
Short Communication

Driving Under the Influence of Drugs: When the Law Misses the Mark

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Abstract

According to Florida law, an individual is not guilty of driving under the influence of drugs unless impairment is observed and is due to one or more controlled drugs listed in the Florida Statutes. Many prescription drugs, over-the-counter drugs and novel psychoactive compounds that can cause significant impairment are not included in this list. Five other states within the USA including Alaska, Hawaii, Massachusetts, New York and Oregon have similar or other restrictive language in their impaired driving statutes. From January of 2007 to February of 2018, 1,344 blood specimens and 1,796 urine specimens were analyzed for drugs in impaired driving cases in Palm Beach County, Florida. Over the past 11 years, 21% (212 out of 1,028) of all drug-positive blood specimens and 47% (711 out of 1,527) of all drug-positive urine specimens contained at least one non-controlled drug, often mixed with controlled drugs. Despite documentation of observed impairment with the concurrent identification of impairing drugs, an impaired driving charge could not be supported due to the phrasing of the law in Florida. If the intent of drug-impaired driving laws is to improve safety by removing impaired drivers from the road, a more all-encompassing “any impairing drug” law would be more appropriate. Linking the charge to a drug possession law framework or using other restrictive language is not the most effective means to improve road safety.

Introduction

While alcohol remains the most commonly detected drug, the incidence of alcohol use by drivers has declined and drug-impaired driving is of increasing concern (1–3). Reviews of drug-impaired driving laws in each state of the USA have been reported (4–6). However, these reviews fail to completely capture the potentially limited scope of the impaired driving laws in some states. This may in part be due to the terminology of the laws in some states that makes it difficult to ascertain their meaning. Without reviewing relevant case law for these states, the scope of compounds included in the language of the statute can be unclear.

In Florida, the law that applies to driving under the influence of drugs (DUID) considers that the individual must be driving or in actual physical control of a vehicle in the state and that their normal faculties are impaired by a chemical or controlled substance (7–9). Compounds with the potential to be abused as inhalants are defined

as chemical substances in the Florida Statutes (9). Interestingly, this statute gives some latitude on the compounds that are included by listing specific compounds (e.g., toluene, etc.) followed by the statement “or any similar substance for the purpose of inducing a condition of intoxication or which distorts or disturbs the auditory, visual, or mental processes” (9). Controlled substances are defined in a scheduling framework that is similar to the Controlled Substances Act of the USA (CSA) but does not mirror the CSA in the specific drugs that are listed (8). Although some leeway has been recently applied with analog language for fentanyl analogs, synthetic cannabinoids and substituted cathinones; many over-the-counter, prescription and novel psychoactive compounds may not be included. A few notable compounds with the potential for significant impairing effects that were not included are diphenhydramine, cyclobenzaprine, gabapentin, tramadol, zaleplon, zopiclone and zolpidem.

Methods

In Florida, urine samples are routinely collected for DUID investigations when breath alcohol (BrAC) results are below 0.08 g/210 L. Blood samples are only collected when criteria specified in the Florida Statutes (10, 11) is met (e.g., when it is impossible or impractical to perform a BrAC test and/or collect urine or when the officer has probable cause and a serious bodily injury or death is involved). A volatile analysis was performed on all blood specimens (12, 13). Drug analysis was performed on all urine specimens and all blood specimens involving a serious bodily injury or death. Blood specimens collected for misdemeanor cases were only analyzed for drugs if the ethanol concentration was below 0.1 g/dL from January of 2007 to September of 2014 and from June of 2017 to February of 2018 or was below 0.15 g/dL from September of 2014 to June of 2017.

