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

NHTSA

DOT HS 813 018

October 2020

Drug and Alcohol Prevalence in Seriously and Fatally Injured Road Users Before and During the COVID-19 Public Health Emergency

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Suggested APA Format Citation:

Thomas, F. D., Berning, A., Darrah, J., Graham, L., Blomberg, R., Griggs, C., Crandall, M., Schulman, C., Kozar, R., Neavyn, M., Cunningham, K., Ehsani, J., Fell, J., Whitehill, J., Babu, K., Lai, J., and Rayner, M. (2020, October). *Drug and alcohol prevalence in seriously and fatally injured road users before and during the COVID-19 public health emergency* (Report No. DOT HS 813 018). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 813 013		

4. Title and Subtitle	5. Report Date
Drug and Alcohol Prevalence in Seriously and Fatally Injured Road Users Before and During the COVID-19 Public Health Emergency	October 2020
	6. Performing Organization Code

7. Authors	8. Performing Organization Report No.
Thomas, F. D., Berning, A., Darrah, J., Graham, L., Blomberg, R., Griggs, C., Crandall, M., Schulman, C., Kozar, R., Neavyn, M., Cunningham, K., Ehsani, J., Fell, J., Whitehill, J., Babu, K., Lai, J., and Rayner, M.	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Dunlap and Associates, Inc. 110 Lenox Avenue Stamford, CT 06906	11. Contract or Grant No. DTNH2211D00225L, Task Order 6

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Office of Behavioral Safety Research National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590	Final Report, September 2019 – July 2020
	14. Sponsoring Agency Code

15. Supplementary Notes

Amy Berning served as the Project Manager

16. Abstract

A gap in knowledge exists regarding drug use among drivers and other road users (pedestrians, bicyclists) who are seriously or fatally injured in crashes in the United States. This study examines the prevalence of alcohol as well as selected over-the-counter, prescription, and illegal drugs in the blood of seriously or fatally injured drivers and other crash victims near the time of their crashes before and during the COVID-19 public health emergency. Data was collected at Level 1 trauma centers and medical examiner offices. The 3,003 participants represent a convenience sample of roadway users who were seriously or fatally injured during the study period. Trauma centers and medical examiners made available small volumes of blood for toxicological analyses from the total collected during their normal clinical procedures. The results indicate drug prevalence was high among seriously and fatally injured roadway users before the public health emergency began and was even higher during, especially for alcohol, cannabinoids (active THC), and opioids. Drivers in particular showed significantly higher overall drug prevalence during the public health emergency, with 64.7% testing positive for at least one active drug, compared to 50.8% before. Drivers also showed an increase in testing positive for two or more categories of drugs going from 17.6% before to 25.3% during the public health emergency. Of particular note, active THC was more prevalent among drivers during the public health emergency than alcohol (32.7% versus 28.3%), and opioid use among drivers almost doubled from 7.5% to 13.9%. Overall, the results of this study suggest the highway safety community should be concerned about the impact of other drugs as well as alcohol. In particular, the observed cannabis and opioid prevalence rates before and during the public health emergency could be indicative of a growing problem. These findings are prevalence rates only and cannot be used to determine whether the people were impaired at the time of their crash.

17. Key Words	18. Distribution Statement
alcohol, drugs, drivers, drugged driving, drug prevalence, injured road users, pedestrians, bicyclists, trauma	Document is available to the public from the National Technical Information Service, www.ntis.gov.

19 Security Classif. (of this report)	20. Security Classif. (of this page)	21 No. of Pages	22. Price
Unclassified	Unclassified	59	

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

Acknowledgements

We are grateful to the hospital and medical examiner personnel who participated in the study. This study could not have been accomplished without the assistance of these people and organizations. The findings and conclusions presented here are the responsibility of the authors and do not necessarily reflect the opinions or policies of the other project participants or their employers.

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Executive Summary

Background and Objective

Until recently relatively little was known about the prevalence of drugs other than alcohol in the systems of drivers. The National Highway Traffic Safety Administration has conducted studies using roadside data collection techniques to estimate the population level prevalence of drinking and drugged driving on U.S. roadways (Lacey et al., 2009; Kelly-Baker et al., 2016) and to estimate the relative crash risk associated with drugs other than alcohol (Compton & Berning, 2015; Lacey et al., 2016). These studies have provided substantial insights on the topic of drugged driving, but a gap in knowledge exists regarding drug use among drivers and other road users (pedestrians, bicyclists) who are seriously or fatally injured in crashes. The objective of the current study was to examine the prevalence of selected over-the-counter, prescription, and illegal drugs in the blood of drivers and other road users who were seriously or fatally injured in crashes.

