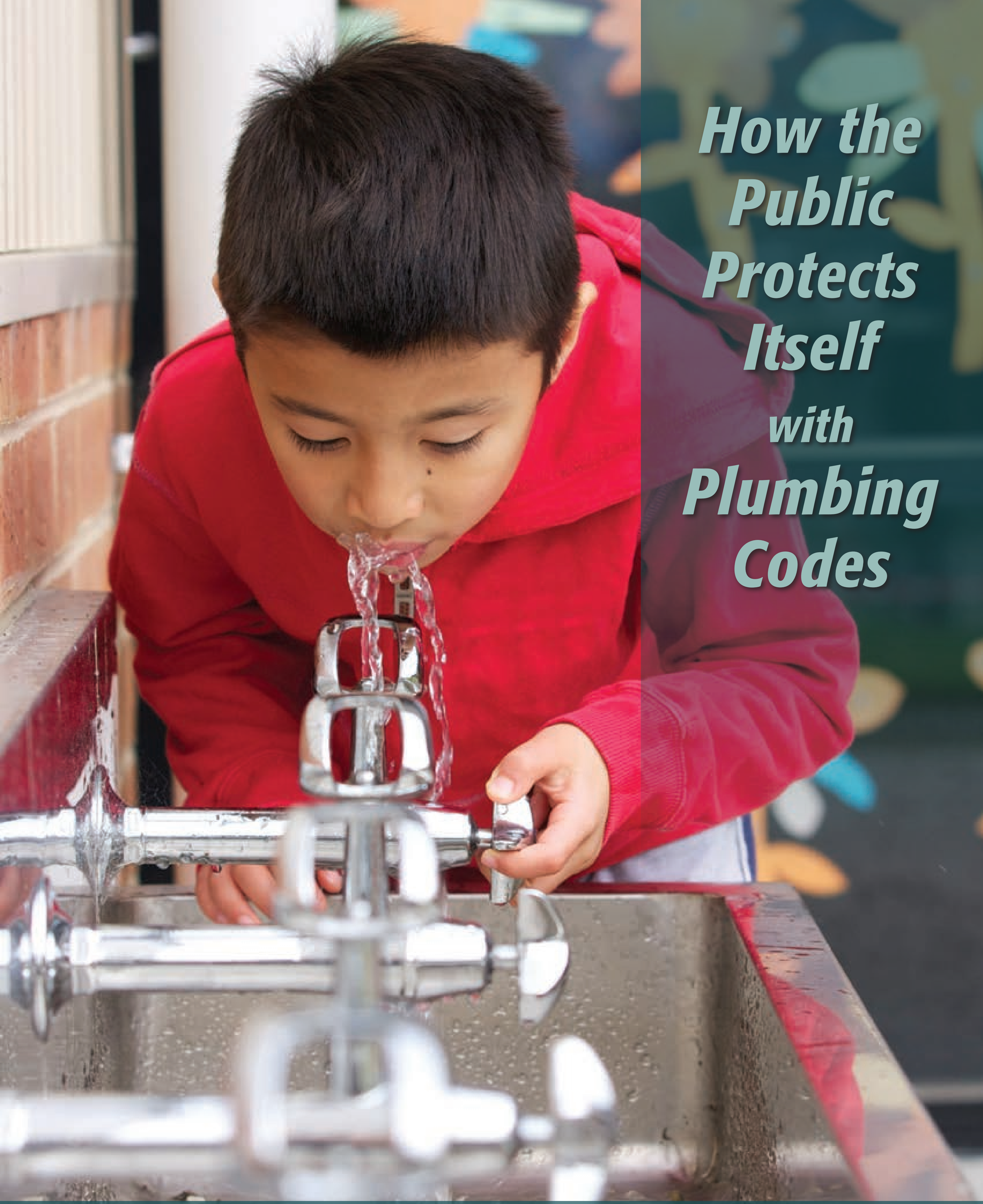
How the Public Protects Itself with Plumbing Codes



...a summary of the relationship between plumbing and public health

Plumbing in Washington State

A Framework for Protecting Washington Citizens

Since the 1960's, the citizens of Washington State have approached the issues of public safety and health, in regards to sanitary and domestic water systems, with the seriousness which it deserves.

Starting with some of the larger municipalities and later expanding to cover the entire state, systems designed to protect the health of Washington citizens include the certification programs for Plumbers, who are trades people indicating to the public that they are qualified to install plumbing systems in a safe and proper manner, codes which guide the design of systems which will protect the citizens and lastly a permitting and inspection structure which ensures that proper installations are adhered to.

The intent of this system of controls is to protect the public from everything from poorly designed and installed systems which will not work to the possibility of tragedies like described in chapters in this booklet. The historical reasons are clearly delineated as to why these systems are in place. Washington State has been a leader in ensuring its citizens' health and safety are a primary objective in the writing and implementation of the Washington statutes.

Under three headings (Certifications & Licenses, Codes, Permits & Inspections), the following is a brief summary with links for detailed rules for installing plumbing systems in Washington State.

Plumber Certifications and Contractor Licenses in Washington State

Contractors in Washington State, including all Plumbing Contractors, must be licensed by the state to legally have the ability to promote to the public that they are ready, willing and able to provide the advertised plumbing contracting services.

Information about Contractor Licensing Requirements can be found here:

http:/lni.wa.gov/TradesLicensing/Contractors/default.asp

Also, Plumbers who work for those contractors must have the proper certifications, which are obtained through a combination of documented hours in the field working with a certified journey worker and classroom time learning the theory behind the installation methods and codes. The on-the-job training and the classroom instruction culminate with the individual being qualified to take a test regarding proper installation procedures, once minimum hour and training requirements have been met. This certification process ensures that the consumer can have confidence that the certified Plumber is what they advertise they are. Also, in Washington State, there are various sub-divisions of Plumber Certifications, such as Residential Specialty, Backflow Specialty or Well Specialty which address specialized aspects of the industries they serve.

Complete information about Plumber Certification rules in the state of Washington can be found here:

http://www.lni.wa.gov/TradesLicensing/Plumbing/default.asp

For more information, contact Washington State Department of Labor and Industries at http://www.lni.wa.gov

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"The society which scorns excellence in plumbing because it is a humble activity and tolerates shoddiness in philosophy because it is an exalted activity will have neither good plumbing nor good philosophy: neither its pipes nor its theories will hold water."

- John W. Gardner, American Educator and Philosopher

How the Public Protects Itself with Plumbing Codes

…a summary of the relationship between plumbing and public health

It is very important that citizens and their representatives in state and local governments understand the vital role plumbing codes and controls play in safeguarding the health of our modern society. Since the middle of the last century, the importance of plumbing to public health has been sufficiently recognized primarily because people had been able to compare how people lived before the advent of plumbing systems and how the general health and well being of society had improved after standards for systems and installers were introduced. In the early part of the last century, in the US, over 100,000 people died annually from diarrhea-enteritis and dysenteries. 23,000 annually died from Typhoid Fever. Plumbing Codes in the US have taken those numbers to virtually zero. Much of the rest of the world still has a long way to go.

For centuries, it was common place for large sectors of society to be stricken with very preventable diseases and epidemics because they did not understand how important of a role access to clean water plays in the public health arena. As one of the most valuable public health standards human beings have ever introduced, plumbing is often taken for granted, because of the job government and the industry have done in instituting and applying those standards for the health of everyone.

As plumbing systems do their silent work in improving the lives of people, it is very easy to forget how far we have come. Evidence of this is revealed in every new proposal to relax the codes, standards and controls which protect our citizens. This booklet is offered in an attempt to remind the public and public officials of the lifesaving importance of the systems within their walls.

What is a Plumbing Code?

A plumbing code is simply an installation guide of plumbing systems to follow in the jurisdiction or area (City, County, State) which has adopted it. Plumbing codes are designed to prevent installation of faulty plumbing which may create a public health hazard by inducing disease epidemics into the community.

A code is one of four safeguards usually present in public control over plumbing.

The second protection for the public in the plumbing industry is certification. Plumbers in Washington State must demonstrate to a certification body – the Washington State Department of Labor and Industries – that they are competent in their craft and they have met the training requirements to be able to competently install plumbing systems according to code standards.

The third protection for the public is the permitting process. This process insures that installations are properly documented and designs are reviewed to meet community standards. The process also gives the inspector a plan to check before the consumer has spent money on the contemplated plumbing work.

