has a simple mechanism, and the sealing properties are low even when operating properly.

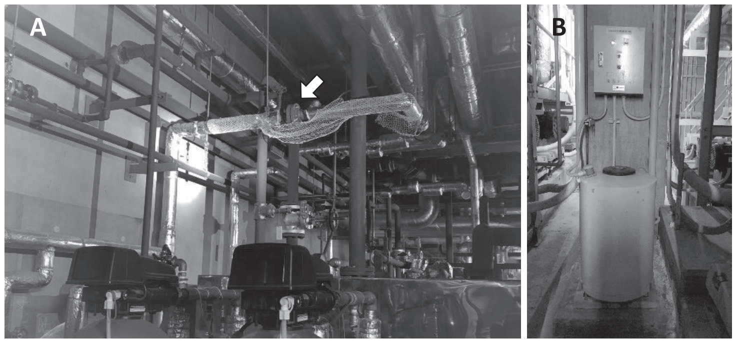

Figure 5 The water system in the hospital building. (A) The pipe connected to the air-conditioning system. The part where the check valve was installed is indicated with a white arrow. (B) An anticorrosion agent was injected from a tank with a pump, both of which were installed in the central machine room.

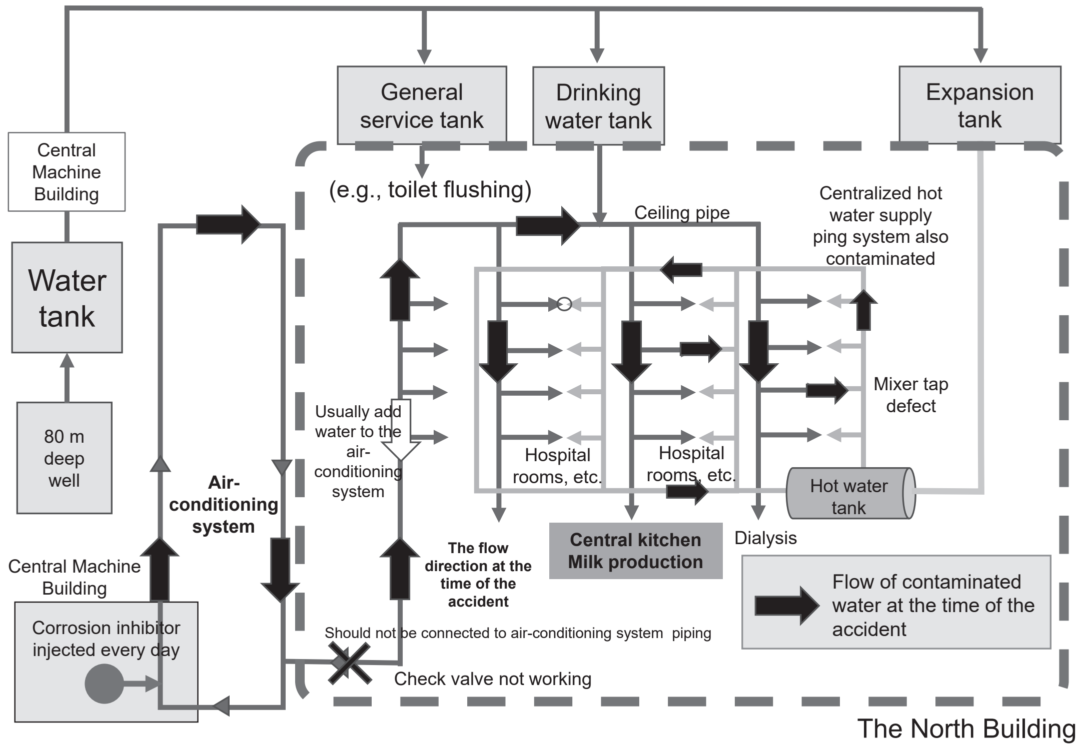

Figure 6 Schematic diagram of ward piping. Dashed lines indicate wards where accidents occurred. The authors added the contaminated water flow to the Gunma University press release on December 16, 2021 [14]**.**

Then, the water supply system in the north building, the site of the accident, was restored.

