

Health risk assessment for dental healthcare employees and patients due to the exposure to *Legionella* spp. in dental unit water systems in Slovenia

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ABSTRACT

Due to a possible *Legionella* contamination of dental unit water systems (DUWS) in dental chairs and the possibility of infection when using fast rotating parts (turbines) of dental chairs, we identified the health risks for employees and their patients in dental clinics by following the recommendations of the European Working Group for *Legionella* Infections (EWGLI), based on the Kinney methods. Five hundred thirty-seven water samples from DUWS were microbiologically analyzed. *Legionella* spp. was found in 18.3 % of the samples. In 55.9 % of contaminated samples, the concentration of *Legionella* spp. was >100 CFU/100 ml. *Legionella pneumophila* sg.1 presented 36.3 % of all isolated *Legionella* spp.

Key words: *Legionella* spp., *Legionella pneumophila*, dental healthcare, health risk

Received: 1. 8. 2016

Accepted: 22. 8. 2016

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INTRODUCTION

In the water systems of dental chairs, there are often bacteria of the genus *Legionella* which can easily present a risk to the health of employees and their patients in dental clinics. The problem already arises with the connection of terminals of dental chairs to the domestic water system, especially in large constructions where the very structure of the building or the diversification of the water network distribution allows water blockages, temperatures between 25 and 42 °C, biofilms and other conditions that are ideal for *Legionella* [1] to multiply. A high level of incidence of legionellosis in Slovenia compared to a rate of incidence in the EU may mean that the employees are in good health and they carry out their work professionally and identify and consistently report cases of infection on time. A high incidence rate of legionellosis can also mean that the precautionary measures for the prevention of legionellosis are either inadequate, inadequately carried out, or not carried out at all, which in turn poses a problem for people getting infected and sick, especially for people with weakened immune systems and the elderly, in which cases complications, permanent consequences and even death may arise.

The most common cases of infections with bacteria of the genus *Legionella* are Legionnaires' disease and Pontiac fever. Infections with *Legionella* occur most frequently by inhalation of water vapors and aerosols, small droplets that reach the lungs [2]. Inadequate implementation of measures for the prevention of the occurrence and spread of *Legionella* bacteria may also be associated with the results of sampling of 537 samples of water from DUWS, which was conducted by the Health Inspectorate of the Republic of Slovenia (HIRS) in 2010.

METHODS OF WORK

The inspectors from the HIRS took the water samples from DUWS. The samples were taken in accordance with the recommendations and under the following conditions: the samples were taken by using sterile packaging which was obtained in the reception office of the Department for Sanitary Microbiology of the National Laboratory of Health, Environment and Food (NLZOH); prior to the start of the sampling and in order to prevent the contamination of the sample, a socket instrument was removed from the turbine; sample collection was performed in a sterile manner (using protective masks, hand washing, sterile gloves, sterile surfaces); when the sample was taken from the spout (a part of the turbine where the water comes out), first a few jets of water were released, and the spout was disinfected with a 10 % solution of sodium hypochlorite; after the disinfection, the spout was rinsed for approximately 5 seconds; after opening the package of sterile containers, due to a possible recontamination, the package covers were either held with the interior down or placed in the same manner on the sterile surface; for the microbiological testing, approximately 350 ml of water were taken; after sample collection, the container with the water was closed; finally, when the sample was properly labeled, it was protected

Legionella can easily present a risk to the health of employees and their patients in dental clinics.

Infections with *Legionella* occur most frequently by inhalation of water vapors and aerosols, small droplets that reach the lungs.

from the light with aluminum foil, and temporarily stored in a cool box at the temperature up to + 5 °C; the samples were delivered to the laboratory immediately after the sampling.

The microbiological analysis of the samples for the parameter *Legionella* spp. was carried out in the laboratories of NLZOH. When determining the bacteria *Legionella*, the standard ISO 11731 was used. A genus of the bacteria *Legionella* was defined with the test Oxoid Legionella Latex. A confirmation of the strain of *Legionella* spp. with the above mentioned test means that the strain belongs to one of the following *Legionella*: *Legionella longbeachae* sg. 1 and 2, *Legionella bozemanii* sg. 1 and 2, *Legionella dumoffii*, *Legionella gormanii*, *Legionella jordanis*, *Legionella micdadei*, *Legionella anisa*. In accordance with the professional recommendations of EWGLI, the microbiological results of water samples were analytically and statistically analyzed according to the number of *Legionella* bacteria in the water sample, which should represent a particular risk to the human health.

