

Ventilation Systems and Prevention of Respiratory Illness: Requirements for Heating, Ventilation and Air Conditioning in Health Care Facilities

Wednesday November 9, 2005

Operator: Good afternoon and welcome to the Health Care Health and Safety Association's Teleconference on Ventilation Systems and Prevention of Respiratory Illness. At this time all participants are in a listen-only mode. Following the presentation we will conduct a question-and-answer session. To participate, press *, 1 to register for a question. Should you require any assistance during the call, please press *, then 0 on your touch-tone phone. I would now like to turn the meeting over to HCHSA Consultant, Peggy Swerhun. Please go ahead Peggy.

Peggy Swerhun: Thank you. Good afternoon and thank you for joining us. As the Operator mentioned, our topic today is Ventilation Systems and Prevention of Respiratory Illness. My name is Peggy Swerhun, the HCHSA Consultant for central northeast Ontario, and I'll be your host this afternoon.

We are very pleased to have Dr. Leon Genesove as our speaker today. Dr. Genesove is the Chief Physician for the Ontario Ministry of Labour, Occupational Health and Safety Division. He is a specialist in occupational medicine and a lecturer at the University of Toronto, Department of Medicine. If you wish to download today's PowerPoint presentation, you may go to our website, www.hchsa.on.ca and click on the Teleconference link. And now, Dr. Genesove.

Dr. Leon Genesove: Thank you very much Peggy. And I'd like to thank the Health Care Health and Safety Association for their invitation to speak to you today. So first, let me give you a list of topics I'm going to cover. It's slightly broader than the title of the presentation because I'm going to focus on a number of aspects related to Legionnaires' Disease and Prevention of exposure to *Legionellae*.

So I'm going to start off with a review of Legionnaires' Disease; then a regulatory review, specifically in terms of occupational and safety; discuss a bit on HVAC and potable water system maintenance; a little bit on airborne infection in isolation rooms because that relates to ventilation, although it's not specific at all to Legionnaires; and then a review of the guidelines that relate to prevention of *Legionellae* transmission, Ministry of Labour guidelines which deal with HVAC systems; finish with disease control, ASHRAE and CSA guidelines, although I may go through them quickly depending on our time; and then finally discuss what I'm sure a lot of you want to know: what expectations does the Ministry of Labour have? To you as the employer, as the workplace party, as the worker joining the health and safety committee, what does the Ministry of Labour expect you to do to protect your workers from *Legionellae* exposure? And again, I'll be focusing mainly on occupational health issues and worker protection. Of course, in most cases, this will also protect residents and patients of your facilities, but I won't be speaking to that specific issue of patient safety.

So, what is Legionnaires' Disease? And if you're following along in the presentation package, the PowerPoint, we're on Page 3, we're going to expand a bit from what's there. The Legionnaires' Disease is an essentially fatal pneumonia that's caused by infection with *Legionellae* bacteria. And again, our concern here is *Legionellae* pneumophila bacteria. It causes pneumonia, and people may have a range of symptoms. Some of the more severe symptoms that people have when they develop this disease are high fever, dry cough, shortness of breath and diarrhea. So if

one has an outbreak within a facility of patients or workers with these symptoms, especially in a health care facility, then certainly *Legionellae* infection should be part of the differential diagnosis.

The *Legionellae* bacterium is very common in the natural aquatic environment and it's found pretty much in all sources in the natural environment, in wet soil and a number of other locations, anywhere where there's water and wet soil. It grows extremely well at water temperatures of 25 degrees Celsius to 42 degrees. The problem occurs when you have amplification in man-made water systems, meaning that the *Legionellae* bacteria starts to multiply and they tend to grow and infect, in the aquatic environment, protozoa and amoebae. There'll be a lot where there's protozoa and amoebae are growing in an aquatic environment; generally the *Legionellae* will be multiplying in zygote organisms.

But certain conditions will cause *Legionellae* growth in man-made water systems or air-handling systems that have cooling towers. Cooling towers have a range of water of temperatures of 30 to 45 degrees Celsius. And when I'm talking about cooling towers, I'm referring to one specific type of cooling tower. There's three main types of cooling towers and one type that's in common use is susceptible to *Legionellae* contamination. The type I'm referring to is an open, recirculating water, cooling tower system and I'm going to describe that a little bit later on.

So there's a risk when bacteria grow or amplify and when they become airborne somehow. So either through spraying, splashing, misting, or bubbling of air through contaminated water, this will create droplets or aerosols of water that are contaminated with *Legionellae* and create the potential for exposure and inhalation. The infection is caused by inhalation of the water droplets or aerosols deep into the lungs. There, the *Legionellae* bacteria will multiply inside of pulmonary macrophages in the lung, which are scavenger cells that pick up debris and bacteria, and the lung will pick them up and then the *Legionellae* grows inside them and if they overgrow then they cause infection and symptoms I mentioned, plus pneumonia.

So who is at risk? We're on Page 4: who is at risk? So not everyone who inhales the *Legionellae* bacteria will get Legionnaires' Disease. The fact is that what increases the risk for developing Legionnaires' Disease include: increased age; heavy smoking, which has a very detrimental effect on the respiratory system; a weakened immune system; underlying medical problems; and heavy consumption of alcohol. So outbreaks in health care facilities are commonly reported, especially in long-term care facilities because many patients will have at least some of these risk factors.