Although the hospital suspended outpatient care for approximately one week, many inner workers were hard at work, carrying emergency water in polyethylene tanks using temporary piping from other routes. Analyzing the nitrite concentration in each of the many hot water circulation systems and faucets in the building and cleaning the nitrite in the water taps took more than one month to complete from the start of the investigation of the original water supply system.

VIII. The simulation of water flow in the building

Pipeline calculations were performed to reproduce the flow of water in the building with a particular emphasis on the reverse flow of water from the piping for the air conditioning to that for water supply. EPANET [16], a software for pipeline simulation, was used. The flow rate based on the estimated water volume and information on pipes based on the committee survey were utilized in the simulation system.

Hydrological simulations in the north building were performed for two cases: base demands at the two nodes adjacent to the piping connected to the air conditioning (i.e., kitchen and shower) were 5 L/sec (Figure 7A) and 10 L/sec (Figure 7B), and the water demands at the kitchen (Demand 1) and shower (Demand 2) were moderately at a higher level. In other words, the water demands of 10 L/sec are within the expected range during the designing of the facility. The reservoir with a head of 50 m described on the top of the two figures corresponds to the rooftop tank from which tap water is distributed to the entire building. Therefore, in usual conditions, all the water in the pipeline described in Figure 7 should be introduced from this reservoir. It should be noticed here that all the simulations were performed under the assumption that the check valve described in Figure 7 did not work properly. Therefore, both upward and downward flows were possible in the piping connected to the air-conditioning system.

In case the water demand in both Demands 1 and 2 is 5 L/sec (Figure 7A), water in the piping connected to the air-conditioning system flows downward with a flow rate of 0.17 L/sec. As mentioned earlier, this flow regime is normal and in accordance with the design concept. Conversely, upward flow with a flow rate of 0.05 L/sec is expected to be generated when the water demands in both Demands 1 and 2 increased to 10 L/sec (Figure 7B). This alteration in the flow direction is attributed to the elevated head loss in the piping adjacent to the “Reservoir” shown in Figure 7

