7　まとめ

(1)　研究の経緯

本研究は、平成１８年度からの3カ年計画で貯水槽水道の管理水準の向上のための方策を研究することを目的として実施された。

18年度は3カ年計画の初年度で、貯水槽水道の管理に関する登録検査機関、水道事業者、給水管工事業者、清掃業者などに対する調査を行い、貯水槽水道における具体的なトラブルとその実態について、把握・整理した。

また、貯水槽水道の管理の先進国（シンガポール）の調査を行うとともに、「水安全計画」政策の中心的国際組織である世界保健機関（WHO）において担当者と国際的な整合性について調整を行った。

平成19年には

貯水槽水道の構造、材質、経年劣化の状況、補修工事の実施状況、日常管理体制について、18年度の基本調査を踏まえ、検査機関、水道事業者、保健所、給水管工事業者、ビル管理業者、清掃業者を対象に詳細調査を実施した。

また、これらの調査結果をもとに貯水槽水道をランキング（分類）する手法および、これに応じた管理のポイントについて検討するとともに、貯水槽水道の管理の実態調査（国内、国外）を実施した。

また、貯水槽水道の規模などに応じた、定期点検の方法、高度な水質検査のあり方、配管、貯水槽の劣化診断手法の開発、施設更新の考え方などを開発した。

これまでのこれらの調査研究により、貯水槽水道における衛生問題の現状を把握し、問題点を明らかにした。またそれぞれの問題点に対する解決策を検討し貯水槽水道の管理水準向上のための政策をまとめた。

その結果、貯水槽水道の管理の状況が把握され一部管理状況が悪いものがあることが把握された。

その原因のひとつとして、水道局からの飲料水を建築物内の貯水槽に貯留しそれを各家庭などの利用者に供給するという貯水槽水道のシステムにあることがわかった。

貯水槽水道の管理責任はその施設の設置者・管理者である。しかし本調査の結果、本来の管理責任を有する設置者の認識が低い事が判明した。

つまり、

貯水槽水道の管理水準の向上を図るには

- 貯水槽水道の現状を広く一般に知らせること
- 誰でもわかりやすく用意に実施できる管理方法をマニュアル化すること
- 設置者管理者が率先して管理を行う誘導策が必要であること

が必要であるとの結論を得た。

平成20年度は貯水槽水道の設置者や管理者が率先して管理を行うための誘導策としてのランキング制度について検討することとし、ランキング制度案を策定した。その経緯やその内容および論点についてはすでに詳述したところであるが、貯水槽水道の管理はその設置者にゆだねられているので、管理レベルを向上させるのは規制的手法と規制以外の誘導策が考えられるが、規制的手法については、貯水槽水道の数が非常に多いこと。(平成19年3月31日現在、上水道事業が1572箇所、簡易水道事業が7630箇所であるのに対し、貯水槽容量10㎥以上の簡易専用水道が約21万箇所、小規模のもの（10㎥未満）が約89万箇所もあること。）さらに法律での規制対象となっている簡易専用水道であっても法定検査の受検率が79%にすぎないこと、小規模のものについての受検率がわずか2.9%に過ぎないことから規制を強化する手法をとったとしても効果が期待しにくいことが考えられた。そのため本来の管理主体である設置者などが率先して管理を行うようにする誘導策としてのランキング制度について検討することとしたものである。

(2)　研究の成果

またこのランキング制度について横浜市を中心として56の貯水槽水道を対象にテスト実施した。また同時に登録検査機関、貯水槽清掃業者、高層住宅管理事業者、地方自治体担当者、水道・ビル関係業界紙、日本給水タンク工業会などにランキング制度についてアンケート調査を実施した。

その結果はこれまでに述べたとおりであるが、結論としては、そこのランキング制度を導入することが貯水槽制度の管理レベル向上に一定の効果があることが示唆された。

(3)　今後の課題

ランキング表示制度を具体的に実現していくためには、今後以下のような課題をクリアしていく必要がある

（1）ランキング表示制度は、ビルやマンションの管理事業者、不動産業界、そして何よりもビルやマンションの所有者に理解され、その価値を評価するものとして認識され、活用されることが重要と考えられる。このため、その考え方、評価項目等その内容を広く普及していくことが不可欠である。