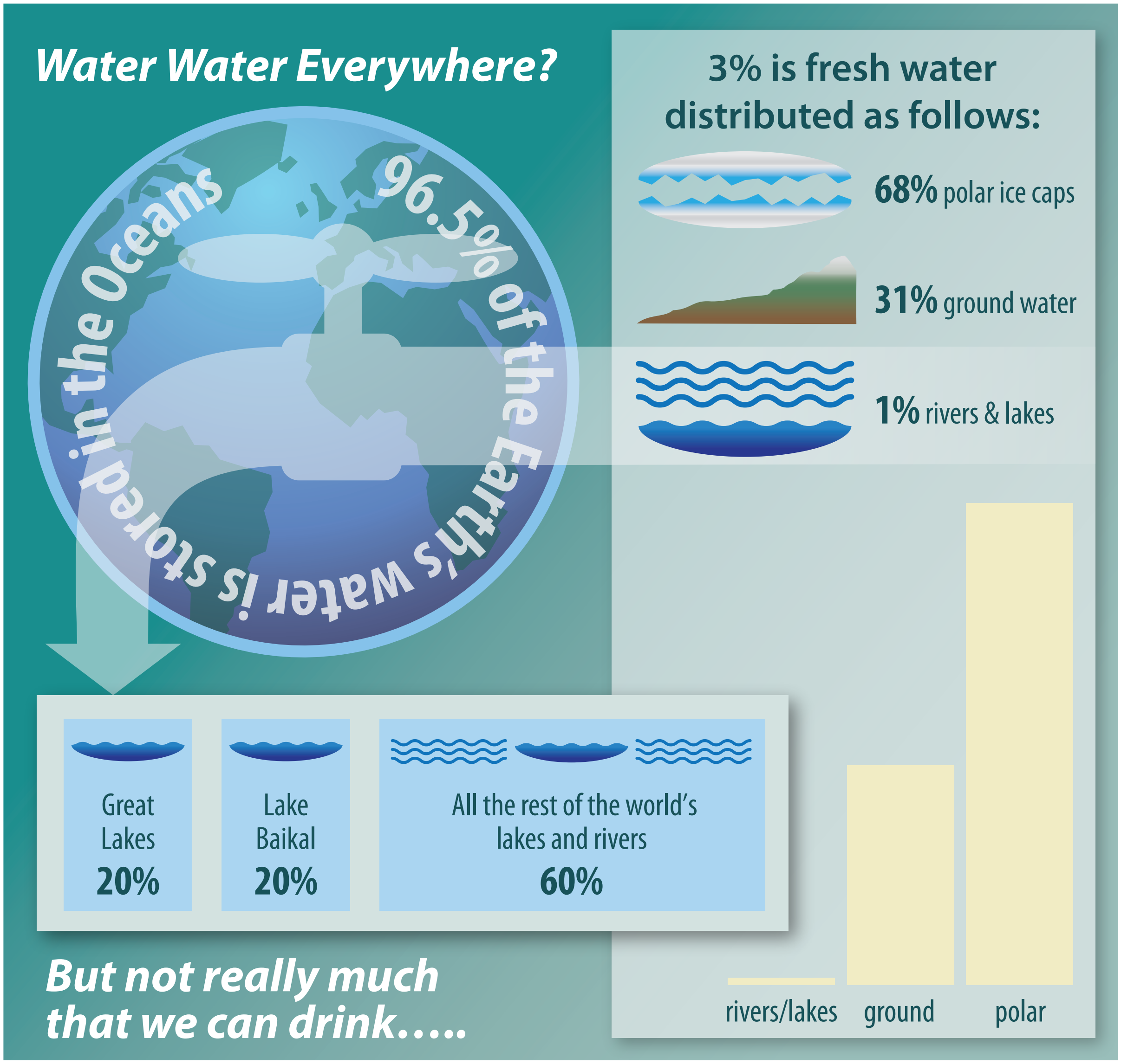
Finally, there is the fourth protection of the public – the inspection itself. The inspector checks the completed job against code standards and either approves it or requires the plumber to make changes which will meet the standard.

Appropriate to the goals of the public health authority, all four safeguards are typically under the control of the health department of the community.

Does the plumber need to follow prescribed plumbing codes? Only in the sense that a doctor, as a recognized professional, must meet certain minimum standards for patient care or an airline pilot must follow certain procedures for transporting the public in the air. Plumbing Codes, the equivalent to flight manuals and medical procedures for pilots and doctors respectively, have been developed with public safety in mind. Plumbing Codes direct the plumber how to do his/her work so that the public drinking water is protected and human waste is properly treated.

This booklet presents the facts which demonstrate the importance of codes, certifications, permits and inspection as the only means by which the public can protect itself against the numerous hazards of substandard plumbing. Its most important objective is to discourage indifference on the part of the public and to encourage the public and public officials to realize that these controls are the public's own means of self-protection and the standards need to be maintained with the same attention and care due other public health risks.

Water, Water Everywhere?



A Short History of Plumbing

The very description of civilization includes how people come together in communities. Amongst all of the problems which develop when large groups of people come together is how do you supply the populace with sufficient clean water and how do you get rid of the waste. For many centuries, the groups of people formed in the various experiments with civilization, were mobile. Part of the reason for this mobility was the fouling of the resources which happened when the group grew and stayed in one place too long. When early permanent settlements began to form, little thought was put into sanitary issues, because science had yet to establish the link between diseases and the unsanitary conditions in which people lived.

The first known plumbing systems were installed on the Isle of Crete about 4000 years ago where the Minoan Palace of Knossos featured four separate drainage systems that emptied into sewer systems constructed of stone.

The Greeks also had some rudimentary systems, but many thought that it was unmanly to use hot water, so they bathed in cold water.

The Romans took plumbing to a whole new level. At their peak they had both aqueducts and sewer systems, the sewer systems predating the aqueducts by about 500 years.

The word "Plumber" is derived from the Latin word "plumbum"- which means "lead or lead shot". The "plumbarius" or eventually shortened to the word "plumber" was one who worked with lead. Of course at that time in history the health effects of lead were also an unknown, but lead was an easily worked material for forming into parts and equipment for plumbing systems.

By the 4th century A.D., Rome had 11 public baths, 1352 public fountains and cisterns and 856 private baths. In Pompeii, some homes had 30 taps. Their system at its peak carried 300 gallons of water every day for every citizen.

In Great Britain, following Roman custom, Emperor Claudius developed the hot springs near the city of Bath, England and the Romans maintained control of this site for about 500 years. However, when the Romans left, the secrets of sanitary design went with them.

The early Christians rejected almost everything Roman including washing. They considered it "unsanitary to be clean" with Saint Benedict pronouncing that "to those that are well, and especially the young, bathing shall not be permitted." A 4th Century pilgrim to Jerusalem would brag that she had not washed her face for 18 years so as to "not disturb the holy water" used at her baptism.

This lack of sanitary conditions on many levels was one of the reasons for the Black Plague which enveloped Europe during the Dark Ages.

The idea of the possibility of disease being transmitted through water and waste began to sink in during the 17th and 18th Centuries. However, prior to this idea coming to light, the rivers were treated as open sewers. For example, in the mid-1800's, the Thames River in England was used to collect both personal and factory waste from nearly 3 million people who were living in London at that time. During several hot summer days during 1859, Parliament was suspended as window blinds saturated with lime chloride and other disinfectants failed to subdue the odor.

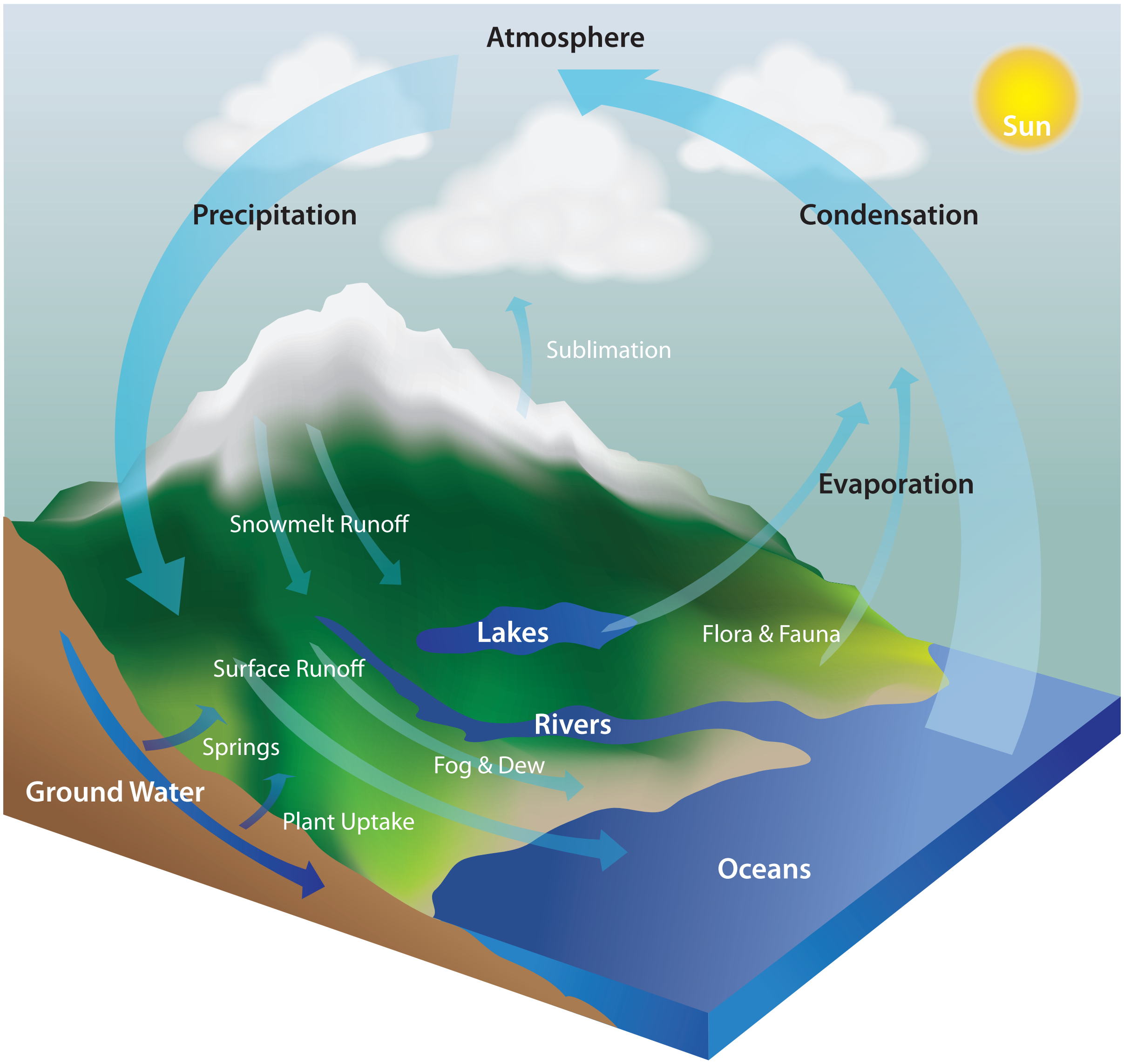
The invention of the water closet and the advent of indoor plumbing are both relatively recent innovations. These items represented watershed moments for the human race seeking to secure a more sanitary environment.