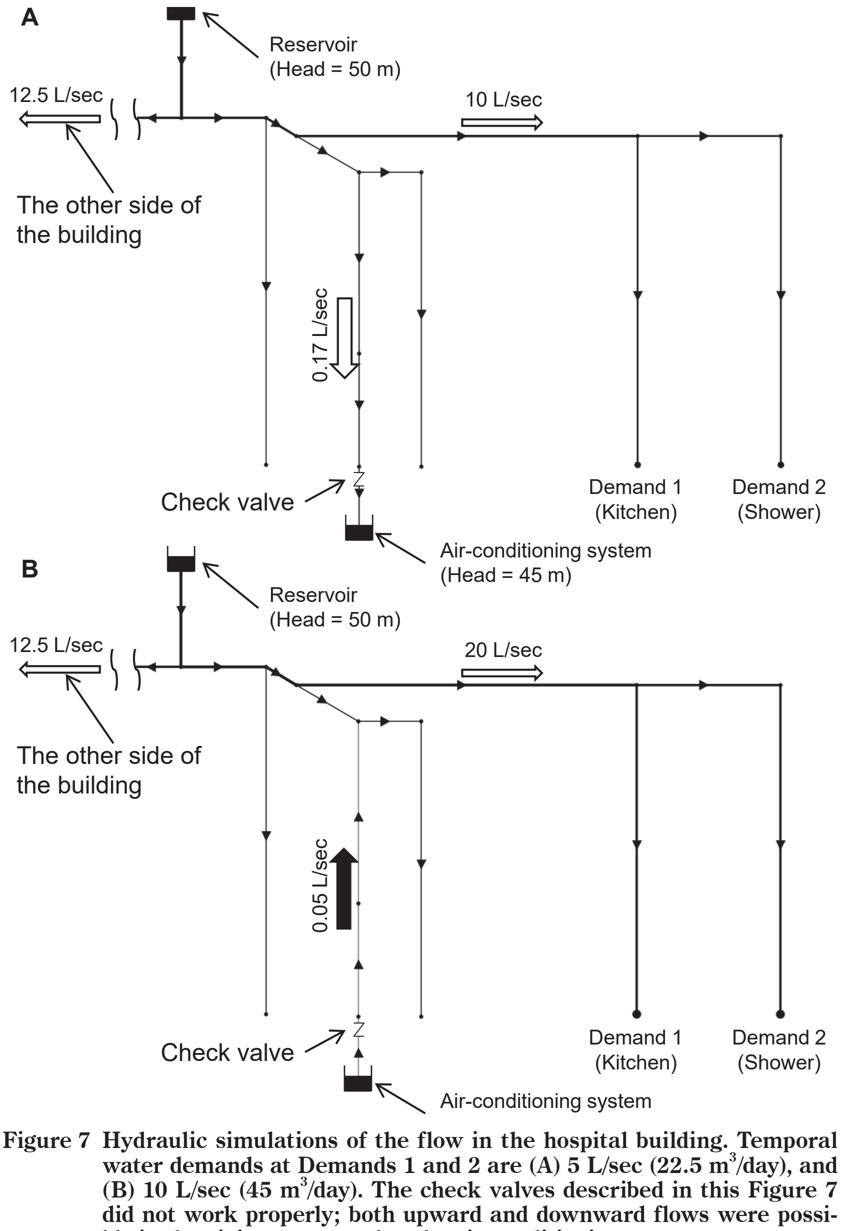

Figure 7 Hydraulic simulations of the flow in the hospital building. Temporal water demands at Demands 1 and 2 are (A) 5 L/sec (22.5 m^3/day), and (B) 10 L/sec (45 m^3/day). The check valves described in this Figure 7 did not work properly; both upward and downward flows were possible in the piping connected to the air-conditioning system.

(i.e., rooftop tank). As the water usage in Demands 1 and 2 increased, the flow rate in the piping connected to the rooftop tank also increased. Increase in flow rate results in increase in friction loss and decrease in the available head at the branch of the piping connected to the air-conditioning system. Eventually, the head of the air-conditioning system overcomes the one associated with the rooftop tank. In such situations, a reverse flow from the air-conditioning system to the piping of the water supply system could occur.

IX. Relationship with regulations

The following is an excerpt from the Office Communication, plumbing fixtures for drinking water (including plumbing fixtures that share the same water supply system as drinking water) shall not be directly connected to other plumbing facilities. 4) regarding the legal position. In this case, the connection point with the water piping for air conditioning was in a hospital ward, and therefore, the provisions of Article 129-2-4 of the Building Standard Law Enforcement Order (Cabinet Order No. 338 of 1950) were applicable to this case. However, if there is a misconnection with other piping facilities in the building, there is a possibility of contaminating the water to be used, and even though it is not directly regulated by the Water Supply Law, it is necessary to keep this in mind.

When confirming the installation of an SPOW under Article 32 of the Water Supply Law (Law No. 177 of 1957), prefectures, must ensure that the structure of the water supply facilities concerned is such that there is no risk of water contamination and that it complies with the facility standards. It must be ensured that it is not connected to pipes used for different purposes. Additionally, the public health center shall continue to provide guidance to the private waterworks installer. Moreover, if deemed necessary to ensure proper management of the waterworks, the public health center shall appropriately supervise the private waterworks installer by collecting necessary reports or conducting on-site inspections as stipulated in Article 39, Paragraphs 1 and 2 of the Waterworks Law.

In the event of drinking water quality abnormalities, occurring at water service providers, private water supply installers, private drinking water wells, etc. (other than those related to the Food Sanitation Law), public health centers must immediately contact the Water Supply Division, Pharmaceuticals and Consumer Health Bureau, MHLW, based on the "Guidelines for Drinking Water Health Risk Management Implementation" and "Proper Implementation of Health Risk Management and Provision of Information on Damage to Water Facilities and Abnormal Water Quality, etc." it is necessary to immediately contact the Water Supply Division, Pharmaceuticals and Consumer Health Bureau, MHLW.

