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OREGON STATE POLICE

Forensic Services Division Newsletter

TOXICOLOGY TOPICS

STILL WAITING FOR THOSE TOX RESULTS? WHY DOES IT TAKE SO LONG?

By Jeff Eitner, Springfield Lab

The answer is more complicated than you may imagine.

We know it can be frustrating to wait six months or longer for the results of a urine analysis. This timeline is a reflection of our backlog rather than the time required for analysis. Toxicology analysis takes place in the Portland Metro and Springfield Forensic Labs, and it typically requires two weeks or less to do the analysis and issue a report. The long waiting times are a function of a large backlog of old cases that has been created by chronic understaffing.

A common misconception is that our analysis is equivalent to workplace drug testing, which only gives results on the potential presence of certain common drug classes, such as amphetamines, opiates, or benzodiazepines. Those results do not distinguish between controlled and non-controlled substances—a necessary part of DUII litigation. Our analysis specifically identifies the individual drugs present in a urine sample.

For a toxicologist, the majority of the analytical time is spent reviewing large quantities of instrumental data. Each sample is first screened for general drug classes, and then analyzed on our gas chromatograph/ mass spectrometers (GC/MS) at least once. In the case of complex samples, such as those from poly-drug users, a sample may be analyzed multiple times. Figure 1 is a representation of the chromatogram portion of a data file. Each peak in a chromatogram represents a compound in the sample. Only a few of these compounds are actually drugs or drug metabolites. Each peak also has a corresponding mass spectrum, as illustrated in Figure 2. The mass spectra are used to identify any drugs present by comparing them to known drug standards.

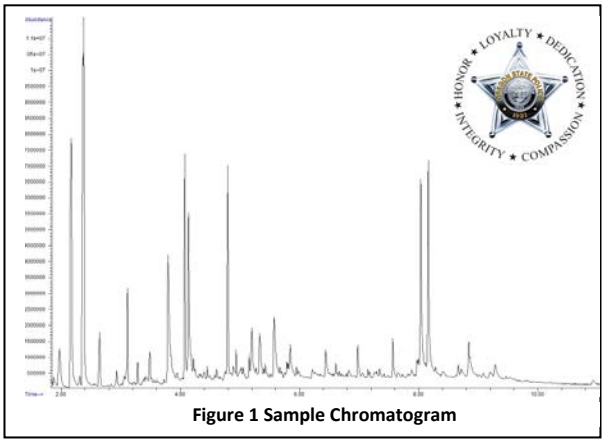

Figure 1 Sample Chromatogram

After the analyst examines all of the peaks and mass spectra in each sample's data file, relevant data is compiled to confirm the presence of any drugs present. That data is then reviewed by a second analyst to ensure no errors were made. After the review is complete, a final report is issued.

We are always looking for more efficient ways to deliver the same reliable and scientifically valid results. We are also hiring and training new toxicologists. If you have any questions, please contact your friendly neighborhood toxicologists.

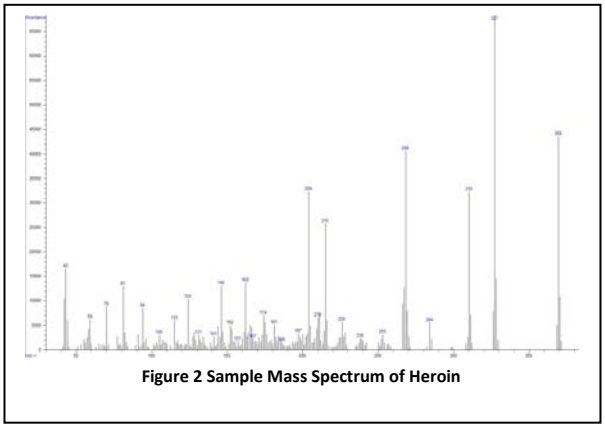

Figure 2 Sample Mass Spectrum of Heroin

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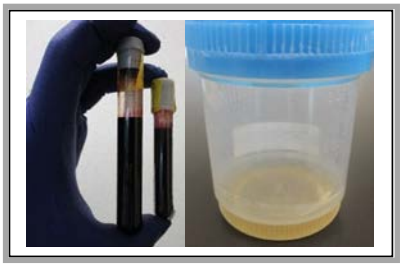
TOXICOLOGY TESTING: FROM SAMPLE COLLECTION TO FINAL SUBMISSION, DETAILS MATTER!

