



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**



DOT HS 813 264

March 2022

Drug Testing and Traffic Safety: What You Need to Know

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Suggested APA Format Citation:

Berning, A., Smith, R. C., Drexler, M., & Wochinger, K. (2022, March). *Drug testing and traffic safety: What you need to know* (Report No. DOT HS 813 264). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No. DOT HS 813 264	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Drug Testing and Traffic Safety: What You Need to Know		5. Report Date March 2022	
		6. Performing Organization Code	
7. Authors Berning, A., Smith, R.C., Drexler, M., and Wochinger, K.		8. Performing Organization Report No.	
9. Performing Organization Name and Address Office of Behavioral Safety Research National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No.	
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590		13. Type of Report and Period Covered Report	
		14. Sponsoring Agency Code	
15. Supplementary Notes Amy Berning and Kathryn Wochinger are research psychologists with NHTSA's Office of Behavioral Safety Research			
16. Abstract The drugs-and-driving topic is both of great interest and very complex. As attention on the topic has risen, so have discussions about the use of data on drug presence among road users. This report continues that discussion by examining the process of obtaining and reporting drug use data from people involved in motor vehicle crashes. It examines processes along the way, and the resulting data entered into the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS) - a national census of fatal motor vehicle crashes in the United States. The report describes challenges in drug testing and reporting in the United States. The limitations identified here are not necessarily unique to drug testing, or to FARS, and are presented to inform discussions on drugs and driving and lay the groundwork for improving the data collection and reporting. For a crash to be included in the FARS database, it must have included a motor vehicle that was traveling on a public road and resulted in at least one person having died within 720 hours (30 days) as a result of the crash. The FARS database is a cornerstone of NHTSA's information collection systems and the information has provided Federal and State agencies, legislators, advocacy groups, and researchers key data about fatal motor vehicle crashes for all road user types and on all public roads. It is internationally respected for its breadth and depth of data. For example, FARS data on alcohol-impaired driving have been a foundation for national- and State-level planning, research, and policymaking for decades. In contrast, reporting of drug use, across a myriad of potential substances, and with varying testing protocols across forensic laboratories and across States can lead to confusion about the meaning of results at the community- or national level. Whether to test, what to test for, and how to test for the presence of drugs is determined at the local level. Currently, the limitations described in this report constrain interpretation of drug test results data, including comparisons across jurisdictions or across years. In some other research areas with missing or incomplete data, estimates may still be useful. This is not the case with FARS drug data. These missing data cannot be imputed using statistical techniques as are not missing "at-random" - a necessary property for missing data imputation. For example, limited drug testing panels and false negatives lead to underestimated drug prevalence; conversely, false positive results from drug screening tests may lead to overestimates. The report discusses NHTSA's actions for improving the quantity and quality of drug data in its FARS.			
17. Key Words FARS, drug tests, drug-impaired driving, drugged driving prevalence		18. Distribution Statement This document is available to the public from the DOT, BTS, National Transportation Library, Repository & Open Science Access Portal, rosap.ntl.bts.gov .	
19 Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21 No. of Pages 31	22. Price

Acknowledgements

NHTSA is grateful to the following forensic toxicology laboratories for information about their testing procedures, limitations, and innovations: Orange County (California) Crime Laboratory; Forensic Laboratory Services Bureau at Washington State Patrol; Wisconsin State Laboratory of Hygiene; District of Columbia Office of the Chief Medical Examiner; and NMS Labs (Willow Grove, PA).

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Introduction

The topic of drugs and driving is both of great interest and very complex. As attention on the topic has risen, so has the discussion of data on drug presence among road users. Rather than discussing the prevalence of drugs in fatality crashes, this report discusses the process of *obtaining* and *reporting* drug use data, which includes forensic testing to determine the presence of drugs in a body, and reporting of those results into the National Highway Traffic Safety Administration's national census of fatal motor vehicle crashes, the Fatality Analysis Reporting System (FARS). Understanding the process is crucial when interpreting test results as presented in the media, in journal articles, and at conferences; and when considering policy, legislation, countermeasures, and funding priorities.

NHTSA's FARS data are a cornerstone of its data collection systems and are relied upon by Federal and State agencies, legislators, advocacy groups, and researchers to provide key data about crashes across all road user types. It is a model for other countries as they seek to improve their traffic safety data systems. The data have been a foundation for national- and State-level planning, research, and policy making on alcohol-impaired driving for decades. The procedures for collecting data on drug-positive drivers involved in fatal crashes are still evolving and are far more complicated than for alcohol.

The quality and quantity of drug data in traffic safety databases can be limited for many reasons. As NHTSA wants to obtain the most accurate information about drugs and driving – as well as note the caveats of that data, and make that data intelligible for comprehensive policy decisions, we are providing additional information about testing for drugs of road users in motor vehicle crashes in the United States. This report examines these issues and discusses NHTSA's efforts to increase and improve the data on drug-related fatalities in FARS. The challenges identified here are not necessarily unique to drug testing, or to FARS, and are presented to inform discussions on drugs and driving, and to lay the groundwork for improving the data collection and reporting.¹

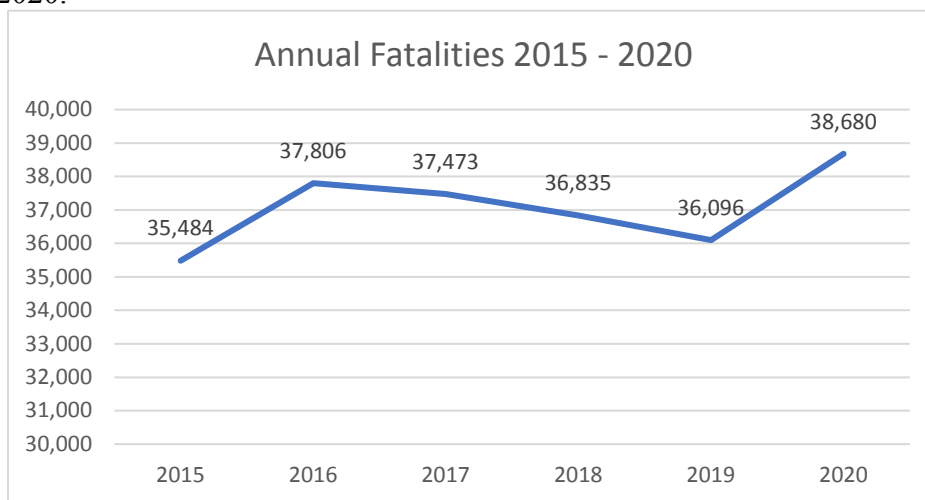
In 2014 NHTSA released a Research Note on the limitations of the drug data in FARS and its plans to increase the quantity and quality of the data (Berning & Smither, 2014). To augment this work, NHTSA participated in a webinar hosted by the Transportation Research Board's Standing Committee on Impairment in Transportation (2019) to inform the public about these issues. Unfortunately, misinterpretation of drug data, including FARS data, continues. Of particular concern is how drug-driving data is often presented and results are shared without discussion of the substantial limitations that impact use for policy or countermeasure decisions. It is common to hear reports of increases in drug-involved traffic fatalities and increases in the use of specific drugs amongst drivers. These often hail from research efforts with findings of "increased" drug prevalence in drivers in fatal crashes – which leads to research publications and conference presentations, where repeated stories are echoed. The problem is measuring the prevalence of drug-driving is complex and can vary based on methodology. Important factors that can drive reported increases in drug prevalence other than an actual increase in drug use and driving are often omitted. As one example, a jurisdiction may have changed its procedures to include

¹ This report discusses limitations on obtaining and reporting drug prevalence data at the U.S. *population level* in fatal crashes. The same limitations do not necessarily apply to the interpretation of drug prevalence in *individual criminal or administrative cases* arising from fatal crashes.

fentanyl in its drug test panel. The count of fentanyl then recorded in FARS will obviously rise – from zero (before the testing protocol existed) to the current year’s numbers. This change will make interpretation unclear whether any increase in the number or percentage of people positive for that drug is due to an actual increase in people who used the drug or is only an artifact of the change in testing protocol. Similarly, some States may appear to have a more significant drug problem than other States, when the key issue in comparing drug-positive cases lies in differential testing protocols (e.g., a more comprehensive testing protocols that will yield higher numbers). Without understanding these critical factors, users may make conclusions that are not supported.

