

# Prevention and Control of Legionella Infections in Mountain Huts – the New International Recommendation of the Medical Commission of the Union Internationale des Associations d'Alpinisme (UIAA MedCom)

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## Abstract

*Legionnaire's disease* is a life threatening respiratory tract infection that is commonly associated with a stay in communal accommodations such as hotels, hostels, guesthouses and camping sites.

In the European Alps and some other areas of the world mountain refuges and huts can sometimes accommodate over 100 guests in almost hotel like comfort. Such a “hut” may have cramped dormitories with multi-occupancy bunks and a basic water supply system possibly with hot water. Some will have showers. The water supply may be limited by the environment. As such these may pose a high risk for transmission of *Legionellosis*. In an environment of a hut which is more difficult to control than others.

Unfortunately countries differ in their guidelines for the prevention of *Legionnaire's disease* transmission within tourist accommodation. The aim of this paper is to propose a set of simple and pragmatic rules that can prevent the development of *Legionella* infections in mountain huts and other accommodations situated in the wilderness environment.

**Keywords:** Legionella pneumophila, legionellosis, hygiene, mountain huts, infection control

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## Background

Following the death of a Spanish Mountaineer in hospital in Aosta (Italy) in 2009, the CAI (Italian Alpine Club) was involved in a public health enquiry and an associated medico legal case. The mountaineer had died of pneumonia due to a *Legionella* infection. The investigation conducted by the Region Agency for Environment Protection concluded that the infection had been contracted during an earlier stay in a Swiss hut. The investigation conducted

by the Region Agency for Environment Protection concluded that the infection had been contracted during an earlier stay in a Swiss hut. The tests performed in the Italian hut were negative. The problem of potential transmission of *Legionella* in a mountain hut should be considered in all countries.

In Europe specific guidelines exist in many countries for the prevention of this infection in tourist accommodation [1-3] but this does not cover mountain huts although there is an important difference between mountain huts and other tourist destinations: In mountain huts all facilities are often not in use for weeks or even months, often there is no or limited hot water and often the systems are quite old. All these factors were identified as special risk factors for *Legionella* pneumonia [4].

This paper presents the official recommendation of the Medical Commission of the UIAA (Union Internationale des Associations d'Alpinisme – International Mountaineering and

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Climbing Federation). It gives simple, pragmatic, easily applicable rules to prevent the problem of Legionella in mountain huts [5]. The UIAA is the world umbrella organization of alpine and mountaineering federations with representatives of 68 countries worldwide. The main goal of the Medical Commission (UIAA MedCom) is to establish worldwide standards for preventive medicine and health at altitude and in any discipline of climbing and mountaineering.

## Introduction

Legionellosis is the term used for infections caused by Legionella pneumophila and other related bacteria. Legionella bacteria are only dangerous in respirable form and generally only in susceptible individuals for whom inhalation of the bacteria in aerosols or water droplets (showers) may cause severe pneumonia and, in extreme cases, death. Legionella is common in many environments and although more than 45 species and 70 serogroups exist, approximately 90% of infected cases are due to Legionella pneumophila [6].

Legionellosis takes two distinct forms:

- **Legionnaires' disease**, also known as “**Legion Fever**”, is the more severe form of the infection and produces high fever and pneumonia.
- **Pontiac fever** is caused by the same bacteria but produces a milder respiratory illness without pneumonia that resembles acute influenza. Pontiac fever also has a spontaneous recovery.

Legionnaires' disease acquired its name in July 1976 when an outbreak of pneumonia occurred among people attending a convention of the American Legion at the Bellevue-Stratford Hotel in Philadelphia. On January 18, 1977 the causative agent was identified as a previously unknown strain of bacteria, subsequently named *Legionella*. Some people can be infected with the *Legionella* bacteria and have only mild symptoms or no illness at all. However, since it is a potentially life-threatening disease it needs special attention at places which include specific risk conditions as mountain huts do.