In the late 1800's the trade of plumbing began to take hold as more and more homes strived to have this comfort and convenience in their homes and workplaces. This was the precursor to the health authorities beginning to recognize a connection between sanitation and the health of the community. People also began to recognize the need for access to clean fresh water. In Washington State the populace is blessed with many natural resources and the top amongst them are the fresh water rivers which provide drinking water for almost 6 million people. The City of Seattle, as an example, has some of the finest drinking water in the country because the Cedar River watershed and the Tolt River watershed were secured early in the 1900's as sources for a growing region.

And Plumbers are entirely responsible for getting the water where it is found and delivering it to the citizens. They are also responsible for what happens to the water when you are done using it and seeing to it that it is clean enough to re-enter the environment in a safe manner.

Today plumbers are also integrally involved in piping systems that sustain patients in medical facilities, feed people in food processing facilities, provide life saving drugs in pharmaceutical manufacturing and many other facets which we take for granted in our daily lives.

The Water Cycle



Water is a Medium of Disease Transmission

Today, it is common knowledge that disease can be transmitted and spread by water. A hundred years ago, it wasn't. Epidemics then raged through cities, killing thousands and blotting out entire communities. Many times the epidemics were attributed more to divine providence than to polluted water or waste contamination.

"The Governor noted once again how Pete Engel's Corral Feed and Livery Stable had been built out over Indian Creek, so the stable boys could simply kick the piles of dung into the water- a common habit up and down the stream. It had occurred to some Cassandras that such practices might have something to do with the typhoid epidemic raging through Caldwell. In a recent letter to the Caldwell News, a correspondent calling himself I.M.Sane had inveighed against the unsanitary conditions that had contributed to the awful scourge of typhoid and to the diphtheria epidemics that periodically beset the town. Later the News warned: "The practice of throwing the carcasses of dogs, chickens etc. into Indian Creek should be stopped at once."

- Big Trouble, J. Anthony Lukas (1904, Caldwell, Idaho)

As men began to apply scientific methods to the study of disease and its spread, they learned about the microorganisms which now are understood to be the causes of disease. They learned that some of these microorganisms live in water and can be transmitted from one human being to another through water.

One of the first disease outbreaks for which water took the blame was the Asiatic cholera epidemic of 1854 in London. An epidemic of Typhoid Fever in Plymouth, Pennsylvania, in 1885, was another milestone in the discovery of how disease is transmitted through water.

One by one, the water-borne diseases have been identified. Today, epidemiologists include among them cholera, typhoid fever, paratyphoid fever, amebic dysentery, bacillary dysentery, hookworm, flukes, and diarrhea.

Ensuring safe drinking water from the source of the water to the tap is a complicated and detail intensive task which has required the support of all parties to complete. As the human populations on the planet have exploded to a size and scope unimagined by our ancestors, fresh water resources, once thought of as infinite, have become so valuable, competing interests now spend a great deal of time, energy and money arguing over access and use. This is another place where the plumbing codes play a role in managing the distribution of those resources efficiently and safely.

Disease	Etiological agent	Mode of transmission	Prevalence
Ancylostomiasis (hookworm disease)	Necator americanus and rarely Ancylostoma duodenale	Contaminated soil, water containing larvae, soiled food, hand-to-mouth transmission from handling soiled objects.	Endemic in Southern States particularly amoung white children of school age.
Cholera	Cholera vibrio, Vibrio comma	By water and food polluted by infectious agent; direct contact, carriers, flies, and contact with articles freshly soiled by discharges of infected persons or carriers.	Rare in North America.
Dysentery, Amoeobic (Amebiasis)	Endamoeba Histolytica	By drinking contaminated water, by eating infected food, hand-to-mouth transfer of infected material.	Not Common in North America, epidemic outbreaks rare.
Dysentery, Bacillary	Dysentery bacillus, Shigella dysenteriae, Shigella para-dysenteriae.	Eating infected food, hand-to-mouth transfer of infected material; flies, objects soiled with discharges of infected persons or carriers, drinking polluted water.	Endemic, epidemic and sporadic. Most common in summer months and in sub-tropical and tropical areas.
Typhoid Fever	Typhoid bacillus, Eberthella typhi	Conveyance of the specific micro-organism by direct or indirect contact with a source of infection. Among indirect means of transmission are contaminated water, milk, shell-fish and probably flies.	Occurs sporadically and as small contact and carrier epidemics endemic in small southern rural areas.
Paratyphoid fever	Paratyphoid bacillus A, B, or C; Salmonella paratyphi; Salmonella schottmuelleri.	Directly by personal contact, indirectly by contact with articles freshly soiled by the discharges of infected persons or through milk, water, or food contaminated by such discharges, probably by flies.	Relatively rare, occurs sporadically or in small local carrier or contact epidemics.
Schistosomiasis (flukes)	Animal parasites of the class Trematoda, genus Schistosoma; S. japonicum, S. hematobium, S. manson.	Ova hatch in water and enter mollusk, genus Planorbis in the West Indies, in the mollusk they multiply and develop into larval forms called "cercariae" which on leaving the mollusk penetrate the skin of man and certain animals.	Not indigenous in the United States at present.
Diarrhea	A number of specific organisms suspected, among which are the coli-aerogenes group of bacteria.	Polluted water and other causes not known.	Universal, epidemic, endemic, and sporadic
Legionellosis (Legionnaires' disease or Pontiac fever)	Legionella bacteria	By breathing in a mist or vapor that has been contaminated with Legionella bacteria.	Each year, between 8,000 and 18,000 are hospitalized with Legionnaires' disease in the U.S. Usually found in the summer and early fall.
Severe Acute Respiratory Syndrome (SARS)	SARS-associated coronavirus (SARS-CoV)	Close person-to-person contact. It is thought to be transmitted most readily by respiratory droplets, can also be spread when a person touches a surface contaminated with infectious droplets. In addition, it is possible that SARS-CoV might be spread more broadly through the air (airborne spread).	Since 2004, there have not been any known cases of SARS reported anywhere in the world.

Purifying the Water Supply at its Source

The first battle against water-borne disease (see facing page) outbreaks was to eliminate impurities from the community water supply at its source. Cities, faced with the necessity of providing a safe and pure drinking water supply for their growing populations, took precautions to protect their sources of water from pollution by sewage and other contamination.

Sand filtration and chlorination processes were introduced to disinfect water known to be impure. The municipal purification plants, which are essential fixtures in most communities, have done such a good job at reducing the incidence of water-borne disease, many people now take these systems for granted.

As early as 1931, studies regarding the outbreaks of typhoid fever and dysentery in the United States showed a great many of the outbreaks were caused by untreated water supplies. But, also telling in those early studies was the fact that almost 45% of the 228 outbreaks studied were classified as due to contamination of water at some point between the source and actual delivery to the consumer. According to the report, 43.7% of the 9,367 typhoid cases, and 66.1% of the 93,712 dysentery cases, were "due primarily not to the use of polluted water at its source, but to laxity in source treatment and distribution methods."

Protecting Water Supply Distribution Systems

The problem of fighting water-borne disease thus did not end with the attainment of safe water through purification processes.

In another early study, it was shown that 2,055 cases of typhoid fever occurred because of pollution of apparently safe water as it was being distributed to consumers.

Of these cases, 1,995 or more than 95% were due to unprotected cross-connections between the distribution system and secondary polluted water supplies. The term "Cross Connection" in these examples means connections between the main water supply pipes and auxiliary supplies taken from rivers and other sources for non-drinking purposes, such as fire protection or industrial use. The contaminated secondary supply thus was mixed with the treated water.