From January of 2007 to February of 2018, 1,796 urine specimens and 1,344 blood specimens were analyzed for drugs for DUID cases. Blood specimens were screened using a basic extraction with scan gas chromatography mass spectrometry (GC-MS) and an 11-panel enzyme-linked immunosorbent assay (ELISA) utilizing kits from Neogen (Lexington, KY) for amphetamines, barbiturates, benzodiazepines, buprenorphine (2013–2018), carisoprodol, cocaine/benzoyllecgonine, fentanyl (2015–2018), methamphetamines, opiates, oxycodone/oxymorphone and cannabinoids. Urine specimens were screened using a basic extraction with scan GC-MS and a nine-panel ELISA for barbiturates, benzodiazepines, buprenorphine (2013–2018), carisoprodol, cocaine/benzoyllecgonine, fentanyl (2015–2018), opiates, oxycodone/oxymorphone and cannabinoids. Amphetamines and methamphetamine ELISA analytes were covered sufficiently by the urine basic extraction, hence the ELISA kits were not utilized for urine specimens. The cutoff concentrations used for the blood and urine ELISA analysis are listed in Table I and are compared to the 2017 recommendations for DUID testing (14). Drug history and observations of impairment provided by the officer on a laboratory analysis request form required for evidence submission to the laboratory were also reviewed. Further testing was performed based on specific drugs that were suspected by the officer. All positive results were confirmed with GC-MS and/or liquid chromatography tandem mass spectrometry (LC-MS-MS). Quantitation

of drugs in blood specimens was performed by LC-MS-MS, GC with flame ionization or nitrogen phosphorus detection and/or GC-MS.

Results

From January of 2007 to February of 2018, drugs were detected in 1,028 out of 1,344 (76%) blood specimens and 1,527 out of 1,796 (85%) urine specimens. Over the past 11 years, 21% (212 out of 1,028) of all drug-positive blood specimens and 47% (711 out of 1,527) of all drug-positive urine specimens contained at least one impairing non-controlled drug, often mixed with impairing controlled drugs. The top 10 non-controlled drugs excluding selective serotonin reuptake inhibitors (SSRIs) identified in both blood and urine are listed in Table II. The SSRIs were excluded as they generally do not have significant impairing side effects. Six case examples that had sufficient information available are presented below that were selected to illustrate the challenges with a restrictive DUID law.

Blood case example 1

The subject was a 28-year-old male and the incident occurred at 01:44 on a Tuesday morning. He was driving on a blown tire with severe front end damage due to an accident that occurred in his parking lot at home. The subject stated he had taken sleeping pills. He appeared dazed and disoriented with slow, deliberate movements, slurred speech and mydriasis. A blood specimen was obtained ~2 h after the traffic stop. No ethanol or other volatiles were detected. The blood drug screen (BDS) identified diphenhydramine at 64 ng/mL and zolpidem at 745 ng/mL. The prosecutor did not file charges in this case as the drugs identified were not controlled and, therefore, did not meet the DUID statute. Furthermore, the prosecutor did not feel that the elements required for the lesser charge of reckless driving could be established (15).

Blood case example 2

The subject was a 33-year-old female and the incident occurred at 01:07 on a Thursday morning. She was in a single vehicle crash in which the car left the road and hit a tree in the median. The officer instructed the subject several times to sit down and then had to take

Table I. ELISA cutoff levels for blood and urine analysis compared to 2017 recommendations for Tier I compounds^a

Assay	Blood Cutoff (ng/mL)	Recommended (ng/mL)	Urine cutoff (ng/mL)	Recommended (ng/mL)
Amphetamines	50	20	100 (GC-MS)	200
Barbiturates	100	Not included	200	Not included
Benzodiazepines	12.5	10/50	25	50/100
Buprenorphine	2	1	5	5
Carisoprodol	1000	500	1000	500
Cocaine/benzoyllecgonine	50	50	300	150
Fentanyl	1	1	5	1
Methamphetamine/MDMA	50	20	50 (GC-MS)	200
Opiates	25	10	200	200
Oxycodone	12.5	10	200	100
THC	10	10	50	20
Tramadol	50 (GC-MS)	100	20 (GC-MS)	100
Methadone	10 (GC-MS)	50	10 (GC-MS)	300
Zolpidem	50 (GC-MS)	10	50 (GC-MS)	20

^aLogan et al. (14).