Motor Vehicle Crashes and FARS

Motor vehicle crashes continue to be a serious issue in the United States. Preliminary FARS data for the first quarter of 2021 show an estimated increase of in total fatalities of 10.5% over the same quarter of 2020, from 7,900 to 8,730. Overall, for 2020, the first year with domestic COVID-19, there was a 7.2% increase in the estimated number of fatal crashes from 2019. Figure 1 summarizes FARS annual fatality data for the past 5 years, illustrating the estimated increase in 2020.



Adapted from NCSA, 2021²

Figure 1: FARS Motor Vehicle Fatalities in the United States 2015 to 2020

The Basics – What is FARS?

FARS is a national census of fatal crashes in the United States. To be included in FARS, a crash must include a motor vehicle traveling on a public road, and at least one person must have died within 720 hours (approximately 30 days) as a result of the crash. NHTSA's National Center for Statistics and Analysis works to obtain crash data from the 50 States, the District of Columbia, and Puerto Rico through individual cooperative agreements. Each State has at least one FARS analyst who collects and analyzes motor vehicle safety data consistent with NHTSA's data-based programs and enters it into FARS. Each State provides its own data from the information it obtains from a variety of sources. The processes may differ somewhat across States as to which local agencies (medical examiners, State departments of transportation, law enforcement agencies) house specific data, and how the State's analysts obtain it. The FARS analysts code more than 140 data elements for each crash, including elements related to the crash event, environmental factors, physical roadway, vehicles, pre-crash characteristics, and the people involved. Figure 2 illustrates some of the data points and complexities related to obtaining drug use data for a fatal crash case. As complex as this flowchart appears, the actual route of the drug test conducted to the drug test result entered in FARS is often more complicated. For example, a person may be both arrested, and transported to a hospital. Across the process, agencies will have

² The numbers for 2015 to 2019 in this graph are from NCSA's *final* files. The 2020 data are *preliminary* and will likely change; however, it is the most recent data available.

reporting requirements besides the information sought by NHTSA for FARS. See the FARS Manuals (NCSA, 2020, 2021) for complete information about the system.

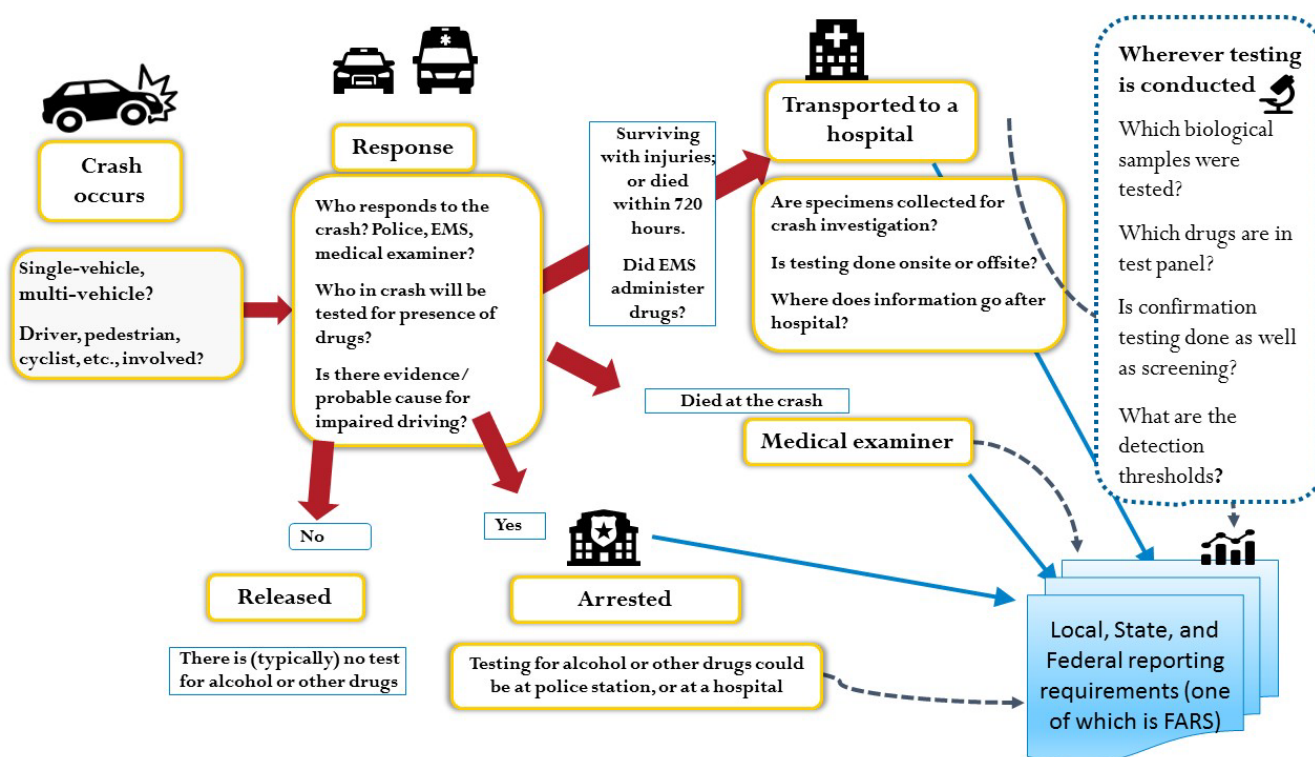


Figure 2: Obtaining Drug Data for FARS

Drivers (or other road users) who are fatally injured *and* those who survive can be tested for alcohol or other drugs. Policies regarding who is tested, and under what circumstances, vary across States. These differences are often based on local laws, on a jurisdiction's resources, and other unique factors not easy to quantify. For example, a surviving driver may have been a responsible party in a crash but if the investigating officer did not have probable cause at the time of the initial investigation, this driver may not have been tested for drugs. Conversely, someone with an empty beer bottle in the vehicle may have a higher likelihood of being tested for impairing substances – even if the bottle may have been there for weeks and is unrelated to the crash. Also, drug test data may be obtained for a severely or fatally injured person in a crash due to the comparative ease of obtaining the data over other surviving individuals, but these individuals may not be the responsible parties for the crash. There can be further complexities. Moreover, a sample could be collected from a surviving participant and held by authorities for several days and then destroyed when believed no longer needed as there were no fatalities. It is possible after this period, but still within 30 days (720 hours) of the crash, a criterion for inclusion of a crash in FARS, that a participant dies. There is now no longer a sample for testing. Interestingly, some surviving participants who know they have not consumed any drugs may request to have samples tested to document the absence of drugs.