The authors of the report said: "The public health importance of unprotected cross-connections is further emphasized by the fact that this rated second in causes of total outbreaks (typhoid fever) and fourth in dysentery cases. From these figures it might well be classed as the outstanding public health danger in water works operation."

Aroused by the study findings, municipal health and water works people made a concerted effort throughout the country to check this source of contamination.

Internal Cross-Connections are a Plumbing Hazard Too

While city governments quickly grasped the idea that cross-connections could introduce contamination into the distribution system after purification, they were slower to realize that the same danger of contamination exists within the plumbing systems of individual buildings, which are a part of the distribution system. The plumbing industry had been interested in this problem for many years, but it took a disastrous amoebic dysentery epidemic in Chicago in 1933 to focus attention of the public and its city governments on the problem. Since then great strides have been taken by cities in every part of the country, through revision of codes, to reduce the possibility of water-borne disease outbreaks resulting from plumbing cross-connections and other plumbing defects.

Cross-connections in the plumbing system may, like those in a city water distribution system, involve a secondary water supply within a building. More often, though, they are connections between the ordinary household water supply and waste disposal facilities. And they can be introduced in many different ways. (See pages 12 &13)

Recognition of this plumbing hazard, however, merely added a powerful reinforcing link to the chain of knowledge which had long since led the public to protect itself through regulation of materials and methods used in plumbing installations. To insure safe, sanitary plumbing, controls were already in effect in most places prescribing: (1) use of traps to seal off the sewer from the building and thus prevent entrance into living quarters of sewer gases and vermin, (2) ventilation of the drainage system of the building to prevent loss of the trap seal which would render traps useless, (3) proper fittings, pipe and other materials to prevent leakage of sewage from pipes in the building, and (4) specifications governing the number of fixtures which may be serviced by pipe of a given size. All of these items make up the details of our plumbing codes.

Plumbing is a Major Factor in Disease Control

The gradual completion of the circle of protection of the public from exposure to water-borne disease is dramatically revealed in statistics. Death rates from water-borne diseases have gone down and down. In the US, one hundred years ago 100,000 people died annually from diarrhea-enteritis and the dysenteries, and 23,000 died from typhoid fever. After the first 50 years of which public authorities recognized the importance of protection of the water supply through proper installations of water and waste systems, fewer than 600 died of typhoid and about 15,000 from other enteric diseases annually. Today the incidence of illness due to plumbing systems is thought of as rare, because the routing of water from the source to the tap is taken very seriously. The development of modern plumbing is many times understated in playing an integral part in achieving this record.

What *Can* Happen - Major Plumbing Hazards

Cross-Connections

Few people are aware of the scores of possible cross-connections in plumbing systems through which sewage or other foreign matter can enter the fresh water supply. This can happen in the homes where they live; in factories where they work; in restaurants where they eat; in hospitals, institutions and public places of all kinds.

Cross-connections are dangerous because of the vacuum which inevitably will develop, according to the laws of physics, in water supply lines under certain conditions. Reduction in city water pressure, shut-off of water for repairs, heavy demand for water during fires, or mere operation of the system can create a partial vacuum or negative pressure in the water pipes.

The reversal of flow which results when a vacuum occurs in water piping is known as back-siphonage. Back-siphonage, wherever there is a cross-connection, is the drawing of sewage or other non-potable material into the fresh water supply.

The elimination of cross-connections can be accomplished only by (1) use of plumbing fixtures designed so that the water supply inlet is separated by an air space from the highest possible flood level of the fixture, (2) protection of fixtures in which air-break design is impossible with accessories known as vacuum breakers, (3) periodic inspection of installations to insure that protective devices continue to function properly.

Examples of cross-connection hazards are legion. In the home…most water-closets and many lavatories, bathtubs, electric dishwashers, automatic laundries, faucets. In industry…water-using tanks, aspirators, chemical-carrying pipes. In eating places…dish washing equipment, soda fountains. In hospitals…bedpan washers, sterilizers, hydrotherapeutic equipment.

Leakage From Soil and Waste Lines

Leakage of soil and waste pipes (the building drainage system which is connected to the sewer) constitutes another hazard. Leakage endangers not only the water supply, but food, food-handling equipment and any exposed article which offers a mode of disease transmission. This hazard arises from improper location of pipes, improper materials and installation methods.

Accidents

Accidents are the third great plumbing hazard. Injuries, deaths and property destruction can and do result from numerous types of faulty installations. Among them are: failure to protect hot water heaters with temperature-pressure relief valves (result: explosions); failure to protect hot water supplies from overheating (result: scalding); crossing of hot and cold water pipes (result: scalding). Properly, this hazard should not be labeled “accidental”; it is the price paid by those who refuse, or are ignorant of, the protection which they have in plumbing controls against incompetent installers.

What *Has* Happened

Wooden latrine at a historic fort.

Much of the advancement of plumbing systems into our daily lives took place because of tragic things that happened with interactions with systems which little thought or care was used to assemble. While it's hard to imagine our lives without access to plumbing systems today, the fact is there have been many skeptics about the science behind, the rules established because of the science, and the regulations around enforcing those rules regarding plumbing systems. Many have simply thought that plumbing is as simple as "it flows downhill, right?"

Events have proven over and over that the need has been there. Unfortunately, many times tragedies have had to happen before citizens and civic leaders decided to recognize improperly designed and installed plumbing systems as a serious public health threat.

Ten Cases and Issues

On the following pages are 10 historical cases which led to an eventual public awakening to the benefits of plumbing done correctly and the hazards of plumbing done incorrectly. They are either cases where something tragic has happened and found to be caused by improper installations of plumbing systems or describe situations of possible risk to people from their piping systems. The illustrations demonstrate how plumbing was involved or could be involved.

> *"Water is fundamental to life and health. The human right to water is indispensable for leading a healthy life in human dignity. It is a prerequisite to the realization of other human rights."*
>
> *United Nations Committee on Economic, Cultural and Social Rights statement declaring access to safe drinking-water to be a human right.*

Case #1

Cross Connections and Backflow – Chemicals in The Drinking Water?

"Cross connections allowing contaminated or polluted water to flow back into the drinking water are the scourge of clean drinking water systems. The fact that water can backflow from a source of contamination/pollution has been known for more than a century, yet cross connections are still very commonplace. In the US alone, over 10,000 incidents of backflow contamination are reported every year. Who knows how many incidents go unreported."- Environmental Aspects of Plumbing, World Plumbing Council 2010

The Environmental Protection Agency (EPA) 2003 "Cross-Connection Control Manual" describes the following real-life situations regarding backflow due to outside (other connected pressurized system) pressure overcoming domestic water system pressure and causing contamination in a public water system. In some cases, people were burned, sickened, or as in most of these cases, just plain lucky that neither of those things happened to them.

1. Human blood in a domestic water system from a funeral home hydraulic aspirator used to remove blood from human remains as part of the embalming process.

2. Sodium hydroxide from a tanker entered a domestic water system after a water main break siphoned the chemical from a tank. Residents of a small town were burned in their showers as a result.

3. Homeowner heating system pressurizes after shutting off the city water supply and pushes anti-freeze into their domestic water system.

4. A shipyard fire protection system pressurizes a domestic water system and introduces salt water into the drinking water system.

5. A small town in Maryland has a pesticide (paraquat) introduced into their domestic water system when the water system was temporarily put out of service and the pressure dropped allowing the powerful herbicide to enter the system from a holding tank.

6. Natural gas was introduced into a domestic water system by the gas company using fire hydrant pressure to purge some tanks. The tanks had 85-90 psi and the water system had 60-65 psi. This caused hundreds of people to be evacuated from the town until the danger was abated, but not before an explosion occurred in one house and another burned to the ground.

7. The chemicals chlordane and heptachlor were introduced into a domestic water main when the main was taken down for repair and the chemicals were siphoned out of a truck. It was decided to abandon the mains and replace all of the affected plumbing systems. The apartment complex affected was without its normal water supply for 27 days. The same issue happened in another location in North Carolina in 1986, and another location in an eastern city in 1979. Chlordane was also found in Kool-Aid being mixed by women for a church function in a small town in South Carolina in 1978. It had been introduced by a drop in main pressure and siphoning from a bucket a pest exterminator had been adding water to. Approximately a dozen children and three adults drank the concoction before the problem was discovered.

8. Boiler water entered a high school drinking water system, because no backflow preventer was installed to isolate the heating system from the domestic water system.

9. A car wash contaminated almost 100 square blocks of a Washington city water main. The grey-green slippery water was discovered by residents and the water department initiated an investigation. Subsequently it was discovered a high pressure pump at a car wash was responsible for the recycled water from the car wash being pumped into the city's water main.