I've talked about the risk of exposure from aquatic environments and where water is contaminated with *Legionellae*, but it's important to note that in a health care setting there is no human-to-human transmission. So if you have an individual or patients or residents infected with *Legionellae* there is no human-to-human transmission. In a health care setting only routine precautions are required in patient care settings for health care workers when they're dealing with patients who have known *Legionellae* pneumonia.

Now let's look at sources of *Legionellae* on Page 5. *Legionellae* bacteria have been isolated from or associated with outbreaks from various man-made water sources including water mist from cooling towers or evaporative condensers in heating or ventilating systems or air conditioning systems; humidifiers and grocery produce misters; hot and cold potable water distribution systems, although the main problem is in hot water systems; and others such as hot tubs, spas, baths, decorative fountains and non-potable water cooling systems. Now, in a health care

setting, potable heated water systems, as I've mentioned, and cooling towers are probably the most important potential sources of *Legionellae* for the health care systems.

And now a little bit about what a cooling tower is. It's not in the written part of the presentation, but just so everybody knows, a cooling tower is an evaporative heat transfer device, where outdoor air cools warm water through direct contact between the water and the outdoor air and by evaporating part of the water. Air movement through a cooling tower is usually achieved by a fan, though in some cases it may be passive, but usually it's achieved by fan. And often there's some type of fill that's used to increase contact between the water and the cooling outdoor air.

Now, water from the cooling tower is piped to an evaporative condenser inside the air conditioning system, which is located inside the building. There the cool water is heated by warm air from inside the building, so the warmth of the air from inside the building is removed by being basically drawn up by the cool water. Then this cool water, which has become warm now because it's absorbed the heat from the warm air, is sent back to the cooling tower to be cooled again. So basically, it's a two-part system, with a cooling tower outside and the evaporative condenser somewhere inside or at the top of the HVAC system, depending on the type of system; there are many different designs.

Now, the water temperature in the cooling tower and the entire system usually ranges from 29 degrees Celsius to 35 degrees Celsius. Sometimes it has a wider range depending on the external temperatures, but generally it's 29 to 35, which happens to be the ideal temperature range for *Legionellae* growth. That's why cooling towers, if they're not properly maintained, are high risk, because they're at the proper temperature for *Legionellae* amplification.

Now, how does the *Legionellae* get into the cooling tower water system? Well, it usually enters the cooling water system through the makeup water. This is water that's used in the cooling towers to replace water that's evaporated, and it will often contain traces of *Legionellae*. Then the *Legionellae* will infect and go inside the amoebae and protozoa, which are always in any type of recirculating water system. And the *Legionellae* will grow and with the water temperatures that are typical in the cooling towers, you get amplification of *Legionellae*.

The protozoa that I mentioned that are found in any recirculating water source are highly resistant to biocides that are put in cooling towers. Therefore, it's very important - and we'll see this in the Standards that I'll discuss later on - it's very important to limit and clean any microbial biofilm that will provide the protozoa with nutrients to grow, because the *Legionellae* grow in the protozoa, so you've got to ensure that the microbial biofilm is kept to a minimum. *Legionellae* will also grow the same way in potable water plumbing systems in dead-end segments where you get sludge and biofilm accumulating. The *Legionellae* grows there because there's a biofilm that *Legionellae* and the protozoa thrive on.

There are other types of cooling towers, as I've mentioned. They all have their own specific maintenance requirements, but they're not usually a problem for *Legionellae* growth.

So what are the conditions for *Legionellae* bacteria growth? I've discussed some of this already. The conditions that promote the growth of *Legionellae* bacteria in water systems include hot temperatures and stagnation, so if the cooling tower hasn't been used for three days or has been turned off for more than three days or is only used once a week, there'll probably be *Legionellae* starting to amplify in the system once it's been stagnant for more than three days. If there is sediment, rust, scale, or sludge, this all provides a nutrient source for the protozoa and amoebae and subsequently for the *Legionellae* that grows there in slime and other water organisms. And

you also see *Legionellae* in cold water systems, the potable systems, if the water temperature isn't maintained below 20 degrees Celsius.

We'll talk a little bit about the Ministry of Labour Role. In the event of an outbreak of Legionnaires' Disease, where workers are affected together with the public, such as we had recently, the local public health unit usually leads the investigation. Legionnaires' is a reportable disease, and usually the local public health unit will lead an investigation of a Legionnaires outbreak. The Ministry of Labour coordinates with public health where there is joint jurisdiction, meaning workers are involved, and the Ministry of Labour will investigate to ensure that employers take the appropriate precautions to protect workers and prevent a recurrence. The Ministry of Labour also has a proactive role to ensure employers take steps to prevent worker exposure and illness. ... and just to let you know - because somebody's going to ask this, I'm sure - the Ministry of Labour right now is working together with the Ministry of Health and Long-Term Care to develop a common approach to *Legionellae* to avoid undue compliance problems.

Anyhow, what should employers do? Employers have control of the workplace and the main responsibility for protecting workers. Employers have to identify and assess the risk of bacterial growth in all water systems and all ventilation systems in the building. Employers have to develop written preventive maintenance programs with appropriate control measures. They have to develop non-emergency and emergency start-up and shut-down procedures. The employer has to train workers who are maintaining or operating the air handling systems and water systems in the measures and procedures required to maintain those systems in a safe manner. So precautions are necessary to protect workers; even personal protective equipment, if necessary. Employers are obligated to train workers. And this all has to be done, of course, in consultation with the joint health and safety committee in the workplace. The employer also has to monitor the effectiveness of the control program for the water systems on a scheduled basis: that may be measuring water temperature, checking biocide levels and doing visual inspections. I'll go through some of that in detail later on.