（2）今回の案では、ランキング制度が、法定検査とリンクした形で策定されており、その結果、簡易専用水道に重点が置かれることになっている。しかしまだ検査がほとんど行われていない小規模貯水槽水道においても、問題は同様に発生しており、今後いかにこの仕組みを小規模貯水槽水道に広げていくかが課題となる。

（3）今回の研究では横浜市で、ランキング表示制度のテスト実施を行うとともに有識者

によるアンケート調査、ヒアリングを行い、制度の実施可能性を確認しているが、なお、その内容をブラッシュアップしていくことも求められている。今後、引き続きテスト実施やアンケート調査を継続し、その内容をより改善していくとともに、できるだけ早く実施すべく努力していく必要がある。

WHOの水安全計画は、安全な飲料水の供給のためには、水源管理から建築物内に居住する利用者にいたるまでの過程をいくつかのプロセスに分け、それぞれのプロセスにおいてリスク評価し、そのリスクを最小化していく方策を考え、実現していくことが重要だとしている。
同時に、実現可能なレベルの目標を設定し、それを達成した後に順次目標レベルを上げることによって最終的にゴールに到達できるようにするという、現実的な対応をとることを推奨している。とにかくまず第一歩を踏み出すことが重要であるとの考え方が、水安全計画の重要な考え方である。
われわれのランキング手法もこの考え方に基づいて、貯水槽水道の管理レベル向上に向けてさらに研究を継続していかなければならない。

F　研究発表
研究成果は平成20年度には
厚生労働科学研究費研究成果等普及啓発事業として
平成20年7月に航空会館（東京都港区）「貯水槽水道に関するシンポジウム」（主催；水安全計画による貯水槽水道の管理水準の向上に関する研究委員会、全国給水衛生検査協会、（社）全国建築物飲料水管理協会、（社）日本公衆衛生協会）を開催し発表した。
平成20年11月には、すまい・るホール（東京都文京区）において「貯水槽水道シンポジウム」（リビングアメニティ協会主催、全国給水衛生検査協会共催））
において研究成果を発表。
またテレビによる広報活動として
平成20年9月　フジテレビ　イブニング・ニュース
平成20年11月　テレビ朝日　近未来予測テレビジキルとハイド
平成20年12月　ＴＢＳ　イブニング・ファイブ
に研究代表者が出演し広報活動を行っている。

G　知的所有権の取得状況
特になし

（参考資料）

World Health Organization

WATER SAFETY in BUILDINGS

Version 9 - July 2008

WATER SAFETY in BUILDINGS

Section 0

Introduction and overview of the document

Extensive experience has shown that inadequate management of water systems in buildings of all types is associated with outbreaks of disease. The building types, water uses, disease outcomes, and individuals affected are each very diverse. The associated health risks can be readily controlled [and at low cost]. However available evidence - both from outbreak detection and from understanding of underlying driving forces - suggests that the overall trend is increasing. The rising trend, preventability and cost-effectiveness of interventions suggest the issue should be considered a [public health] priority.

In most cultures for buildings (other than private domestic premises, e.g. other than 'owner occupiers') there is a person or institution that bears some responsibility for the safety of water installations. This text, which is a supportive text to the Guidelines for Drinking-water Quality - is intended to support the improvement of such management. Its target audience includes the full range of 'actors' that influence the overall safe management of building water in particular it is directed to those who design, manage, operate, maintain and regulate water systems in buildings. It is intended to be a useful resource for the development of training and information material.

Building types from which water-derived disease outbreaks have been detected include buildings where people are likely to drink water, consume food prepared using water or be exposed to water for washing, showering etc. such as school / college, hospital, residential care / retirement home, nursing home, vet surgery, ambulance station / fire station as well as restaurant, guest House (bed & breakfast) bar, campsite, museum, sports ground, health clubs / fitness centres, cinema, hairdresser beauty salon, prison / detention centre, factories, apartment blocks (low rise and high rise), airports, bus / coach stations as well as domestic buildings. With increasing global urbanization the overall exposure of the human population to such buildings is increasing rapidly and in consequence the potential risk is increasing.