Outbreaks of Legionnaires' disease receive significant media attention. However, this disease usually occurs as single, isolated cases not associated with any recognized outbreak. When outbreaks do occur, they are usually in the summer and early autumn, though cases may occur at any time of year. The fatality rate of Legionnaires' disease has ranged from 5% to 30% during various outbreaks [7-10]. The death rate for patients who develop Legionnaire's disease while in the hospital is close to 50%, especially when antibiotics are started late,” according to the NIH and U.S. National Library of Medicine, although it has decreased since 2015 [9]. Most infections occur in those who are middle-age or older [9]. Since this is the typical age group of visitors of alpine huts where it is always difficult to maintain proper hygienic con-

ditions the topic is of special interest of such alpine accommodation. The problem is even more pronounced by other risk factors which the visitors carry along, e.g. smoking, diabetes mellitus, intake of corticosteroids, and others.

Patients with Legionnaires' disease usually have fever, chills, and a cough, which may be dry or may produce sputum. Some patients also have muscle aches, headache, tiredness, loss of appetite, loss of coordination (ataxia), and occasionally diarrhea and vomiting. Confusion and impaired cognition may also occur, as can a so-called “relative bradycardia”, i.e. low or low normal heart rate despite the presence of a fever. However, this is a difficult topic in mountain huts since heart rate may be increased by altitude. Laboratory tests may show that patients' renal functions, liver functions and electrolytes are deranged. Hyponatremia is common. Chest X-rays often show pneumonia with bi-basal consolidation. It is difficult to distinguish Legionnaires' disease from other types of pneumonia by symptoms or radiologic findings alone; other tests are required for diagnosis. Persons with Pontiac fever experience fever and muscle aches without pneumonia. They generally recover in 2 to 5 days without treatment.

The time between the patient's exposure to the bacterium and the onset of illness for Legionnaires' disease is 2 to 10 days; for Pontiac fever, it is shorter, generally a few hours to 2 days. Since mountaineers regularly change the huts according to their itinerary and climbs the follow-up of infections and therefore infection control is harder in this environment than for normal tourist destinations.

*Legionella* bacteria are widespread and found in many aquatic environments, where they feed on algae and organic matter in sludge, sediment and silt, in a pH between 5 and 8. They tolerate a range of temperatures, although below 20°C and above 50°C they are dormant and above 60°C they do not survive [4,11].

When *Legionella* bacteria enter man-made systems offering favourable conditions they may proliferate. If water droplets are created and dispersed into the atmosphere, residents in the vicinity will be at risk of inhaling the bacteria. To eliminate or reduce the risk, control measures must be in place to prevent the proliferation of the organism in water systems, and to minimize the generation of water droplets and aerosols.

The European surveillance program EWGLI (European Working Group for Legionella Infections) was created in 1986 and since 1993 has been coordinated by the National Bacteriology Laboratory in Stockholm and the Public Health Laboratory Service (PHLS), Communicable Disease Surveillance Centre (CDSC) in London. The system allows interchange of information between EC Countries for epidemiological investigations and appropriate interventions [12].

In order to minimize the risk of LD it is therefore necessary to implement strategies that ensure *L. pneumophila* is eliminated from these systems and that the generation of water droplets and aerosols are kept to a minimum. In Europe there are specific

guidelines for tourist accommodation including hotels, apartments, camp sites and cruise ships for the prevention of infection transmission [1,2,3,13]. The guidance suggested here takes the special conditions of mountain huts into account.

## European guidelines for legionellosis prevention

A review of the guidelines for prevention of infection from different countries reveal differences in approach to environmental controls and decontamination (Tab.1 & 2). Whilst countries such as France and Switzerland only targets hospitals and other health-care facilities [14-16], Germany tests any facility which provides drinking water for members of the public [17,18]. Although water is tested in all cases, countries such as Italy, Spain and Switzerland also examine the biofilm within the water storage systems [3,16,19]. Thresholds for *Legionella* also vary between countries. In France, quantities above 100 colony forming units per litre (CFU/l) are deemed unacceptable, whilst in Italy this limit is set at 10000 CFU/l [14,15,20,21]. In Germany, concentrations vary depending upon the site tested. In “high risk” facilities more than 1 CFU/l is deemed unacceptable whilst 1000 CFU/l is the threshold in other facilities [17,18].