Next, on Page 9, I'll just go quickly through some of the legislation and guidelines that may impact here from an occupational health and safety standpoint. There's the *Occupational Health and Safety Act* and the *Regulation for Health Care and Residential Facilities*, which will be very important for the health care sector. CDC has the *Guidelines for Environmental Infection Control in Health Care Facilities*, which is extremely good. They also have the *Guidelines for Preventing Health-Care-Associated Pneumonia*. ASHRAE has an excellent guideline on minimizing the risk of legionellosis associated with building water systems: I urge all of you to make yourselves especially familiar with that particular guideline. CSA has a standard on requirements for HVAC systems in health care facilities [Z317.2-01], which everybody should have and be following. There's also a very important standard on infection control during construction or renovation of health care facilities [Z317.13]. So if you're doing any construction in your health care facility or major renovations and you want to protect people from those nosocomial infections, you have to look at that standard. Health Canada of course, also has a standard on *Prevention of Construction-related Nosocomial Infections to Protect Patients in Health Care Facilities*.

In the *Occupational Health and Safety Act*, I want to go quickly through a number of the employer's responsibilities in the specific sections of the Act that you should be looking at. 25(1)(b) requires employers to ensure that equipment, materials and protective devices are maintained in good condition. The Ministry of Labour interprets that as including maintenance of water and ventilation systems to prevent *Legionellae* growth.

Employers are required to provide information, instruction and supervision to protect workers, so that'll be people doing preventive maintenance or operation of water and ventilation systems or any emergency operations; that's 25(2) (a) of the *Occupational Health and Safety Act*.

25(2) (h) of the *Occupational Health and Safety Act* states that employers should take all reasonable measures for the protection of workers. And again, from the enforcement standpoint of the Ministry of Labour, that will include identifying, assessing and implementing control measures to prevent *Legionellae* growth in water and ventilation systems.

If an outbreak occurs, under 52(2) of the Act, the employer is required to report an occupational illness to the Ministry of Labour and the joint health and safety committee and trade union, if any, in the workplace in writing within four days. So, as an employer, if you have a worker that develops a *Legionellae* infection - or for that matter any other communicable disease infection - as a result of exposure in the workplace, then that's considered an occupational illness, and you must report to the Ministry of Labour, take it to the committee, trade union, if any, in writing within four days of your becoming aware of that.

There's the *Regulation for Health Care And Residential Facilities*, which hopefully everybody's familiar with. Again, this has additional employer responsibilities. In that regulation, in Section 8, it says that in consultation with the joint health and safety committee, the employer has to develop, establish and put into effect measures and procedures to protect the health and safety of workers. It has to be reduced to writing to protect health and safety for the control of legionellosis. And again, these measures and procedures should be in writing in terms of safely inspecting, cleaning and maintaining water and ventilation systems. Also, in (1)12, it says the employer shall reduce to writing measures and procedures for the use, wearing and care of all personal protective equipment; meaning any personal protective equipment that's used by workers who operate, inspect or maintain water and ventilation systems. There have to be written measures and procedures and there has to be training, of course. And again, in consultation with the joint health and safety committee, the employer has to develop and provide training programs on these measures and procedures.

On Page 12, on Section 10(1) of the regulation, the employer has to ensure that workers who are required to use any protective clothing, equipment or device - for example, those maintaining ventilation systems - are trained on the care, use and limitations of that protective device before using it. And the employer also has to ensure that the protective equipment is properly used, maintained, inspected, stored, and is a proper fit. So, if it's a respirator, it has to be an appropriate size, and there must be proper fit testing for it if it's a type that requires fit testing.

The *Health Care And Residential Facilities* regulation has specific requirements for ventilation - this is on Page 13. It is very important that employers carry out these responsibilities. Section 19(2) requires that the mechanical ventilation system shall be inspected every six months to ensure it is in good condition, meaning no potential for *Legionellae* growth. This is a generic requirement; it's a minimum inspection only. As you see for cooling towers, they'll actually need much more frequent inspection and maintenance. The inspection has to be carried out by a qualified person, and the qualified person has to file an inspection report and provide a copy of the inspection report to the joint health and safety committee. The ventilation system has to be serviced and maintained in good condition as recommended by the manufacturer or by a qualified person as per the inspection report. So you have to look at the manufacturer of the cooling tower system and find out what their maintenance procedures are. You're probably using biocides in that cooling tower system, and you have to go by the recommendations of the

biocide manufacturer. Also, whoever supplies you the biocide should be giving you advice on maintenance and what to do, and you have to follow that.