Outbreaks and cases of typhoid, cryptosporidiosis, legionella and lead or copper poisoning have been associated with water mismanagement in buildings.

'Drinking water' is a long-recognized cause of water borne disease caused by both pathogens and toxic chemicals arising from ingestion of the infectious (e.g. legionellosis or mycobacteria) or toxic agents (e.g. lead, copper, nickel, vinyl chloride, all of which are prone to increase in water between its arrival and use due to the means of its storage and use). There are uses of water in buildings other than ingestion that are associated with disease such as Legionellosis following inhalation of 'aerosols'/showers etc and this route of infection has been associated with health care settings, garden centres, schools etc, or following exposition to secondary devices / amplifiers such as cooling towers and spas ... Other health outcomes that may be prevented by achievable improvements in water management in buildings include drowning, scalding...

A significant proportion of such water-borne disease is associated with contamination within buildings. This arises from direct contamination (e.g. pigeon droppings into tanks); indirect (e.g. cross connections between potable water and contaminated water, buried/immersed tanks and pipes and growth of indigenous microbes (e.g. legionella) if devices such as cooling towers and hot or warm systems are not appropriately maintained.

Though this document deals with water contamination within buildings, hazards may also be introduced (e.g. pipe running at low pressure) in building water system from the incoming water and may carry pathogens from faeces or contain toxigenic cyanobacteria.

The impacts on health of inadequate management of water in buildings is considerable and has in turn significant economic impacts. [? expand with some example of economic impacts - costs to people getting ill, costs to health care system, lost opportunity arising from illness (productive and school time lost). In health care settings [add a statistic or link to one of the case studies that 'sells' the scale of impact and cost savings attainable]. Travel and hotel stays are recognized as risk factors for legionellosis (WHO, 1990). In Europe, approximately 20% of detected legionellosis cases are considered to be travel associated (Joseph, 2002). Cases of legionellosis in hotels have often received extensive publicity in the mass media.

Different population groups may be especially susceptible to certain water-related hazards and certain building types are therefore of special concern. Important examples include health care environments where growth of Pseudomonas aeruginosa is a significant health concern and leads to substantive avoidable costs; care homes for the elderly (scalding) or renal patients (water used for dialysis).

The third edition of WHO's Guidelines for Drinking-water Quality introduced the concept of 'water safety plans' and a 'Framework for Drinking-water Safety' (see box x and insert the simple version as a box - from available materials). The Framework focuses attention on effective preventive management and thereby disease prevention. The Guidelines Chapter 6 deals with the application of the Guidelines in a series of settings with specific reference to 'Large Buildings' such as health care facilities and schools and day care. The Guidelines recommend that 'large buildings' such as these have their own 'water safety plans to ensure the maintenance of water safety within such premises, with the intention that such 'building water safety plans' complement the water safety plans of water suppliers.

At the meeting of government-nominated experts that finalized the third edition of the Guidelines the issue of water safety in buildings was identified as a priority. This lead to a plan of work and the development of this document which deals with the buildings identified in the guidelines as well as others (see chapter 3 section 1).

This document therefore deals with the control of water safety in buildings through the development and implementation of 'building water safety plans' as recommended in the Guidelines for Drinking-water Quality. It draws on two other processes and publications: the WHO Guidelines for Safe Recreational Water Environments Volume 2: swimming pools and similar environments; and Legionella and the prevention of Legionellosis.

This document does not deal with:
* good practice in plumbing, which is dealt with in a separate supporting document to the GDWQ: 'Health Aspects of Plumbing'
* recycling of water which is the focus of a separate initiative under the 'rolling revision' of the GDWQ
* direct management of water sources (such as wells) by building managers which is addressed directly in the GDWQ

This document is therefore structured in four sections as outlined in figure 1.