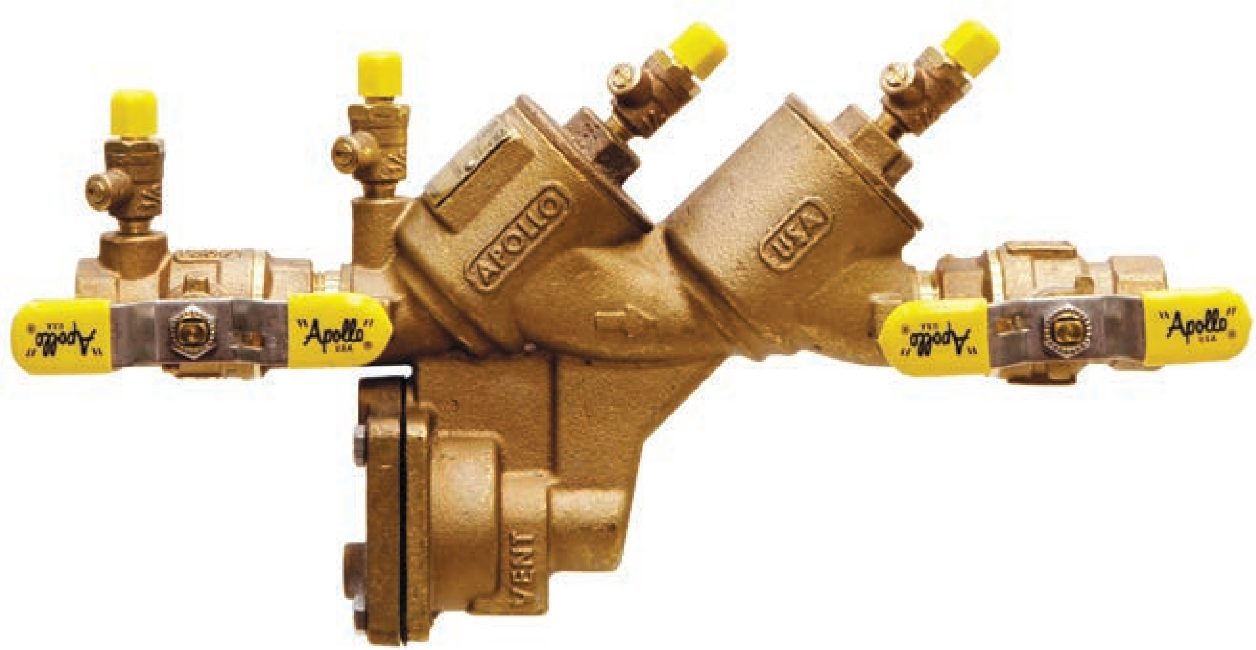
10. Hexavalent chromium was introduced into a drinking water system at a manufacturing facility in Massachusetts in 1982 when a mechanic, trying to cool a laser, installed a tempering valve. Maintenance on a chiller supplying cooling water to the laser used a pump with an outlet pressure of 150 psi and connected it to a domestic water line which operated at 60 psi. Therefore the treated chilled water was pumped into the domestic water system contaminating the system.

11. The make-up water system for a solar heating water storage tank did not have backflow protection and subsequently introduced chemicals into a domestic water service because of lower line pressure experienced when a fire suppression system and fire department equipment lowered the water main pressure.

12. Ethylene glycol, an anti-freeze additive added to air conditioning cooling tower water, inadvertently entered the potable water supply system in a medical center in Illinois and two of the six dialysis patients succumbed as a direct result of the contamination.

13. Creosote entered the water distribution system of a southeastern county water authority in Georgia as a result of a cross-connection between a ¾" inch hose that was being used as a priming line between the fire service connection and the suction side of a creosote pump. While repairs were being made to a private fire hydrant, the creosote back-siphoned into the water mains and contaminated a section of the water distribution system.

Backflow Preventer



Case #2

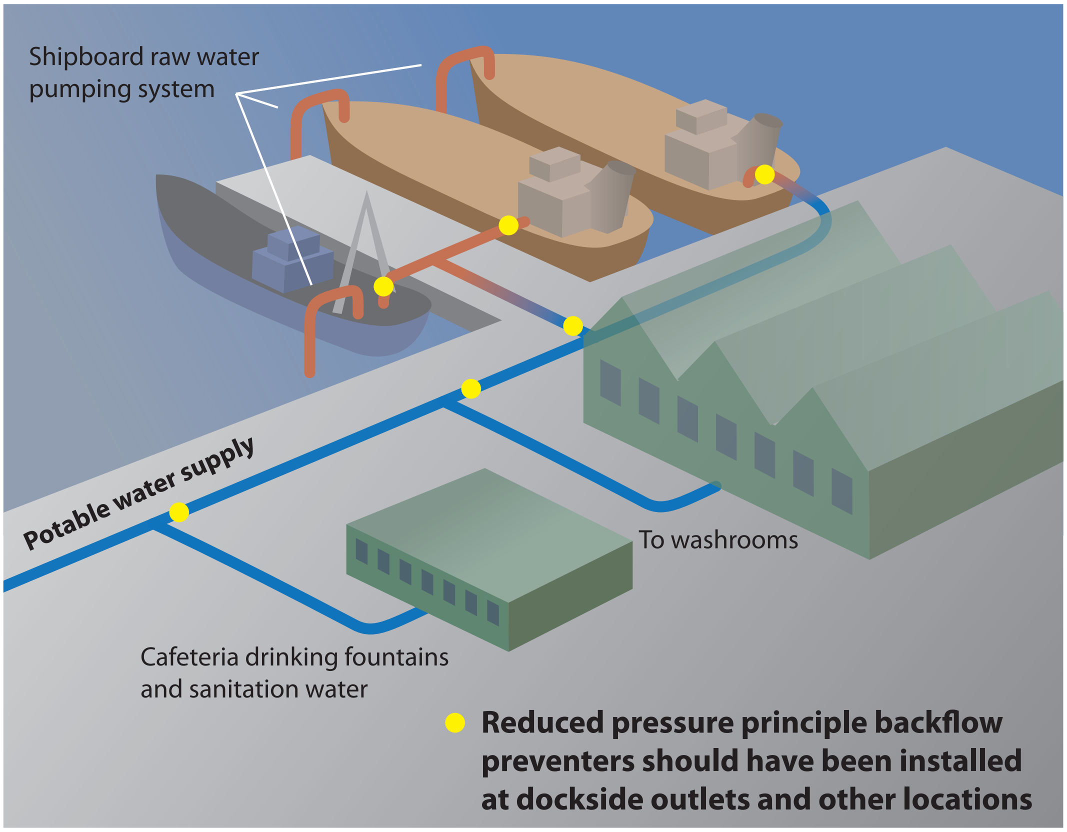
Shipyard Gastroenteritis – 1,179 cases

Unfortunately, instances of cross connections within shipyard facilities have been quite common over the last 75 years.

An outbreak of gastroenteritis at a shipyard in Oregon resulted in 1,179 known cases among the yard's 15,000 employees. The outbreak resulted from a cross-connection on a ship between the city water supply and water taken from the Willamette River, which at the time was a stream polluted with raw sewage. The river water was used for fire lines, but the city water connection constituted an alternative supply. The valve which controlled the two supplies was defective. Because the pumped river water was under higher pressure than the city water, polluted water was forced into city lines and contaminated the drinking water at the yard. The cross-connection existed for a week before the danger was realized.

In numerous other cases, the domestic drinking water supply for shipyards has been contaminated with salt water. This again, happened because the onboard fire protection pumps of a ship, which had a greater pressure, forced salt water through a cross connection between the freshwater line and the fire suppression system on the ship and into the fresh water system of the shipyard, contaminating the system.

In every case, the practice of installing reduced pressure backflow preventers would have prevented the misery that was suffered by the people who were stricken. Today, these devices are required by most code authorities.