These recommendations point to the risk of legionellosis: the concentration of <1,000 CFU/100 ml represents the low risk of outbreaks of legionellosis to human health. Most at risk are immunocompromised patients and they are advised not to use the chairs; the concentration of >1,000 CFU/100 ml – 9,999 CFU/100 ml represents the medium risk of outbreaks of legionellosis for the healthy people. Also in this case the immunocompromised patients are advised not to use the chairs; the concentration of ≥10,000 CFU/100 ml represents the high risk of outbreaks of legionellosis for the healthy people. In this case, all the patients are advised not to use the chairs until the implementation of the measures [3].

When selecting a risk assessment method for the exposure to *Legionella* which are present in DUWS, the Kinney method was chosen due to its universality of application. The risk (R) is evaluated based on the following parameters: probability (P) or the occurrence of accidents/damage, frequency (F) of the risk exposure, seriousness (S) of the consequences. The level of the risk is calculated as follows: $R = P \times F \times S$ (where the individual parameters are numerical values) [4].

When calculating the level of the risk for employees in dental services due to the exposure to *Legionella* which are present in DUWS, the following pieces of information have been taken into consideration: the probability of damage (P) due to the use of personal protective facial mask by the employees in dental services was given the rank 3 (probable or little probable) with the numerical value of 0.5 ($P = 0.5$); when determining the frequency of risk exposure (F) regular daily work was considered and we set the rank of 5 (regular or daily) with the numerical value of 6 ($F = 6$); in determining the seriousness of the consequences (S), we considered the consequences of getting sick with legionellosis and we determined the rank of 4 (very severe individual injury or illness, death) with the numerical value of 15 ($S = 15$). When calculating the level of risk for patients who are exposed to *Legionella* present in DUWS, we took into account the following pieces of information: for the probability of damage

(P), rank 4 was determined (unlikely but possible) with the numerical value of 1 ($P = 1$); when determining the frequency of risk exposure (F), regular checks and other possible visits to dental care were considered and were determined as rank 3 (monthly) with a numerical value of 2 ($F = 2$); in determining the gravity of the consequences (S), we considered the implications of getting sick with legionellosis and we determined the rank of 4 (very severe individual injury or illness, death) with the numerical value of 15 ($G = 15$).

RESULTS

Out of the total number of 537 samples that were taken, 439 or 81.7 % were negative and 98 or 18.3 % positive.

In the 80 positive samples with a concentration of *Legionella* <1.000 CFU/100 ml, the test results identified 84 different strains of bacteria of the genus *Legionella* spp. Table 2 shows that the maximum concentration of *Legionella* in <1,000 CFU/100 ml was validated with the Oxoid Legionella Latex test in 43 samples or 51.2 %. *L. pneumophila* sg. 1 was confirmed in 30 samples, representing 35.7 %.

Table 1 shows the results of water samples taken from DUWS to Legionella at RD (*regional districts) by HIRS.

RD HIRS	Number of samples taken	Negative samples		Positive samples	
		number	%	number	%
Celje	81	55	67.9	26	32.1
Dravograd	31	26	83.9	5	16.1
Kranj	70	45	64.3	25	35.7
Ljubljana	125	91	72.8	34	27.2
Maribor	80	78	97.5	2	2.5
Nova Gorica	40	38	95	2	5
Novo Mesto	40	36	90	4	10
Murska Sobota	30	30	100	0	0
Koper	40	40	100	0	0
Total	537	439	81.7	98	18.3

Table 2: Demonstration of the number and types of *Legionella* bacteria in water samples from DUWS with the concentration of *Legionella* <1,000 CFU/100 ml

RD HIRS	Number and types of <i>Legionella</i> bacteria with the concentration <1,000 CFU/100 ml			
	<i>L. pneumophila</i> sg. 1	<i>L. pneumophila</i> sg. 2-14	<i>Legionella</i> confirmed with Oxoid Legionella Latex test	<i>Legionella</i> not confirmed with Oxoid Legionella Latex test
Celje	5	1	11	1
Dravograd	0	0	3	2
Kranj	3	0	17	0
Ljubljana	16	3	11	4
Maribor	1	0	1	0
Nova Gorica	1	0	0	0
Novo mesto	4	0	0	0
Total	30	4	43	7