When collecting biological samples for toxicological analysis, several details should be considered before submitting the evidence to the laboratory, including sample size, storage methods and evidence labeling and packaging. Accurate and complete Tox results depend on getting these details right.

Sample volumes and conditions are critical. For urine samples, a minimum volume of 25-30 mL is required to ensure that the sample can be screened and analyzed for all possible drugs. (The lab may be able to perform a complete screening with less, but it depends on the combination of drugs in the sample.) For blood, a minimum volume of 0.75 mL is needed, but two full blood vials are preferred. The second blood vial can be preserved for requested defense testing or further analysis by an outside laboratory. *See Figure 1*. The condition of the sample should also be considered. If the urine collected is off-color, foamy or cooler than expected, collect a second sample and submit both to the laboratory. When handling blood vials, make sure the vials are adequately mixed to ensure that the preservatives are dissolved. Keep samples refrigerated to prevent degradation of drugs and microbial growth that can interfere with analysis.

Figure 1: Shown at left, adequate blood volumes for analysis. Gray-stoppered 7mL vacutainer® tubes are best for collection. At right, this urine sample is inadequate for full toxicological analysis. Submit at least 25-30mL (1 fluid ounce).



Proper sample labeling with the collection date and time helps directly correlates the sample to the person under investigation. At a minimum, every vial label should include the person's name, the date, and time of collection/draw. This establishes chain of custody for the sample and ensures that the laboratory analyzes the intended samples. *See Figure 2.*

Figure 2: Adequate urine volume and legible label information.

Sealing and packaging of evidence is important, but don't overdo it. The most important seal on the evidence is the external seal on the outer-most layer of packaging. The lid on a urine cup should be evenly threaded and not over-tightened. Evidence tape added to the top of a urine specimen cup doesn't create a liquid-tight seal and will not prevent the cup from leaking. Any urine that leaks out of the original specimen cup is no longer viable for analysis. Excessive evidence tape can also obscure the important label information on the cup or vial. *See Figure 3 for examples.*

What about the request form? The Form 49 is the analytical request form required for submission of evidence to the laboratory. It should list the name of the investigating agency as well as the case number, especially if it is different from the DRE agency's case number. For urine toxicology, including the suspected drug categories or illicit drugs/prescriptions mentioned by the suspect allows the laboratory to ensure that the sample is tested for any drugs require specialized procedures for confirmation. The request form should also clearly describe the sample and identify the analysis needed. If the information is too vague, or if important information is absent from the Form 49, the evidence may be rejected. At this time, OSP Forensic Toxicology can analyze urine samples for drugs and blood samples for ethanol. If a toxicological drug screen is required on a blood sample, it must be submitted to an external laboratory for analysis.

Figure 3: Label information obscured by tape.

For complete storage guidelines for blood and urine samples, please refer to Section 15 of the **OSP Physical Evidence Manual via http://www.oregon.gov/osp/FORENSICS**

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NEW OPIOID DRUGS TIED TO OREGON DEATHS AND NEW TOOLS TO IDENTIFY THEM

The Postmortem Toxicology section in the Portland Laboratory works with the Medical Examiner's Office on investigations homicides, officer-involved deaths, traffic fatalities and many other suspicious or unattended deaths. Postmortem Toxicology examines blood, urine and tissue specimens for the presence of alcohol, controlled substances and pharmaceuticals. In August 2015, two cases proved to be of particular interest to law enforcement; both involved deaths caused by ingestion of new designer opioids. The Toxicology section developed a new method for determining the amount of these drugs in the blood of decedents. We also demonstrated that a new instrument currently being validated will be very helpful in identifying new designer drugs as they appear in casework. Submission of the actual drugs found at the scene of these two deaths was also extremely helpful in determining the cause of death.