Shortly after this project began, an outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections started a worldwide public health emergency of respiratory disease referred to as coronavirus disease 2019 or COVID-19. A public health emergency was declared in the United States on March 13, 2020 (WhiteHouse.gov, 2020). Shortly thereafter, many States began closing schools, putting restrictions on business operations, and advising residents to shelter-in-place or otherwise greatly reduce travel behaviors to mitigate the impacts of the viral outbreak. This report provides an examination of alcohol and other drug prevalence among seriously and fatally injured roadway users before and during the public health emergency through mid-July 2020.

Methods

Data collection took place at trauma centers and medical examiner (ME) offices that served the following metropolitan areas.

- Charlotte, North Carolina
- Jacksonville, Florida
- Miami, Florida
- Baltimore, Maryland
- Worcester, Massachusetts

Data collection began on a rolling basis across sites, but was halted at four study sites and reduced at the fifth starting in mid-March 2020 due to COVID-19's impact on research operations in hospital settings. Study protocols were revised to meet new restrictions on research at the hospitals and to process samples to allow the National Institutes of Health (NIH) to conduct serological testing of collected samples for SARS-CoV-2 antibodies as part of a separate, but coordinated, research effort. With the addition of the antibody testing and revisions to the study protocols, all sites that had previously shut down were able to restart data collection.

The results reported here represent a convenience sample of 3,003 seriously or fatally injured roadway users who were involved in motor vehicle crashes and transported by emergency medical services (EMS) to the participating trauma centers or directly to the MEs from the scene of a crash before and during the COVID-19 public health emergency. Because this is a convenience sample, data collection was not uniformly distributed throughout the year, and was not the same each month. There were different numbers of samples across months, and also across sites. Participants included the following.

- Drivers of motor vehicles (e.g., cars, pick-up trucks, SUVs, motorcycles, commercial vehicles)
- Passengers in motor vehicles
- Bicyclists

- Pedestrians
- Electric kick scooter riders (e.g., scooter sharing systems)
- Other people injured in motor vehicle crashes on public roadways (e.g., moped riders, all-terrain vehicle riders).

A typical participant entered the study as a result of the following sequence of events.

1. Seriously or fatally injured in a crash as a driver, passenger, pedestrian, bicyclist, or other roadway user
2. Transported by EMS to trauma center (or morgue if deceased at the crash scene)
3. Trauma team activated by EMS or treating physicians in accordance with prevailing criteria
4. Blood samples gathered by clinical staff during normal treatment or autopsy procedures and other data collected about the individual and the crash (all de-identified)

For our analysis purposes, the "Before" period includes cases from September 10, 2019, to March 16, 2020. March 16 was chosen as the conclusion of the Before period because it is when States such as North Carolina, Massachusetts, and Maryland began responding to the public health emergency by implementing statewide mandates such as ordering in-person service at bars and restaurants to cease. Additional statewide stay-at-home, or safer-at-home, orders soon followed with a variety of new restrictions implemented and lifted at various points in each State. As such, the samples collected before statewide mandates began are the best representation of drug use by seriously or fatally injured road users at the time of their crash under what were formerly considered "normal" travel patterns in the United States. The "During" public health emergency period covered by this report includes cases from March 17 to July 18, 2020.

Results

The prevalence rates of confirmed drug category positives among all road users in the study before and during the COVID-19 public health emergency are presented in **Table ES-1**. Results broken out for drivers and pedestrians are shown in **Table ES-2**. These results indicate that the active components of at least one drug in the category was found to be in the participant's blood.

Table ES-1. Positive for Drug Category: All Road Users Combined

	Before (N= 1,880)		During (N= 1,123)	
Drug Category	**n**	**%**	**n**	**%**
Alcohol	400	21.3	302	26.9*
Cannabinoids†	402	21.4	350	31.2*
Stimulants	190	10.1	115	10.2
Sedatives	158	8.4	95	8.5
Opioids	142	7.6	145	12.9*
Antidepressants	37	2.0	5	0.4*
Over-the-Counter	43	2.3	18	1.6
Other Drugs	27	1.4	20	1.8
At Least 1 Category	959	51.0	714	63.6*
Multiple Categories	341	18.1	267	23.8*

*Significantly different ($p < .05$) compared to Before period.