The Ministry of Labour a long time ago - I think about 10 years ago, when the Health Care Reg first came out - published a guideline for Ventilation Inspection And Records For Health Care And Residential Facilities. So that was put on the Health Care Health and Safety Association [<http://www.hchsa.on.ca/products/teleconf/VentilationInspectionEng.pdf>] website as part of this presentation. Generally, it details requirements for Section 19 of the Regulation for semi-annual inspection and record keeping. So the HVAC system records should include a description of the location of the outdoor air intake and air handling units; air volumes; percentage of outdoor air; how the fans and dampers for the outside air are controlled; and how the temperature, humidity and air distribution are controlled - these are all very important items to know, and they are required for maintenance purposes. The records should also include what types the filters are; the maintenance schedule whereby they're changed and inspected on a regular basis; the maintenance program for fan and drive components, drain pans, the valves, the nozzle controls, et cetera - you have to be checking these, monitoring, keeping records. You also have to know about the type of biocide that's used and how frequently it's used.

The guideline talks about qualified persons inspecting the system and what the inspection has to include: the exhaust hoods, outdoor air intakes, ductwork, reheat coils and mixing boxes, the HVAC equipment, et cetera. In the humidifiers, cooling coils and drain pans, et cetera throughout the entire ventilation system, you have to look for cleanliness, ensure there's no slime or mould, that the drains are clear, and that there's no stagnant water or odours. For the cooling towers, you must ensure, again, that the drains are clear, and that there's no stagnant water, no bird droppings, no slime or biofilm or mould build-up.

I want to go over quickly the Centers for Disease Control *Guidelines for Environment Infection Control in Health Care Facilities*. They discuss a number of issues both in terms of air handling systems and potable water systems that I'm just going to briefly review. There are recommendations for air handling systems in that guide, and they also discuss construction, renovation, remediation, repair and demolition. The guideline outlines the infection control and ventilation requirements for the patients' protective environment rooms, for airborne infection isolation rooms, and for airborne-transmitted infections in operating rooms. It's very important that you have a look at this because they have different, specific requirements. They also discuss other infectious aerosol hazards in health care facilities.

A little bit about airborne infection isolation rooms. I think it's a good time to just review this, although it's not related to the topic of *Legionellae*, but it is part of the title of the presentation today. We want to maintain continuous negative air pressure, and that means that the air pressure in the room has to be monitored periodically - at least, as far as I'm concerned, daily, when there's a patient in the room - with a permanent visual monitoring mechanism. You have to ensure that the rooms are well sealed with no leakage, and there have to be self-closing devices on exit doors.

For newly constructed airborne infection isolation rooms, there should be at least 12 air changes per hour. For existing rooms, the guidelines say at least six air changes per hour. The exhaust from these rooms should be directed outside, away from the intake or, if it has to be filtered, there should be HEPA high-efficiency filtration and/or ultraviolet-light-filtered exhaust. Again, one has to monitor and document daily the negative airflow in all these rooms when they're occupied by patients. One has to provide backup emergency power air-handling and

pressurization systems to maintain the filtration. There has to be constant air changes per hour and pressure differentials in these isolation rooms. Whenever feasible, one should design and install fixed backup ventilation systems for new or renovated construction of isolation rooms, and implement environmental infection control measures for patients that are diagnosed or suspected of having airborne infectious disease.

Again, in the CDC guidelines there are recommendations for preventing the spread of waterborne micro-organisms, including *Legionellae*. It talks about routine prevention of waterborne microbial contamination within the distribution system, as well as strategies for repair or emergencies, and any additional engineering measures that may be necessary following an epidemiologic investigation in the event of an outbreak. It has general infection control guidelines for preventing Legionnaires' Disease and for preventing Legionnaires' Disease in protective environments and transplant units. It talks about cooling towers and evaporative condensers and some other sources of *Legionellae* contamination specific to the health care system. For example, you may have to look at quality of dialysis water and dialysate, and consider the hydrotherapy tanks and pools - which should be operated in ideal temperatures, of course, for *Legionellae* growth - because if there's air bubbling through them, you get mists and aerosols, and it's a high risk. There have been many reports of *Legionellae* outbreaks associated with hydrotherapy tanks and pools. And then there's all sorts of other miscellaneous medical equipment that's connected to some type of water system.

The CDC guideline also has some general infection control measures for preventing Legionnaires' Disease. One has to conduct an infection control risk assessment - this applies to everything, of course, in the health care system - and implement general strategies to detect and prevent Legionnaires' Disease, including a surveillance process, meaning surveilling both patients and staff; informing health care staff about the potential for Legionnaires' Disease and Legionnaires' contamination in the environment; and the ability, of course, to provide lab tests for diagnosis; to ensure one has systems in place either in-house or externally to be able to test clinical and possibly environmental samples for *Legionellae* - again, one wants to maintain a high index of suspicion in high risk facilities, as I've mentioned - and reporting cases of Legionnaires to local public health authorities, and to the Ministry of Labour if they're work-related cases. The CDC guidelines also discuss any follow-up measures that are necessary if there is an outbreak, as well as measures to decontaminate and prevent *Legionellae* growth.

They also discuss specifically cooling tower and evaporative condensers and how they should be maintained: if you're planning construction of a new facility or if you're putting in a new cooling tower, you want to make sure that you locate the cooling towers so that drift is directed away from air intake systems. You want to design the towers with drift arresters to minimize the volume of aerosol drifts. And the CDC guideline also talks about implementing the ASHRAE standards, which I'm going to talk about later on. Again, CDC also tells you that if the cooling towers or condensers are implicated in an outbreak, it's important to decontaminate the entire cooling water system.