Table 3: Demonstration of the number and types of *Legionella* bacteria in water samples from DUWS with the concentration of *Legionella* bacteria from >1,000 CFU/100 ml to <10,000 CFU/ 100 ml

RD HIRS	Number and types of <i>Legionella</i> bacteria with the concentration from >1,000 CFU/100 ml to <10,000 CFU / 100 ml			
	<i>L. pneumophila</i> sg. 1	<i>L. pneumophila</i> sg. 2-14	<i>Legionella</i> confirmed with Oxoid Legionella Latex test	<i>Legionella</i> not confirmed with Oxoid Legionella Latex test
Celje	4	0	3	0
Kranj	1	0	2	0
Ljubljana	1	1	1	0
Total	6	1	6	0

Table 4: Demonstration of the number and types of *Legionella* bacteria in water samples from DUWS with the concentration of *Legionella* >10,000 CFU/100 ml

RD HIRS	Number and types of <i>Legionella</i> bacteria with the concentration >10,000 CFU/100 ml			
	<i>L. pneumophila</i> sg. 1	<i>L. pneumophila</i> sg. 2-14	<i>Legionella</i> confirmed with Oxoid Legionella Latex test	<i>Legionella</i> not confirmed with Oxoid Legionella Latex test
Celje	0	0	1	0
Kranj	1	0	2	0
Nova Gorica	0	1	0	0
Total	1	1	3	0

Legionella, which was not confirmed with the Oxoid Legionella Latex test was detected in 7 samples i.e., 8.3 %. The smallest number of samples in which *L. pneumophila* sg. 2-14 was confirmed, i.e. 4 samples, accounted for 4.8 %.

It is evident from Table 3 that in positive samples with a concentration of *Legionella* bacteria from >1,000 CFU/100 ml to <10,000 CFU/100 ml we identified most of *L. pneumophila* sg. 1 and *Legionella* which were confirmed by laboratory tests Oxoid Legionella Latex, each in 6 samples. The survey also identified a positive sample to *L. pneumophila* sg. 2-14. *Legionella*, which were not confirmed with the Oxoid Legionella Latex test, were not found.

From Table 4 it is evident that 5 positive samples had a concentration of legionella >10,000 CFU/100 ml. Most samples were confirmed by the test Oxoid Legionella Latex, namely 3 samples. Also one sample of *L. pneumophila* sg. 1 and one sample of *L. pneumophila* sg. 2-14 were confirmed.

From Table 5 it is evident that we mostly identified *Legionella* confirmed with the test Oxoid Legionella Latex found in water samples from DUWS, namely 52 times. *L. pneumophila* sg. 1 was confirmed in 37 samples, followed by *Legionella* which was not confirmed by the test Oxoid Legionella Latex in 7 samples. *L. pneumophila* sg. 2-14 was proved in the lowest number of positive samples of water, namely 6.

The results indicate that the temperature has an effect on the growth of *Legionella* bacteria.

Table 5: Demonstration of search parameters in the samples from DUWS and the presentation of risk types

Parameters in DUWS samples	Risk		
	Low	Medium	High
<i>L. pneumophila</i> sg. 1	30	6	1
<i>L. pneumophila</i> sg. 2-14	4	1	1
<i>Legionella</i> confirmed with Oxoid Legionella Latex test	43	6	3
<i>Legionella</i> not confirmed with Oxoid Legionella Latex test	7	0	0
Total	84	13	5