Figure 1: Document structure

Contents
Section 0 - Introduction and overview of the document:
Section 1 - What is the problem *Chapter 1: Hazards.* *Chapter 2: People (Target groups and actors)* *chapter 3: building types*

Contents
Section 2 - Roles and responsibilities
Section 3 - Water Safety Plan Chapter 1 - Team building (stakeholders) Chapter 2 - Understanding the water system *Chapter 3 - Identification of Hazards* *Chapter 4 - Risk Assessment* Chapter 5 - Risk Management *Table: Main hazardous situations and risk events in water systems inside buildings*
Section 4 - Supporting Environment *Chapter 1 - Independent (technical) inspection* *Surveillance - different approaches including certification, audit, testing* *Chapter 2 - Disease surveillance / Outbreak* *Chapter 3 - Policy framework / public interest* *Chapter 4 - Capacity building, including training*
Unbalanced case studies spread as examples over the text matching the respective chapter

Section 1 is made of short introductions with principles which describe the problem related to water safety in building and put the document into context specifically how it fits into the Water Safety Plan Approach. It is organized by chapters addressing hazards and risks, people and building types.

Section 2 concerns the role and responsibilities of stakeholders who can influence the safety of water systems within buildings. Stakeholders can be involved in the planning, design, construction and renovation of buildings as well as development of water safety plans and ongoing maintenance and operation of water systems.

Section 3 concerns the various steps in developing and implementing Water Safety Plans and provides examples on how those key principles can be applied to buildings. A key requirement of the WSP concept is its periodic review or after significant changes of the supply system. Periodic review ensures regular updates of system assessment and management procedures but also explicitly allow for incremental improvement strategies in system upgrades, for example. This section is organized by chapters addressing team building, understanding the water system, the identification of hazards, risk assessment, risk management and has a table addressing the main hazardous situations and risk events in water systems inside buildings.

Section 4 concerns the environment that supports the delivery of safe water within building but do not affect water quality directly. This section is organized by chapters addressing independent technical inspection and surveillance including certification, audit and testing, but also disease surveillance outbreak, policy framework and public interest, capacity building and training.

Section 1 - What is the problem
Leader: Jeni COLBOURNE

Note: see notes below. This section should be made of short introductions with principles....

Chapter 1 - Hazards
Note: this would include:
- identifying hazards
- identifying consequences
- likelihood exposure
- risk prioritization including a simplified matrix and the matrix table 4.2 in the GDWQ. It also includes the table - criteria for confirmation of biological... involved in waterborne outbreaks...

Introduction and Overview of Hazards

Approach to this chapter: we believe there should be a general but short introduction that puts the document into context specifically how it fits into the Water Safety Plan Approach as advocated by WHO in the Drinking Water Guidelines 2004. This is something that it is consistent with all other WSP guidance documents. However, we would suggest that this needs to explain why drinking water quality in buildings has to be handled differently from water supply quality i.e. water suppliers, be they public or private, are organisations who can be held accountable for water safety, sufficiency and quality in the public interest, this is not the case for water within buildings, where the accountability falls to the owner and it is for the building being safe (water being but one of many factors (and not something that the owner can be expected to have a deep knowledge of).
Note: we envisage most sub sections will be a short paragraph, nothing longer.

1.2.1.Introduction to the concept of a hazard

1.2.2. Microbiological Hazards - Sewage/excrement
Domestic single premises and multi-occupancy (as agreed not aimed specifically at individual householders who would not be expected to have a WSP but to building managers / landlords of either individual or multi-occupancy buildings).
1.2.2.1.Types of system and uses (piped systems; mains and borehole / well for drinking and food preparation, for cleaning; personal hygiene; washing; etc, also hot tubs; swimming pools).
1.2.2.2. Risks associated with domestic drinking water systems (eg untreated water from borehole supplies;; system design; long runs in reticulated systems; poor temp; scalding control; hot tubs and swimming pools
1.2.2.3. Risks associated with domestic hot tubs; pools etc

1.2.3 Microbiological Hazards – growth of environmental organisms
Public buildings (not healthcare) includes schools; offices; hotels; leisure complexes; spa resorts etc
1.2.3.1. Systems and uses piped systems; mains and borehole uses to include large scale catering food preparation; irrigation (in addition to above cooling systems; pools; water features ;grey water ;fire sprinklers; hot tubs / spa pools swimming pools etc)
1.2.3.2.Risks to include intermittent usage; maintenance; management at risk users etc