The CDC's other guideline on *Preventing Health-Care-Associated Pneumonia*, which came out in 2003, has a section on Legionnaires' Disease. It talks about two approaches to primary prevention of Legionnaires' Disease when there's no identified cases. The first approach, which I don't recommend, depends on routine culturing of water samples from the health care facility's potable water system. Generally, it's not recommended. It's not a substitute for a good maintenance system. If the test results are negative it doesn't mean that there might not be *Legionellae* bacteria in some other part of the system. It's not something to rely on.

What you want to do, the second approach, is an engineering prevention and control approach by maintaining a high index of suspicion, investigating any potential sources, ensures one's maintaining cooling towers and potable water systems appropriately and maintaining appropriate potable water systems; for example, cold temperature systems below 20 degrees C and storing hot water at greater than 60 degrees C, with a minimum circulating temperature of 51 degrees Celsius. And of course, you have to have temperature valves at the end use, such as the showerheads and taps, to ensure that there's no scalding. That of course creates some maintenance and engineering difficulties for us, but basically you've got to keep the temperature of the hot water system high to prevent *Legionellae* and then have temperature valves at the point of use to ensure that the temperature is not too high, to prevent scalding.

Then there is secondary prevention, which is basically what you do when you've identified cases and you have to deal with an outbreak. Again, there's reporting requirements both to public health and to the Ministry of Labour if they're work related cases. You have to do an investigation to determine the source of the *Legionellae* contamination, and in this particular instance, environmental sampling for *Legionellae* contamination will be very useful and will help you determine what the source of the outbreak is. It may require a lot of detective work, a lot of sampling in the potable water systems and in the cooling towers and, results may be negative, but a positive result of contamination will point you to the source of the problem. That's why environmental sampling is necessary when there is an outbreak. Again, there has to be decontamination to treat or eliminate the problem.

I want to go through some examples of controlling *Legionellae* in cooling towers, so I put together the next couple of pages, 24 and 25, as a composite of various sources as practical examples rather than just giving you guidelines. I want to discuss that for the next few minutes then quickly go through some of the other guidelines and then take some questions.

When you're starting up a cooling tower early in the cooling season, in April or May when everyone starts their cooling systems, what do you have to do for a safe start-up of a cooling tower? Well, first you have to close the ventilation air intakes located in the vicinity. One has to proceed with visual inspections to see if there has been any biofilm or sediment build-up during the winter, and to ensure that the high efficiency drift eliminators are in place and aren't damaged, and then conduct any repairs that are necessary.

After the water is put in the system, one has to add disinfectant in sufficient quantities to maintain that disinfectant's ability. Some of the guidelines talk about maintaining a high amount of disinfectant during at least one day during the system's start up and then gradually ramping down to normal levels of disinfectant or biocide. You want to ensure that the system minimizes water stagnation and minimizes any leaks into the system that might provide nutrients for bacteria to grow.

Regular maintenance on cooling water systems: basically you're looking at proceeding with at least monthly visual inspections. And again, there are recommendations to empty and clean cooling towers at least four times a year to clean out the sediment and any biofilms. You have to treat the water using a biocide and a corrosion inhibitor, and you'll usually do a routine microbiologic and biocide testing as recommended by the biocide supplier and manufacturer, that includes some routine bacteria testing, not for *Legionellae* but for other bacteria. One has to keep a log of maintenance operations and results. Workers that perform cooling tower maintenance procedures need protective equipment, and if the cooling tower is contaminated, they may need respirators and you may need to get some advice on that. Again, routine testing

for *Legionellae* specifically is not required: only if there's an outbreak or if you're looking for a specific source.

In an emergency shutdown, when one does have a contaminated cooling tower or suspects that cooling towers are contaminated, then the system has to be shut down and cleaned, so one has to ensure that maintenance workers are trained and protected from the contaminated cooling water tower. A high level of personal protection is required to protect these maintenance workers. One has to close any ventilation air intake that's located in the vicinity of the cooling tower during the emergency shutdown, and one wants to shut down the water system completely, except for recycling pumps, which are usually kept going. This is another situation when you have to take environmental samples for *Legionellae* to confirm the source. During emergency decontamination - I don't want to go into too many details - it requires adding a high level of disinfectant and maintaining that high level of disinfectant for a day, then emptying the device and repeating the disinfection operation, cleaning the equipment or removing the grime and then refilling the water and starting up again.

Page 26: I'm going to review quickly the ASHRAE guidelines on minimizing the risk of Legionellosis associated with building water systems. Again, these are excellent guidelines, and I urge all of you to go through them carefully. The purpose of this guideline is to provide information and guidance in order to minimize *Legionellae* contamination in building water systems. The ASHRAE guidelines discuss both potable water systems and emergency water systems, which I'm going to go through now, and also discuss cooling tower and evaporative condenser water systems.

ASHRAE talks about factors that may influence growth of *Legionellae* such as the chlorine concentration; the temperature; the plumbing system design details in the potable water system such as the frequency of use, stagnant water, dead legs, and the temperature. The type of plumbing materials may lead to *Legionellae* amplification: rubber washers and fittings may be sources for *Legionellae* growth. The greatest risk is when contaminated potable water systems disperse small droplets into the air, so that may be at shower nozzles or aerators, or anywhere where water impacts a hard surface. If there's sludge, that's a source of nutrients for microbial growth.