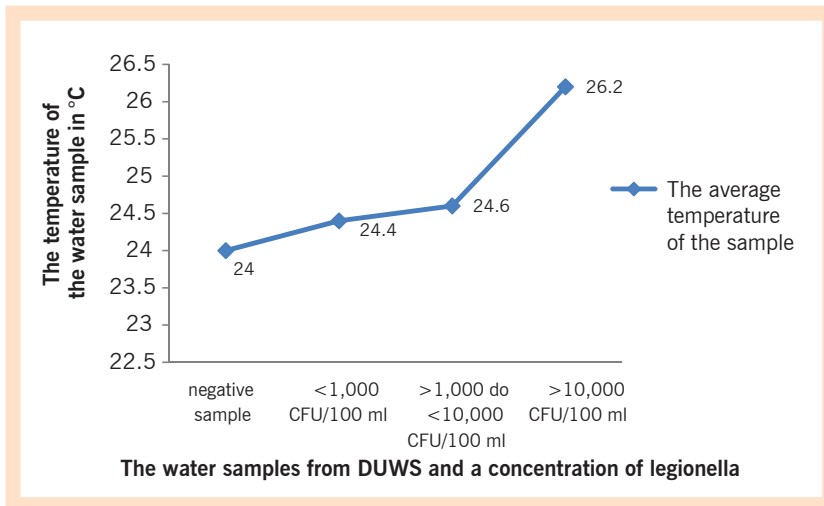


Figure 1: Average temperature of the water samples from DUWS

The results in Figure 1 indicate that the temperature has an effect on the growth of *Legionella* bacteria. From the data obtained, the average temperature of the negative sample was the lowest. In the positive samples of water, results indicate that by increasing the temperature of the water the number of *Legionella* bacteria increases, so that the water samples with a concentration of *Legionella* >10,000 CFU/100 ml had a maximum average temperature of the water.

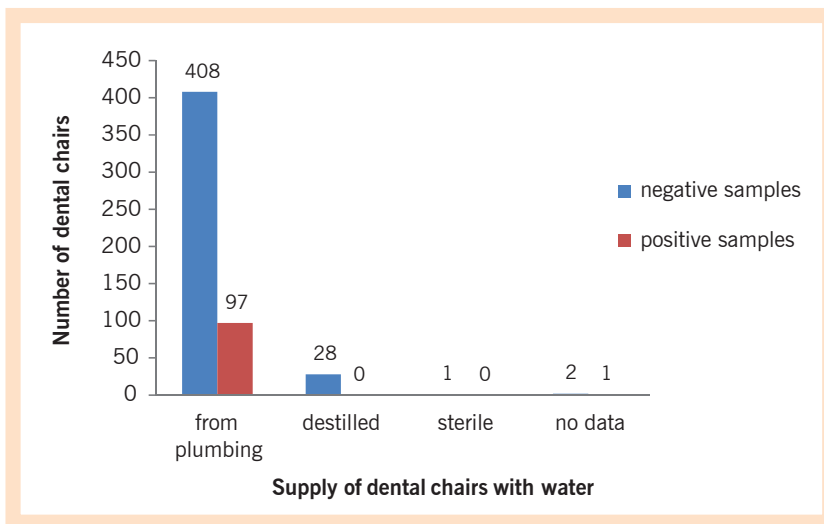


Figure 2: Presenting connections or water usage from analyzed DC

From Figure 2 it is evident that the majority, or 94 % of all analyzed samples were taken from dental chairs (DC) which were connected to a domestic water system (DWS) and had a provision of tap water. From the samples taken from the water from DUWS, it is evident that a small part, or 5 % of DC had the supply of distilled water. There was also an example of a water sample from the DC with sterile water. For the three water samples, there was no information available as to how DC was supplied with water.

When processing and analyzing the data relating to the preparation or implementation of water disinfection in DUWS, we found that the majority (368) or 69.3 % of all treated samples (531), for which we collected data, showed that water preparation or disinfection measures had not been performed. 163 or 30.7 % samples showed that water preparation or disinfection measures had been applied. Of those 163 water samples from the DC, where disinfection was carried out, 141 samples were negative, and a disinfection measure was carried out successfully. The remaining 22 samples, where a measure of disinfection was also carried out were positive, therefore the disinfection measures were not implemented successfully. For 6 samples there was no information regarding the implementation/non-implementation of disinfection measures.

The analysis of data relating to the use of mechanical filters for cleaning the water that enters the DUWS showed that 396 or 74 % of the DCs had a mechanical filter for water purification; 115 or 21 % of DCs had no mechanical filters. For 26 DCs or 6 % there was no information with regard to the equipment with mechanical filter.