A package mailed from Sweden contained two nasal-spray bottles of *para*-fluorobutyrylfentanyl, a Schedule I controlled substance in Oregon, and included safety warnings.

Case 1: A 28 year old graduate student was found dead in his apartment. The suspected cause of death: snorting diphenhydramine (Benadryl). The agency submitted three unknown powders found at the scene to our Drug Chemistry section, and blood and urine specimens were sent to Toxicology. The Medical Examiner indicated that the deceased had obtained a new drug off the internet, U-47700 (also known as Euphoria). This drug, developed at Upjohn in the 1970s but never marketed to the public, is approximately 7.5 times more potent than morphine. In one of the powders from the scene, the Drug Chemistry section detected a compound that was later confirmed as U-47700. The same compound was identified in the blood and urine of the decedent; fentanyl was also present in a lethal concentration. In addition, butyrylfentanyl, another new designer opioid, was detected both in the biological specimens and the powders. One week after his death, the decedent received a mailed package containing yet another designer opioid, *para*-fluorobutyrylfentanyl (see photo).

Case 2: A 23 year old man was found dead in his van. His computer was examined and it was determined that he had been searching for new drugs on the internet. A large bag of solid dose drugs was analyzed by the Chemistry unit and multiple drugs were identified, including fluoroamphetamine, etizolam, mitragynine, ethylphenidate, and the designer opioid *para*-fluorobutyrylfentanyl. Toxicology received a blood specimen from the body but, due to its decomposed nature, identification of these compounds in the blood was not possible.

We have received additional cases involving designer fentanyls including acetylfentanyl, furanylfentanyl and *para*-fluorofentanyl, as well as illicitly-manufactured fentanyl and several more cases involving U-47700. A recent case involving a U-47700 fatal overdose is being prosecuted under the Len Bias law (mandatory minimum sentence of 20 years) by federal prosecutors. Our Antemortem Tox section has also detected U-47700 and furanylfentanyl in three DUII cases. These findings were recently published in the December issue of Tox Talk, a newsletter published by the Society of Forensic Toxicologists. The Chemistry section also cooperated with the Board of Pharmacy to regulate U-47700 and fentanyl-related drugs as Schedule I controlled substances in Oregon.

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TOXICOLOGY'S NEW TOOLS (CONTINUED)

In the Toxicology cases described on page 3, the results were communicated to the Medical Examiner. However, at this stage the results were purely qualitative—meaning the drugs were detected but the amounts were not measured. The ME's Office asked if we could develop a quantitative method to determine the amounts of the designer opioids present in the decedents.

We validated a new method for synthetic opioids in September 2016. The Toxicology section has also acquired a new, sensitive screening instrument called an LC-Quadrupole Time of Flight Mass Spectrometer (QTOF). Using the samples in these cases, we were able to show that drugs such as these designer opioids could be detected by this highly-sensitive instrument, even if the samples are weak or degraded. The QTOF identified both U-47700 and butyrylfentanyl in Case 1, and *para*-fluorobutyrylfentanyl was identified in the decomposed blood specimen from Case 2 (as well as fluoroamphetamine and etizolam). Our intention is to use this powerful new instrument to improve both the efficiency and quality of our screening process, ultimately providing faster and more complete analysis.

The Toxicology section has received many other cases involving new or unusual drugs, including Mitragynine (Kratom), 3-Methoxy PCP (a designer PCP analog), Fluoroamphetamine, 25C-NBOMe, α-pyrrolidinohexanophenone, Methoxetamine, Flubromazepam, Flubromazolam, 4-EAPB, and N-ethylpentylone.

Death investigations have also led to the identification of unusual or newly abused pharmaceuticals including Loperamide (Imodium), Propylhexedrine, Clonidine, Flecainide, Lacosamide, Modafinil, Phenylpiracetam and Phenibut. We are currently unable to provide quantitative assays for any of these drugs.