Table II. Top 10 non-controlled drugs identified in blood and urine (excluding SSRIs)

Blood (<i>n</i> = 1,028 positive cases)			Urine (<i>n</i> = 1,527 positive cases)		
Analyte	# Of cases	% Of positive cases	Analyte	# Of cases	% Of positive cases
Diphenhydramine	56	5.4	Diphenhydramine	181	11.9
Zolpidem	45	4.4	Zolpidem	107	7.0
Tramadol	25	2.4	(d) Methorphan	68	4.5
(d) Methorphan	16	1.6	Cyclobenzaprine	65	4.3
Cyclobenzaprine	13	1.3	Tramadol	62	4.1
Trazodone	12	1.2	Norquetiapine	58	3.8
Topiramate	7	0.7	Trazodone	56	3.7
Lamotrigine	7	0.7	Doxylamine	49	3.2
Mitragynine	7	0.7	Chlorpheniramine	38	2.5
Chlorpheniramine	7	0.7	Gabapentin	32	2.1

SSRIs, selective serotonin reuptake inhibitors.

her by the arm and assist her to sit. The subject appeared dazed and disoriented, “on-the-nod”, and unresponsive. She also had slow and slurred speech, two fresh injection sites on her arm, and pin point pupils with no reaction to light. The subject stated that she had injected oxycodone the day before. The blood specimen was collected 30 min after the incident. No ethanol or other volatiles were detected. The BDS identified diphenhydramine at <20 ng/mL, hydro-morphone at <2.5 ng/mL, oxycodone at 495 ng/mL, oxymorphone at 5.7 ng/mL and zolpidem at 263 ng/mL. The prosecutor filed the case as reckless driving.

Blood case example 3

The incident occurred at approximately 15:20 on a Sunday afternoon. The subject was a 63-year-old male. While operating a motor vehicle, he abruptly changed speed several times before rear-ending another vehicle stopped at a traffic signal. The subject then exited his vehicle and asked the passenger of the vehicle he struck if they were hurt and apologized for the collision. The subject returned to his vehicle, reversed and drove forward again striking the same vehicle. After this collision, the subject exited his vehicle and asked a pedestrian at the intersection to move his car for him. The driver was found unconscious on the sidewalk by paramedics. Constricted pupils were observed and naloxone was administered. The subject admitted to drinking a couple of alcoholic beverages prior to the crash. A blood specimen was collected ~1 h and 45 min after the incident. Ethanol was detected at 0.025 g/dL. The BDS identified lorazepam at 31 ng/mL, buprenorphine at <0.5 ng/mL, norbuprenorphine at 2.3 ng/mL, carfentanil, mitragynine and diphenhydramine at 23 ng/mL. The case was filed by the prosecutor as a DUI due to the observed effects that were consistent with the detection of the potent opioid carfentanil.

Urine case example 1

The incident occurred at 02:12 on a Monday morning. The subject was a 44-year-old male. He was involved in a crash in a parking lot where his vehicle appeared to have rolled into another vehicle at low speed with minimal damage. When officers arrived the subject was asleep in the vehicle with his head back and snoring. The vehicle was still in drive and the officer reached into the car through the window, placed it in park, turned off the ignition and removed the keys. The officer then had to wake up the subject and asked for identification. The subject started to reach for his wallet, but fell

asleep again. The officer was able to wake up the subject again. The subject had droopy eyes and slow and lethargic movements. All six clues were observed for HGN and the subject had problems following directions, poor balance and poor dexterity when completing the other standardized field sobriety tasks (SFSTs). The BrAC did not detect ethanol. The urine drug screen (UDS) identified nordiazepam, temazepam, oxazepam, meprobamate, cyclobenzaprine, gabapentin, mirtazapine and tramadol. Although all eight compounds are central nervous system (CNS) depressants, only the first four are controlled in the state of Florida. No charges were filed.

