Welcome to the forensic toxicology podcasts. I am Dr. Sanela Martic, professor at Trent University in the Department of Forensic Science. This podcast is about heavy metal toxicants. Let's listen to Dr.

Joel Schwartz from McGill University who posted a YouTube video back in September 2019. The video is called all about arsenic. Local. Josh Swartz, Director of the Medical Office for Science and Society, speaks about the history of arsenic as one very important metal ion and toxicant and how its poisonous presence has been detected in the past. Let's take a listen. Alright, Think of a poison. I read your mind. Arsenic.

Arsenic actually is a metal. When we talk about arsenic being a poison, we're talking about compounds of arsenic, like arsenic trioxide or arsenic sulfide. Those are the classic ones. Arsenic sulfide is available as real gar, or PMNs. These are naturally occurring minerals known to the ancient poisoning with arson and goes back a long time. But most people of course, are familiar with the 1900's for movie Arsenic and old lace. Or they've read Agatha Christie who used arsenic as a poison. Or perhaps her stories about Napoleon who was poisoned. So the story goes by the British. Or if you don't like that story, arsenic used in the wallpaper where he was imprisoned, leached out into the air and that poison tip. Anyway, we know that arsenic is highly toxic. The board Joe's of course used it to poison people. And then there was Julianna to funnel and Italian lady who specialized in creating wealthy widows by poisoning their husbands. It's not surprising that royalty was worried about being poisoned mostly by arsenic. And kings had tasters. And of course they could dispense with the taster of the taster perished. They knew not to partake of the food. In ancient Korea, though, the kings had a different idea. They knew something about chemistry. They knew something about silver. Tarnishing.

Silver, of course, is a bright clustering metal, but can know that if you leave it out into the air, this is what happens.

It tarnishes. That is not silver oxide, that is silver sulfide. It happens because the air has traces of hydrogen sulfide that reacts with the silver and you get the tarnish. Of course, it can be cleaned off, but this is the bane of silverware collectors. Arsenic sulfide will react with silver, tarnish the silver, and the ancient Korean kings are aware of this. So what did they do to detect arsenic in the food? If there was any, they would resort to silver chopsticks. The idea was that if there was arsenic sulfide in the food, the silver would tarnish. Not likely to have worked because you need quite a bit of arsenic to tarnish the silver. And furthermore, it doesn't happen right away. Also, there are other foods that contain sulfides like garlic. So if they were eating garlic, that also would have tarnished silver. But there is something interesting, though, historically about the use of the silver chopsticks. Because in Asia, of course, chopsticks have been popular for a very long time made of bamboo or other types of wood. But Korea is the only Asian nation where metal chopsticks are still use. That probably goes back to the time of the ancient kings. Because the people wanted to emulate what the things we're doing. But of course they couldn't afford silver chopsticks. They started to make chopsticks out of other metals. That tradition has continued to this day. If you go to a Korean restaurant, proper Korean restaurant, you will be given metal chopsticks. Of course, you won't be eating any food that is tainted with arsenic. In most likely you will dining on kimchi, which is a fermented food. And it's very interesting because it contains a lot of bacteria. And as a probiotic, it is set to be good for us. So you don't have to worry about arsenic in the kimchi. However, the salt content, that's quite stunning. Of course, when you eat it occasionally as we do in North America, It's not a worry. But in Korea, where they eat it off in three times a day, there's a frightening increase in hypertension and also of gastric cancer that has been linked with the high salt content. And of course, the metal chopsticks are not going to detect the salt.

Taste buds. Will you just heard Dr.

Schwartz talk about arsenic and one very historically relevant and known metal ions contaminant that is toxicant. Let's turn to another well-known heavy metal ion that's toxic and specifically lead. And you're going to consider this lead-based case, specifically Canlli case 23518302016, CanLii 34067 CA VRAB. In this particular case, the applicant had provided service to the country and the RCMP from 1979 to 2011. The panel members recognize that wonderful service and the claim is brought forward as the applicant. Is dissatisfied with the review decision back from 2015, which denied pension entitlement under the RCMP act in accordance with subsection 21 and Pension Act for the condition of lead poisoning in a Veterans Affairs Canada official decision back in 2011, pension entitlement was denied on the grounds off. And I'm paraphrasing here. We recognize that you developed elevated lead levels in your blood in 1996. We also recognize that these elevated levels appear to be associated with exposure on the gun range. Here we have a connection is between the lead that's part of that main part of the GSR.