Table 6 demonstrates the implementation of disinfection of DUWS from which water samples were taken for analysis

Water samples from DUWS	Disinfection of DUWS		
	Carried out	Wasn't carried out	No data
Negative	141	294	4
Positive	22	74	2
Total	163	368	6

Table 7 shows the use of filters in DCs where samples of water were taken from

Water samples from DUWS	DC and mechanical filters for cleaning the water entering DUWS		
	Had a filter	Did not have a filter	No data
Negative	320	97	22
Positive	76	18	4
Total	396	115	26

Calculation of the level of risk

Calculation of the level of risk for employees in dental services due to the exposure to *Legionella* which are present in DUWS:

$$R = P \times F \times S = 0,5 \times 6 \times 15 = 45$$

Calculation of the level of risk for patients in dental services due to the exposure to *Legionella*, which are present in DUWS:

$$R = P \times F \times S = 1 \times 2 \times 15 = 30$$

The obtained numerical digits “45” for the employees in dental services and “30” for patients in dental services belong to the group from 21 to 70, representing R – II risk or “low risk”. The risk to the health of patients in dental services due to the exposure to *Legionella* from DUWS is present and it is low.

The criteria for determining the level of risk based on the Kinney state that a low risk is acceptable risk and can be managed through the implementation of organizational measures in the field of security and in accordance with prescribed procedures. Following and measurement (monitoring) of danger parameters [13] is desired.

DISCUSSION

The implementation of preventive measures in order to prevent contamination of the water supply systems with *Legionella* and the prevention of reproduction and spread of *Legionella* bacteria in water distribution systems are difficult and responsible tasks, especially when it comes to the implementation of health activities and when immunocompromised patients are at risk. In the field of health services, preventive measures regarding the occurrence and the spread of infectious diseases, which include legionellosis, are carried out on the basis of the Law on infectious diseases (LID), which defines that any physical or legal person who performs medical activity should carry out the control of infectious diseases programme (CIDP). With the official controls provided by LID and the Law on health inspection (LOHI), the health inspectors deal with issues regarding the implementation of measures to prevent legionellosis, when health care services are carried out in residential, commercial or mixed activities with a number of different owners – legal and/ or physical persons who are connected to the same water supply network. If, as considered above, dental chairs do not have semi-automatic or automatic disinfection of DUWS, the risk of water contamination and the spread of *Legionella* bacteria in DUWS are greater. The responsible person or the holder of dental care in that case can execute all the preventive measures prescribed by the program of management of hospital-acquired infections (PMHAI) but has no powers to implement preventive measures related to the DWS itself. If the water in DWS is contaminated with *Legionella*, this may mean that the contaminated water has come to DUWS and will contaminate it. From the above we can conclude that even if a responsible person providing dental care performs daily DUWS disinfection measures, it cannot gua-

If dental chairs do not have semi-automatic or automatic disinfection of DUWS, the risk of water contamination and the spread of *Legionella* bacteria in DUWS are greater.

DUWS in Slovenia is less contaminated with bacteria of the genus *Legionella* spp. as in, for example, Germany, Italy, South Africa and Switzerland.

rantee that water, which at the end comes from DUWS (turbines), is not contaminated with *Legionella*.

Given the situation described and the difficulties in implementing preventive measures to prevent the occurrence and spread of *Legionella* in the DUWS in residential-business or other facilities where medical activities are also carried out, we propose a legislation on the basis of German legislation which defines that the owner, in the case of renting the premises or using them for a profitable activity, is responsible for providing health suitability of drinking water and must perform sampling of water on *Legionella* spp. in a certain period of time or on the amount of water [5].

The legislation in force in the field of drinking water in Slovenia or Regulation on Drinking Water [6] prescribes that: the drinking water should not contain microorganisms, parasites and their developmental forms in the number which might pose a risk to human health; it must not contain any substances in concentrations which alone or in a combination with other substances can pose a threat to human health, and that the drinking water is suitable if it complies with the requirements set out in Parts A and B of Annex I, which forms an integral part of that Regulation. Given the above, the monitoring of the drinking water, which is used to determine the presence of microorganisms listed in Annex I of the Regulation on Drinking Water, is being carried out in Slovenia. These analyses of the drinking water samples do not include testing for the presence of *Legionella* bacteria, which means that Slovenia has no information (type, number) on the presence of *Legionella* bacteria in the drinking water.