Urine case example 2

The subject was a 41-year-old female who indicated she had back problems and several resulting surgeries attempting to address those problems. The traffic stop occurred at 07:25 on a Tuesday morning while she was on her way to drop off her child at school. She was observed drifting in and out of her travel lane and nearly striking a curb when turning. The subject had slow and delayed movements, almost fell upon exiting the vehicle and lost her balance several times. During the SFSTs, the subject had problems following instructions, poor dexterity and slurred speech. The officer also performed a modified Romberg alphabet task and observed the subject to have difficulty reciting the alphabet. The subject recited the English alphabet through the letter H, then said “A”, “G” and abruptly stopped. She also could not remember the name of the university that she had attended and stated that she was prescribed several medications but only took gabapentin that morning. The BrAC did not detect ethanol. The UDS identified carisoprodol, meprobamate, diazepam, nordiazepam, temazepam, oxazepam, hydrocodone, hydromorphone, morphine, carboxy-delta-9-tetrahydrocannabinol, cocaine, benzoyllecgonine and gabapentin. Whether or not the observed impairment was due to a controlled drug could not be substantiated. Therefore, the prosecutor filed the case as reckless driving. Following a jury trial, the jury found the subject guilty. During a sidebar in the middle of the trial, the judge scolded the prosecutor for not charging the case under the impaired driving statute and wasting the court’s time on a reckless driving trial.

Urine case example 3

The incident occurred at approximately 13:30 on a Monday afternoon. The subject was a 74-year-old female who indicated she had hip problems and took medication for pain. She backed her vehicle

into a light pole in a parking lot. She then accelerated forward into a handicapped parking space, drove over the concrete parking bumper and almost drove into some bushes. The driver then backed out of the parking space and proceeded through the parking lot, jumped a concrete curb, drove over landscape bushes then hit a parked vehicle. A witness ran after the subject's vehicle when it continued driving after the accident and was able to get the driver to stop. The driver appeared dazed and confused and had slurred speech. The driver indicated that she did not know that she hit a vehicle. She also stated that she drove over the concrete bumper, curb and bushes because she was looking for the parking lot exit. The parking lot was that of her regular physician. The driver had difficulty maintaining her balance, swayed and almost fell several times while standing. She stated that she had taken her pain medication 2 h prior to driving. During the administration of SFSTs, the subject had difficulty understanding and following instructions, demonstrated six indicators during HGN and had problems with balance. She attempted to perform the walk and turn, but fell off the line and stated that she could not complete the task. The one leg stand task was not completed. A finger-to-nose task and modified Romberg alphabet task were performed during which the officer observed slow deliberate movements, problems with dexterity and continued problems with balance (extreme sway, almost falling backwards). During transport, the subject immediately fell asleep in the back of the patrol car. The BrAC was negative for ethanol. The UDS identified only tramadol. No charges were filed.

Discussion

The DUID laws in the USA lack uniformity, yet most include a very broad scope of drugs or substances. A summary of the scope of compounds included in the DUID laws for each of the states, Puerto Rico, and the District of Columbia is presented in Supplementary Data, Table SI. This summary was generated using previously reported reviews (4, 5) supplemented by further research and verification of each state's DUID law. Another review was completed in 2016 by the National Alliance for Model State Drug Laws and provides a more complete description of the scope of compounds included yet does not highlight the specific issue presented herein (6). Relevant case law was included when helpful in determining the scope of compounds encompassed by the statute. Puerto Rico, the District of Columbia, and 43 of the states have "any impairing drug" or somewhat similar, more inclusive language. If the goal of DUID laws is to improve safety by removing impaired drivers from the road, regardless of the substance that is causing the impairment, this statutory language is imperative. Six states, including Alaska, Florida, Hawaii, Massachusetts, New York, and Oregon, use language that restricts the DUID law to impairing compounds that meet specific requirements. The applicable sections of the statutes for those states that employ restrictive DUID laws are summarized in Table III. The challenge this latter approach creates is evident in the case examples presented herein. All except one of the case examples describe drivers who may be impaired by compounds that are not included in the Florida statute and therefore cannot be charged with driving under the influence. A law requiring that a charge of DUID for an impaired driver be supported only by specific compounds, while excluding other impairing compounds, is confusing, as described in "Urine Case Example 2" and does not advance the goal of enhancing driving safety.

The five most prevalently detected non-controlled drugs that were excluded by the Florida DUID law in both blood and urine

specimens were diphenhydramine, zolpidem, methorphan (this laboratory cannot distinguish between dextro and levo methorphan), cyclobenzaprine and tramadol. Although having different treatment indications, all are CNS depressants with side effects that include sedation, blurred vision, trouble concentrating and impaired coordination (15–32). These effects have the potential to cause impaired driving and are shared with many CNS depressants that are controlled in the state of Florida and included in the DUID law.