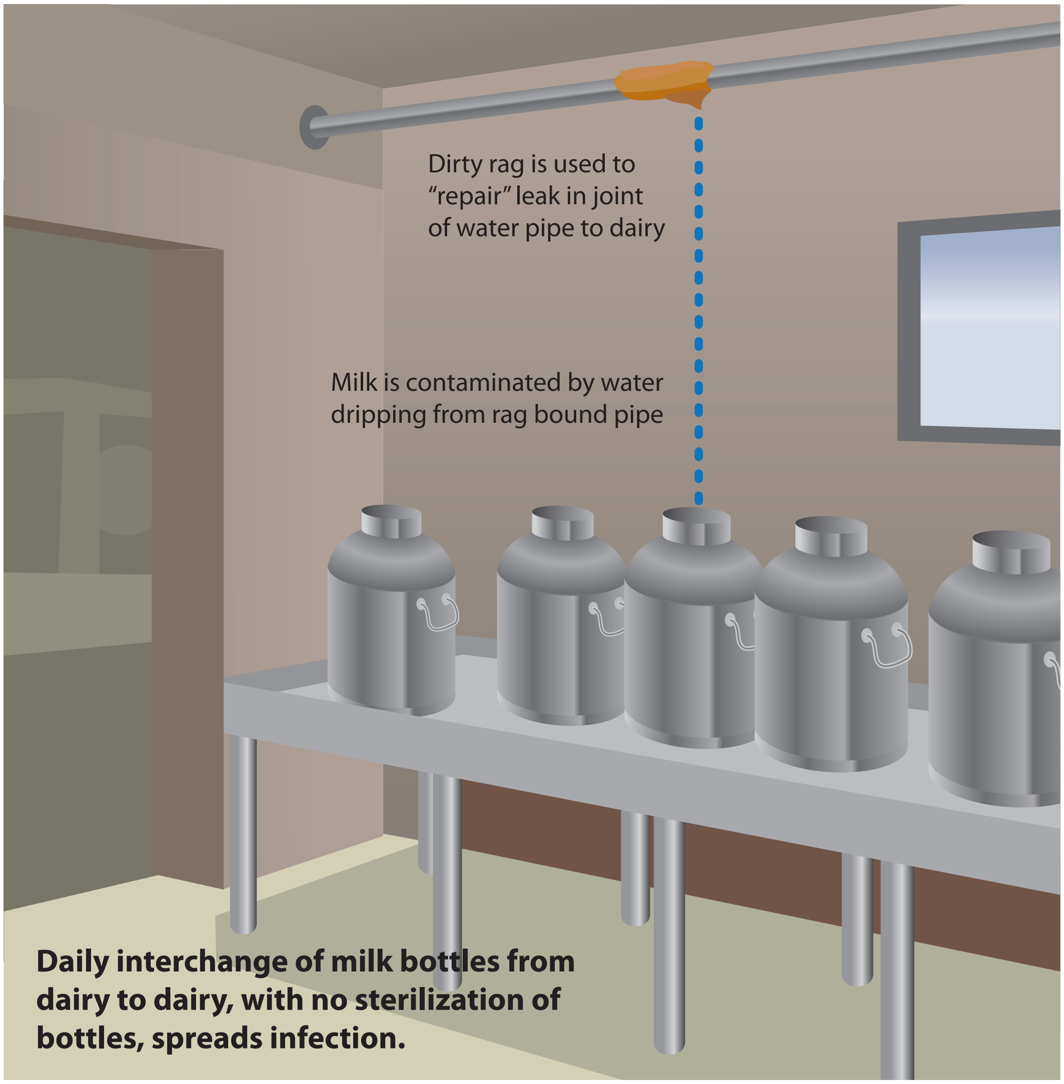


Case #3

Acute Enteritis – 9 Deaths, 409 Cases

An epidemic of acute enteritis in Kansas was traced to polluted milk. The milk was demonstrated to be infected by water dripping into milk from a rag which had been tied about a pipe joint as a "repair" measure. The water dripping from the cloth was shown to contain the causative organism. Equipment of both pasteurizing plants involved also was found open to continued contamination by flies and other means. The daily interchange of bottles from dairy to dairy, with no sterilization of the bottles, made for the spread of the infection from one dairy to another, or from homes in which the infection was present to the dairies.

A total of 409 cases were found in the community. Of 24 infant cases hospitalized with the infection, nine died. All of the 24 infant cases were believed to have been secondarily infected from mothers, nurses or other carriers of the disease. Adjacent areas, having much in common in the way of environmental surroundings, but having different milk supplies, were not affected.



Case #4

Severe Acute Respiratory Syndrome (SARS)- 8,273 Infected, 775 Deaths

Following the November 2002 - July 2003 SARS coronavirus epidemic, which infected over 8,000 people and claimed 775 lives, the World Health Organization (WHO) whose objective is "the attainment by all people of the highest possible level of health", issued a press release following intensive investigations into the causes that headlined "Inadequate Plumbing Systems Likely Contributed to SARS Transmission".

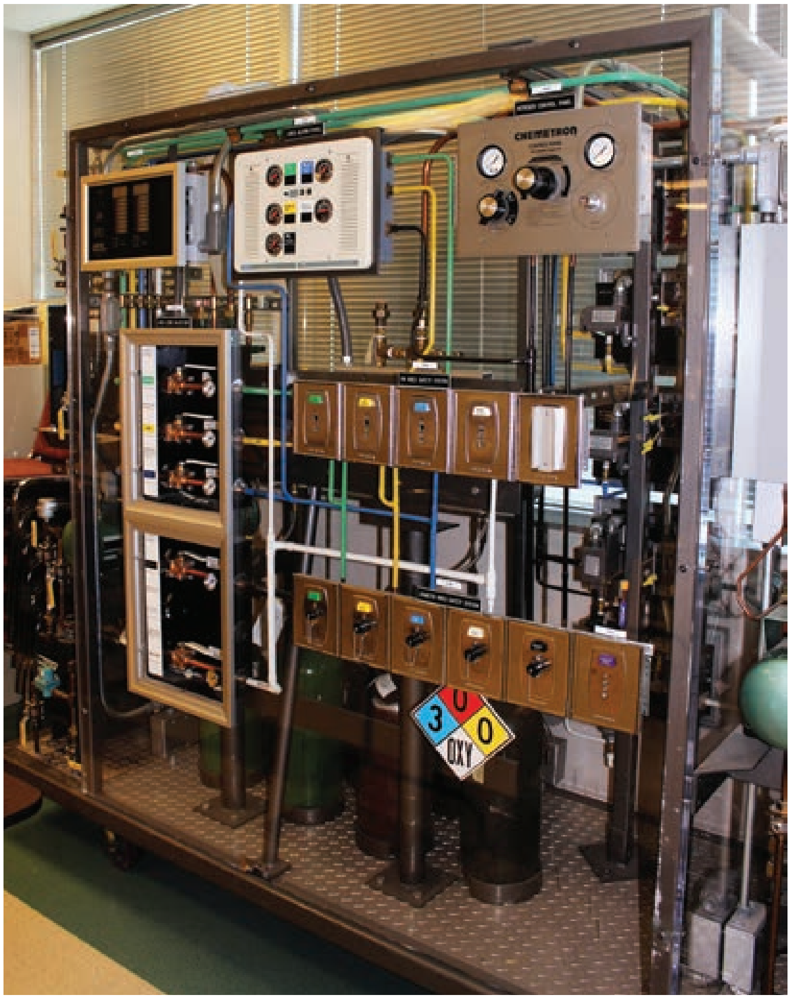
The investigation into the causes of the outbreak led health authorities to a probable source described as "defects in the drainage systems of the Amoy Gardens1" apartment complex in Hong Kong. The release went on to explain "viruses that can be transmitted by the fecal droplet route also include gastro-enteritis virus (such as Norwalk-like viruses), some adenoviruses and enteroviruses responsible for a number of gastro-intestinal and neurological diseases." In the 2003 SARS outbreak in Hong Kong, droplets originating from virus-rich excreta in a given building's drainage system re-entered into resident's apartments via sewage and drainage systems where there were strong upward air flows, inadequate "traps" and non-functional water seals." The Technical Consultation, explained the press release, "emphasized that the solution – proper plumbing – is a simple public health measure which is often overlooked but can be addressed at minimal cost. Nevertheless, it is a significant tool in stopping fecal droplet transmission of the disease." Finally, the release stated a resolve by the World Health Organization to "enhance joint efforts of ministries of health, building authorities, local governments and architects/designers to both raise general awareness of the risks from inadequate plumbing and sewage systems, and to take concrete actions to address shortcomings in this area."

Case #5

Life Saving and Critical Environments

In March of 2009, a Kansas High School senior went to his dentist's office for a routine removal of his wisdom teeth. After being sedated with medical gas, complications occurred, according to the Lawrence Journal World. The dentist thought he was administering 100 percent oxygen, but was instead giving his patient pure nitrous oxide. The teen stopped breathing and emergency medical personnel were called. He was then transported to Lawrence Memorial Hospital and then on to Kansas University Hospital with life threatening brain injuries due to oxygen deprivation.

The cause was later determined to be that "the individual manifolds used to connect the oxygen and the nitrous oxide were inadvertently transposed" and that "the accident was solely related to the incorrect hookup of the manifolds." The dentist's office had undergone a recent remodel and the plumbing contractor had turned the newly installed system over to the dentist without having the medical gas installation certified for use. The city's adopted codes did require contractors to hire outside inspectors for medical gas systems, though at the time it had no obligation to enforce this provision and, in fact, city officials confirmed to journalist, Stephen Webb, that they had no record of an inspection of the system taking place.



Since the tragedy, which almost took the young man's life and left him in a coma for a while, then blind, hard of hearing, with significant problems with his speech and walking with a cane, both the city and the State of Kansas have put regulations in place to require inspections of medical gas systems by a certified medical gas inspector prior to a building occupancy permit being granted.

Litigation initiated by the teen's family resulted in the plumbing contractor denying liability and settling, with the approval of the court, for a $3 million judgment. The city ($50k) and other identified parties in the suit settled out of court for amounts undisclosed after mediation a few months later.

Many states and municipalities require inspections and testing for piping systems which are critical to life safety. Whether in a hospital or dental facility, or in the case of food or pharmaceutical manufacturing processes, the application of codes and regulations many times come only after tragedies have happened. Many of these situations are totally preventable if we use what we have learned to control risks through codes and regulations.

Case #6

Mythbusters - Exploding Water Heater

Few homeowners realize the possible destructive power contained in their homes in the form of their water heaters. Improperly installed or maintained water heaters can pose a serious risk to life and property.