The problem of water contamination with *Legionella* is, except DUWS contamination, generally well known and studied by experts. DUWS contamination is another case. Here, in Slovenia, we have been paying too little attention to it, hence our focus of the research work is determining water contamination from DUWS with bacteria of the genus *Legionella* spp. Statistically and analytically, 537 samples were processed by the official control inspectors of HIRS. Water samples were taken from DUWS throughout Slovenia, from fast rotating part of the EF (turbines) or at the place where aerosols are generated. We found that 82 % of the samples taken were negative and 18 % of the samples were positive. When compared to similar studies in Europe and worldwide, we found that the results of our research are better, or that DUWS in Slovenia is less contaminated with bacteria of the genus *Legionella* spp. as in, for example, Germany, Italy, South Africa and Switzerland. A study [7] shows that in water samples from DUWS in Germany there was 28 % contamination with *Legionella* spp.; in Italy [8] and South Africa [9] 33 %; in Switzerland [10] the presence of *Legionella* bacteria was found in 24 % of water samples from DUWS.

When comparing the data of our study with a similar survey in Germany from 2013 [7], we found:

- that DUWS in Slovenia are more frequently contaminated with *L. pneumophila* sg. 1 than in Germany (Slovenia 36.3 %, Germany 28 %);

- that information about the presence of *L. pneumophila* sg. 2-14 in samples from DUWS are comparable (Slovenia 5.9 %, Germany 4 %);
- that DUWS in Slovenia are more contaminated with *Legionella* in concentrations <100 CFU/100 ml (Slovenia 44.1 %, Germany 16 %);
- that DUWS in Germany are more contaminated with *Legionella* in concentrations ≥ 100 to <1,000 CFU/100 ml (Slovenia 38.2 %, Germany 52 %) and in concentrations >1,000 to <10,000 CFU/100 ml (Slovenia 12.8 % Germany 28 %);
- that contamination of DUWS with *Legionella* in a concentration $\geq 10,000$ CFU/100 ml is comparable (Slovenia 4.9 %, Germany 4 %).

CDC guidelines for dental activities recommend that water, used for routine dental care, meets the standards for drinking water (<500 CFU/ml of water for heterotrophic bacteria) [10]. Recommendations of the Commission for hospital hygiene and infection prevention at the Robert Koch Institute in Germany for all DC recommend the concentration of *Legionella* <100 CFU/100 ml and also the total number of colonies <100 CFU/ml. For the treatment of immunocompromised patients, no *Legionella* spp. may be present according to the recommendations. In order to maintain high microbiological quality, it is recommended that only water of the drinking water quality or sterile water should be used in dental chairs [7]. In selecting criteria for determining the risk for the health of employees and their patients in dentistry, based on the concentration or the number of *Legionella* bacteria in water samples from DUWS in our study, we followed the criteria based on the recommendations of EWGLI [11].

As legionellosis are life-threatening diseases that killed 22 people in Slovenia from 1997 to 2014, and as we have demonstrated in the study the possibility of infection with *Legionella* from DUWS, we suggest that in the case of an epidemiological survey when suspecting legionellosis, a question about a visit to the dentist should be included as well. The proposal can be supported with a report on the event of the death of 82-year-old patient who died due to the infection of *L. pneumophila* sg. 1, which was isolated from DUWS [8] and unvalidated data connected to the death of a dentist due to legionellosis and suspected of being infected with *Legionella* from DUWS, in other words, in the workplace [9].

Regarding the exposure to *Legionella*, which can be transmitted by aerosols during the active usage of DC and the rapid rotating parts of DC (turbines), the employed in dental services are more exposed than their patients. Exposure of employees depends on the period of the usage of fast rotating parts (turbine) of DC and varies according to the purposes of the use of DC such as: dental care for children and youth, dental practice activities for adults, orthodontic activities, maxillofacial activities, prosthetic purposes. The exposure of employees is low or nil if employees use prescribed protective equipment such as appropriate protective masks to prevent inhalation of aerosols, which may be contaminated with *Legionella*. The exposure of patients depends on the frequency of visits to

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The exposure of employees is low or nil if employees use prescribed protective equipment such as appropriate protective masks to prevent inhalation of aerosols, which may be contaminated with *Legionella*.