Recommended treatment from ASHRAE for potable water systems includes, again, keeping the cold water below 20 degrees C, the hot water above 60 degrees C and circulated with a minimum temperature of 51 degrees Celsius. Again, you have to be careful to avoid scalding. I've gone through some of these requirements earlier. The recirculating pipes should have insulated runs to keep the temperature high, and you want to avoid dead legs. There's a new approach in potable water systems to minimizing *Legionellae* contamination, which you may want to look in to if you're concerned, called the "copper-silver ionization system for hot water systems."

High risk patient rooms: probably the only point I'm going to touch on patients is high risk patients rooms. You want to consider monthly removal of shower heads and tap aerators to clean out sediment and scale and then clean the heads and aerators with chlorine bleach. Again, there are requirements for repair and construction they talk about. The ASHRAE standard talks about decontamination of hot water systems if they are contaminated and you have an outbreak of *Legionellae*, such as raising the water temperature to 71 or 77 degrees or shock treatment with chlorine or flushing out the system at high temperature at each water outlet.

The ASHRAE standard also talks about - on Page 30 in the presentation - heated spas and architectural fountains, cooling towers and evaporative condensers and other systems.

A little bit about ASHRAE and cooling tower evaporator condensers on Page 31. What ASHRAE are recommending for system maintenance includes: regular visual inspections, as I've mentioned; ensuring the cold water basin is cleaned if there's any dirt or organic matter or debris visible; you want to use a mechanical filtration system on the water to reduce solids in the water; drift eliminators have to be inspected and cleaned regularly or replaced if deteriorated or damaged - this is extremely important; they tend to get damaged, the drift eliminators - and, of course, one has to keep operation and maintenance records.

And ASHRAE goes into what's listed on Page 32 - I'm not going to go over it - the type of operation and inspection records that are required to be maintained. Again, just as a reminder, the Ministry of Labour is going to be looking to you as employers to implement the ASHRAE standards, if it's appropriate for your workplace, together with the CSA standards, so I think you may want to take a quick look at the ASHRAE standards.

Page 33, water treatment systems: I'm just going to leave this for you to go through.

Now on Page 34 is the CSA standard. This is a CSA standard with the detailed special requirements for heating, ventilation and air conditioning systems in health care facilities. I just want to bring to your attention - I'm not going to go through this now; you can read this - on Page 35, there are three items I want you to have a special look at.

Section 6.6.8.1: the outdoor air intake has to be located to avoid sources of contamination - the outdoor intake in the CSA standard has to be located at least 7.5 metres from the cooling tower - and air handling units have to be configured to continuously drain water that's ingested through outdoor intake and condenser cooling coils and humidifiers. I've been into a few workplaces where that's been a problem.

I'm going on now to page 37 and a couple of other items from the CSA standard for ventilation systems in health care facilities. 8.2.1 requires that the expertise and training of operations and maintenance personnel shall reflect the complexity of the systems. You have to ensure that your maintenance and operation personnel are appropriately trained and competent, that is, the Occupational Health and Safety Act definition of what the Ministry of Labour considers competent. 8.2.2 in the CSA standard talks about maintenance, that schedules and procedures shall be prepared for regular cleaning, decontamination, repair and maintenance of all components. Again, two very important items.

On Page 38, I just want to go over one item, Section 8.4, which talks about Construction-Related Nosocomial Infections, another important item that you have to look at.

On Page 39, - we've finished with the CSA standard - there's one standard that deals very specifically with construction and renovation, from Health Canada, as I'd mentioned, and CSA has another standard on infection during construction and renovation of health care facilities. I just want to remind everybody that if you're doing a construction project, there are requirements in the Occupational Health and Safety Act and the construction regulations, under certain conditions to submit a notice of project, before construction projects and major renovations, to the Ministry of Labour. Just a reminder to everybody about submitting notice of project for construction and major renovations.

On Page 40, other relevant standards that may be important to you: there's the Ontario Building Code, which has ventilation and plumbing requirements. And again, there's a CSA standard

which has special requirements for plumbing installations in health care facilities. You should have copies of all of these and go over them.

Wrapping up now before our questions: the Ministry of Labour's expectations of you as an employer - what's the bottom line? What's the Ministry of Labour expecting? Where are we going to look for compliance with the Occupational Health and Safety Act and its regulations? This is just a really brief summary about worker training and education and protection, involving the Joint Health and Safety Committee, implementation of regular preventive maintenance, routine maintenance and emergency maintenance procedures based on CDC guidelines, ASHRAE guidelines, the CSA standards or other professional guidelines that have been developed and are acceptable. So this is the bottom line, what the Ministry of Labour is expecting from you in terms of compliance. I've gone through these standards, so look carefully at them and how they apply to your facility for cooling water systems and potable water systems. And remember the other issue I mentioned, about ensuring that airborne isolation rooms are properly maintained and kept under negative pressure.

That wraps up the presentation component, and Peggy I'll turn it over to you to deal with moderating the questions.

Peggy Swerhun: Thank you very much Dr. Genesove. We will now accept questions from participants. The Operator will open the lines and provide you with assistance.

Operator: Thank you. Ladies and gentlemen, we will now conduct a question-and-answer session. If you have a question, please press the *, followed by the 1 on your touch-tone phone. You will hear a tone acknowledging your request. Your questions will be taken in the order in which they were received. To remove yourself from the queue, please press the pound sign. One moment please for your first question. Your first question comes from Charlene Lunny, and she's calling from OANHSS. Please go ahead.