†Active THC (Δ-9-THC or 11-OH-THC)

Table ES-2. Positive for Drug Category: Drivers and Pedestrians

	Drivers				Pedestrians			
	Before (N=1,157)		During (N=699)		Before (N=274)		During (N=142)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	252	21.8	198	28.3*	67	24.5	43	30.3
Cannabinoids†	241	20.8	227	32.7*	51	18.6	44	31.0*
Stimulants	106	9.2	64	9.2	33	12.0	23	16.2
Sedatives	93	8.0	61	8.7	25	9.1	13	9.2
Opioids	87	7.5	97	13.9*	22	8.0	17	12.0
Antidepressants	26	2.2	3	0.4*	5	1.8	1	0.7
Over-the-Counter	25	2.2	10	1.4	8	2.9	6	4.2
Other Drugs	17	1.5	15	2.1	4	1.5	2	1.4
At Least 1 Category	588	50.8	452	64.7*	139	50.7	94	66.2*
Multiple Categories	204	17.6	177	25.3*	54	19.7	40	28.2

*Significantly different ($p < .05$) from Before period.

†Active THC (Δ-9-THC or 11-OH-THC)

Discussion

The results indicate drug prevalence was high among seriously- and fatally injured roadway users as a whole before the public health emergency and was even higher during it, especially for alcohol, cannabinoids (active THC), and opioids. Drivers, in particular, showed significantly higher overall drug prevalence during the public health emergency with 64.7% testing positive for at least one active drug compared to 50.8% before the public health emergency began. Drivers also showed an increase in testing positive for two or more categories of drugs going from 17.6% before the pandemic to 25.3% during. Of particular note, active THC was more prevalent among drivers during the public health emergency than alcohol (32.7% versus 28.3%), and opioid use among drivers almost doubled going from 7.5% to 13.9%. Other roadway user groups (e.g., pedestrians, passengers) also showed increases in prevalence for some drugs, but the sample sizes of these groups were small relative to drivers which limited the power of the analyses.

The observed increases in drug prevalence among the studied populations could be a function of a variety of factors including:

- Normal seasonal differences in drug use and drugged driving;
- Differential driving patterns for drug users and non-drug users during the public health emergency; and
- Drug use, and subsequently drugged driving, increased during the public health emergency due to factors such as stress.

Without similar toxicology data for these populations from prior years, it is not possible to determine if the observed effects are recurring seasonal fluctuations. Similarly, without driving exposure data for drug users versus non-drug users, it is not possible to know if one group is driving more or less during the public health emergency, and subsequently being injured at a higher or lower frequency than before. Regardless of the interpretation of the findings, it is clear that drug prevalence is high among the seriously or fatally injured roadway users included in this study, and the data suggest the public health emergency may potentially be associated with the increased use of drugs while driving.

It is important to note these findings may not be representative of the entire United States. Also, the drug results obtained here cannot be used to assess impairment of any individual at the time of the crash or to make any assessment of crash risk relative to drug use. The findings do suggest, however, that additional research is needed to determine whether drugs such as those studied here may increase the risk of being seriously or fatally injured in a motor vehicle crash.

Introduction

With the exception of alcohol, relatively little is known about the prevalence of drugs in the systems of drivers or other roadway users (pedestrians, bicyclists) who are involved in motor vehicle crashes. A quantitative relationship between alcohol and the risk of crashes was first documented in 1964 (Borkenstein et al., 1964; Borkenstein et al., 1974) and confirmed in a later study (Blomberg et al., 2005; Blomberg et al., 2009). Another study showed the level of alcohol in a pedestrian's system was related to that person's risk of being struck by a motor vehicle (Blomberg et al., 1979).

Much less is known about the prevalence of drugs other than alcohol among roadway users and how overall highway safety may be impacted by drug use. Compton (2017) summarized what is known about cannabis-positive driving, but many questions about cannabis and other drugs remain unanswered. The prevailing information on drivers using drugs largely comes from self-report surveys such as the National Survey on Drug Use and Health; from NHTSA Fatality Analysis Reporting System (FARS); from relatively small-scale studies of the prevalence of drugs in fatal crashes when toxicology reports are available (e.g., Terhune et al., 1992); and from injury-producing crashes when toxicology analyses are conducted (e.g., Soderstrom et al., 2001). Self-report studies can provide valuable information but are subject to biases that may limit their validity, and the studies focusing solely on fatalities or small samples of injury victims also suffer potential biases based on their sampling parameters, how the toxicology samples were acquired, testing protocols, and the numbers of drugs investigated.