In a 1996 National Board Bulletin of the National Board of Boiler and Pressure Vessel Inspectors, William Axtman wrote that "if you could capture all the energy released when a 30-gallon home hot water heater tank flashes into explosive failure at 332 degrees Fahrenheit, you would have enough force to send the average car (weighing 2,500 pounds) to a height of nearly 125 feet- or more than the height of a 14-story apartment building – starting with a lift velocity of 85 miles per hour!"

His calculations showed that if "liberated in a rupture, a 30-gallon hot water tank at 90 psig has approximately 314,095 foot-pounds of energy to flash its water into steam at 332 degrees Fahrenheit. This equates to the explosive force of .16 pounds of nitroglycerin."

In discussing a flashpoint conversion factor chart for water to steam, Axtman also noted that "the increase in volume has a factor of 1,600 to 1. When water or a similar dense liquid that normally needs one cubic foot for containment suddenly needs 1,600 cubic feet, explosion occurs."

Following the QR Code below will lead you to what Mythbusters actually put together to show that the possibility of an explosion with a water heater is real. In this case, the myth was not busted, but proved to be not a myth. As you can see in their video, if the safety devices fail and the heating element is allowed to run wild, the result can be catastrophic to a home and its occupants.

Proper installation of water heaters along with simple regular checks of the safety devices can save homeowners a lot of grief. While failure of hot water heater safety devices is somewhat rare, occasional news reports of water heater explosions remind us of the need to maintain those systems with the utmost care.

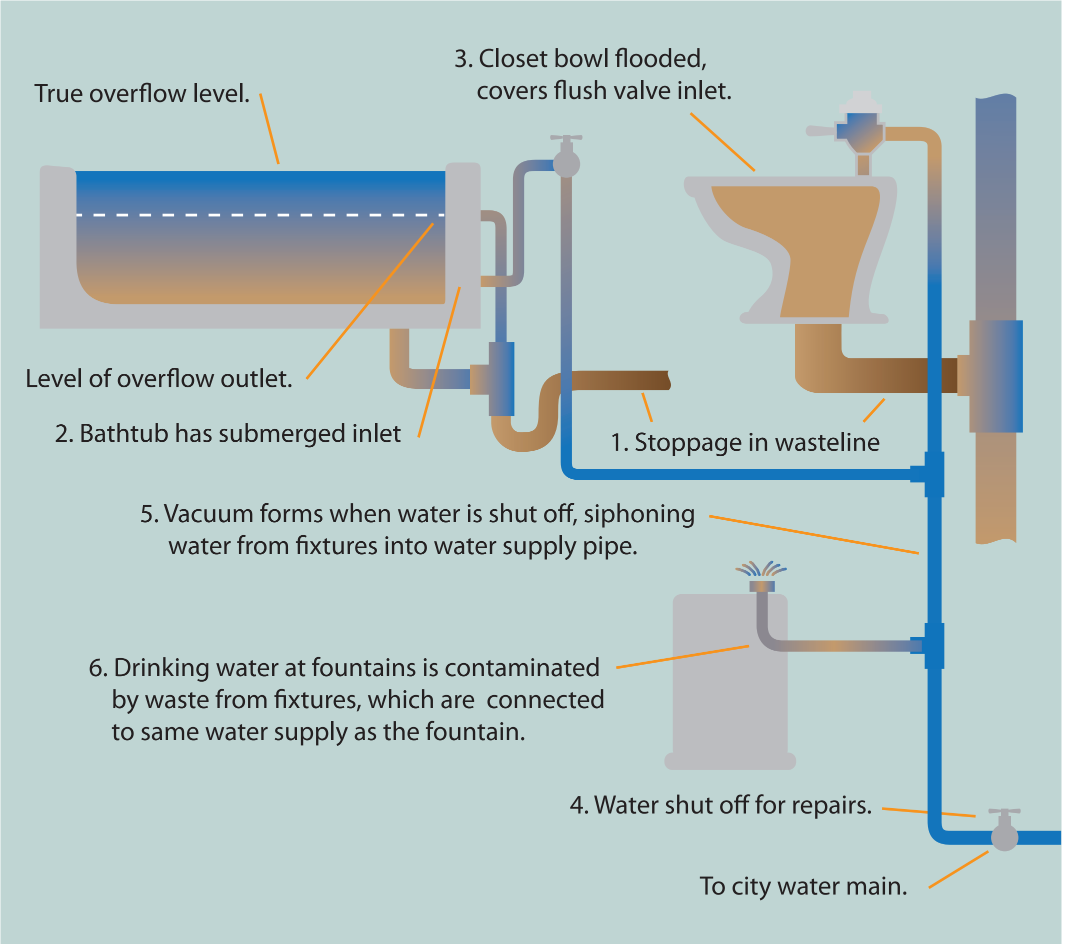
http://www.discovery.com/tv-shows/mythbusters/videos/water-heater-evolution-high-speed.htm

Scan the QR code for a link to the Mythbusters segment illustrating the power of a water heater.

Case #7

Amoebic Dysentery…98 Deaths, 1409 Cases

Among all disease outbreaks known to be caused by defective plumbing, the Chicago amoebic dysentery epidemic of 1933 was a watershed moment. Because thousands of people, coming from all parts of the country to attend a World's Fair, were threatened, the epidemic stirred public opinion everywhere. A special committee of nationally known public health authorities conducted an investigation. Their report revealed plumbing cross-connections, old and defective plumbing fixtures, and leakage from an overhead sewer into a cooled drinking water tank, in two large hotels as the source of contamination of the fresh water supply. The committee officially blamed: "Old and generally defective plumbing potentially permitting back-siphonage of fixtures, as bathtubs and toilets, into water lines; chance breaks in sanitary service or heavy overflow of mixed sanitary sewage and storm water draining in and outside of basements; cross-connections of serious character between water lines carrying potable water and water potentially subject to contamination." Although the record shows there were 98 deaths and 1,409 cases of illness, the probability is that many other affected persons never came into contact with investigating agencies, because when they became ill, they left Chicago and went home.



Case #8

Scalding Issues- Hot Water Too Hot?

The proper adjustments to a water heater fall under code constraints. Scalding injuries have been prevalent during the years since the introduction of hot water systems and many people have been injured due to scalding problems. Nearly 25% of the recorded injuries from scalding have occurred in children, most often in the bathroom and the average scald injury covered about 12% of the body with 3rd degree burns. 42% of scald burns have involved more than 10% of a child's body and an average of 12 children ages 14 and under die from scald burns each year with ages 4 and under accounting for nearly all the deaths. In 1999, an estimated 99,500 children ages 14 and under were treated in ER's for burn related injuries and out of that 23,620 were scald burns. The elderly are also at a higher risk because of slower reaction time to feeling the heat of water and the fact that their skin tends to be thinner from aging.

Time + Temperature Causing Scalding

Temp. (F)	2nd Degree	3rd Degree
111	220 Minutes	400 Minutes
113	120 Minutes	180 Minutes
115	30 Minutes	60 Minutes
118	15 Minutes	20 Minutes
120	5 Minutes	10 Minutes
124	2 Minutes	4.2 Minutes
130	18 Seconds	30 Seconds
140	3 Seconds	5 Seconds
150	Instant	Less Than 2 Seconds
158	Instant	Less Than 1 Seconds

> *"Environmental sanitation problems are a direct challenge to the public health engineers in this country.... It is obviously ridiculous to protect the water supply from its original source to the building, and then to subject it to the various hazards of contamination from a poorly designed and installed plumbing system."*
>
> **-M.C. Hope, Sanitary Engineer, U.S. Public Health Service**

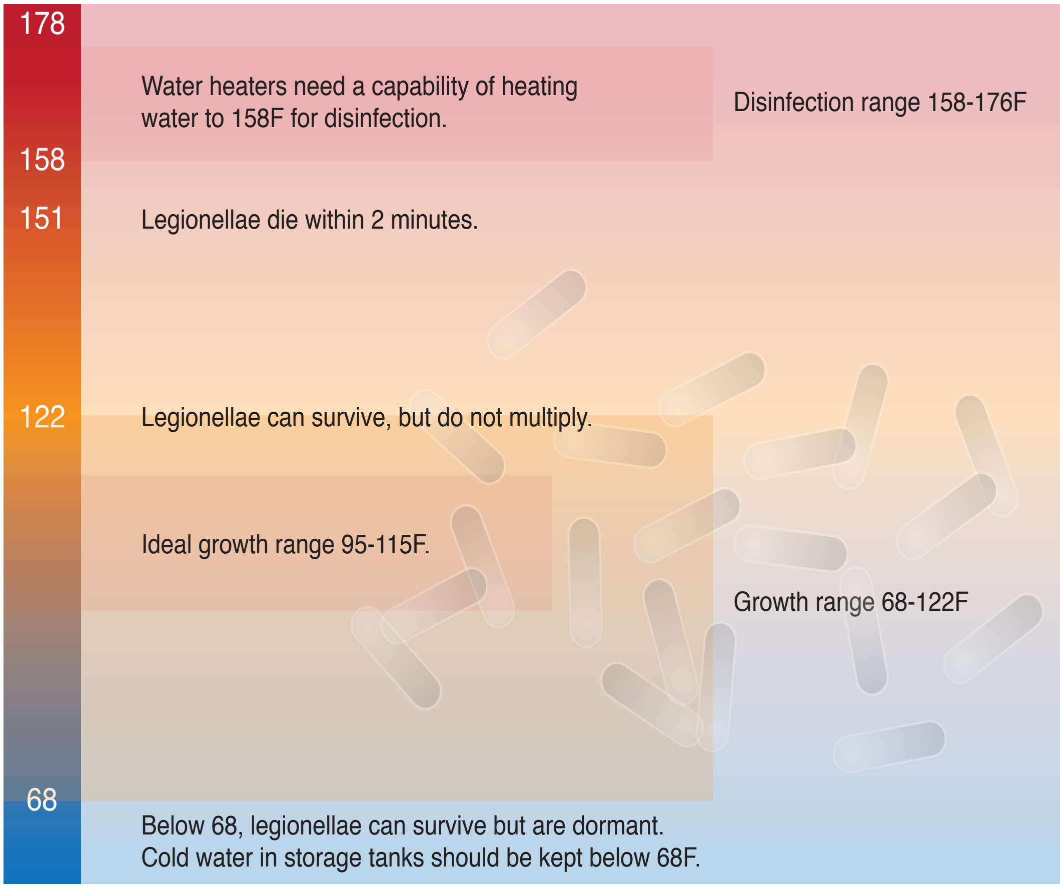
Legionnaires Disease and Energy Conservation - Hot Water Too Cold?

