THE STRUGGLE WITH LEGIONELLOSIS

Legionellosis remains an acute problem of health care and the statistics shows that its scale is continuously growing.

The problem acquired its name after 221 veterans of the American Legion who had assembled at their congress in Philadelphia in 1976 fell ill together. The outbreak of the disease was caused by pollution of the air-conditioning system at the hotel where the meeting of the legionaries took place. As a result 34 of them died and the majority of those who survived became invalid with such physical and mental disorders as amnesia, respiratory impairment, problems of lungs, kidneys and heart, stomach and others.

The health care statistics registers annually quite a number of cases of human legionellosis practically in all countries of the world. The illness proceeds fast in a sharp form with a few non-intensive attacks, but about 12% of cases have fatal outcome.

The pathogen of legionellosis is the Leionellae microorganisms whose genus includes today 43 varieties. They are gram-negative non-spore-forming polymorphous bacteria. It is them that cause from 4 to 20% of human contagious pneumonia and are regarded as the second or third cause of pneumonia that requires hospitalization. However due to the problems of separation of these bacteria from the diseased people and because of medical treatment that eliminates these pathogens before they can be identified, the above figures are certainly less than the real ones.

A major natural habitat for the Leionellae microorganisms is water supply systems. The table below shows the data of investigation of such systems that point at a close connection of potential pathogen microorganisms and people residences.

Presence of the legionellosis pathogen in water supply systems

Water supply system	%	Location	Source
A household water supply system			
drinking water	3-33	USA	Russin 1997
underground water	83	24 samples from 12 gs	Riffard 2001
drinking water supply facilities in houses and institutions	61	in 96 % were < 1 000 ml	Atlas 1999
houses	6	Canada	Marrie 1994
blocks of flats	25	Canada	Marrie 1994
boilers	21-79	Europe	Tiefenbrunner 1996
Shower rooms, fountains			
mineral springs	2	Singapore	Heng1997
decorative fountains	15-19	Singapore	Heng1997
shower rooms	8-92	Europe	Tiefenbrunner 1996
Hot and cold water supply systems			
cooling towers	51	USA	Miller 1993
cooling towers	36	Singapore	Heng1997
cooling towers	47	Finland	Kusnetsov 1997
cooling towers	90	Registration by means of PCR	Koide1993
hospitals	47	France (Paris)	Nahapetin 1991
hospitals	68	south-east Germany	Luck 1993
hospitals	70	Saxony	Habicht 1988

out-patient clinics	50	south-east Germany	Luck 1993
dental clinics	58	south-east Germany	Luck 1993
public institutions	85	south-east Germany	Luck 1993
hotels	18	Saxony	Habicht 1988
private households	65	mainly < 100 cfu/ìë	Luck 1993
flats	30	mainly in shower cabins	Zacheus1994

The objective of a recent research conducted in 6 towns in Italy was to study microbiological pollution of household hot water, in particular in respect of such pathogens as Legionellae. Samples of hot water were taken from shower nozzles and bathtub bleed holes. The result showed that 33 of 146 samples i.e. 22.6% contained various types of the Legionella microorganisms.

The reason for appearance of colonies of Legionella is design defects and adopted modes of water supply systems maintenance, which are incapable of providing the system sterility. Favourable conditions for growth of Legionellae cells are the water temperature of 25-42 degrees Celsius, stagnation of water, sediments, steam, condensate, and presence of amoebas.

However, it is worth noting that the Legionellae microorganisms can be found wherever there are conditions suitable for their existence and development. For example, a fountain in a pavilion at the Flower Exhibition in Holland in 2001 became the source of a mass outbreak of legionellosis among visitors and participants of the exhibition, which led to the death of over 30 people.

It is a fact that organisms of Legionellae exist everywhere. They can live in soil and in water along with other bacteria and protozoa, especially inside biofilms. And since organisms of Legionellae reproduce actively (especially when the water temperature is 20-50 degrees Celsius) and can be dispersed with aerosols through air-conditioners, for example, they can be inhaled easily (in particular drops of less than 5 mcm in diameter), which represents another cause of the disease.

Experts are seeking optimal ways to prevent and struggle with the legionellosis infection. The most effective of them is controlling of populations of the Legionellae microorganisms and disinfecting of water supply systems on a regular basis. For this purpose various hardware-based and reagent modes of water procession are used. According to the data received in two investigations in US hospitals the frequency of detecting organisms of Legionellae among pneumonia patients dropped from 16.3 to 0.1% in a six-year period, while decreasing from 76 to 0.8% among deferred immunity patients in ten years.