Effective 1 July 2018, HB 21 added two of the five most prevalently detected non-controlled drugs, tramadol and zolpidem, to the controlled substance schedules in Florida (33). However, the other compounds frequently identified in DUID specimens outlined in Table II remain excluded by the DUID law.

In DUID cases, it is not uncommon to identify multiple drugs in blood and urine specimens. In urine, where detection windows exceed the duration of effects, it is not possible to determine the extent to which each individual drug contributed to any observed impairment. Even in blood specimen cases, when numerous drugs are detected and adverse effects in controlled and non-controlled drugs are identical, the relative intensity of the effects from each contributing drug many times cannot, and scientifically should not, be parsed out. There are some instances, such as in "Blood Case Example 3", in which the effects observed are very distinct and/or the drugs identified are so potent that it may be surmised that a non-controlled substance may not have contributed significantly to the observed impairment. However, when substances that can cause similar impairment are detected together, some included in the law and some not, the effectiveness of the law to remove impaired drivers from the road is diminished.

One solution to the issue of non-controlled impairing drugs identified in combination with impairing drugs might be to cease testing for those drugs that do not support the DUID charge. This would allow the straightforward prosecution of cases that would be very complex or unsupported otherwise and would conserve valuable laboratory resources. There are two significant problems to this approach. First, the forensic laboratory has the duty to provide unbiased service to the entire criminal justice community (34). This includes unbiased testing services that do not seek to exclusively support successful prosecution. Rather the testing services should seek to encompass those impairing compounds that may be encountered in a given jurisdiction within the capabilities of the laboratory while making the most efficient use of available resources. Second, some cases may be reported as negative, when in fact commonly impairing substances which are within the capability of the lab to test for may be present. This can be observed in "Blood Case Example 1" and "Urine Case Example 3". While there will always be compounds outside the testing capability of a toxicology laboratory, simply choosing to limit the scope of testing based on inclusion in the DUID law deprives the criminal justice system of information as to the compounds that may have caused the observed impairment.

There are other differences in the DUID laws of the individual states within the USA which may impact their effectiveness. Some examples include the use of *per se* limits, the specimen type that is permissible to be collected and the use of affirmative defenses. Differences in sentencing guidelines and other legal ramifications which are outside the purview of the forensic toxicologist have been reviewed elsewhere and will not be discussed further here (4–6).

The use of *per se* limits for drugs other than alcohol have been employed in some states. Although for drugs other than alcohol, there is a lack of scientific support for concentrations at which

Table III. Summary of state DUID laws in the USA with restrictive language

State	Scope of DUID law	Applicable language in the law	Applicable case law/comments
Alaska	Controlled substances and inhalants	Alaska Statutes § 28.35.030 (a)(1) [U]nder the influence of an...inhalant, or any controlled substance, singly or in combination	
Florida	Controlled substances and inhalants	Florida Statutes § 316.193 (2)(a) [U]nder the influence of...any chemical substance set forth in § 877.111, or any substance controlled under chapter 893...	§ 877.111 lists inhalants
Hawaii	Controlled substances	Hawaii Revised Statutes § 291E-61 (a)(2) [U]nder the influence of any drug that impairs the person's ability to operate the vehicle in a careful and prudent manner Hawaii Revised Statutes § 291E-1 "Drug" means any controlled substance, as defined and enumerated in schedules I through IV of chapter 329, or its metabolites	
Massachusetts	Marijuana, narcotic drugs, depressants, stimulants and vapors of glue	Massachusetts General Laws Chapter 90, § 24 (1)(a)(1) [U]nder the influence of intoxicating liquor, or of marijuana, narcotic drugs, depressants or stimulant substances, all as defined in section one of chapter ninety-four C, or the vapors of glue...	Chapter 94C § 1 lists definitions for each category that limit inclusion based on whether "the United States Attorney General has by regulation designated as having a potential for abuse."
New York	Controlled substances	New York Consolidated Laws, Vehicle and Traffic Law § 1192 3. Driving while intoxicated. 4. Driving while ability impaired by drug No person shall operate a motor vehicle while the person's ability to operate such a motor vehicle is impaired by the use of a drug as defined in this chapter New York Vehicle and Traffic Law § 114-a The term "drug" when used in this chapter, means and includes any substance listed in section thirty-three hundred six of the public health law	Section 3306 of the Public Health Law contains the schedules of controlled substances In reference to "§ 1192 (3). Based on the language, history and scheme of the statute, we conclude that the Legislature here intended to use "intoxication" to refer to a disordered state of mind caused by alcohol, not by drugs." <i>People v. Litto</i> , 872 N.E.2d 848, 8 N.Y.3d 692, 840 N.Y.S.2d 736 (2007).
Oregon	Cannabis, controlled substances and inhalants	Oregon Revised Statutes § 813.010 (1)(b) [U]nder the influence of intoxicating liquor, cannabis, a controlled substance or an inhalant...	