Drug Use Information

Use of FARS data for alcohol and driving issues is a common and useful practice based on the quantity and quality of alcohol test results included in FARS. For crashes with missing alcohol test results, NHTSA uses a statistical model called “multiple imputation” to estimate the blood alcohol concentration (BAC) of a driver at the time of the crash (Subramanian, 2002).

While the testing and reporting of drugs in FARS is improving, drug data are still often limited, both in quantity and quality. And whereas there is a statistical adjustment for the missing data with alcohol, the amount and characteristics of missing drug data make it inappropriate for similar modeling. Furthermore, unlike alcohol, there are hundreds of specific drugs that would need to be imputed for the “drug” field as opposed to just one (e.g., alcohol).

Table 1 provides information on the six elements in FARS related to drug use by a road user in a fatal crash. If all fields have input completed, interpretation may be clear-cut. If data points are missing, “not reported,” or “unknown,” especially across elements, more caution is needed in interpreting the information.

Table 1: FARS Coding for Drug-Related Attributes, and Additional Notes

Data Element	Attribute Code Categories (abbreviated)	Notes
Police-Reported Drug Involvement	No (Drugs Not Involved), Yes (Drugs Involved), Not Reported, Unknown (Police Reported), Reported as Unknown	This is an indication and judgment by an officer the person had used recently and consumed a drug other than alcohol. It may be based on the person acknowledging use, or paraphernalia on the person or in the vehicle. It may, but does not necessarily, stem from a laboratory report of drug testing. One challenge in the recording of results into FARS is an officer may update the crash report as evidence becomes available but the version of the report to the FARS analyst may not be updated.
Method of Drug Determination by Police	Evidential Test (Blood, Urine), Drug Recognition Expert (DRE) Determination, Observed Behavior or Standard Field Sobriety Test (SFST), Other, Not Reported	Each of the types of attributes provides some information about presence of a drug(s) in a person. Only an evidential (that is, beyond screening) test of a biological sample provides definitive data on presence of a substance. Information from an officer provides supporting information.
Drug Test Status	Test Not Given, Test Given, Not Reported, Reported as Unknown if Tested	This attribute allows for knowing whether a biological sample was tested – but if not obtained does not always provide why. If a driver refuses to supply a specimen, the refusal is noted under the Related Factors-Driver data element.
Condition (Driver Impairment)at Time of Crash)	Under the Influence of Alcohol, Drugs or Medication Also codes for non-substance-related, such as a physical issue or use of crutches, etc.	This identifies impairment that may have contributed to the crash, as determined and reported by the investigating officer or a drug recognition expert. This is based on the officer’s determination, not on a toxicology result. The officer <i>may</i> include their reasoning for this determination on the crash report. Coding for this attribute also allows for other conditions unrelated to alcohol or other drugs. This variable can be used to show if a driver is considered to be “under the influence” of alcohol or other drugs but it cannot reliably be used to exclude driver

Data Element	Attribute Code Categories (abbreviated)	Notes
		impairment as it may only be recorded as “Not Reported” if there is not information available on other potentially impairing conditions. Officers may defer an opinion on driver impairment by alcohol or drugs pending receipt of lab results.
Drug Specimen	Test Not Given, Whole Blood, Urine, Blood Plasma/Serum, Blood Clot, Oral Fluids, Vitreous, Liver, Not Reported, Unknown Specimen, Other Specimen, Reported as Unknown if Tested	The <i>matrix</i> (type of specimen) depends on if the person was a fatally injured or surviving participant, the lab’s testing practices, and condition of the body. The biological sample used for the toxicological test may be drawn from several places in the body. For those fatally injured in a crash, blood is the most common specimen. Vitreous fluid (from the eye) is more typically used for determination of alcohol use and may be especially useful in cases where the body has been contaminated from injuries in the crash. For example, the vitreous matrix allows an unaffected sample when a body sustained blunt force trauma and there was rupturing of organs or tissue. Also, for a drug such as heroin that is quickly cleared from blood, vitreous may be used. For surviving drivers, a blood sample may be obtained; oral fluid samples are also common. Each method has benefits and may be preferred by a toxicologist based on drugs of interest, and available resources. The time frame of interest is also important. For example, as oral fluid will provide more information about recent use, as the substance is still present in the oral cavity. Blood samples may be tested to yield information on recently used substances, including those that have begun to be metabolized in the body, and permit quantitation and comparison to a wide body of reference literature. Currently, the testing attribute fields do not allow notation of whether only a screening test was performed or if a confirmatory test was also conducted. This attribute also does not distinguish between antemortem and postmortem collection of specimens used in the drug testing.
Drug Test Result	Not Tested for Drugs, No Drugs Reported/Negative, Not Reported, Narcotic, Depressant, Stimulant, Hallucinogen, Cannabinoid, Phencyclidine (PCP), Anabolic Steroid, Inhalant, Other Drug, Tested for Drugs-Results Unknown, Tested for Drugs-Drugs Found-Type Unknown/Positive, Reported as Unknown If Tested for Drugs	In 2018 coding for this attribute was changed to allow all drugs detected to be listed, across multiple specimens. Previously, the system allowed space for only three drugs, regardless of the number of drugs detected. Drugs were listed in a defined priority sequence. The inability to capture all drugs present in the data limits the ability to compare drug presence across years.

Adapted from NCSA (2020, 2021)

Advancing Our Understanding of Drug Data Limitations

While FARS remains one of the most comprehensive resources for understanding traffic harm on our nation's roadways, the limitations to the drug data in FARS must be better understood. NHTSA's 2014 Research Note provided an overview of several key limitations with the drug data in FARS. Key concepts included: (1) testing positive for a drug does not necessarily imply impairment from a drug, (2) inconsistencies in drug testing procedures within and across States, and (3) limitations with collecting and coding drug data. This report builds upon that discussion of limitations and provides more background and context in this area. It specifically focuses on two areas and their implications for interpreting drug results in FARS: (1) incompleteness of drug data in FARS, and (2) challenges in the collection, testing, and reporting of the drug data that are available.

Limited Drug Testing Results in Incomplete Data

While data in FARS are generally considered to be accurate and complete for most collected variables, for drugs, the lack of consistent drug testing in fatal crashes produces significant missing data. Unlike a breath test for alcohol, testing for drugs requires the collection of a biological sample, such as blood, and extensive and costly toxicological analyses. As a result, drug testing data are more varied and difficult to collect than alcohol testing. Unlike alcohol, drug data points in FARS are considered nonignorable (i.e., missing not-at-random) which means multiple imputation cannot be conducted to compute missing values. As a result, the drug data available in FARS cannot be assumed to be representative of all drivers in all locales. As noted earlier, a driver suspected of using drugs based on evidence found in a vehicle may be more likely to be given a drug test than a driver with little or no evidence of using drugs. In the resulting non-random selection, drivers given a drug test may be more likely to have a positive drug result than drivers who are not tested. In this case, using reported drug results to estimate prevalence of drugs for all drivers or to impute missing data would overestimate drug positivity.

Challenges to obtaining drug testing are reflected in the amount of missing drug data. Overall in 2019³ only 36.2% of drivers had reported drug tests in FARS. Thus, researchers and practitioners using national estimates of drug prevalence and positivity from FARS are using a data set where over 60% of the data are missing. This can create inaccurate national estimates of drug positivity for any year, and when looking at changes across time.