Procedures to disinfect water storage systems also vary. Whilst all recommend the regular running of hot water, the temperature, duration and frequency all vary. In most countries chlorine dioxide is added to the water. However additional agents such as hydrogen peroxide are also used. Given these differences the UIAA Medical Commission has established the following consensus in accordance with the EWGLI recommendations.

## Prevention: recommendations for mountain huts

The following practical advices for the prevention of *Legionella* infection in mountain huts acknowledges the practical problems and environmental difficulties in geographically remote mountain huts but are based on the existing international guidelines (EWGLI adapted).

1. If the sanitary water is heated at the moment of the use (gas boiler) to 70°C or more treatment is not required.
2. If sanitary water is warmed and stored (e.g. electric boiler or solar panel), and therefore “stagnates” in water containers, treatment is required, even if it has been initially been heated to temperatures higher than 70°C:
  - a. Procedure for the **water container**:  
Once a year, prior the seasonal opening, the water container should be thoroughly cleaned and then disinfected with 50mg/l chlorine for 2-4 hours.
  - b. Procedure for the **water**:  
Once a year, prior the seasonal opening, the water

supply should be disinfected by:

- i. **Thermal shock** heating water to 70-80°C for short periods of time has been used successfully for both emergency disinfection and periodic disinfection, as part of a long-term control programme. Thermal disinfection is carried out by raising the temperature of the contents of the hot water storage heater to 70-80°C then circulating this water throughout the system for up to three days. To be effective, the temperature in the hot water storage heater should be high enough to ensure that the temperature at the taps and appliances does not fall below 65°C. Each tap and appliance should be run sequentially for at least five minutes with water at 65°C. This temperature should be measured. Recommendation: on an annual basis, the water should be heated to 70°-80°C for 30 min/day for 3 consecutive days.
- or
- ii. **Constant maintenance of the temperature between 55-60°C**: At 60°C it takes approximately two minutes to inactivate 90% of a population of *L. pneumophila*. Maintaining the temperature at 60°C has been successfully achieved in both hospitals and hotels. Circulating water at 60°C, such that the temperature at each outlet reaches at least 50°C within one minute of opening the outlet, is the most commonly used method to control *Legionella* in hot water distribution systems. Recommendation: the water should be always maintained > 60°C.
- or
- iii. **Sodium hypochlorite shock**: Chlorine has also been used for preventing the colonisation of *Legionella* species in hot water systems. The bactericidal action of the chlorine is pH sensitive and decreases rapidly at values above 7. Therefore the pH of the water will need to be monitored regularly and may need adjustment. Treatment with sodium hypochlorite must be carried out in cold water (below 30°C). A free residual chlorine concentration of 20-50 mg/l is required throughout the installation, including distal points. After a contact period of at least two hours with 20 mg/l of chlorine or at least one hour with 50 mg/l of chlorine, the water is drained. Fresh water is then let into the installation until the level of chlorine returns to the concentration of 0.5-1 mg/l.

Recommendation: periodically the concentration in the water is maintained up to 50 mg/l for 1 hour or up to 20mg/l for 2 hour (e.g. on an annual basis the water storage system should be treated with sodium hypochlorite).

or

iv. **Continuous chlorination**: This is achieved by the continuous addition of chlorine, usually in the form of calcium hypochlorite or sodium hypochlorite. Residual levels of chlorine can vary depending on the quality of the water, the flow, and the amount of the biofilm in the system. The concentration of chlorine must be kept between 1 and 2 mg/l. Where there are stagnant areas or circulation problems in the water distribution system, the chlorine will not inactivate Legionella in these areas.

Recommendation: sodium hypochlorite is added continuously to the water supply in order to maintain a residual concentration of 1-2 mg/l.

In these two last cases label all outlets should be provided with appropriate warning signs: “**chlorined sanitary warm water, not drinkable**”.

c. Action on **flushing outlets** (taps, showerheads):  
 Shower heads and taps should be kept clean and free from scale.  
 Once a year, prior to seasonal opening, the flushing outlets should be cleaned using a descaler (e.g. acetic acid or vinegar!), then disinfected by soaking them overnight in a sodium hypochlorite solution (bleach!) and rinsed before reinstalling.  
 All taps and showerheads should be run for several minutes at least once a week if they are unoccupied. Also mountaineers who may be worried whether the showers of the respective hut are maintained correctly or not in regular use may flush hot water (as hot as possible) directly into the drain for some minutes before they start showering.