Legionella (L. pneumophila), the name of the bacteria found to cause the deadly Legionnaires Disease, has been referred to as "the Disease of the Modern Plumbing System."

First discovered in a July 1976 outbreak among people attending a convention of the American Legion in Philadelphia. The outbreak sickened 221 and caused 34 deaths. The cause was identified in January of 1977 as a previously unknown bacterium subsequently named Legionella.

The potential for Legionella to grow within a plumbing system has gone up with the move towards saving energy. As people lower the temperatures on their water heaters in order to save energy, and therefore to save money, they are upping the ante towards raising the risk that their water system may grow Legionella. Legionella thrives at temperatures from 95 to 115 degrees. The bacteria can live in water up to and including 122 degrees but has been found in systems as high as 124 degrees due to system design and circulation issues. The lowering of temperatures for a system will dramatically reduce scalding issues, but also expose people to the risk of growing the bacteria in their system.

Legionnaires bacteria has also been found in indoor water features of hospitals and other places where the water is not properly treated to kill bacteria and the ideal temperature for growth is met.



Case #10

Water Conservation Issues

As shown on page 3 of this booklet, fresh water resources on Earth are limited. These resources, given the chance, are periodically recharged by the Earth's natural system of evaporation and condensation, ie. the water cycle.

In some instances, the human population has used the resource to the extent where the recharging system has not been able to keep up, with the result being that rivers (like the Colorado River in the US) and lakes are drying up.

This has led us to rethink our relationship with water and come to the conclusion that the resource is finite. As the human population on Earth continues to grow, more efficient use of our water resources will become critical to our survival. With this in mind, plumbing systems and equipment are evolving. Along with that evolution, the codes which apply to those systems are also evolving.

It should be noted though, that care must be taken to ensure that the goals of the system are still able to be met by changes to systems. Sometimes the rush to move to a solution can create problems of another fashion.

This point is illustrated in what has been a rapid move to lower the flush volumes of toilets. Truly the early models were built without water conservation in mind. Water resources at the time seemed limitless. Now that the wasting of water is taken more seriously, lower and lower flush volume toilets have been developed. They have been developed, and in some cases, required by municipalities faced with water shortages. As the flush volumes have been continually lowered, another problem has presented itself, "dry drains". The movement of solids, in some places, has been retarded by the lack of water in the systems which has led some of those municipalities to pump water into their municipal waste treatment systems. This action, of course, negates somewhat the water conservation achieved by the low volume flush toilets. As we strive to find the right balance between water conservation and the physics that achieve what we want them to achieve, the codes will continue to evolve.

Another place where people have taken the water conservation movement has also led to a higher possible risk for scalding (see page 20). With reduced flow rates below 2.5 gallons per minute in showerheads, homeowners are trying to conserve water without the education they need to protect themselves and their loved ones. Low-flow showerheads should never be used with non-automatic compensating type shower valves. The non-automatic compensating shower valves coupled with low-flow showerheads can lead to significant pressure imbalances, which can cause thermal shock and scalding issues. The maximum flow rate of a showerhead should be matched with an automatic compensating valve with a flow rate equal to or lower than that of the showerhead. Homeowners should also know that with a water heater set for 120 degrees, the thermostat will cycle on and off between 105 and 135 and it is not uncommon to find 150 degree water rising to the top of the tank. This creates a possibly dangerous set of circumstances for the homeowners, especially if they have children or elderly members of the family using the hot water for showers, baths or sinks. Flushing the toilet in one part of the house could burn a family member in another part of the house.

> *"Television is like the invention of indoor plumbing. It didn't change people's habits. It just kept them inside the house."*
>
> **Alfred Hitchcock**

Controls…. The public's means of self-protection

What defense is there against the plumbing hazards which produce water-borne disease outbreaks? Against hazards which create the conditions of filth that breed other diseases? Against accidents, such as exploding water tanks?

The community has only one effective weapon: regulation. And regulation, to be effective, demands four kinds of controls:

1 CODES

- Outlines modern, safe methods and materials for installations
- Sets minimum standards for public health and safety
- Deems plumbing vital to community water/waste disposal systems
- Promotes responsible installations

2 CERTIFICATION

- Assures installation proficiency
- Sets technical standards
- Confirms installer competence and knowledge

3 PERMITS

- Measures effectiveness of code and licensing controls
- Provides for community oversight of consumers and installers

4 INSPECTIONS

- Assures planned improvements meet code requirements
- Verifies plumbing installations are completed to the public standard

This four-point system of control is the culmination of many years of trial-and-error search for adequate protection. Today, it is the pattern for plumbing regulation in US cities and states.

The purpose of statewide codes is to protect the health and safety of people living outside the jurisdiction of city ordinances.

But, even when every element of control is provided for, the community will still be exposed to danger unless vigilant enforcement is maintained. Some cities have modern codes, but do not provide funds for adequate enforcement or adequate inspection service. Only an aroused public interest can remedy this fault.

Likewise, in some cities throughout the country, proposals are periodically made which, if accepted by the community, would have the effect of weakening or destroying plumbing controls. For instance, some sellers of plumbing products fight controls, because they hope to evade the responsibility for competent installation of the merchandise they sell. Some well-meaning citizens want to pull down controls in the mistaken belief that this will effect a reduction in building costs. Good plumbing actually costs the consumer no more than faulty plumbing; but even if that were not true, could any saving be more important than the protection of public health? City authorities and citizens should be vigilant to see that the real purpose of controls is not distorted to permit selfish advantages to be gained by individuals who sell plumbing materials.

The great need for every community or region is to maintain in proper perspective the true purpose of plumbing controls; namely, self-protection.

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Page 24, Prince of Wales Quote

“In 1871, the Prince of Wales lost his groom, a friend and almost his life to an outbreak of typhoid in Londesborough Lodge where he and his friends were staying. The investigation proved that contamination in the plumbing lines were the problem. The craftsmanship of the 19th century sanitation engineer had come almost full cycle from the days of King Minos. In tribute the Prince was quoted as saying, “If I could not be a Prince, I would rather be a Plumber.””

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(continued from the front inside cover)

Plumbing Codes in Washington State

Codes are installation methods and procedures which are designed to eliminate mistakes, poor practices, and poorly designed systems and equipment from being installed. Consumers need confidence that the systems they purchase will stand the test of time and provide trouble free service.

In Washington State, by statute, The Uniform Plumbing Code, as published by the International Association of Plumbing and Mechanical Officials (IAPMO), has been the law of the land since 1972. Extensively vetted on a regular basis and amended through a process with the Washington State Building Code Council, this code provides minimum standards, which all entities within Washington State must meet.

Complete information about the Uniform Plumbing Code and the Washington State Building Code Council can be found here:

https://fortress.wa.gov/ga/apps/sbcc/page.aspx?nid=4

Plumbing Permits and Inspections in Washington State

Plumbing permits and the inspections which go along with them, are designed to give consumers the confidence that the systems which are installed on their behalf, truly are what they have paid for. Some think that plumbing, as a trade, is a simple thing which any one can perform properly. The old adage "it just flows downhill" is how many people perceive the trade of plumbing.

Over a hundred years of scientific trial and error have proven this is not the case in any area of expertise, let alone the plumbing trade. Whether or not it flows downhill is one aspect. As in many aspects of life there are nuances in the trade, which left undone or overdone, can have big implications regarding whether a particular system works or doesn't.

Having a Code Qualified Inspector look at a system and judge whether or not it had been properly designed and installed leaves consumers with confidence that an impartial person with the skill to review installation procedures is looking out for them to ensure the system will work as advertised.

In Washington State, local Health Departments are in charge of permits and inspections of plumbing systems: For more information regarding Plumbing Permits and Inspections, please contact your City or County Health Department.

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