

Welcome to the forensic toxicology podcast. My name is Dr. Sanela Martić. I'm an Assistant Professor in the Department of Forensic Science at Trent University. Today's podcast is on presumptive testing. In the two cases, you will hear about presumptive testing in forensic science and how in case one presumptive testing can be used to detect illicit drugs as trace powders. While in case two, you will hear how presumptive testing can be used to detect drugs and metabolites in biological fluid, such as urine. Let's consider the first case, R. versus Dexter Boyce 2015 ONSC 46-2 CanLII. Dexter Boyce was charged with conspiracy to import a controlled substance into Canada. He was alleged to be involved in a conspiracy to import 356 grams of cocaine from Costa Rica to Toronto. The cocaine was sitting inside two packages of travel brochures and was discovered when the packages were examined in Panama, a transit point for shipments. In Panama, the white powder in two books, seized was suspected to be cocaine. A drug detecting canine reacted positively and the substance was sent to the Panamanian Laboratory of Control Substances for analysis. A field tests on the substance was positive for cocaine. They ran two non confirmatory tests, meaning presumptive tests. And one confirmatory test. Specifically, Mr. Juzado concluded that the substance was cocaine, with a total weight of about 355 grams. That's based on Panamanian expert report. So let us look at more detail at the report. The report issued by the Republic of Panama's Laboratory of Forensic Controlled Substances, describe the use of three tests for the identification of cocaine. The two tests were presumptive. Those two tests were Scott's Test and the Microcrystalline Test. And they are being considered as a non confirmatory variety. So, the sample underwent MR Key Test for the detection of opiates, a modified Scott Test for the detection of cocaine and microcrystals in a very aqueous gold chloride solution. Let's first look at the Scott's Test. It is a presumptive tests for cocaine, and it's typically done by using a 2% cobalt thiocyanate solution in glycerine in water, which is followed by addition of HCl and chloroform. And, hence, you will have a two dye basic reaction. You will have two phases, aqueous phase and organic phase. A positive test is indicated by the blue color in the organic layer, specifically chloroform layer, which indicates positive for cocaine. What about Marquis Test, Marquis Reagent used in in case? It is really a simple spot test to presumptively identify alkaloids as well as other compounds. And it's done by using a mixture of formaldehyde with concentrated sulfuric acid as well as the suspicious powder. And the color change is really indicative of the element. The Marquis Reagent would turn really purple to black if there is ecstasy present. The colour will be orange to brown if it's amphetamine and methamphetamine present. And it's true that the Marquis Test is likely to be transparent, so colourless if the cocaine is present. So, the two non confirmatory tests have been done. What about this confirmatory test that I've mentioned? The confirmatory tests used for identification of cocaine was Infrared Spectroscopy. Now, how do these tests compare to other databases or other organizations? The drug analysis service does not use Scott Colour Test or the Microcrystalline Test as non confirmatory tests to screen for presence cocaine. The drug analysis services from Health Canada specifically uses methods that are recognized by United Nations Office of Drugs and Crime, UNODC, as well as the Scientific Working Group for the Analysis of Seized Drugs, as WG drug. Rosol Al-Hakim, a specialist at the Toronto lab of Drug Analysis Services Health Canada has advised in a letter that the confirmatory tests provided by the Panama, that information was valuable to figure out the identity of the compounds and have the ability to identify a drug and related substances, while eliminating other substances from consideration. Dr. Al-Hakim advised that the two confirmatory tests used by Health Canada's drug analysis include GC Mass Spec, Gas Chromatography Mass Spectrometry, and the Infrared Spectroscopy Test. The Panamanian report, as well as the comment or evaluation by the Drug Analysis Services, has commented on that; the analyzed sample was positive for cocaine in the amount of 355 grams. So, in this case, you see how colour test was used to screen the suspicious powders, look at the classes of compounds from amphetamines to cocaine. And you can also see that in addition to several presumptive methods, there has also been confirmatory methods such as FTIR, which provided information