impairment or lack thereof can be established. An example is discussed in a recent review regarding the use of *per se* limits for delta-9-tetrahydrocannabinol (THC) (35). In the USA, 5 ng/mL of THC in blood is the most commonly used threshold. Unfortunately, some chronic users of marijuana with an acquired tolerance may display little impairment at this concentration, while more naive users may be significantly impaired at concentrations much lower than 5 ng/mL. Other factors such as delayed sample collection and rapid decline of THC in blood after cessation of smoking can add to the difficulty of employing a strict *per se* limit.

Another weakness in the Florida DUID law that is shared by several other states (e.g., New York, Ohio and Oregon) involves the use of urine as the toxicology specimen. In Florida, the officer has no discretion to request blood when urine is practicable or possible to be obtained (10) and cannot obtain a warrant for a blood draw for misdemeanor cases (36, 37). While in other states (e.g., Alabama, New Mexico, and Washington), breath (for alcohol) or blood are the primary specimens. The principal disadvantage of urine as a specimen for DUID is the extended detection times for compounds beyond their duration of effect, as described above. Urine does have advantages such as higher concentrations of analytes resulting in easier detection and fewer issues with limited sample volume. However, in general, if the specimen can be collected in a close proximity to the incident, blood is the ideal specimen for toxicology analysis in DUID cases. Detection times for compounds in

blood are shorter and concentrations of drugs in blood, unlike urine, can provide additional meaning, especially for pharmaceuticals.

Some states (e.g., Arizona, Louisiana and Utah) allow affirmative defenses for drugs provided that a valid prescription has been obtained. This does not address the reality that some drugs, even when taken as prescribed, may still cause impairment to an individual's normal faculties and impact their ability to safely operate a motor vehicle.

The National Highway Traffic Safety Administration has proposed model language for DUID laws (38). One semantic issue that may cause problems with the recommended language is that the substance must "render[s] him or her incapable of safely driving" (38). Newer medications and novel compounds that have not been researched extensively might be difficult to tie directly to incapacity for safe driving and lead to inappropriate arguments that since there are no driving studies for the specific compound this cannot be proven. Therefore, the use of "impairs normal faculties" may be more appropriate.

Conclusion

The driving under the influence charges in many if not most of those cases with non-controlled drugs were either dropped or not filed. In many of these cases, the issue of impairment was of little dispute. The focus was instead on whether or not the impairing drugs that

were identified were included in the law. If the intent of DUID laws is to improve traffic safety by removing impaired drivers from the road, then more inclusive statutory language such as “any impairing drug” is more appropriate than linking the charge to a drug possession law framework or using other similarly restrictive language.

Supplementary Data

Supplementary material is available at *Journal of Analytical Toxicology* online.

Acknowledgments

The authors would like to thank Palm Beach County Judge Sherri Collins and Adam Rose, Esq. for their tremendous work while at the State Attorney’s Office of the 15 Judicial Circuit in researching and interpreting the DUID laws and case law; Boris Moczula, Esq., Brent Nelson, and Michael Stypa for their additional help in interpreting the DUID laws and case law in their respective states; Dr. Cecelia Crouse for her helpful review of this manuscript; and the Palm Beach County Sheriff’s Office for supporting this work.