Drug testing as reported to FARS also varies significantly across States. Figure 3 shows reported drug testing rates in 2019 across States for fatally injured drivers. Typically, fatally injured drivers are the road users mostly likely to be tested for drugs in crashes involving fatality – more so than for surviving drivers. As can be seen in Figure 3, reported drug testing ranged from nearly 0% in North Carolina to over 95% in Alaska. States such as North Carolina may conduct drug testing but results may not be communicated to the FARS analyst for processing into the NHTSA datafile.

³ The most recent year with this data available.

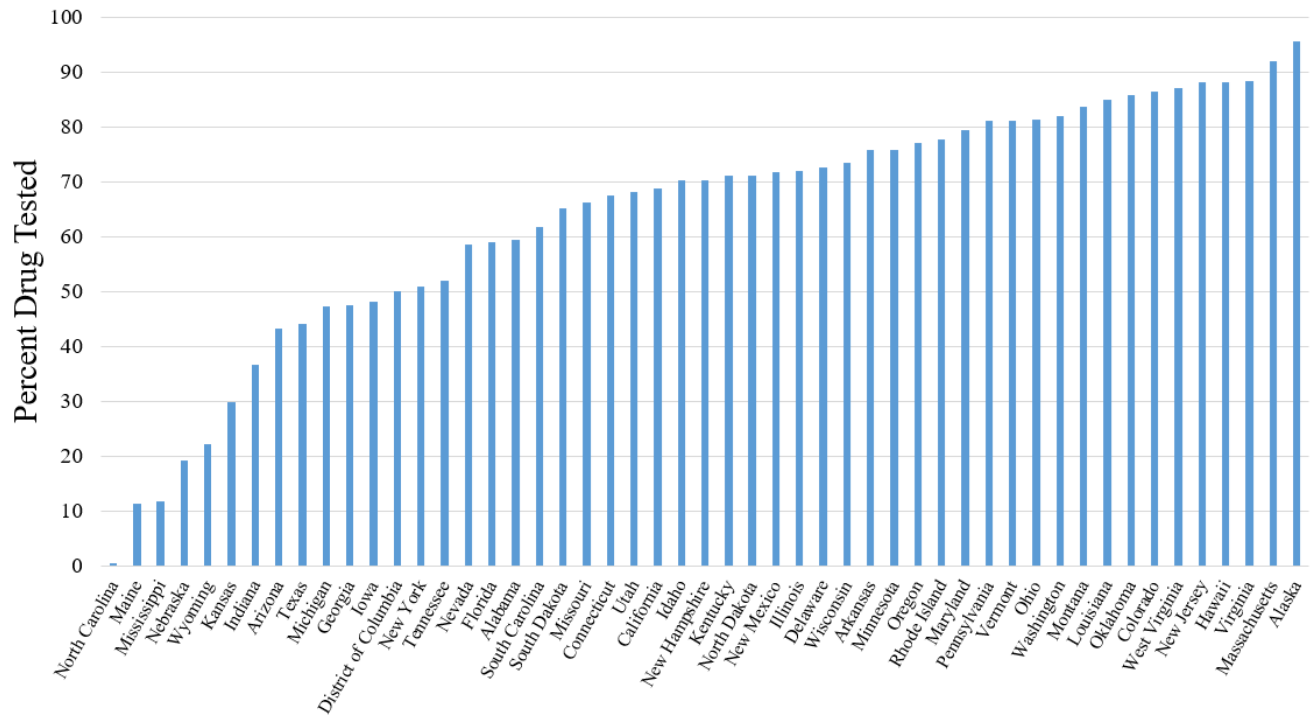


Figure 3: Percent of Fatally Injured Drivers Drug Tested as Reported to FARS, by State

The significant difference in reported drug testing to FARS by States reflects substantial variations in State drug testing laws. Protocols for testing of drivers or other road users after motor vehicle crashes is determined at the State- and local levels through laws and policies. Relevant laws can be found on State government websites, or through compilations, such as NHTSA’s Digest of State Laws: Driving Under the Influence of Drugs (2018).⁴ Some States may test both fatally injured and surviving drivers; in other States there may be limited testing of surviving drivers involved in a crash. Specific bodily specimens may be noted, as well as specific drugs, or there may be little specification. There may be additional constraints on testing or reporting. As an example from a State, North Dakota’s law includes the following:

In cases of death resulting from a motor vehicle accident or other unnatural death occurring in a motor vehicle, the county coroner shall require that specimens of blood, urine, and vitreous humor be withdrawn from the body of the decedent within twenty-four hours after the decedent's death by a coroner, coroner's physician, or other qualified person, prior to embalming. The specimens must be collected and preserved by methods and techniques established by the director of the state crime laboratory or the director's designee. The specimens so drawn must be sent to the director of the state crime laboratory or the director's designee for analysis for alcohol, carbon monoxide, and other drug content. The director of the state crime laboratory or the director's designee shall keep a record of all such examinations to be used for statistical purposes. The records must be made available to the director for use by the national

⁴ Also see the National Conference of State Legislatures annual report, *Traffic Safety Trends: State Legislative Action 2020* (Bloch et al., 2021) The report examines Federal and State legislation and details State traffic safety laws.

highway traffic safety administration in analyzing fatal accidents. The information in the possession of the director may be obtained from the director of the state crime laboratory or the director's designee only as provided in this section. Except as provided, the results of the examinations referred to in this section must be used only for statistical purposes, except that the results must be released upon the issuance of a subpoena duces tecum by a court of competent jurisdiction in any civil or criminal action N.D. Century Code § 39-20-13

As another example, Tennessee's law allows discretion regarding drug testing for a person killed in a crash, using this language:

When a death is reported as provided in § 38-7-108, it is the duty of the county medical examiner in the county in which the death occurred to immediately make an investigation of the circumstances of the death. The county medical examiner shall record and store the findings, and transmit copies according to the death investigation guidelines developed by the Tennessee medical examiner advisory council. In any event the county medical examiner is authorized to remove from the body of the deceased a specimen of blood or other body fluids, or bullets or other foreign objects, and to retain such for testing and/or evidence if in the county medical examiner's judgment these procedures are justified in order to complete the county medical examiner's investigation or autopsy.

--Tenn. Code Ann. §38-7-109

Inconsistency of Drug Data: Why All Drug Results Are Not the Same

There is a patchwork of laboratory procedures, capabilities, and toxicological reporting that result in substantial inconsistencies in toxicology data both across and within States. There is no “standard” drug test panel. Testing performed at one laboratory can vastly differ from testing performed at another laboratory with regard to the drugs tested for and the detections levels used. This has important implications for the outcome and interpretation of toxicology results. Further, each State has its own process for providing drug test information to FARS analysts. Some processes may result in critical information loss before toxicology data can be entered into FARS.

Drug Test Results: Interpretation, Inconsistencies, and Challenges

Even when there is a drug test, there are numerous factors that impact the quality, scope, and interpretation of the results. It is often difficult, or impossible, to compare drug prevalence results across labs (or States) unless full details of each case are available and conducted in the same manner. This often makes statistical analyses using FARS data for drugs impractical to conduct.

What Does a Positive Drug Result Mean? A positive drug test result does not in itself indicate a person was impaired by that substance, including at the time of the crash. Data from the National Center for Health Statistics (2019) for 2015 to 2018 indicated 46% of people used at least one prescription drug “in the past 30 days” and 11% had used five or more drugs in that period.