about functional groups present in the suspicious sample, in order to confirm the chemical structure and not only confirm the class of compounds. Case two: R. versus Humphrey 2007 CanLII 59379 (ON SC). In 2006, Kevin Humphrey, stabbed Richard Kent with a knife, a number of times and cut his throat. As a result, Mr. Humphrey is charged with attempted murder, aggravated assault, and assault with a weapon, and possession of a weapon, namely the knife, for purpose of dangerous to the public peace. Mr. Humphrey pleaded not guilty to these charges and elected for trial before the judge without a jury, Mr. Humphrey admits that he did inflict injuries suffered by Mr. Kent, that they were life-threatening, but testify that he did so because Mr. Kent attacked him. The central issue of accordingly, is whether or not the Crown has proven beyond a reasonable doubt that Mr. Humphrey did not act lawfully in self-defense. Did Mr. Humphrey reasonably believe that he was being unlawfully assaulted by Mr. Kent? Did Mr. Humphrey use force against Mr. Kent because he had a reasonable apprehension of a risk of death or grievous bodily harm? Did Mr. Humphrey use force against Mr. Kent because he reasonably believed that he could not otherwise save himself from death or grievous bodily harm? In this case, you will find evaluation of drugs and metabolites in Mr. Kent's system to determine if Mr. Kent was under influence and, has, may have attacked Mr. Humphrey, who in turn reacted and assault Mr. Kent. A sample of urine was collected from Mr. Kent and tested using a urine tox screen and immunoassay and chromatography. Here you immediately see that immunoassay is one of the presumptive methods used commonly to screen for various classes of compounds. So, let's look at the details of the tox report. A sample of urine from Mr. Kent was collected at 07:44 PM and was tested using urine tox screen, immunoassays, and urine drug screen and chromatography. The immunoassay screen detected amphetamines, cocaine metabolites, and opioids. So here we have kind of three general categories. The chromatography tests detected cocaine, cocaine metabolites, but did not detect amphetamines, morphine and morphine metabolite. Here we quickly see the difference between immunoassay screen versus chromatography screen, there is a discrepancy. Although the chromatography analyzer used to screen the urine sample can detect over 900 different drugs and metabolites, the only drug detected was cocaine and cocaine metabolites. And that's really interesting. So what is the reason for this discrepancy, for example? So, there is an additional note in the report states that all the immunoassay screen gave positive results for opiates, meaning morphine and metabolites, it was not confirmed by chromatography. And, some of the reasons are insufficient concentrations of opiates to be detected by chromatographic method. The report explains that opioid immunoassay measures total opiates, for example, everything. Morphine, codeine, heroin and so on, and the respective metabolites. And hence, it has a higher sensitivity because you have many of these you can detect. Apparently even poppy seeds can cause a positive opiate immunoassay result. That means that immunoassay screen can detect amphetamine and opiates because they're all considered as in one pot, and it's very sensitive because it collects all of that information at the same time. Chromatography is different because chromatography separates not only classes of compounds, but also separates morphine from 6-MAM and so on. And so by doing separation in chromatography, you are detecting very specific compound, and hence that compound alone may not be added at the sufficient concentration to detect, compared to immunoassay, where we look at total amount of opiates, which could be anywhere between 5 to 12 compounds. So to recap, in this expert report, we find that opiate immunoassays measures total opiates, but under a big umbrella, which encourages positive results. We also find that chromatography separates the compounds and measures that separately at a separate time points, and that then dilutes it down to maybe potentially low concentrations that are not enough to detect. At the end the toxicologist, Mr. Mitchell, who submitted this report, stated that to Mr. Kent did not take morphine intravenously and that this contradicts the evidence of Mr. Humphrey who likely claimed that Mr. Kent was under influence. No evidence was presented on how fast morphine and it's metabolized dissipate in the urine in order to describe the discrepancy between an immunoassay test and chromatography. But it is also important consideration, right,

because we know that drugs and metabolites maybe degrading over time. And so while they may be present in one test, by the time you go to run a second test on the same biological fluid, those drugs could be degraded and the second test, can you give me negative result for them. So in this case two, you find that immunoassay was used as a presumptive testing

tool, and it was compared to a second presumptive method, chromatography. You also find the discrepancy between the two methods. And in this case, the toxicologist use sensitivity of the methods. And there's still activity as a reasoning and as an argument to describe those differences. You heard two cases that rest on use of presumptive testing and forensic science to detect a class of drugs, a drug class such as cocaine, amphetamines, opiates even. And you've heard how drugs can be detected in biological fluids or as trace evidence in these two cases. You also heard how there's a variety of presumptive testing tools available to a forensic scientist, going from pure color test all the way to immunoassays and to chromatography. And so, these tests are very specific to drug class, and these tests are also very different in terms of sensitivity and selectivity. You certainly see that highlighted in case two where the immunoassay result and a chromatography result did not fully match. And this concludes our forensic toxicology podcast on the topic of presumptive testing. Thank you for joining us.