X. Published notice

In this case, because the infant's symptoms of poisoning by nitrous acid were acute and obvious, the provision of milk was stopped immediately, treatment was initiated, and the cause was immediately treated properly.

In general, the plumbing in hospitals, hot springs, and lodging buildings is often complex, but no other pipes should ever be connected to the water supply system for drinking. The management of circulating water in the hot water system, including from the perspective of *Legionella* control, will require further attention in the future.

In addition to aging, expanding, and remodeling of buildings, buildings are affected by summer and winter air-conditioning piping system changes and pressure fluctuations. It may be difficult to continuously secure appropriate personnel who are familiar with the facility and its structure due to personnel transfers, contract changes, etc.

If warm or smelly water comes out of the cold water faucet or if the continuous monitoring of dialysis machines shows abnormalities, changes in the water quality may be present.

Additionally, in areas where pesticides and fertilizers are used or groundwater is contaminated, nitric and nitrous acid concentrations may be high to begin with, requiring careful water quality control even when there is no piping error.

The SPOWs that use groundwater do not have a wide-area backup system with a distribution pipe network or spare pipes and pumps, making it difficult to respond in the event of an earthquake, plumbing accident, or accidental water contamination. Routine cooperation with local waterworks and neighboring institutions is required.

We hope that this paper will be of interest to public health sector personnel and engineers.

XI. Conclusions

In SPOWs, incidents such as cross-connections, aging facilities, and accidental water contamination are likely to occur. Recent accident cases are summarized. As for the outbreak of methemoglobinemia at the University Hospital, it was caused by the backflow of nitrite in the anticorrosion agent in the water for air conditioning due to cross-connection. Hydraulic calculations also showed that backflow can occur from air-conditioning water. We must be extremely careful about the inadequate piping in facilities, especially those related to medical care.

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Table 1 Major water quality incidents from 2019 to 2022[a]