1.2.4. Chemical Hazards – accidental contamination
Industrial premises
1.2.4.1(Additional systems and uses; including both open and closed cooling systems including continuous use; food manufacture (cross ref to codex)
1.2.4.2 Additional risks e.g; industrial processes with high nutrients / special waste considerations eg plastics factories ;wastewater and reclamation; long systems runs etc

1.2.5. Problems caused by materials in contact with drinking-water

Healthcare premises
1.2.5.1.Systems and uses (in addition to above; dental chairs; hydrotherapy pools; endoscope washers; sonicating baths etc
1.2.5.2.Additional risks; large systems; intermittent usage; at risk populations etc

1.2.6. Chemical Hazards – inadequate maintenance
Buildings for special purposes (e.g. fire stations; pumping stations; laundries) (to discuss)
1.2.6.1.Systems and Uses
1.2.6.2 Risks

1.2.7. Design hazards – Temperature

1.2.8. Design Hazards – exposure

1.2.9. Design hazards – reliability

1.2.10 User hazards

1.2.11 Natural Hazards and disasters

Table

Examples of hazards associated with water in buildings

Etiologic Agent	Incubation Period	**Clinical Syndrome**	Persistence in water systems	Sources	Exposure
Legionella spp	3 - 6 days 5 h -3 days	Legionnaires' disease (pneumonic illness) Pontiac fever: flu-like symptoms such as high fever often greater than 39.5°C (103°F). Severe cough with mucous production, gastrointestinal symptoms with diarrhea, nausea, vomiting. headaches, muscle aches, chest pain, and shortness of breath.			Cooling towers, domestic hot-water systems that operate below 60 °C, humidifiers, spas and whirlpools, dental water lines at a temperature above 20 ° C, water to ice machines, other water sources including stagnant water in fire sprinkler systems patient comfort.
Pseudomonas aeruginosa	48 h (range 8 h to 5 days)	Hot tub or swimming pool dermatitis/ folliculitis, otitis external (swimmer's ear), conjunctivitis, diarrhea, breast inflammation, flu-like symptoms, coughing and sore throat, urinary tract infections, and nausea			Direct contact with water (public hot baths, whirlpools, swimming-pools or saunas) *Minor relevance*: ingestion of water and ice, inhalation of aerosolized water droplets
Escherichia coli (enteroinvasive or enterotoxigenic)	10-12 hours (heat-stable toxin) 10-12 hours (heat-labile toxin)	Profuse watery diarrhea without blood or mucus, abdominal cramping, vomiting, low-grade fever and dehydration		Fecally contaminated water	Ingestion

Etiologic Agent	Incubation Period	**Clinical Syndrome**	Persistence in water systems	Sources	Exposure
E.coli O157:H7 (Enterohemorrhagic)	48-96 hours (up to 10 days)	Bloody or non-bloody diarrhea, severe abdominal cramps and occasional vomiting, fever infrequent		Fecally contaminated water	Ingestion
Salmonella typhi	3 days - 3 months (1-3 weeks)	Insidious onset of fever, headache, malaise, constipation or diarrhea, anorexia		Fecally contaminated water	Ingestion
Shigella	24-72 hours (12-96 hours)	Diarrhea, fever, nausea, vomiting, severe abdominal cramping		Fecally contaminated water	Ingestion
Vibrio cholerae 01 or 0139 *Vibrio cholerae* non 01	24-72 hours (few hours-5 days)	Sudden onset of profuse watery diarrhea, rapid dehydration, vomiting watery diarrhea, vomiting		Fecally contaminated water	Ingestion
Hepatitis A virus	28-30 days (15-50 days)	Acute febrile illness, anorexia, fever, abdominal discomfort, nausea, jaundice		Fecally contaminated water	Ingestion
Norovirus and Sapovirus	24-48 hours (10-96 hours)	Nausea, vomiting, diarrhea, abdominal cramps, muscle aches, headaches, low-grade fever		Fecally contaminated water	Ingestion