References

- Berning, A., Compton, R., Wochinger, K. (2015) Results of the 2013–2014 National Roadside Survey of Alcohol and Drug Use by Drivers. DOT HS 812 118. https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/812118-roadside_survey_2014.pdf. (accessed Mar 12, 2018).
- Brady, J.E., Li, G. (2013) Prevalence of alcohol and other drugs in fatally injured drivers. *Addiction (Abingdon, England)*, **108**, 104–114.
- Schwilke, E.W., Sampaio dos Santos, M.L., Logan, B.K. (2006) Changing patterns of drug and alcohol use in fatally injured drivers in Washington state. *Journal of Forensic Science*, **51**, 1191–1198.
- Walsh, J.M. (2009) A state-by-state analysis of laws dealing with driving under the influence of drugs. DOT HS 811 236. <https://www.ems.gov/pdf/811236.pdf>. (accessed Mar 12, 2018).
- (2014) A State-by-State Analysis of Laws Dealing With Driving Under the Influence of Drugs. NMS Labs. http://stopduid.org/documents/2014_StopDUID_Report.pdf. (accessed Mar 12, 2018).
- (2016) Drugged Driving: 2016 Summary of Key Provisions of State Laws. National Alliance for Model State Drug Laws. <http://www.namsdl.org/library/69E90627-FF72-B4ED-6F552DD0E047972C>. (accessed July 16, 2018).
- (2017) Florida Statute 316.193. <http://www.flsenate.gov/Laws/Statutes/2017/316.193>. (accessed Mar 12, 2018).
- (2017) Florida Statute 893.03. <http://www.flsenate.gov/Laws/Statutes/2017/893.03>. (accessed Mar 12, 2018).
- (2017) Florida Statute 877.111. <http://www.flsenate.gov/Laws/Statutes/2017/877.111>. (accessed Mar 12, 2018).
- (2017) Florida Statute 316.1932. <http://www.flsenate.gov/Laws/Statutes/2017/316.1932>. (accessed Apr 12, 2018).
- (2017) Florida Statute 316.1933. <http://www.flsenate.gov/Laws/Statutes/2017/316.1933>. (accessed Apr 12, 2018).
- Tiscione, N.B., Alford, I., Yeatman, D.T., Shan, X. (2011) Ethanol analysis by headspace gas chromatography with simultaneous flame-ionization and mass-spectrometry detection. *Journal of Analytical Toxicology*, **35**, 501–511.
- Tiscione, N.B., Yeatman, D.T., Shan, X., Kahl, J.H. (2013) Identification of volatiles by headspace gas chromatography with simultaneous flame ionization and mass spectrometric detection. *Journal of Analytical Toxicology*, **37**, 573–579.
- Logan, B.K., D’Orazio, A.L., Mohr, A.L.A., Limoges, J.F., Miles, A.K., Scarneo, C.E., et al. (2017) Recommendations for toxicological investigation of drug-impaired driving and motor vehicle fatalities—2017 update. *Journal of Analytical Toxicology*, **42**, 63–68.
- (2017) Florida Statute 316.192. <http://www.flsenate.gov/Laws/Statutes/2017/316.192>. (accessed Mar 12, 2018).
- Dextromethorphan side effects. *Drugs.com*. <https://www.drugs.com/sfx/dextromethorphan-side-effects.html> (accessed Mar 13, 2018).
- Zolpidem side effects. *Drugs.com*. <https://www.drugs.com/sfx/zolpidem-side-effects.html> (accessed Mar 13, 2018).
- Tramadol side effects. *Drugs.com*. <https://www.drugs.com/sfx/tramadol-side-effects.html> (accessed Mar 13, 2018).
- Diphenhydramine side effects. *Drugs.com*. <https://www.drugs.com/sfx/diphenhydramine-side-effects.html> (accessed Mar 13, 2018).
- Cyclobenzaprine side effects. *Drugs.com*. <https://www.drugs.com/sfx/cyclobenzaprine-side-effects.html> (accessed Mar 13, 2018).
- Baselt, R.C. Zolpidem. In: *Disposition of Toxic Drugs and Chemicals in Man*, 11th edition. Biomedical Publications: Seal Beach, CA, 2017; pp. 2295–2296.