To provide a better estimate of drugs and driving in the United States, NHTSA has conducted studies using roadside data collection techniques to estimate the population level prevalence of drinking and drugged driving on American roadways (Lacey et al., 2009; Kelly-Baker et al., 2016). Such studies include testing for a wide variety of potentially impairing drugs, and their approach provides an objective measure of the extent of alcohol and other drugs in drivers' systems while they are actually on the roadway. Estimates of drinking and drugged driving based on biological specimens collected from randomly sampled drivers serve as a highly valid approach to measuring prevalence in the general driving population. Roadside surveys have also been used to determine how cannabis prevalence changed among drivers after the legalization of recreational cannabis use in Washington State (Ramirez et al., 2016). These roadside studies, however, are designed to learn about drivers actively driving on the road and do not involve drivers involved in crashes or who have been arrested for impaired driving.

Another study (Brubacher et al., 2016), conducted in Canada, examined the prevalence of alcohol and a variety of other potentially impairing drugs among seriously injured drivers (N = 1,097) who arrived for treatment at an emergency department within six hours of a crash. De-identified study samples were obtained under a waiver of consent when a physician had ordered blood for clinical/treatment purposes. This study found that 40.1% of the drivers had at least one drug of interest in their blood, and 12.7% had two or more drugs. Alcohol (17.8%) and cannabis (active THC, 7.3%) were the most prevalent individual drugs. The relatively small sample size of this Canadian study impacted the precision of the estimates for lower prevalence drugs as well as the reliability of results if subdivided by other variables of interest (e.g., age, sex, vehicle type). In addition, the study did not include any roadway users other than drivers.

In 2010 and 2011 NHTSA sponsored the first large-scale and carefully controlled study in the United States designed to estimate the relative crash risk associated with drug use other than alcohol by drivers (Compton & Berning, 2015; Lacey et al., 2016). This study, known as the "Virginia Beach Study" because of its sampling location, used a case-control design and included drivers involved in police-reported crashes. Because all crash severities were included, a large percentage (66.4%) of the Virginia Beach sample consisted of property damage-only crashes. Also, no information on drug prevalence among other roadway users (e.g., pedestrians, bicyclists, e-scooter riders) injured in crashes was gathered. This underestimates the total risk and cost to the transportation system associated with substance use.

Only one study has attempted to estimate the elevated crash risk from alcohol and drug use by drivers involved in serious injury or fatal crashes (Hels et al., 2011). This large-scale European study found that drugs other than alcohol can increase the risk of being seriously injured in a crash, but the study did not test for as many drugs as did the Virginia Beach Study, and it had some methodological issues that are often inherent in this type and scale of research.

The studies have provided substantial insights on the topic of drugged driving, but a gap in knowledge exists regarding drug use among drivers and other road users (e.g., pedestrians, bicyclists) who are seriously or fatally injured in crashes. The current study sought to fill this gap by examining drug use among a large sample of crash victims presenting to selected trauma centers and medical examiners (MEs).

Shortly after this project began, an outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infections started with a respiratory disease referred to as coronavirus disease 2019 (COVID-19). A national public health emergency was declared in the United States on March 13, 2020 (WhiteHouse.gov, 2020), and shortly thereafter many States began closing schools, putting restrictions on business operations, and advising residents to shelter-in-place or otherwise greatly reduce travel behaviors in an effort to mitigate the impacts of the viral outbreak. With these orders in place, it was unclear how drugged driving would be impacted. Study protocols were revised to continue data collection under new restrictions on research in hospital settings during the public health emergency. This offered a chance to examine drug use among seriously and fatally injured roadway users before and during the public health emergency.

Objective

The objective of this study was to examine the prevalence of alcohol and over-the-counter, prescription, and illegal drugs in the blood of seriously or fatally injured drivers and other road user crash victims before and during the public health emergency.

Method

Study Sites

Researchers conducted a nationwide site selection process that included a review of publicly available information on the following.