Charlene Lunny: Yes, my question is related to the reference to "qualified person," and I know the Act speaks to the fact that you either could have a qualified contractor or you can have an employee who is "qualified" doing the various maintenance and inspection activities. What is the Ministry of Labour's definition of qualified person? Is there a certain stamp of approval that we should be looking for when we hire somebody?

Dr. Leon Genesove: The Occupational Health and Safety Act talks about a "competent" person. A person is considered competent by training or experience. There are some main requirements where people may have to be, for HVAC systems, certified to certain standards to maintain HVAC systems. I can't tell you the details of all of these, but you have the responsibility as an employer to look into that. But the person that does your maintenance has to be competent either through training or through experience. Again, I'm not familiar with all the training programs or all of the certifications for maintenance of ventilation systems but you know there are training courses in maintenance of ventilation systems and some agencies offer some type of certification. You have to be satisfied - you have to ensure, as an employer - that whoever's maintaining your system is competent by some authority or some experience.

Charlene Lunny: OK. So to get someone that's certified in maintenance of an HVAC system is satisfactory?

Dr. Leon Genesove: Yes, if it's appropriate certification and they have the training and experience to know what they're doing. But, it's your responsibility to ensure that the people know what they're doing.

Peggy Swerhun: Next question?

Operator: Thank you. Your next question comes from Lee Bertrand calling from the Village of Riverside Glen. Please proceed.

Lee Bertrand: Yes, hi there. Am I correct to assume that the best way for potable water is ultraviolet, and can *Legionellae* be killed with an accelerated hydrogen peroxide like Virox?

Dr. Leon Genesove: There are various ways of dealing with potable water systems. I'm not an expert in all the methods of dealing with potable water systems, But if you look at the ASHRAE standards, which I've got here somewhere with me, it talks about using different types of decontamination systems and different methods, like the silver ion methods, and I'm not sure about the other methods. So you look at the various systems in the ASHRAE standards, and you also have to make sure whatever you do is compatible with the building code for plumbing. There are a number of ways of doing it. These are all listed in the ASHRAE standard and in some of the other CDC guidelines. I can't get into the details of each particular system and what's better, other than saying that you have to do that.

Peggy Swerhun: Thank you. Next question?

Operator: Thank you. Your next question comes from Tom Clancy calling from Providence Health Centre. Please go ahead.

Navik Kalil: It's Navik Kalil from Providence Health Care. I'd like to ask you a question. What is the acceptable upper limit of *Legionellae* for a hospital water distribution system?

Dr. Leon Genesove: Extremely low. You're talking about potable water systems? What I mentioned in the talk is you want to rely on maintenance, procedures and preventive maintenance and not on sampling numbers. Because if you're talking about potable water systems you could have zero *Legionellae* when you take a sample now and then you could have a growth, a spurt an hour later, or you could have a dead leg somewhere in the system with slime and sediment in it that will be growing *Legionellae* that you'll never get on routine environmental sampling. You can have a showerhead contaminated that you won't find. So you want to rely on specific maintenance, plus the fact when you do environmental sampling it usually takes two weeks to get the results back at least, so it really doesn't do you any good. You want to concentrate on preventative maintenance.

In the event of an outbreak then you want to do extensive environmental sampling throughout the system. Some of the standards you look at, or if you go to some the manufacturers of biocides, or the standards of the Cooling Tower Institute who publishes guidelines for prevention of *Legionellae* in cooling towers, and some of the other water system maintenance suppliers, they will have tables for levels of *Legionellae* that are acceptable or not acceptable. But again, I think that you want to rely on preventive maintenance and not rely on *Legionellae* numbers that may come and go; you won't get the results for two weeks anyhow.

Navik Kalil: OK. Where can we get your presentation from now?

Dr. Leon Genesove: My presentation is right on the website now, the Health Care Health & Safety Association's web site.

Peggy Swerhun: The transcript will also be on our website in a few days.

Navik Kalil: Thank you very much.

Peggy Swerhun: Thank you. We have 10 more minutes for questions.

Operator: Thank you.

Dr. Leon Genesove: I just want to say you can also get information from your suppliers of biocide and people who maintain your cooling towers and through other people that maintain potable water systems and provide systems for maintaining it. But a good place to start is the ASHRAE standards and CSA standards and the CDC: they have very good outlines of what to do, and you're going to have to develop a composite that's appropriate for your facility.

Operator: Thank you. Your next question comes Norm Stinson calling from St. Joseph Health Care, London. Please proceed.

Norm Stinson: Doctor, you touched on this just a moment ago, but my question was going to be that it takes up to 10 days, I'm told, to get a sample. From a control point of view, that just doesn't cut it; I mean, there's no way you can control when you don't get your results for 10 days. Is there some sort of testing that we can use to give us an indication of whether or not we have a problem and the magnitude of that problem?