Etiologic Agent	Incubation Period	**Clinical Syndrome**	Persistence in water systems	Sources	**Exposure**
Nontuberculous or atypical mycobacteria (NTB).*	one week - two months	Pulmonary disease in adults, cervical lymph-node disease in children, skin, soft tissue and bone infection			home distribution systems, hot and cold water taps, ice machines, heated nebulizers, and showerhead sprays. High densities in biofilms on the insides of pipes and taps. NTM can colonize, survive, persist, grow, and multiply in tap water
Acanthameba					
Cryptosporidium parvum	7 days (2-12 days)	Profuse watery diarrhea, abdominal cramps, nausea, low- grade fever, anorexia, vomiting		Fecally contaminated water	Ingestion
Entamoeba hystolytica	2-4 weeks (few weeks-several months)	Illness of varying severity ranging from mild chronic diarrhoea to fulminant dysentery.		Fecally contaminated water	Ingestion
Giardia lamblia	7-10 days (2-25 days)	Diarrhea, abdominal cramps, bloating, weight loss, malabsorption. Infected persons may be asymptomatic		Fecally contaminated water	Ingestion
Heavy metals (copper, lead nickel)	Usually <1 hour (5 min-8 hours). (may be very long).	Compatible clinical syndrome – usually gastroenteritis May cause chronic effects			High acid beverages stored or prepared in containers coated or contaminated with the offending metal
Cooling fluids and oil	Usually <1 hour (5 min-8 hours)	• Vomiting • Methemoglobinamea if nitrate is included			

Etiologic Agent	Incubation Period	**Clinical Syndrome**	Persistence in water systems	Sources	Exposure
Organic chemicals including solvents	Usually <1 hour (5 min-8 hours)	Could be diverse (depends on the chemicals, see MSDS of chemicals or materials)			
Water treatment chemicals including their by-products	Usually <1 hour (5 min-8 hours). DBP can cause chronic effects				

* *M. gordonae, M. Kansasii, M. marinum, M. scrofulaceum, M. xenopi, M. avium complex, M. chelonae and M. fortuitum*

Chapter 2: People (target groups and actors)

Vulnerability and hazard exposition

In order to define the health risk of the people that attend or work in public buildings, it is necessary to take in account, among other factors, their degree of exposition to the existing or potentials hazards of a water system in this type of public buildings and the vulnerability of this people. Therefore, it is necessary first to define the exposed population and the relative vulnerability of the population to the identified hazards, combining then these conditions to define appropriately the risk of the vulnerable people in different exposition situations.

a) Exposed population to the water related hazards in public buildings

- People *working* in the public building. The health of these people is generally protected by the health and hygiene workers and services.

i. Administrative employees
ii. Maintenance and cleaning employees (Legionella, Pseudomonas)
iii. Etc.

- People *living* in the public building
- People *attending* the public building

i. *For short periods of time,*

1. are immune competent and will not undergo any immune depressive and/or invasive medical treatments or procedures. For example, the people that enter a public building to do some kind of paperwork in the administrative department, or enter a transport terminal to take a bus or any transportation.
2. are immune competent, and enter a health care center where they undergo any kind of invasive procedure. For example those who are going to receive an immune depressive drug or those who are undergoing a dialysis process, a tooth extraction, endoscopies, etc.

ii. *For regular periods of time*

1. At health care centers, those who are immune competent but will undergo a surgical procedure or other even more invasive procedures.
2. At health care centers, those who are immune compromised or become so at the hospitals for the environment conditions (including the stress in the ER areas).
3. In kindergartens, schools, or educational institutes.

iii. *For long periods of time*

1. Psychiatric Centers – Hospitals
2. Infectious Disease Centers – Hospitals
3. Military Barracks
4. Jails

The most important conditions of the water systems in public buildings, which might increase the hazards and people's exposition to them are among others:

- Higher Water Stagnation
  - Higher probability of lixiviation of substances in mains, deposits and reservoirs.
  - Higher probability of THM formation.
  - Higher probability of bacterial growth.
  - Higher probability of residual chlorine loss.

- Higher Complexity and Length of the systems
  - Higher probability of contaminants entering the system.

- Higher probability of structural and operational deficiencies (breaks, crossed connections, depressurization) and higher difficulties to identify and correct them.