- Locations of Level 1 trauma centers (those centers that treat the most serious injuries)
- Size of the surrounding population served by each trauma center
- Number of other trauma centers serving the same population
- Prior history of traffic safety research at the potential sites

When a site appeared promising, trauma center management was contacted directly and more information was gathered on the following.

- Degree of trauma center interest in the study
- Annual driver/patient flow rate
- Nature of catchment area (e.g., urban, suburban, rural)
- Experience of staff on research projects
- Extent the trauma center routinely collects blood for studies
- Degree of local ME interest
- Estimated cost for participation in the study

The study selected five high-flow Level 1 trauma centers that served large catchment areas. This approach ensured the study would get the majority of seriously or fatally injured roadway users in each area and could acquire a large sample size in a relatively short period of time. The five selected sites are described below.

Charlotte, North Carolina. Atrium Health/Carolinas Medical Center is the only Level 1 trauma center in the area and served as the trauma center sampling site. The study also joined with the Mecklenburg County ME's office on cases involving deceased people.

Jacksonville, Florida. The University of Florida Health TraumaOne (UF Health), the only Level 1 trauma center in Northeast Florida and Southeast Georgia, was the study's sampling site in Jacksonville. The Jacksonville ME's office joined on the project for cases involving deceased roadway users.

Miami, Florida. The Ryder Trauma Center at the University of Miami/Jackson Memorial Medical Center served as the as the Level 1 trauma center sampling site in South Florida. The study joined with the Miami-Dade ME's office on cases involving deceased people.

Baltimore, Maryland. The R. Adams Cowley Shock Trauma Center at the University of Maryland Medical Center, a primary adult resource center in Maryland, served as a sampling site. The study also joined with the Maryland Office of the Chief Medical Examiner on cases involving the deceased. Johns Hopkins University assisted with ME data collection.

Worcester, Massachusetts. UMass Memorial Health Care served as a Level 1 trauma center sampling site in Worcester. The University of Massachusetts, Amherst, assisted the project in the acquisition of study data. Data on deceased people was not available for Worcester.

Office of Management and Budget and Institutional Review Board Approvals

This study received approval from the Office of Management and Budget (OMB Control Number 2127-0744), the Chesapeake/Advarra Institutional Review Board (which served as the central IRB for four sites), and the University of Florida Institutional Review Board (for UF Health Jacksonville). De-identified samples and other data was included in the study under an IRB-approved waiver of consent and authorization.

Dates of Collection

Data collection began on a rolling basis across sites, but had to be halted completely at four trauma centers starting in mid-March 2020 until early May due to COVID-19's impact on research operations in hospital settings. The Baltimore trauma center never completely stopped data collection but had reduced coverage at times. Study protocols were revised to meet new restrictions on research at the hospitals, and to process samples to allow the National Institutes of Health to conduct serological testing for SARS-CoV-2 antibodies as part of a separate, but coordinated, research effort. With the addition of the antibody testing and revisions to the study protocols, data collection was allowed to restart on a full-time basis at all trauma centers. All MEs continued data collection with little to no pause during the public health crisis. The dates of collection, with the slight pauses noted above, at each site covered by this report are:

- Charlotte – September 16, 2019 to July 18, 2020;
- Jacksonville – September 10, 2019 to July 16, 2020;
- Miami – October 17, 2019 to July 16, 2020;
- Baltimore – December 11, 2019 to July 17, 2020; and
- Worcester – January 27, 2020 to July 16, 2020.

For our analysis purposes, the "Before" period of this study includes cases from September 10, 2019, to March 16, 2020. March 16 was chosen as the conclusion of the Before period because this is when States such as North Carolina, Massachusetts, and Maryland began responding to the public health emergency by implementing statewide mandates such as ordering in-person service at bars and restaurants to cease. Additional statewide stay-at-home, or safer-at-home, orders soon followed with a variety of new restrictions implemented and lifted at various points in each State. As such, the samples collected before statewide mandates began are the best representation of drug use by seriously or fatally injured road users at the time of their crash under what were formerly considered "normal" travel patterns in the United States. The "During" COVID-19 public health emergency period covered by this report includes cases from March 17 to July 18, 2020. Because this is a convenience sample, data collection was not uniformly distributed throughout the year, and was not the same each month. There were different numbers of samples across months, and also across sites.