Below is

A comparative table of modes of water procession designed to struggle with legionellosis (in water)

	Corrosion of pipes	Toxins	Temperature itivity	Ðí sensitivity	Causes dandruff	High power umption	Fast decay from water treatment	Durability of the t in water	Easy to use
Thermoshock	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No
Maintenance of constant perature	Yes	No	No	Yes	Yes	Yes	Yes	No	No
Regular chlorination	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Shocking hyper-chlorination	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
Continuos chlorination	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Chlorine dioxide	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Monochloramine	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Argentic hydrogen peroxide	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No
Ultraviolet	No	No	No	Yes	No	Yes	Yes	No	Yes
Ionization	No	No	No	No	No	No	No	Yes	Yes
DEZAVID	No	No	No	No	No	No	No	Yes	Yes

To comment the data in the table the following is worth to be noted:

- thermoshock and maintenance of the constant temperature modes are not applicable to process big amounts of water (both modes are power consumptive and low efficient because of relative resistance of micro-organisms to high temperatures);
- disinfection with chlorine-containing reagents and chlorine dioxide is low efficient as it is toxic, harmful to materials, and besides chlorine dioxide is an explosive. Moreover the Legionellae microorganisms are relatively resistant to such reagents. Their resistibility to chlorination grows if they penetrate amoebas or reproduce inside biofilms. It is not surprising then that organisms of Legionellae are regularly detected in chlorinated water, that meets microbiological standards for drinking water;
- the effectiveness of monochloramine, as well as argentic hydrogen peroxide so far has not been proved by tests;
- ultraviolet and ozonization are effective but do not have a sustained action and are power-consumptive;
- ionization has shown its stable efficiency, but shares all shortcomings of hardware-based modes of processing and greatly depends on the design of the respective water supply system.

A most optimal product to solve the problem in focus **is a new Russian-made disinfectant, DEZAVID that has demonstrated its remarkable ability to annihilate the Legionellae micro-organisms not only in water but in air-conditioning systems too, an objective to be reached with none of the other modes included in the table above.**

DEZAVID is built on organic polymers (soluble bactericide polyelectrolites on the basis of guanidine compounds) that exterminate gram-positive and gram-negative bacteria. Besides these polymers possess characteristics of a cation-type flocculent, which considerably improves organoleptic qualities of water.

DEZAVID has the following special features:

- there are only two active substances in the structure of the preparation;
- their proportion in the basic preparation is just over 3%;
- their proportion in working solutions is of homeopathic quantity;
- the preparation is multipurpose;
- it is easy to manufacture, store, and use;
- the preparation is safe to flora, fauna and the human body, and if entered the latter would be fully excreted;
- the preparation is harmless to any materials;
- it is used economically.

The above has been confirmed by results of investigations, laboratory and industrial tests conducted by experts of the Research Institute of Disinfection Science of the Russian Academy of Medical Sciences, the Research Institute of Human Ecology and Environment Hygiene named after A.N.Sisin of the Russian Academy of Medical Sciences, the Virology Research Institute named after D.I.Ivanovsky of the Russian Academy of Medical Sciences, the “Moscow Water Supply Project Institute” state company, the “Bryansk MIS” state company, and of registered laboratories in Thailand, Turkey, Bulgaria, Italy, China and Australia.

As to the effectiveness of DEZAVID in regard of the Legionellae micro-organisms it may be concluded on the basis of the below results of tests on the activity of the preparation to neutralize Legionella pneumofila:

<u>in water</u>

Test No.	Test objects	Dose, mg/l	Exposure time,	Effectiveness, %
1	A can with hot water, $T=65^0C$	1,5	15	100
		3,0	15	100
2	A can with cold water, $T=18^0C$	1,5	15	100
		3,0	15	100

<u>on surfaces</u> (air-conditioning systems)

Test No.	Test objects	Dose, mg/l	Exposure time,	Effectiveness, %
1	Filters of air-itioning systems	1,0	30	100
2	Gratings of air pipes	1,0	30	100
3	Air supply systems	1,0	30	100

Another thing to emphasize is the frugality of DEZAVID. An example of comparative practical application in Turkey of two preparations, Ferrocid Henkel 5280, an effective means to struggle with legionellosis, and DEZAVID shows that with the same price of 1 liter of both preparations the cost of processing 1 cubic meter of water is Euro 0.1 for the former, and Euro 0.015 for the latter. The reason is that to disinfect the same volume of water a triple amount of Ferrocid Henkel 5280 is required as compared to the maximum dose of DEZAVID (3 grams per 1 cubic meter).

As to the application mode of DEZAVID for disinfecting water it is enough to add the preparation directly to the water processed, the doses being from 1.5 to 3 grams per 1 cubic meter of water dependant on the extent of its infection by the Legionellae microorganisms.

For disinfection of outer (the case and gratings) and inner (filters, dust collectors, moisturizers, heating units, air pipes) surfaces of air-conditioning systems the well-known methods of rubbing and sprinkling are used. It will be just enough to replace the formerly applied preparations with a 1% working solution of DEZAVID.