Type of water supply, the number of people supplied with or who possibly ingested the water, the number of patients, and date of the incident	Facility	Summary of incident	Cause of the incident	Further action
Water supply system with tank storage (commercial building) Hyogo The number of people to be supplied: unknown The number of patients: 35 February 5, 2019	Underground drinking water storage tank	Gastroenteritis cases were reported to Kobe City, and the local public health center identified the contamination of drinking water storage tank with untreated groundwater through an overflow tube. Norovirus GI and GII were detected in water samples collected from the tap and groundwater collection tank in the building. Kobe City instructed the owner of the water supply system including the storage tank to thoroughly maintain and manage them.	Contamination of underground drinking water storage tank	Consideration and implementation of measures to prevent recurrence
Private water supply, Hokkaido September 13, 2018	Chlorine disinfection (deep well)	The drainage pump in the drainage tank adjacent to the hotel's drinking water storage tank (underground) failed, raising the water level in the drainage tank to flow into the storage tank from the old pipe. This was discovered because of a complaint from a guest. Water quality was tested and found to contain general bacteria exceeding the standard value (56,000 CFU/mL), with abnormal taste and odor. No health hazards occurred.	Failure of miscellaneous drainage tank pump	Repaired the drainage and cleaned the drinking water storage tank. Renewal of pumps in the drainage tank and installation of a water level alarm system
Water supply system with tank storage (condominium) Hyogo The number of people who possibly ingested the water: 200 The number of patients: 15 June 18, 2020	Underground drinking water storage tank	A public sewer flowed into the water supply because of a misconnection to the pipe of the water storage tank at the condominium facility. The pipes were disconnected, and the water in the storage tank, rooftop tank, and pipes were ozonated to clean.	The incorrect joint of the pipe and public sewer pipe	The purpose of the pipe located in the storage tank was unknown. No drawings were found.
Small water supply (Common building) Hokkaido September 26, 2020	-	Sewage overflow from the inhibition collector installed on the first floor of the building flowed into the drinking water storage tank under the floor through cracks in the floor surface. We confirmed cloudiness and foaming in the water in the storage tank and prohibited drinking the water from the storage tank. As an emergency measure, the drainage of the inhibition collector was improved, and the drinking water storage and high-set water tanks were cleaned and confirmed to meet water quality standards.	Sewage inflow into storage tank due to inadequate building structure	The water supply was changed to a direct connection system that directly supplies water to the high-set water tank using temporary piping, and drinking was resumed because there was no longer any risk of wastewater flowing into the tank.
SPOWs (hospital) Shizuoka November 20, 2020	Membrane filtration (industrial water)	During the periodic on-site inspection, the residual chlorine level was less than 0.05 mg/L, so the water supply was stopped and chlorine injection dose was adjusted. The dose of chlorine injection was increased, the water in the water storage tank was replaced, and water supply was provided after confirming that 0.2 mg/L of residual chlorine was detected at the terminal hydrant.	Insufficient adjustment of chlorine injection equipment	He instructed that daily inspections should be conducted to ensure that residual chlorine is checked and that the water supply technical manager should supervise properly.
Small-scale water supply system Shizuoka December 18, 2020	Chlorine disinfection (deep well)	Because the residual chlorine level was less than 0.05 mg/L in the periodic water quality inspection, the company introduced the fact that water should be boiled if it was to be consumed. It was found that sodium hypochlorite had leaked out because of a loose air vent drain bolt on the chlorine injection pump and was not being injected properly. The injection pump was adjusted, and it was confirmed that 0.2 mg/L of residual chlorine was now detected.	Insufficient adjustment of chlorine injection equipment and failure to properly conduct daily inspections	Educate residents who conduct daily inspections and contracted workers who conduct inspections.
SPOWs (Multi facilities) Fukuoka July 15, 2021	Deferrization demanganese, activated carbon, and membrane filtration (deep well)	Because of damage to a component in the membrane filtration equipment, water containing contaminants removed by membrane filtration (concentrated water) was mixed with the purified water, causing manganese and chloride ion levels and color to exceed water quality standards. Additionally, the system monitoring the water treatment facility did not function because of a power outage, resulting in contaminated purified water being supplied for approximately half a day. Parts of the membrane filtration equipment were replaced, and the water tank was cleaned, and it was confirmed that the water quality standards were met.	Monitoring system shutdown due to damage to membrane filtration equipment components and power outages	To ensure that the alarm system is working properly, check the operation status during daily inspections.