It is important to note the findings in this report may not be representative of the entire United States. The data collected to date offer an opportunity to see how drug prevalence among seriously or fatally injured road users may have changed during the first months of the public health emergency in the five areas included in this study.

Participants

Participants represented a convenience sample of seriously or fatally injured roadway users who were involved in motor vehicle crashes. Each was transported by EMS to the participating trauma centers or MEs from the scene of a crash and included the following.

- Drivers of motor vehicles (e.g., cars, pick-up trucks, SUVs, motorcycles, commercial vehicles)
- Passengers in motor vehicles
- Bicyclists
- Pedestrians

- Electric kick scooter riders (e.g., shared scooter systems)
- Other people injured in a motor vehicle crash while on public roadways (e.g., moped riders, all-terrain vehicle riders)

The study attempted to gather information on every participant who met the following inclusion criteria.

- Roadway user seriously injured in a motor vehicle crash with treatment requiring trauma team activation at one of the participating trauma centers, or an individual declared deceased at the scene of a crash and transported directly to the ME's office
- Blood collection necessitated as part of clinical treatment or for autopsy purposes
- Age 18 or older

A total of 3,017 participants were sampled during the study period. Of these, 3,003 had sufficient blood available for complete toxicological analyses and are included in the results presented in this report. No compensation was provided to participants.

Table 1 provides the number of participants from each site before and during the public health emergency. Given the rolling start to data collection, the numbers of participants varied substantially across sites, especially before the public health emergency began.

Table 1. Participant Counts by Site

	Baltimore		**Charlotte**		**Jacksonville**		**Miami**		**Worcester**	
Source	**Before**	**During**	**Before**	**During**	**Before**	**During**	**Before**	**During**	**Before**	**During**
Trauma	285	347	871	210	174	207	364	122	30	65
ME	76	126	31	19	2	7	47	20	NA	NA
Total	361	473	902	229	176	214	411	142	30	65

Table 2 shows that a slightly higher, and statistically significant, percentage of the sample was male during the public health emergency compared to before. There were also more cases with unknown sex during the public health emergency.

Table 2. Sex of Participants

	Before (N= 1,880)		**During (N= 1,123)**	
Sex	**n**	**%**	**n**	**%**
Male	1,234	65.7	793	70.6*
Female	636	33.8	294	26.2*
Unknown	10	0.5	36	3.2*

*Significantly different ($p < .05$) from Before period.

Table 3 shows that the age distribution of roadway users sampled across all sites was very similar before and during the public health emergency, though there was a small and statistically significant decrease in roadway users 65 and older during the public health emergency.

Table 3. Age of Participants

	Before (N= 1,880)		During (N= 1,123)	
Age Category	**n**	**%**	**n**	**%**
18-34	762	40.5	470	41.9
35-44	307	16.3	186	16.6
45-54	278	14.8	156	13.9
55-64	248	13.2	162	14.4
65+	257	13.7	114	10.2*
Unknown	28	1.5	35	3.1*

*Significantly different ($p < .05$) from Before period.

Table 4 indicates the distribution of position in crash was also very similar before and during the public health emergency with over 60% of the cases being drivers. There was an increase in unknown position in crash during the public health emergency and a slight decrease in the percentage of passengers.

Table 4. Position in Crash

	Before (N= 1,880)		During (N= 1,123)	
Position in Crash	**n**	**%**	**n**	**%**
Driver	1,157	61.5	699	62.2
Passenger	276	14.7	133	11.8*
Bicycle rider	72	3.8	38	3.4
Pedestrian	274	14.6	142	12.7
E-Scooter rider	24	1.3	11	1.0
Other	5	0.3	2	0.2
Unknown	72	3.8	98	8.7*

*Significantly different ($p < .05$) from Before period.

The increases in unknown/missing data are likely a function of study staff having less access to patient care areas during the public health emergency to capture information in real time, or due to increases in missing data in hospital and ME records during the crisis.

Materials

Blood Collection Tubes

Each tube was labeled with a unique study identification number and a corresponding barcode. Before the public health emergency began, blood samples at the trauma centers and MEs were collected in 6 ml gray-top BD Vacutainer tubes containing sodium fluoride (stabilizer) and potassium oxalate (anti-coagulant) to ensure drug stability in the uncoagulated blood. To ensure viable plasma could be obtained for SARS-CoV-2 antibody testing for trauma center cases, the study shifted to collecting samples at the trauma centers in 10 ml lavender-top BD Vacutainer tubes containing EDTA (anti-coagulant) during the public health emergency.[1] Samples were then split at a central processing laboratory with up to 6 ml of blood placed in a gray-top tube for toxicological analyses and the remainder processed for plasma for antibody testing. MEs continued to collect samples in the 6 ml gray-top tubes during the public health emergency because daily shipping to a central laboratory for plasma extraction was not viable.