### Conclusion

The procedures presented in this recommendation provide a pragmatic approach for Legionella control in the specific environment of a mountain hut. The recommendation is in accordance with all relevant national guidelines.

**Table 1.** Procedures of *Legionella* control in some countries (examples)

Country and reference	Monitoring programme	Sample	Sampling methods	Thresholds for <i>Legionella</i> concentration
France [14], [15]	Yearly in all health-care facilities	Water	Faucets / showerheads: water samples Water (1 l): a) pre-flushing samples; b) post-flushing (after running water 2-3 minutes to obtain water contained in the plumbing system)	< 103 CFU/l* < 102 CFU/l* < 50 CFU /l*
U.K. [20], [21]	Weekly in system where temperature and biocide levels are not being achieved Monthly in water system treated with biocides Investigation of an out-break	Water	Faucets and showerheads: water samples Water (1 l): Pre-flushing samples	103 CFU/l*
Italy [3]	Investigation of an out-break Periodic sampling where people at high risk might be exposed Validation of the effectiveness of decontamination	Water and biofilm	Faucets and showerheads: biofilm samples and water samples Water (1 l): a) pre-flushing samples; b) post-flushing (after running water 5-10 minutes to obtain water contained in the plumbing system)	> 104 CFU/l*

Spain [19]		Water and biofilm	Faucets and showerheads: water samples Water: a) pre-flushing sample with swab (100 ml); b) post-flushing (1 l)	
Switzerland [16]	Yearly in all health-care facilities Six-monthly in health-care facilities where at-risk patients are hospitalized Investigation of an outbreak	Water and biofilm	Faucets and showerheads: biofilm samples and water samples Water (1 l): a) pre-flushing samples; b) post-flushing (after running water few minutes to obtain constant water temperature	30% of sample are culture-positive
Germany [17], [18]	Annually for any facility which provides drinking water for the public	Water (250 ml taken after some seconds of flow)	Especially warm water of showers and warm water systems of any kind. Colture from 1 ml of sample or membrane filtration with 100 ml	For high risk facilities (e.g. hospitals, clinics, etc): 0 CFU /100 ml; alarm when > 1 CFU/100 ml For other facilities: acceptable result: to be checked at > 100 CFU/100 ml; action mandatory at > 1000 CFU/100 ml; high risk range: > 10000 CFU/100 ml

Modified from [22], \* CFU: colony forming units

**Table 2.** Recommended disinfection procedures when the limit threshold exceeded (procedures for disinfecting water supply, showerheads, taps and hoses)

Country and reference	Recommended procedures
France [14], [15]	<ul style="list-style-type: none"> <li>• Run hot water &gt; 70°C for 30 min</li> <li>• Chlorine dioxide</li> <li>• Hydrogen peroxide + silver ions</li> </ul>
Italy [3]	<ul style="list-style-type: none"> <li>• Run hot water 70°-80°C for 30 min/day, for 3 consecutive days</li> <li>• Chlorine dioxide</li> <li>• Hydrogen peroxide + silver ions</li> <li>• UV light</li> </ul>
Switzerland [16]	<ul style="list-style-type: none"> <li>• Run hot water &gt; 70°C for 30 min</li> <li>• Chlorine dioxide</li> <li>• UV</li> </ul>
Spain [19]	<ul style="list-style-type: none"> <li>• Run hot water &gt; 70° for 12 hours</li> <li>• Chlorine dioxide</li> </ul>
U.K. [20], [21]	<ul style="list-style-type: none"> <li>• Run hot water &gt; 60°C for 5 min</li> <li>• Chlorine dioxide</li> <li>• UV</li> <li>• Ozone</li> </ul>

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#### Conflict of interest

The Medical Commission of the Union Internationale des Associations d'Alpinisme (UIAA MedCom) is a group of specialists whose work is completely voluntary. The authors have no financial or other conflicts of interest to disclose.

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