Municipal water supply Hyogo August 18, 2021	Chlorine disinfection (spring water)	The inspector contacted the water utility because residual chlorine was not detected during a routine water quality test and *Escherichia coli* was detected. The blockage in the pipe of the disinfection equipment was repaired on the same day. In the daily inspection, residual chlorine was also undetectable from the 17th, but the contractor did not report this to the water utility. No adverse health effects occurred.	Injection failure of disinfectant	Thoroughly manage the facility and notify the public water utility in the event of water quality abnormalities.
Small-scale water supply (nursery school) Kanagawa The number of people to be supplied: 150 The number of patients: 5 August 23, 2021	Drinking water storage tank	The standard plate count exceeded the DWQS after cleaning the drinking water storage tank. Five diarrhea cases were identified in the nursery school, although the causal relationship was unknown. Because water with red rust color had come out of the tap for more than 1 week after cleaning the tank, the tank was cleaned again. Water quality testing confirmed no abnormality, and the drinking restriction of tap water was lifted. The nursery school will periodically test the water quality parameters including residual chlorine.	The excess standard plate count is presumed to be caused by biofilm contained in red rust	Temporary water quality testing continues for the time being.
SPOWs (hospital) Gunma The number of people to be supplied: 3,000 Number of patients: 10 (See this article for details.) October 19, 2021	Chlorine disinfection (deep well)	Ten infants developed methemoglobinemia at a hospital. Because high concentrations of nitrite-nitrogen were detected in water purified and disinfected from the university's groundwater used to prepare powdered milk, nitrite was thought to be the cause of methemoglobinemia. As a result of the investigation, no abnormalities were found in the water quality of the groundwater, and it was thought that the cause was contamination of the water for air conditioning connected to the water supply piping via a check valve (chuck valve). The air-conditioning water contains a chemical containing nitrous acid as an anticorrosion agent to prevent rust in the piping, and it was concluded that the air-conditioning water containing nitrous acid was mixed into the water supply system because of the malfunctioning of the check valve. As a recurrence prevention measure, the water supply system piping was disconnected from the air-conditioning water piping and the inside of the water supply system piping was cleaned. As a result, nitrite-nitrogen was no longer detected, and the water supply was resumed.	The water piping for air conditioning is directly connected to the water supply system piping, and nitrite-nitrogen is mixed in the water supply system from the water piping for air conditioning	Temporary water quality tests shall be conducted to confirm that there are no abnormalities. Do not directly connect the water supply system piping to other piping, even through check valves are installed. Issued by the office.
Small-scale water supply (multitenant building) Tokyo The number of people to be supplied: unknown The number of patients: 14 March 3, 2022	Underground drinking water storage tank	Unusual odor and turbidity of tap water was reported to the local public health center. There was malfunction of the drainage pump in the wastewater tank, and wastewater flowed into the drinking water storage tank. After repair of the pump, the underground drinking water storage tank and a water tank on the roof were not cleaned. Water samples collected from the tap exceeded the DWQSs of standard plate count, *E. coli*, odor, color, and turbidity. Norovirus GI was detected in the tap water and toilet flushing water samples and swab samples from the kitchen sink and ice machine. After cleaning the water tanks, water quality testing confirmed the sample met the DWQSs. Unusual odor of tap water was again reported by a tenant of the building after 10 days. The drainage piping above the drinking water storage tank broke, and drainage water flowed into the tank. Water samples collected from the tap again exceeded the DWQSs of standard plate count, *E. coli*, odor, color, and turbidity. After repairing the piping and cleaning the water tanks, water quality testing confirmed the sample met the DWQSs.	Wastewater flows into the drinking water storage tank because of malfunction of the drainage pump and breakage of drainage piping	Consider abolishing the use of underground drinking water storage tanks

[a] Incidents related to SPOWs were selected and organized from MHLW (2022) [4].

[Note 1] An excerpt from the Building Standards Act Enforcement Order

Article 129-2-4 The installation and construction of water supply, drainage, and other piping facilities to be installed in buildings shall be in accordance with the following provisions. (Omitted)

(2) Plumbing facilities for drinking water to be installed in buildings (excluding plumbing facilities that fall under the category of water supply equipment prescribed in Article 3, paragraph (9) of the Waterworks Act): (2) In addition to the provisions of the preceding paragraph, the installation and construction of drinking water piping facilities (excluding piping facilities that fall under the category of water supply equipment prescribed in Article 3, paragraph (9) of the Waterworks Act) installed in buildings shall be as follows:

(i) Plumbing fixtures for drinking water (including plumbing fixtures that share the same water supply system as that of drinking water) shall not be directly connected to other plumbing facilities.

(Omitted)

＜総説＞

大学病院専用水道の配管不備による乳児のメトヘモグロビン血症発生と最近の水質事故について

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抄録

住民100人以上への給水または日量20m^{3}以上の給水を行う水道施設を専用水道（SPOWs）という．専用水道や小規模水道の施設では適切な維持管理が必要であり，特に個人の飲料水用井戸を含む小規模水道では，健康被害を伴う水質事故が多く発生している．SPOWの水質事故の多くは，地下水を原水として使用している施設で発生しており，SPOWを設置する側には水質管理の徹底が求められている．最近の飲料水貯水槽の微生物汚染に関連する水質事故に加え，大学病院の建物で発生した事故について紹介する．2021年10月，大学病院の新生児集中治療室で，乳児17人のうち10人にメトヘモグロビン血症が発症した．これらの乳児は，大学病院の建物内の厨房で調製されたミルクを与えられていたことが判明した．最終的には，空調設備に使用されている防錆剤に含まれる亜硝酸塩が，クロスコネクションによりミルクを調製した水に混入したことが判明した．

キーワード：飲料水供給，リスク管理，水系感染症，メトヘモグロビン血症，給水設備