Storage

All samples for toxicological testing were stored in study refrigerators at a temperature of 2 to 4 °C.

Shipping Materials

All study shipping materials complied with the United States Department of Transportation and International Air Transport Association's (IATA) requirements for shipping biological substances, Category B (UN3373). Samples were first placed in containers designed for the transport of blood tubes. Absorbent material was placed around the samples in case of spillage. Containers that were not already 95kPa rated were placed in a leak-proof 95kPa bag and sealed to prevent issues associated with pressure changes encountered during air transport at high altitudes. The container was placed in an insulated cooler and surrounded by gel refrigerant packs to maintain samples at a refrigerated temperature throughout shipping. The cooler was placed inside a box with DOT/IATA-compliant markings.

[1] Gray-top tubes are generally not used when plasma is required for serological testing because the additives in the tube may interfere with test results. Using lavender tops for initial sample collection allowed for the conduct of both the toxicology and serological testing with minimal impact on either set of results.

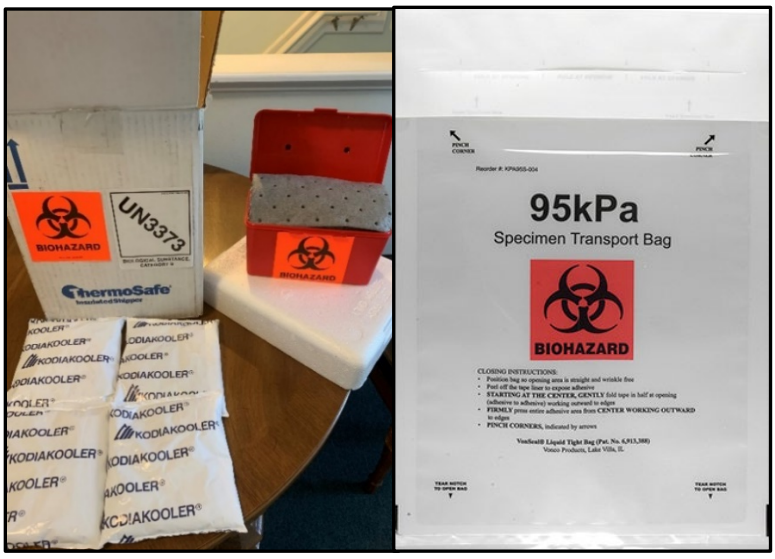

Figure 1. Packing Materials and 95kPa Bag Example

Data Collection System

The study used the Voxco software platform as the basis for a study-designed data collection system. The data collection system allowed research assistants to input data in an offline or online mode on a study tablet or enter data into a web-based portal from any computer with a compatible browser. Data collected in offline mode was securely transmitted to the central database as soon as an Internet connection was established. The study used Samsung Galaxy Tab A 10.1 tablets with the Android operating system. Tablets were housed in antimicrobial cases (**Figure 2**).

Figure 2. Data Collection Tablets

The data security approach was compliant with Federal regulations. The central database system used highly secure internal network storage to prevent data loss, corruption, and unauthorized breach, as well as to administer least privilege, password protected access rights, thus safeguarding all data. The study employed data encryption for both storage and transfer, redundant and fault tolerant disk arrays, strong challenge-response user ID/password combinations, a restrictive role-based access scheme, virus

protection, audit trails, third party audit reviews, secure data networks, uninterrupted power supply, regular back-ups with offsite storage, a recovery plan in the event of a disaster, limited and monitored physical site entry, and comprehensive employee training programs. The study also had systems in place to detect and respond to any unauthorized intrusions.

Data Collection Cards

When collecting data in the patient treatment areas, staff had the option to use a paper data collection card (**Figure 3**), which often allowed for quicker note taking compared to entering data in the tablet. These cards were stored in a secure location at each hospital until data could be entered into the tablet or online portal. The cards were then destroyed per hospital protocols once all data were entered and verified to be correct.