Dr. Leon Genesove: Again, depending on the water system, you have to rely on the preventive maintenance of the cooling towers, and you have to do regular inspections. If you've got anywhere - whether it's the potable water systems or in the cooling towers - if you've got sludge, you have biofilm growth, there's going to be *Legionellae* that's going to eventually start to amplify. You have to maintain your cooling towers and your potable water systems or your decorative fountains, your hydrotherapy pools to ensure that there is no sludge and no biofilm buildup. Now, for cooling towers, there is regular microbial testing that's done often on a daily or weekly basis where you're looking for general bacterial growth, and the biocide manufacturers will tell you to keep the biocide level and the pH levels at a certain level to prevent general bacterial growth and biofilm growth, as these all serve as sources of nutrient for *Legionellae*. If there's too much general bacterial growth, it indicates a poorly maintained cooling tower system, so your cooling water maintenance people will tell you about the frequency of regular microbial monitoring. There's a dipstick you can do, that you can check within a few hours as to whether there's general microbial overgrowth. And there's another system - I forget the name of - that gives you electronically more instant results. But you certainly want to check in your cooling towers for general microbial overgrowth to ensure your biocide and pH levels are correct.

Operator: Thank you. Your next question comes from Lauma Stikuts from Kristus Darzs Latvian. Please proceed.

Lauma Stikuts: Yes, my question right offhand: would you remember if electronic air filters would clean the system, the air supply?

Dr. Leon Genesove: I haven't seen that written anywhere that electronic air cleaners are going to clean your -- you're talking about for the cooling tower system?

Lauma Stikuts: No, within the air supply.

Dr. Leon Genesove: Oh, within the air supply. That's good for general dust. It's not going to help you for infection control. You'll see on some of the tuberculosis standards they'll talk about ultraviolet germicidal light, but electronic air cleaners, you know, they clean big dust particles out of the air; they're not for microbial decontamination.

Operator: Thank you. Your next question comes from Andrew McSherry. Please proceed. He's calling from Hospital for Sick Children.

Andrew McSherry: My question is, I guess, the recommended maintenance is to empty and clean four times a year. Now, the four times a year, is it the tower that has to be emptied and the sump, or is it the entire condenser water system that has to be dumped?

Dr. Leon Genesove: Usually you have to go through the -- I don't want to go through the details of it, because I'm a physician, I'm not a cooling tower system maintenance expert - you're looking at emptying and cleaning the entire system and making sure there isn't any sediment there. So the ASHRAE standard specifically talks about the sump, and I'm glad you brought that up, although I don't remember what it specifically says there in the ASHRAE standard about the sump. What the ASHRAE standard and the other standards do talk about is inspecting the sump to ensure there's no sediment and biofilm buildup that will promote growth, and I suspect you'll have to clean out the sump too also, but you have to check with your competent maintenance people to ensure what's necessary for your particular system.

Andrew McSherry: Thank you.

Operator: Thank you. Your next question comes from Lisa McCaskel and she's calling from Ontario Public Service Union. Please proceed.

Lisa McCaskel: Hi, I'm just curious Dr. Genesove: you've listed the ASHRAE and CSA and CDC standards. Are they all considered enforceable by your inspectors or do they just write recommendations based on them or do they treat them as law?

Dr. Leon Genesove: The first thing we look to is probably Canadian Standards, because CSA gives you a general standard, then one would look to other specific standards. ASHRAE's an extremely helpful standard that was written by a public body, and again CDC. So if it were necessary that an inspector issue an order under the general duty clause in the Occupational Health and Safety Act, Section 25(2)(h), that requires all measures to be taken to protect a worker's health and safety, then the narrative of the inspector's report will reference the ASHRAE standard or CDC guideline as an appropriate reference or guide to follow so that the employer will be in compliance with 25(2)(h)...

Lisa McCaskel: OK. Thank you.

Dr. Leon Genesove: In the order issued under 25(2)(h) with the reference in the narrative, compliance with the ASHRAE guidelines will be considered compliance with 25(2)(h).

Operator: Thank you. Would you like to take another question?

Dr. Leon Genesove: One more question.

Operator: Thank you. Doctor, your next question comes from Gregory Hefferman. He's calling from Providence Continuing Health Care. Please go ahead.

Gregory Hefferman: I have a question to ask you. One of the experts at the Centers for Disease Control, US Department of Health and Human Services, OSHA and Health Canada seem to disagree on the use of sodium hypochlorite as far as killing *Legionellae*, and they can't seem to agree among the four organizations. What's your thoughts on that as far as trying to kill it or control?

Dr. Leon Genesove: Yeah, I can't give you a definitive answer, either. You're looking at basically two groups of chemical biocides: oxidizers and non-oxidizers when you're dealing with chemical biocide. And once when you get into that level of -- I'm sorry I can't give you a specific answer, especially with all the other experts who actually maintain cooling towers. We can't agree or disagree. Again, it's covered in the ASHRAE standards and there's a very good discussion about the question that you've just asked in terms of pros and cons in the -- if you look at the Association of Water Technologies website, which is the website listed at the back of the presentation here, which is www.awt.org, they have a PDF for *Legionellae*, and they get into a discussion of that specific issue. So you may want to have a look there to get that answer.

Gregory Hefferman: Thank you.

Operator: Thank you. Dr. Genesove, I would like to turn the conference back to you, sir, for closing remarks.

Dr. Leon Genesove: I'd like to thank everybody for attending and listening. It's really exciting to have such a high attendance and have everybody so committed to dealing with *Legionellae* prevention and occupational health and safety. Peggy?

Peggy Swerhun: Thank you very much Dr. Genesove for your very interesting and timely presentation. I'd also like to thank everyone for joining us today. Probably the transcript will be available on our website within the next few days. Don't forget to check our website regularly for important occupational health and safety information. The coordinates are www.hchsa.on.ca. This concludes our teleconference.