Drug-positive does not automatically mean drug-impaired

Forensic drug testing in the cases of motor vehicle crashes may include substances such as caffeine, over-the-counter medications, as well as prescription and illegal drugs. Often a person being “positive” for a drug only indicates the person was on medication prescribed by a doctor that, at the therapeutic dosage, may not be impairing, or may not have been impairing at the time of the crash. It is important to also remember that use of many medications may be important for a person to perform functionally, including for driving-related tasks.

For drugs that can be impairing, there are still other complexities. Drugs vary in the amount of time required for metabolism and elimination from the body. Cannabis, for example, can be detected within some matrices weeks after use.⁵ In these cases, a positive result for a drug or metabolite⁶ only indicates the person had consumed cannabis, impairment at the time of the driving event cannot be inferred. The rapid acquisition of a sample for testing in survivors is critical as the concentration of a drug will decrease as the body metabolizes the substance. Inhalants, for example, may be completely metabolized and eliminated by the time a sample is collected for analysis.

Understanding the origin of a substance is also important. In cases of a surviving⁷ driver, emergency medical technicians or hospital personnel may have administered drugs as part of treatment immediately following the crash. A toxicologist may be able to determine if medical administration was the likely source of the substance based on the amount in the body and whether drug metabolism has begun. However, this is not always clear for all drugs. Benzodiazepines and opioids are particularly likely to be given as a part of treatment, and then could be present in drug results, including those sent to a FARS analyst for the case’s record.

Where Does Testing Occur? A jurisdiction may send its biological samples to a municipal, county, State, or private forensic (involved with legal or criminal cases) toxicology laboratory. Some States have a single lab that conducts all testing for the State; other States may use multiple labs across jurisdictions. Labs vary on their protocols, equipment, and training of personnel. Highly complex equipment used for detecting some substances can cost hundreds of thousands of dollars to acquire, and thousands of dollars per year to maintain. Specialized equipment also requires specialized training. In general, lab technicians must be trained on each piece of equipment, and different equipment is needed for the detection of different substances. It is not unusual for jurisdictions to send some samples to one of the specialized commercial labs in the country if it is a matrix they do not have ability to test, or when a drug is suspected (from corroborative evidence) but is not detectable with available equipment. Jurisdictions may also send samples to an outside lab if they have a backlog and quick turnaround is needed.

What Is the Difference Between Screening and Confirmatory Testing? When a lab conducts an *initial screening* test of a sample for the presence of a drug, it is the first step of a comprehensive analysis process. These tests, which are relatively less expensive and much quicker to conduct, test for an array of substances (or possibly for an entire drug category) for indication of presence of a drug. This type of analysis allows for a qualitative result – whether the substance or class of drug is present. Some substances are cross-reactive with other

⁵ See Compton (2017) for an overview of the topic of cannabis use and driving.

⁶ The process of the body breaking down a drug is known as metabolism. The resulting substances are known as metabolites. The process continues until the substance is fully excreted from the body, which, depending on the substance, can occur quickly or, for the case of cannabis with a regular user, can take weeks.

⁷ A crash participant may be a surviving driver initially after a crash but may be deceased within 30 days of the crash and would then be categorized as a fatally injured driver under FARS.

substances. With this broader screening test comes greater opportunity for *false positives* – a type of error whereby there is indication a drug is present when it is not. For a laboratory to identify the presence of a specific drug more precisely, more specialized confirmatory testing is required. This testing allows for a quantitative result – knowing the amount of the substance in the body – not only that it was present. Additionally, initial screening may provide information about possible presence of a drug category, such as cannabis, while confirmatory testing indicates certainty of the drug’s presence and allows detection of components of that substance both the parent drug and metabolites (the chemically changed structures created in the body after it has metabolized in the body, such as 9-Carboxy-11-nor-delta-9-THC).⁸ Only a confirmatory test provides accurate determination that a substance was present. For these reasons, the National Safety Council (NSC) has issued a position statement for transportation safety cases recommending there be confirmation of positive drug screen results by an alternative analytical method prior to issuing a report (NSC, 2008). At present, FARS entries do not differentiate between a screening or confirmatory test.

What Drugs Are in a Testing Panel? States, jurisdictions, and labs greatly vary on the drugs included in a testing panel. Many labs may regularly test for a few substances. A few labs, such as the crime lab in Orange County, California, may test for hundreds of substances. There are multitudes of commonly used drugs in the United States, detection of these drugs can require specialized equipment, staff training, and time to conduct comprehensive testing. These factors are all dependent on resources within a State, and resources vary across time. This results in large inconsistencies in results across jurisdictions and across years. Therefore, comparisons across jurisdictions and time periods are often not appropriate. Even drugs of popular interest, such as cannabis, may not be included in drug testing within a jurisdiction. The number and types of tests also affect the amount of time until results are known.

The number of drugs in a particular laboratory’s panel may increase across time, though this is not always the case. A lab may increase its testing capacity if it receives new equipment or training for personnel, or a different drug may be a known problem in a community and be added to the panel. However, a lab may also lose funding and then must reduce their staff or determine testing for a specific drug is not beneficial and omit it from its testing panel. Additionally, labs may vary testing across crash cases. A lab may narrow testing on a case to focus on selected drugs, for example if an officer’s, especially a drug recognition expert’s,⁹ crash report indicates suspected use of a specific drug. Other labs use the same testing method across all cases. Labs may have a “blind testing” process where the lab analyst does not have access to any information about the crash, including whether the sample is from a fatally injured or surviving driver, or even if the sample is from a motor vehicle crash. As noted, labs testing for more drugs will be able to detect more substances, and thus their drug-positive numbers are likely to be higher than jurisdictions that cannot test for the same, or for as many drugs.

Complicating the issue further, some jurisdictions have “stop-testing” procedures whereby if alcohol is detected at a certain level, such as .08 or .10 g/dL, there is no continued testing for other drugs. This is often because the alcohol result provides sufficient evidence of impairment for prosecution of a criminal case and further results are not seen as providing a benefit given the expense. Testing policies may differ here, too, for surviving drivers (less frequent testing) than

⁸ As cannabis has been metabolized into “carboxy THC,” it is typically thought of as non-impairing, although actual extent is not fully understood. Carboxy THC can be detected in the body for weeks after use of cannabis.

⁹ DREs are officers specifically trained to recognize the signs and symptoms of categories of drug use.

for fatally injured drivers. Conversely, a lab may test for other drugs only if testing for alcohol was negative.

What Are Drug Detection Thresholds? Detection thresholds for drugs are another source of variation across labs. More specialized equipment and techniques can detect substances in a sample at lower thresholds of quantity in a specimen. Older equipment may not have the capability of detecting substances at lower levels. This is another example of how a jurisdiction's prevalence of a drug can seem to increase, despite actual use in the population being the same, or even decreasing. For example, if a driver has 15 ng/mL¹⁰ of a substance in the body, and Lab A has a detection threshold of 20 ng/mL for that drug while Lab B with newer equipment has an improved detection threshold of 10 ng/mL, then this same driver's drug presence would be missed by Lab A (and thus not reported to FARS) but would be detected and reported by Lab B. Thus, Lab B's State will report a larger number of drug-positive cases.