that main part of the GSR. The exposure. It sounds like exposure in the workplace. However, we do not have evidence that you had any symptoms of lead poisoning, your blood levels for lead return to normal by 1998, a medical report submitted with your application does not establish a diagnosis of lead poisoning either. Without an established diagnosis of lead poisoning, evidence of symptoms of lead poisoning or health problems associated with your elevated the levels of lead. We cannot consider a disability pension for this condition. Those were the grounds on which back 22011 veterans, the first kind of official decision was made. As a result, they concluded that lead poisoning did not arise out of and it's not directly connected with the RCMP service. The premises that the applicant may be exposed to lead in a service related environmental hazard. The medical advisors opinion is honest and misleading at the same time contradicts to specialist opinions and did not take into consideration the final human health state of science report on lead published by Health Canada in early 2013. This final human health state of science report and led by hc is a really important document, one you can actually access even today. The advocate reminded that the lead builds up in your body and even small amounts can really cause serious health effects. The advocate concluded that the applicant was subjected to lead poisoning, resulting cognitive symptoms. It is directly connected with his RCMP service pension entitlement is thus justified. We see at the advocate pushing for the pension entitlement based on lead poisoning related to the workforce. The panel concludes that the cognitive symptoms resulting from the condition of lead poisoning arose in part from the applicants RCMP service. Based on the blood lead level test results from 1960s, late 1960's, the panel acknowledge that the applicant had recorded high level of lead, leading to the first test result. And chronic means that the condition has been existed for at least six months. Signs and symptoms are generally expected to persist despite medical attention. Although they may wax and wane over the six month period thereafter and linger. The panel concludes the applicant had a service related chronic condition of lead poisoning. The health Canada final human health state of science report on lead date back to 2013 at refers to a great number of lead sources that affects the general population. Such owing too long history of global anthropogenic use and it's natural occurring presence lead is ubiquitous in the environment. And Canadians may be exposed to lead through environmental media, their diet and various sources, including how their consumer products. The main route of exposure to lead for the general adult population currently is oral exposure from food and drinking water followed by inhalation. We see there are many sources of environmental lead pollutants. We also see in this case that led directly was linked to the service or work-related exposure in this case. Let's consider the last part of this podcast that is focused on heavy metal ion toxicants. Just like the Health Canada document was used in the CanLii case, you can certainly explore the Government of Canada website and find documents that was referenced, indicates, and explore it and look at other toxicants in this case, I would like to focus that shift gears to a mercury. If you look on reports and publications in environmental and Workplace Health published by government of Canada website. And you will find a lot of information about various toxicants. Specific focus here is environmental contaminants such as mercury. In that document, you'll find a couple of different pieces of information about mercury. The two big items I would like to focus on in this podcast is number one, what types of workplace environments potentially increase mercury exposure? That would really link us back to environmental exposure, work-related exposure. And it would really bring back nicely to the Canlii case where lead was a workplace environment potentially linked. What types of workplace environments potentially increase mercury exposure? What are some of the ideas? Based on Canada government website, workplaces and occupations that have a greater potential for elemental mercury exposure include, but are not limited to, for example, manufacturers of electric equipment such as batteries, mercury lamps, thermometers, medical devices, automotive parts, for example, there's still contain mercury being number one, number two, of course, chemical processing plants where they use mercury, production of chlorine, caustic soda, pesticides, biocides, and so on. Sometimes metal processing manufacturing could also lead to that. Manufacturing plans that are producing explosive detonator or also sometimes of mercury. Of course, waste incineration plants, landfills, crematoriums, and cemeteries may also be mercury sites or sources. Construction sites were building parts contain mercury, could be electrical switches, thermometers, latex pain, sometimes cheaper repair facilities. So we really have a wide range of potential sources of mercury exposure. The second question in that document, you could really check out. Please take time to do that. Is there any method of testing that will determine individual exposure to mercury? Now that we've kind of listed potential sources of mercury. Can you actually measure for mercury? Is mercury president in biological fluids for example, or biological matrices? And the answer is yes. Hair, blood, and urine samples are typically tested to detect mercury levels if there is, of course suspected the exposure. Analytical methods can detect inorganic mercury, total mercury. The difference, the organic mercury, the test for elemental mercury is the same test as for inorganic mercury. And interpretation of results being dependent on the type of exposure. These tests are very useful in determining concentration of mercury, but it's very hard to determine the type of mercury exposure beyond inorganic or organic from the blood and urine tests, of course, tests for elemental mercury.

So in the case it is a suspicion of metallic mercury poisoning. The doctor will want to really look at complete occupational and environmental history of the patient or a person who has been exposed for acute effects resulting from exposure to high levels, for example, there will be a whole blood tests done. And whole blood is an indicator of recently character exposure for occupational exposure of the whole blood is collected at the time. Let's say at the end of the last worksheet of the workweek, for example. And then Mercury is measured. If exposure to low levels of elemental or inorganic mercury vapors, for example, occurred over a period of time, then the urine is a good sample to use and is preferred over blood. And you wouldn't can be collected pre shift or you could find the longer-lived metabolites in the urine that developed over time. Now here's samples provide a good method as well for determination of variation of mercury intake over a long period of time. Because you do have this ability to analyze here in segments. And these segments immediately become kind of a chronological data point. Concentration of mercury detectable in blood and urine and the non occupationally exposed population is dependent on the method used analytical procedure to measure the mercury and the living environment of that subject. But specifically, if we talk about blood levels in the occupationally unexposed population, the blood levels of mercury are between 0.1 to ten micrograms per liter of blood. A whole blood concentration of 15 micrograms per liter is considered to be biological exposure index for occupational exposure. So anything 15 micrograms per liter or more is considered potential occupational exposure. Blood concentration above that, 15 micrograms per liter should be certainly followed up. Symptoms should not be present. The BII concentration of 15 micrograms per liter is equivalent to about 0.008 micromoles per deciliter. What about the urine samples? Urine samples for the non occupationally exposed population typically makes concentration of elemental inorganic mercury of less than three microgram per liter. As for the occupationally exposed population or for population with exposure to unusually high environmental concentrations of mercury. The BEI concentration limit is set at 35 microgram per gram of creatinine and that's a compound present in the urine. Concentration of 35 micrograms per gram of creatinine. Is it equivalent to 20 micro moles of mercury per mole of creatinine. Using this endogenous creatinine levels of the urine, which are really an individualistic. There's a range for this concentration depending on the gender and individuals a metabolite, one can actually use creatinine for that individual and use it as a baseline for determining the amount of mercury present. More importantly than to use the mercury versus creatinine ratio to figure out if the BEI concentration is above the limit or below the limit. You just heard three stories on arsenic, lead, and mercury. This concludes our forensic toxicology podcasts on metal toxicants. I hope you enjoyed it.