- Facilities that are not common in apartment buildings
  - Water Dispensers
  - Ornamental Fountains
  - Cooler Tower Pools for Central Air Conditioning Systems

- Maintenance and Cleaning of Sanitary Facilities
  - Less effective and frequent
  - Transmission of pollutants from one facility to the other (water dispensers, taps).

- Use of the water facilities by the employees and public, which favors the pollution possibilities because:
  - The necessary hygiene practices are not applied or they are not the appropriate ones.
  - There is no interest in the maintenance of these facilities.
  - Pollution may vary depending on the way the facilities are used
  - There might be a higher and different type of use and manipulation of these facilities

The population with a higher exposure to this pollution would be:
- People who undergo invasive procedures in hospitals
- People staying in psychiatric centers
- Children in kindergartens
- Elder People in geriatrics
- People in Jails
- Soldiers in military barracks

As it is deduced from the different type of expositions and the vulnerability of the exposed population, the risk arises from the different combinations that might exist, which can be analysed in the chart below:

b). Vulnerability of the population in buildings:

The healthy person which stays for short or long periods of time in the buildings is the one that does not have immunodeficiency or condition that might affect its health when drinking or using the water for personal hygiene, or when using it or having contact with it.

On the contrary, the non-healthy person (unwell) in these buildings, is the one that, due to its physiological, immune or pathological conditions can be more vulnerable to the hazards that the water might contain. These conditions might be:

- Immunodeficiency (natural, acquired or induced)
- Pathologies which might favor the infection or the pathologic effects due to the water pollution
- Gastritis which are medicated inhibiting the stomach's acid secretions, which causes the person to be more vulnerable to gastrointestinal infection
- Physiological conditions which favor the infections or pathological effects: For example the slow methylators in the case of the Arsenic, or the people with specific blood type which are more susceptible to the Vibrio cholera infection.

Even if these conditions increase people's vulnerability to the infections, intoxications or

cancer, they are not exclusive of the people who live , work or enter a building, with the exception of the hospitals, geriatrics or kindergartens, where a higher amount of vulnerable people is concentrated, or where people gets immunodepressed due to medication and invasive procedures they undergo.

In the case of the people that go to a hospital, the vulnerability can determine the risk better than the exposition, while in the administrative public buildings, the characteristic that matters the most in the risk configuration is the exposition

At the hospitals the situation is even more delicate as it is an environment where the water is not only used for drinking or for personal hygiene, but also to prepare solutions for medical use, to disinfect wounds and burns, to wash or rinse medical equipment, etc.

In the kindergarten the children exposition to the contaminated water could be by ingestion of drinking water but it is common the infection by ingestion or contact with water of undisinfected swimming pools contaminated with their own excreta. This transmission pathway has been demonstrated in several outbreaks involving Shigella and Cryptosporidium among other pathogens. For that reasons the children in kindergarten are more exposed and vulnerable to water related hazards.

There is no doubt that the health care centres are the public buildings that concentrate the most exposed and most vulnerable people . In other words agglutinate the people with the more important waterborne disease risks.

Therefore the more vulnerable people in public buildings are , in increasing vulnerability order the following :

- Naturally imunocompromised people
- Immunocompromised people by other diseases
- Immunocompromised people by drugs
- Immunocompromised people by their age (children and elderly people)
- Immonocompromised people by stress
- undernourished people

Even if this type of buildings (health care centres) lodge more vulnerable people that the apartment buildings , it is evident that each time more vulnerable people could be found in the last ones by their convalescent status after clinical diseases or surgical procedures or people that are permanent immunodepressed by chronic diseases and don't need hospitalization. It is less probable that these people go to public buildings that a normal ones . It could signify that in some public buildings (administrative or commercial) it would be less possible found vulnerable people than in the private buildings. In the private buildings there are some particular specific exposition pathways like shower or immersion baths, that are infrequently found in public buildings.

Resuming, in the administrative, commercial, educational, transport terminal and other public buildings, the hazard presence and augmentation and the exposition to these hazards are their more important characteristic related the people health risks . Anyway there are some types of factors that affect these people vulnerability .For instance the stress (military barracks) the different chemical water (for instance sulfates, and other salts) composition of the drinking water with respect to their homes drinking water (similar to traveller diarrhoea)

One of the characteristics of the public buildings water systems that it is necessary to take in account is the quantity of people that could be affected by one water contamination episode that could be larger that the effect in apartment buildings.