With the explosion of new designer drugs available over the internet, we are excited about the QTOF's ability to help us detect drugs we are not able to detect with our current technology. Due to added efficiency and sensitivity in the screening process, we anticipate this instrument will allow us the opportunity to expand our quantitative analysis for a wider variety of drugs. These measurements are essential in death investigations and can, in the future, also be applied to blood samples collected in driving under the influence investigations.

Members of Portland Lab's Postmortem & QTOF validation teams: Emily Lawler, Mike Jackson, Janet Schultz, and Kaylon Wells. Not pictured: Sara Short.

Ante mortem Urine Toxicology and Blood Alcohol analysis are performed at the OSP Portland and Springfield Forensic Labs. Postmortem Toxicology is performed in Portland only. If you have questions about Tox reports, evidence, or submission, please contact your local laboratory.

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URINE TOX TRENDS: TOP 24 RESULTS

We are often asked about the types of drugs we see in DUII cases and how often we are confirming them. The most common drugs are cannabis and methamphetamine/amphetamine, and they have held this distinction for over 20 years, but new trends have emerged since 2011:

- Cannabis (THC) is now found in 61% of our urine tox DUII casework compared to 51% five years ago.
- Meth and amphetamine confirmations have risen in the past five years from 22% of cases to 35%.
- Oxycodone has decreased while 6-monoacetylmorphine (a heroin metabolite) has increased.
- Zolpidem (Ambien) has disappeared from the "Top 24" since 2011, while gabapentin and cocaine have appeared.
- Buprenorphine (Suboxone) appeared in casework and was confirmed 63 times in 2016. Zero confirmations in 2011.
- Diphenhydramine (Benadryl) continues to be the #1 non-controlled substance identified in DUII urine samples.

Most Common Drugs Found in DUII Urine Cases: 2011 vs 2016

Drug Name	2011		Drug Name	2016	
	Confirmed	% of cases		Confirmed	% of cases
9-Carboxy-THC	1132	50.9%	9-Carboxy-THC	1248	60.9%
Meth and Amphetamine	497	22.3%	Meth and Amphetamine	723	35.3%
No drugs confirmed	333	15.0%	No drugs confirmed	237	11.6%
Hydrocodone	240	10.8%	Morphine	225	11.0%
Morphine	216	9.7%	Alprazolam	223	10.9%
Oxycodone	212	9.5%	Diphenhydramine	174	8.5%
Methadone	203	9.1%	Codeine	170	8.3%
Alprazolam	199	8.9%	Oxycodone	155	7.6%
Diphenhydramine	195	8.8%	Hydrocodone	135	6.6%
Dihydrocodeine	170	7.6%	Dihydrocodeine	113	5.5%
Citalopram/Escitalopram	157	7.1%	Ecgonine methyl ester	109	5.3%
Codeine	131	5.9%	Gabapentin	109	5.3%
EDDP (methadone metabolite)	107	4.8%	6-Monoacetylmorphine	107	5.2%
Trazodone	103	4.6%	Benzoylecgonine	106	5.2%
Meprobamate	100	4.5%	Citalopram/Escitalopram	92	4.5%
Zolpidem	96	4.3%	alpha-Hydroxyalprazolam	87	4.2%
Temazepam	94	4.2%	Methadone	84	4.1%
Nordiazepam	81	3.6%	Cocaine	83	4.1%
Carisoprodol	80	3.6%	EDDP (methadone metabolite)	82	4.0%
6-Monoacetylmorphine	79	3.6%	Cyclobenzaprine	69	3.4%
Cyclobenzaprine	76	3.4%	Nordiazepam	66	3.2%
Ecgonine methyl ester	70	3.1%	Buprenorphine	63	3.1%
7-Aminoclonazepam	63	2.8%	Methorphan	63	3.1%
Promethazine	59	2.7%	Trazodone	57	2.8%

Data compiled by Robert Jones, Toxicology Supervisor, Portland Metro Lab