The National Safety Council's Alcohol, Drugs and Impairment Division provides recommendations to labs for toxicological investigation of cases involving drug-impaired-driving arrests and cases with motor vehicle fatalities. Its 2021 release included changes to cutoff thresholds for some drugs to its Tier I recommendations. Tier I drugs include the most frequently encountered substances in impaired driving arrests, and those detected and confirmed with commonly available toxicology laboratory equipment. NSC recently added trazodone and difluoroethane to its Tier II recommendations. Tier II drugs include those with limited or regional prevalence or are generally not seen as often, or they require advanced equipment for detection. NCS's recommendations provide a guide for toxicology laboratories to increase standardization of drug testing. Table 2 is adapted from NSC (2021); see the NSC's full report for recommendations on detection threshold information.

Table 2: National Safety Council's Alcohol, Drugs and Impairment Division's Tier I Drug Classes/ Drugs (2021)

<u>DRE category: Cannabinoids</u>	<u>DRE category: CNS depressants</u>	<u>DRE category: Narcotic analgesics</u>
Δ9-THC	Carisoprodol	Codeine
Carboxy-THC	Meprobamate	6-Acetylmorphine
11-hydroxy-THC	Zolpidem	Buprenorphine
	<i>Low-dose benzodiazepines</i>	Norbuprenorphine
	Alprazolam	Fentanyl
	Alpha-hydroxyalprazolam	Hydrocodone
<u>DRE category: CNS stimulants</u>	Clonazepam	Hydromorphone
Methamphetamine	7-Aminoclonazepam	Methadone
Amphetamine	Lorazepam	Morphine
MDMA	<i>High-dose benzodiazepines</i>	Oxycodone
MDA	Diazepam	Oxymorphone
Cocaine	Nordiazepam	Tramadol
Benzoylcegonine	Oxazepam	O-Desmethyltramadol
Cocaethylene	Temazepam	

Adapted from D'Orazio et al., 2021

¹⁰ Nanograms per milliliter, a common unit of measurement in forensic toxicology.

What Does a Negative Result Mean? The example above demonstrates why a negative drug result does not necessarily imply a driver was unimpaired by drugs at the time of the crash. The drug may not have been tested for; the lab may not have been able to detect the drug; the drug may have metabolized during the elapsed time since the specimen was collected (with the parent drug was not able to be detected). Substances such as inhalants (e.g., paint spray) may be difficult to detect in a drug test given their shortened time to metabolize.

Lack of a drug-positive test does not always mean a drug was not consumed

It is important to know not only which drugs were tested for, but also a lab's individual detection thresholds for each drug. In most cases, this information is not provided by the lab to the FARS analyst. This information is also not yet collected by FARS. FARS does not currently differentiate between a drug test result that was negative from a drug that was never tested.

Information Flow and Documentation of Drug Data in FARS

Submission of Drug Test Results to FARS

Forensic testing agencies serve many clients and have multiple Federal and State reporting requirements. Not all medical examiners, coroners' offices, or testing labs are even familiar with NHTSA or FARS. The results from their tests usually are included in FARS, but not necessarily through a direct route. This is important as it is harder to make improvements when multiple agencies are involved, and especially when separate reporting platforms are involved, before the information reaches the FARS analyst. These systems may not perfectly communicate, and information included in one may not be fully transferred to another – critical drug test information may be omitted. Problems may be as basic as one system allowing for a certain number of variables; the next system along the way allows for only a smaller number, and neither entity realizes data are not moving forward and are subsequently missing. In these cases, despite the testing that was completed, the results are not fully recorded.

Case Omitted

Test results may be omitted in FARS for other reasons as well. For example, results from Tribal Lands or from commercial drivers may not be consistently included. There is also the possibility of data omission from crashes involving a felony or other specific criminal cases where testing is handled by different labs. If testing occurred in a hospital, the results may not be released to FARS due to the HIPAA Privacy Rule.¹¹

Timing of Submissions

Reporting offices may submit information to a FARS analyst as each individual case is completed, or may batch their results – for example, submitting results for a month, or even a year, at a time. In other States, the process may be for the FARS analyst, after checking law enforcement crash reports, to then reach out to coroners or to medical examiners' offices, county by county, for drug test information.

¹¹ The Health Insurance Portability and Accounting Act protects people's medical records; see www.hhs.gov/hipaa/for-professionals/privacy/index.html

Information Loss

Drug testing information can be lost as it moves across various data systems from the time of its collection to its entry into FARS. Even jurisdictions with high drug testing rates and comprehensive toxicology testing can have limited drug data available in FARS (see again Figure 3's percentages of drug testing across States). For example, an officer prepares a thorough description of a fatal crash investigation, including found drug paraphernalia. The deceased driver is taken to the medical examiner's office and a blood sample is obtained. That sample is sent to the county's forensic toxicology lab for alcohol and other drug testing. The toxicology laboratory performs comprehensive testing including an extensive drug panel with state-of-the-art testing equipment for both screening and confirmation testing. The toxicologist enters the results into their agency's reporting system. These results are now sent back to the medical examiner's office to be included with other information about the death. This office is required to report test results to many agencies with a multitude of reporting requirements. Here, the lab's drug test results are merged into the medical examiner's system. However, this spreadsheet may not contain as many data fields as the lab's system. Elements such as the drugs in the test panel, detection thresholds, and specific concentrations detected of each drug can be left off, without the lab knowing. At the end of the month, this office submits its information on all recent cases to the State's FARS analyst housed in another agency. The analyst enters the information, along with the officer's crash report received by fax, into FARS – with its own variable fields.¹² With each step and each agency, there is opportunity for data loss and system translation errors.

What Drug Information do FARS Analysts Receive?

NHTSA recently examined the sources and quality of drug data provided to FARS analysts.¹³ Working through NHTSA's cooperative agreements with the States, the study examined the source material for drug tests submitted to FARS analysts. With this type of information, we seek to improve reporting across States to increase depth of information, and consistency in reporting.

A list of randomly generated FARS case numbers involving a drug test was sent to each State's FARS analyst. For each requested case, the analyst was asked to send NHTSA whatever drug test results they had received for entry, *as they had received them*.¹⁴ The objective was to see exactly what FARS analysts receive and work with when they enter data into FARS. Half of the cases requested were for drivers who had died as a result of the crash, and half were for drivers who survived the crash. Of the 1,600 requested cases, NHTSA received information on 1,186 cases across 32 States and the District of Columbia.

Ideally FARS analysts would receive drug test results directly from the toxicology lab, and in a standard format. Our data collection found of the 973 cases in which the source of the drug test results could be determined, test results came to analysts directly from the lab about one-half the time (51.5%). Test results also came from secondary sources (who the lab had sent their results to such as from a police report (25.6%), or information from a prosecutors' office, or coroners' office, and medical examiner's office. The files may arrive as email, Excel files, or in other forms.

¹² Until 2018 FARS allowed only three drugs to be input, regardless of the number of drugs detected. NHTSA has upgraded the system to allow for all drugs detected to be included.

¹³ Contract # DTNH22-17-F00199

¹⁴ All personally identifiable information was redacted.

Blood is often seen as the gold standard for post-crash testing, especially in relation to urine that may not yield results reflecting drugs exerting an effect at the time of the crash. Of the 1,060 cases NHTSA received, 855 cases included the matrix. Blood was an available matrix in 791 (92.5%) of these cases; urine in 55 (6.4%) cases, and the other nine cases (1.1%) were matrices such as vitreous fluid.

In addition to knowing the matrix, it is critical to know if testing methodology including whether both screening and confirmatory testing occurred. Of the 1,060 cases, most of the cases (n= 817, 77.1%), did not specify whether screening, confirmatory had been conducted. For the cases in which type of testing was discernable, only screening was conducted in 68 (6.4%) cases; in 175 (16.5%) cases, confirmatory testing was conducted. Again, confirmatory testing is necessary for reliable drug reporting and FARS cannot differentiate whether this testing was conducted.