- Baselt, R.C. Diphenhydramine. In: *Disposition of Toxic Drugs and Chemicals in Man*, 11th edition. Biomedical Publications: Seal Beach, CA, 2017; pp. 716–717.
- Baselt, R.C. Dextromethorphan. In: *Disposition of Toxic Drugs and Chemicals in Man*, 11th edition. Biomedical Publications: Seal Beach, CA, 2017; pp. 635–636.
- Baselt, R.C. Tramadol. In: *Disposition of Toxic Drugs and Chemicals in Man*, 11th edition. Biomedical Publications: Seal Beach, CA, 2017; pp. 2147–2149.
- Baselt, R.C. Cyclobenzaprine. In: *Disposition of Toxic Drugs and Chemicals in Man*, 11th edition. Biomedical Publications: Seal Beach, CA, 2017; pp. 559–561.
- Verster, J.C., Volkerts, E.R. (2004) Antihistamines and driving ability: evidence from on-the-road driving studies during normal traffic. *Annals of Allergy, Asthma, & Immunology*, **92**, 294–303.
- Turner, C., Handford, A.D., Nicholson, A.N. (2006) Sedation and memory: studies with a histamine H-1 receptor antagonist. *Journal of Psychopharmacology*, **20**, 506–517.
- Kay, G.G., Schwartz, H.I., Wingertzahn, M.A., Jayawardena, S., Rosenberg, R.P. (2016) Next-day residual effects of gabapentin, diphenhydramine, and triazolam on simulated driving performance in healthy volunteers: a phase 3, randomized, double-blind, placebo-controlled, crossover trial. *Human Psychopharmacology*, **31**, 217–226.
- Otmani, S., Demazieres, A., Staner, C., Jacob, N., Nir, T., Zisapel, N., et al. (2008) Effects of prolonged-release melatonin, zolpidem, and their combination on psychomotor functions, memory recall, and driving skills in healthy middle aged and elderly volunteers. *Human Psychopharmacology*, **23**, 693–705.
- Logan, B.K., Couper, F.J. (2001) Zolpidem and driving impairment. *Journal of Forensic Sciences*, **46**, 105–110.
- Cochems, A., Harding, P., Liddicoat, L. (2007) Dextromethorphan in Wisconsin drivers. *Journal of Analytical Toxicology*, **31**, 227–232.
- Carter, L.P., Reissig, C.J., Johnson, M.W., Klinedinst, M.A., Griffiths, R.R., Mintzer, M.Z. (2013) Acute cognitive effects of high doses of dextromethorphan relative to triazolam in humans. *Drug and Alcohol Dependence*, **128**, 206–213.
- (2018) Committee Substitute for Committee Substitute for House Bill 21. <http://laws.flrules.org/2018/13>. (accessed July 16, 2018).
- (2016) Guiding principles of professional responsibility for forensic service providers and forensic personnel. Version 2.0. ANSI-ASQ National Accreditation Board <https://anab.qualtracxcloud.com/ShowDocument.aspx?ID=6732> (accessed July 17, 2018).
- Logan, B.K., Kacinko, S.L., Beirness, D.J. (2016) An evaluation of data from drivers arrested for driving under the influence in relation to per se limits for cannabis. AAA Foundation for Traffic Safety. <http://publicaffairsresources.aaa.biz/wp-content/uploads/2016/04/Evaluation-of-Drivers-in-Relation-to-Per-Se-Report-FINAL.pdf> (accessed July 17, 2018).
- State v. Geiss., 70 So. 3d 642 (Fla. Dist. Ct. App. 2011).
- State v. Geiss., 88 So. 3d 111 (Fla. 2012).
- Compton, R., Vegega, M., Smither, D. (2009) Drug Impaired Driving: Understanding the Problem and Ways to Reduce It: A Report to Congress. DOT HS811 268 National Highway Traffic Safety Administration. <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/811268.pdf> (accessed July 17, 2018).