It would be possible to think that the more important differences between the risks of the people that attend to public buildings with respect to the people that live in apartment buildings are more quantitative than qualitative. That it to say that the number of exposed people in the same time period is larger in the public buildings because the people quantity and turnover are larger than in private buildings.

What other differences would exist between public and private buildings about the WATER USE ?

WATER USE IN BUILDINGS

BUILDING TYPE
WATER USES
PUBLIC BUILDING
PRIVATE BUILDING
Drinking
X
XX
Personal hygiene
X
XXX
Domestic hygiene
X
XX
Shower bath
X
XX
Immersion bath
-
XXX
Wound and burns cleaning
-
XX
Food preparation
X
XX
Beverages (juices) preparation
XX
XX

PEOPLE USING WATER IN PUBLIC BUILDINGS
WATER USES IN PUBLIC BUILDINGS
EMPLOYEE
PUBLIC
INHABITANT
Drinking
XX
X
XX
Personal hygiene
XX
X

XXX
Domestic hygiene
X/-
-
XX
Shower bath
X
-
XX
Immersion bath
-
-
XXX
Wound and burns cleaning
X/-
-
XX
Food preparation
X
X/-
XX
Beverages (juices) preparation
XX
X
XX

The people that enter a public building to do some paperwork, are possibly less exposed than the employees that work in this same building, simply because they stay less time in the building, and are consequently less exposed to the water which might be polluted.

However, there would be other risks to which this people might be exposed, even in a higher level than the building employees, such as the contamination of public-use facilities:

- Water dispensers
- Public use taps
- Public use bathrooms

These facilities are generally very poorly maintained, when they are maintained at all, at least in Latin American countries. This constitutes a contamination and infection focus for the people that uses them.

Another reason for which it can be considered that in public buildings people is more exposed to existing water risks is because the drinking water bottles have an uncertain origin and maintenance. Most of the time, in public areas, disposable glasses are used to drink water, and these have been stored in inadequate places, in contact with dirt, insects and other vectors. In the case of water being used to prepare food, the hygienic procedures are not always applied as they should, or as they are applied in domestic situations, such as prepare the formulas for children (nursing bottles) with boiled water or boil the milk once it is prepared.

For example, we have found cockroaches in the automatic coffee dispensers.

On the other hand, in the home buildings, the water is drank from glasses and containers properly washed. The water jars that are stored in the fridge, are used by less people than in public buildings, and consequently it is less probable that they get contaminated.

In conclusion, we could say that even if the water is provided by a public network and stored in the reservoirs, has the same quality in public or home buildings, what can make the difference is the way it is manipulated once it is transferred to the recipients which origin, cleanness and maintenance can not be ensured as adequate.

Even if the people that goes to the public buildings is less exposed to the water pollution hazards than the employees, they are still exposed to improperly maintained and operated facilities (water dispensers, public bathrooms water taps, etc.). It has been proved that in bus and train stations, the people prepare the babies´ food with water that they get from the public bathrooms´ taps, obviously of uncertain quality.

Introduction to concept of risk (consequences)
The well person
The unwell person in the community
The unwell person in care

Chapter 3: Building types

Note: what are specific risks associated to specific buildings

Definition of building
Definition of Building (in the context of water safety). We will use the definitions contained in a DWI research report authored by WRc for public buildings expanded to include the domestic and developing country context (buildings with no piped supply but standpipes or tanks/containers)

Types of buildings and associated water systems, uses and associated risks

Introduction to concept of risk (likelihood)
Overview of piped water systems and design issues; availability of water; effect of water quality e.g. of sources mains v borehole; Systems design and materials; water storage; waste water etc

Types of buildings

Set out below, in no particular order, are the kind of buildings, from a UK perspective, we would consider should be included in considering water safety plans for buildings. The main criteria for inclusion is buildings where people are likely to drink water, consume food prepared using water or be exposed to water for washing, showering etc. It is not proposed that this is an exhaustive list of buildings.

School / College
University
Further Education
Nursery school

Hospital
Clinic
Doctor surgery
Dentist surgery