Knowing all the drugs tested for in a panel is important. In the current review, FARS analysts received panel information for 1,007 of the cases. For 325 (32.3%) of these cases, the full testing panel was provided. In 287 (28.5%) of these cases, only drugs with positive results were provided. In 323 (32.1%) cases, it was noted that no drugs had been detected but without specifying what was tested. In 41(4.1%) cases, some results were presented at class-level (e.g., cannabinoids) and some at specific drug level (e.g., Δ^9 -THC). The remaining 31 (3.1%) cases used a coding scheme to report drug results but without a data dictionary to interpret the codes.

As discussed, knowing detection thresholds is important. In most of the cases (1,002; 94.5%), the detection threshold was not provided. In 51 (4.8%), the full reporting thresholds¹⁵ were provided. The remaining 7 (0.7%) cases provided the reporting thresholds for some of the drugs.

When looking for specific (quantitative) drug concentrations versus simply information on the presence, there were 1,045 cases in which this could be examined. Over half of the cases (n = 542; 51.9%) only included negative test results, thus the reporting of positive results could not be assessed. This left 503 cases with positive results. In these cases, only qualitative results (i.e., the drug was present) were reported in 264 (52.5%) of the cases. Results listing drug concentrations were reported in 186 (37.0%) cases, and a mix of both qualitative and quantitative reporting was in the other 53 (10.5%) cases.

Example Toxicology Documents

Examples of the type of information received by FARS analysts on drug results are provided below; these mock examples are not from actual cases nor represent a specific lab. They are shown to illustrate the variety of ways information is submitted for inclusion in FARS.

Table 3 includes information sometimes found in a police report. From this, we can see that testing for drugs did occur, although it is not known where. We can see one person involved in the crash, the fatally injured driver, had drug testing that was positive for amphetamines and methamphetamines; and that quantification was available for each. From this information, we do not know if testing was conducted for other drugs. We also do not know if the other participant, the surviving driver, was tested for the presence of drugs, even though that person may have been partially responsible for the crash.

¹⁵ Also known as testing limits or cut-offs.

Table 3: Example of Toxicology Results Reporting #1

Police Accident Report for Springfield, USA
I am Officer Thorn. I responded to a call about a crash at 11:30 p.m. at the intersection of Vine and 2nd Street. There were 2 drivers involved. Driver 1 did not stop at the stop sign and hit Driver 2 in the Driver's side of the vehicle. Driver 2 was pronounced dead at the scene of the crash. The medical examiner obtained a blood sample at the scene, and I will update this report when those results are available.
[later updated] Driver 2 Blood Test Alcohol = .07; Amphetamine .09; Methamphetamine .38

Table 4 presents the scenario in which a lab sends crash-related drug test results to a FARS analyst in a batch for all recent crashes, for example monthly. This is often in an Excel file. There is basic information identifying the case, the type of matrix, the drug test results, and the concentrations of the drugs detected. This example illustrates when a drug was tested for and the negative results (no drug found) are recorded, as well as the positive results. This type of submission allows more context for the extent of the presence of drugs found.

Table 4: Example of Toxicology Results Reporting #2 (fictional names)

<i>Smythe, A.</i>	Femoral Blood	Amphetamine	50 ng/mL
<i>Jones, B.</i>	Hospital Blood	Oxycodone	15 ng/mL
<i>Warren, C.</i>	Blood	9-Carboxy -11-nor-delta-9-THC	15 ng/mL
	Blood	Insufficient Sample	

Table 5 illustrates information submitted to the FARS analyst that includes the type of matrix, and where the sample was collected. It also specifies the type of toxicological tests conducted, and notes which drugs were included in the test panel.

Table 5: Example of Toxicology Results Reporting #3

<i>[Redacted name]. Case #12345 Medical Examiner, Lu, C.</i>	Crash Date Tests conducted on Date	
<i>Blood Femoral</i>	Ethanol	.09
<i>Vitreous</i>	Ethanol	.09
<i>Specimens were screen by headspace gas chromatography (HS/GC) for ethanol and acetone.</i>		
<i>Specimens were screened by enzyme-linked immunosorbant assay (ELISA) for amphetamines, barbiturates, benzodiazapines, cannabinoids, cocaine metabolites, methamphetamines, opiates, oxycodone, and fentanyl</i>	Cocaine	24 ng/mL

Table 6 illustrates reported results similar to those in the above example but this lab also included its reporting limit (testing threshold). With this information we can understand what that lab's equipment is capable of detecting, and that the individual might still have consumed a drug and had a concentration below the threshold of detection.

Table 6: Example of Toxicology Results Reporting #4

ANALYTE ¹⁶	RESULTS	REPORTING LIMIT
DIAZEPAM	Negative	20 ng/mL
OXAZEPAM	Negative	20 ng/mL
CLONAZEPAM	Negative	20 ng/mL
LORAZEPAM	Positive 208 $\pm$ 14 ng/mL	20 ng/mL
ALPRAZOLAM	Negative	20 ng/mL

Other labs may include additional information such as the type of container (e.g., red top vial) the sample was received in and the volume of the sample. Additional information on a lab report may include information about any substances found at the scene, such as a description of cocaine.

¹⁶ A chemical substance being measured.

Improvements Underway

NHTSA is working to strengthen the drug data in FARS. All changes require planning and coordination, including training for analysts across the country. The improvements follow from limitations noted above, as NHTSA strives to increase the quantity and quality of data in FARS.

Completed Improvements

- Ability to enter each drug that has a positive test result. As of 2018 an unlimited number of drugs can be entered, no longer resulting in some drugs being omitted. *As more drugs can be reported; incidence will go up due to reporting, separate from incidence related to actual use.*
 - In the past, the system was limited space for entry of three drugs, regardless of how many drugs were detected in the matrix. Analysts followed instructions to include drugs based on a hierarchy of drugs of interest. This list had not been updated in many years.
- The specimen list (matrix) has been updated, allowing for more accuracy.
- It is now possible to identify both when a test result is negative; as well as when it is positive.

Short-Term Actions

- NHTSA is updating the list of drugs. There is a growing array of drugs being used and for which labs have ability to detect. Other substances that have been included are no longer used or their common-usage names have changed (e.g., hashish oil). The revised list will include both the drug category (e.g., dissociative anesthetics) as well as the specific drug (e.g., PCP), and will include a broader list of metabolites. There will also be the ability to note a drug not included on the list.
- Allow recording of the data source, such as a toxicology lab.
- Including a variable for test type, such as, whether the testing was for screening purposes, or if there were also confirmation tests.

Longer-Term Actions

- Recording the time and date the specimen was collected; and recording the time and date the tests were conducted.
- For drugs with the quantification, recording of the amount of the drug.
- Including the drug test panel and the detection threshold for each drug.

NHTSA is working through a cooperative agreement with forensic toxicology experts who are helping the agency better understand drug testing issues. In 2021 NHTSA initiated another agreement to support toxicology liaisons with three NHTSA Regional Offices, covering thirteen States. These liaisons will work with toxicologists, law enforcement, and FARS analysts to improve drug-impaired driving toxicology data collection, reporting, and coordination. Another project is supporting meetings across several States to: increase communication among State and local labs, provide training for toxicologists and prosecutors on court room testimony, and work towards standardizing testing and reporting procedures.