The exposure of patients depends on the frequency of visits to the dentist, the number and type of *Legionella* bacteria in the water, the type of intervention, the time of the intervention and the frequency of breathing.

Predisposing factors for the disease are poor immunity, smoking, alcoholism, age over 65, chronic diseases, cancer, treatment with immunosuppressive drugs, particularly after transplantation.

the dentist, the number and type of *Legionella* bacteria in the water, the type of intervention, the time of the intervention and the frequency of breathing. From practice we know that there are individual patients who have not been at the dentist for years which means that exposure to *Legionella* from DUWS is not present. There are also patients who regularly or several times a year (monthly) visit the dentist. With such patients the exposure to *Legionella* from DUWS increases with each visit to the dentist who uses rapidly rotating parts of DC.

For sickness rate with *Legionella* and a form of legionellosis, predisposing factors for the disease are important for the employees as well as the patients: poor immunity, smoking, alcoholism, age over 65, chronic diseases, cancer, treatment with immunosuppressive drugs, particularly after transplantation [1, 12].

The research part highlights the findings that relate to the lack of implementation of preventive measures in DUWS from which water samples are taken. From Table 6 it is evident that the majority or 69 % of water samples, for which we have data, had no prior water treatment or disinfection measures for DUWS were not implemented; 4 % of the samples showed that disinfection of DUWS was unsuccessful. It is also evident that the percentage of positive samples of water on *Legionella* from DUWS in the group of samples where prior water treatment and disinfection of DUWS had not been carried out amounts to 20.1 % and was higher than the percentage of positive samples in the sample group in which preparation of water was carried out and amounts to 13.1 %. The reason for nonperformance and failure to implement disinfection of DUWS is seen in the insufficient instructions for performing CIDP and insufficient awareness of responsible persons in dental care in 2010. Based on the results of the adequacy of water samples from DUWS that have been made public as well, a professional association of private doctors and dentists of Slovenia, together with the representatives of NIJZ and NLZOH, adopted a guidance for the preparation of a plan for the maintenance of the water network dental chair/machine in 2011. We support the provisions of the mentioned guide and suggest that a parameter *Legionella* spp. is added to the regular parameters of microbiological testing.

A weakness of the research was collecting water samples on *Legionella* just in one place or on quickly rotating part (turbine) of DC. The gathered data was used to determine the presence, type and quantity of *Legionella* bacteria in the samples, but we were unable to determine the cause of contamination in the case where *Legionella* was proven in samples. To determine the cause of the contamination (public water/DWS/DUWS) we would need comparative samples that should be taken at least: at the connecting spot to the public water supply network or nearby spout; on the spout in a dental clinic or the farthest spout at the facility; a water sample from DUWS. Having obtained the results of water sampling on *Legionella* in the above sample spouts with the method of exclusion, we would be able to determine the causes of contamination of water systems by *Legionella*.

CONCLUSION

On the basis of the results of our study, we can highlight the following major findings:

- a) after the microbiological testing of water samples from DUWS, the presence of *Legionella* spp. was confirmed in 18.3 % of the samples. Fifteen percent of the samples were those with low risk; 2.4 % carried a medium risk, and 0.9 % of the samples carried a high risk of legionellosis for the healthy people;
- b) in water samples from DUWS, the most virulent and most dangerous to humans *L. pneumophila* sg. 1 was identified 37 times, presenting 36.3 % of all identified *Legionella* spp.;
- c) the implementation of disinfection of DUWS reduces the risk for the emergence and spread of *Legionella* in DUWS (proportion of positive water samples on *Legionella* from DUWS in the group of samples where disinfection of DUWS was not carried out amounted to 20.1 % and was higher than 13.1 % of the positive samples in the group of samples where the disinfection was performed);
- d) the results indicate that by increasing the water temperature, the number of *Legionella* bacteria increases so that the water samples with a concentration of *Legionella* >10,000 CFU/100 ml had a maximum average temperature of the water;
- e) using the Kinney method, we demonstrated that the risk to the health of employees and their patients due to the exposure to *Legionella* which is present in DUWS, is present, however, it is low;
- f) when compared with similar studies in Germany, Italy, South Africa and Switzerland, we found that the DUWS in Slovenia is less contaminated with bacteria of the genus *Legionella* spp. as in these countries.

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