One State's Efforts

The State of California highlights both the challenges to collecting standardized toxicology data, as well as State-level efforts to facilitate wide scale improvements in this area. California's 58 counties make their own decisions about drug testing, with policies and drug panels differing across counties. State law only requires medical examiners or county coroners to test deceased drivers and passengers for the presence of alcohol, but not other drugs. In 2019 lawmakers partnered with toxicologists and law enforcement to address gaps in toxicology and improve the State's ability to track traffic fatalities involving drugs. The proposal required law enforcement to conduct a drug test within 48 hours of a traffic collision involving a fatality. It also required all municipalities to conduct drug testing for all fatal collisions and report the data to the California Highway Patrol. This is an example of how a State can define its need and seek improvements.

The State's Impaired Driving Task Force has since 2021 included these recommendations in its report to the California legislature.

- Additional funding should be considered for State and local government laboratories conducting forensic toxicology testing to purchase efficient and sensitive testing equipment capable of testing for Tier I drugs and provide funding for personnel to conduct forensic toxicology testing.
- Laboratories conducting forensic toxicology testing should test blood samples for alcohol and all Tier I compounds, in at least one recommended matrix, at the prescribed threshold concentrations, for both screening and confirmation testing.
- Laboratories conducting forensic toxicology testing, including screening and confirmatory testing, should continue to evaluate National Safety Council recommendations related to forensic toxicology testing and when new standards are recommended, laboratories should strive to implement those recommendations.

Summary

This report discussed the process of obtaining and reporting drug use data from the time of a motor vehicle crash, and how it is entered in NHTSA's FARS, its robust data collection system including multitudes of variables, with a wealth of information across all the States, the District of Columbia, and Puerto Rico. FARS has been expanding and improving since its inception in 1975. This report is intended to help users of data on drugs and driving data to better understand the complexity of drug testing and reporting. The limitations identified here are not necessarily unique to drug testing, or to FARS, and are presented to inform discussions on drugs and driving, and to lay the groundwork for improving the data collection and reporting.

Missing Drug Data

The magnitude of missing drug data remains a critical issue with FARS. In fact, currently less than 40% of drivers have drug test data reported into FARS. Unlike alcohol, these missing data cannot be imputed using statistical techniques. These other drugs are not missing "at random," a necessary property for missing data imputation. The drug data available in FARS are not representative of the drug data that are missing data. Some of the issues noted in this report would lead to underestimates of drug prevalence – either for a specific drug or drugs overall; others would lead to overestimates. One simple example of a bias in testing is that law enforcement may be more likely to request a drug test for a driver who exhibits signs of impairment or has drug paraphernalia in their car as compared to another surviving driver who exhibits no signs of drug use. In this case, extrapolating missing drug data using drivers with known results would overestimate drug presence.

Along with often low drug-testing rates, there are omissions and inconsistencies with information reported to FARS analysts. Once a lab completes drug testing, the results need to be clearly reported to the State's FARS analyst for recording into FARS. This process may cross agencies' reporting systems and information may be lost as the data moves forward. A jurisdiction may have an excellent drug testing process, but the data are not captured in FARS. This report illustrated the variety of ways the FARS analysts receive drug test information – from very basic information noting a drug was present; to more complete information noting which drugs were tested for, at which detection thresholds, with type of testing, and quantitative results. The bottom line is that even when drug testing is conducted, it may not make it into FARS.

Improving drug testing rates at the State level, as well as the reporting and entry of this information into FARS, is a necessary step to improve the accuracy and usability of these data. These concerns are compounded when laws, policies, and testing abilities vary across States and labs and change across years. The AAA Foundation for Traffic Safety has conducted studies examining drug laws and drug testing across States. Its 2016 report (Arnold & Scopatz, 2016) documenting recommendations from an expert panel found that States should authorize and encourage alcohol and drug testing for all surviving drivers involved in fatal and serious injury crashes; and States should enact laws and/or the appropriate agencies should implement policies mandating alcohol and other drug testing and reporting of the results for all fatally injured drivers. NHTSA has projects underway to help States examine their individual testing and reporting issues, and work together with their partner agencies to strengthen their practices. Some fixes may be easy; others may require more extensive planning and resources.

Available Drug Data Are Inconsistent and Incomparable

Some researchers attempt to address the limitation of missing drug data by only using States or localities where there is a higher percentage of drug data available in FARS. This inaccurately assumes that all drug data in FARS is consistent and comparable. While FARS does have standardized reporting of drug variables, the underlying toxicology data varies substantially across numerous critical domains. These include differences in drug test panels used by labs – labs do not all test for the same drugs; some many only regularly test for a few and others may be able to test for hundreds. Detection thresholds also vary across labs, as equipment (and training to operate specialized equipment) varies. New, and expensive, equipment that allows for increased accuracy may only be available to the minority of labs. Another example is screening versus confirmatory testing. The latter testing type is needed to confirm the presence of a drug. Again, not all labs conduct confirmatory testing, or may only do so in specific cases.

Standardization or, at the least, the development of minimum toxicology standards is needed to allow for meaningful comparisons across jurisdictions. Standards developed by the National Safety Council's Alcohol, Drugs, and Impairment Division that provide recommendations for toxicological investigation of drug-impaired driving arrests and for motor vehicle fatalities, address some of these concerns. They address minimum testing thresholds and a set of Tier I drugs that should be tested across all laboratories.

In the meantime, the lack of consistent and standardized toxicology testing is also complicated by the fact that many of these key laboratory testing differences (e.g., screening versus confirmatory testing) cannot be designated in FARS. NHTSA is working on ways to allow the entry of this information in the future.

Conclusion

There are many complexities in obtaining and reporting drug use data related to motor vehicle crashes. Increasing the percentage of people involved in a crash tested for the presence of drugs, with a standard drug panel and detection thresholds, and clear and complete reporting is challenging and requires strong efforts at local, State, and national levels. NHTSA has enacted changes to its FARS data system to allow for more accurate and robust reporting. Additional changes are planned to further strengthen the data files, which will allow for more accurate interpretation of the data. NHTSA is also working with toxicologists, and with States highway safety offices and partners to better understand drug testing issues, and to help States improve their own testing and reporting. States are striving to make their own improvements, for example, with attempts at requiring additional levels of testing.

As a Federal agency dedicated to transparency, NHTSA shares information on research strategies and challenges, including the barriers to obtaining and reporting information. NHTSA strives to provide comprehensive data on traffic safety to the public, and as issues emerge – such as drug use – data collection procedures and systems must evolve. As NHTSA continues to improve our reporting of FARS drug data in partnership with the States, the data we have will remain available to the public. All data collection and reporting systems have limitations based on the incoming data. The important national conversations and increased research focus on drugs and driving illustrate the need for foundational data such as found in FARS. The limitations identified here are not necessarily unique to drug testing, or to FARS, and are presented to inform discussions on drugs and driving, and to lay the groundwork for improving the data collection and reporting.

Currently, the limitations severely constrain interpretation of the drug data. Comparisons across labs, States, or years are problematic. Drug test results from drivers who survive, and who are fatally injured, along with other existing data sources such as self-report surveys, roadside surveys, and arrest data can provide us with a better understanding of drug use and driving. NHTSA is dedicated to continuously improving our data systems and working with partners to reduce motor vehicle crashes, injuries, and fatalities.

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March 2022



U.S. Department
of Transportation
**National Highway
Traffic Safety
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