Study ID: _____ Arrival Date: _____ Arrival Time: _____ **Trauma Act:_____**

Mechanism of Injury: MVC Other: _____

Position in Crash: Driver Passenger Bicycle Pedestrian Scooter Unknown Other: _____

Motor Vehicle Type: Car SUV Pick-up Truck Van Motorcycle Semi-Truck Other: _____

Airbag: Yes/No/Unknown **Seatbelt:** Yes/No/Unknown **Helmet:** Yes/No/Unknown

Transport Mode: Ground Air Police Vehicle Unknown Other: _____

Transport Origin: Scene of injury Transfer from other facility Other: _____

EMS Agency: _____ LE Agency: _____

EMS Drugs Prior to Arrival: None Ativan Fentanyl Haldol Ketamine Morphine Versed

ER Drugs Prior to Draw: None Ativan Dilaudid Etomidate Fentanyl Haldol Ketamine Morphine Versed

Study Blood Tube ID: _____

Crash Location (Intersection, City/County, Landmarks, Coordinates, Mile Marker):

Reported Symptoms: _____

Figure 3. Data Collection Card

Crash Reports

Each State with a site in the study granted access to its crash report repository. Study staff used information collected at the sites (e.g., date and time of arrival, age, sex) to locate each crash report. When sufficient information was available, study staff could identify the specific crash in which a victim was involved and download the associated report. Information important for future analyses (e.g., seat belt use, number of vehicles involved, type of roadway) was then abstracted from the crash report and entered into the study database. Potentially identifying information was then redacted from the reports

and a copy uploaded to the study database to facilitate possible future analyses (e.g., responsibility analysis for drivers). No personal identifiers were ever entered into the study database.

Selected Drugs

Along with alcohol, a large number of other drugs can be identified in biological specimens using toxicological analysis techniques. NHTSA's research focuses on testing for those drugs that are known or suspected to impair cognitive and motor skills important for driving safely. These include alcohol, over-the-counter, prescription, and illegal drugs/medications. It is important to note that any drug can be misused or over-used resulting in impairment, and even a person using a medication correctly can experience impairing effects. The results of the prior National Roadside Surveys, Washington Roadside Survey, and Virginia Beach Study formed the primary foundation for the drugs selected for analysis in the present study. **Table 5** contains the list of the parent drugs and their metabolites included in this study's toxicological testing.

Table 5. Selected Drugs and Metabolites for Toxicology Testing

Class/Category	Parent Drug or *Metabolite* (Abbreviation)
Alcohol	ethyl alcohol
Cannabinoids	delta-9-tetrahydrocannabinol (Δ-9-THC), *11-hydroxy-Δ ⁹ -tetrahydrocannabinol (11-OH-THC), 11-nor-9-carboxy-Δ ⁹ -tetrahydrocannabinol (11-COOH-THC)*[#]
Stimulants	cocaine, *benzoylecgonine (BZE)*[#]*, cocaethylene*; amphetamine; methamphetamine; 3,4-methylenedioxy-methamphetamine (MDMA); 3,4-methylenedioxyamphetamine (MDA); ephedrine; pseudoephedrine; phenylpropanolamine; phentermine; methylphenidate
Sedatives Benzodiazepines Barbiturates Muscle Relaxers Sleep Aids	diazepam; nordiazepam;* oxazepam;* temazepam;* clonazepam, *7-aminoclonazepam*; alprazolam; lorazepam; chlordiazepoxide; midazolam; bromazepam; butalbital; secobarbital; phenobarbital; carisoprodol; meprobamate; cyclobenzaprine; zolpidem
Opioids/Narcotic Analgesics	*6-monoacetylmorphine (6-AM)*^; morphine;* codeine; hydrocodone; hydromorphone;* oxycodone; oxymorphone;* methadone, *2-ethylidene-1, 5-dimethyl-3, 3-diphenylpyrrolidine (EDDP);*[#] buprenorphine *norbuprenorphine*; fentanyl, *norfentanyl;*[#] furanylfentanyl; acetylfentanyl; carfentanil; fluorofentanyl; tramadol
Antidepressants	sertraline; fluoxetine; amitriptyline; nortriptyline; imipramine; desipramine; citalopram; doxepin; venlafaxine; trazadone
Over the Counter	dextromethorphan; diphenhydramine; chlorpheniramine; doxylamine
Other	phencyclidine; ketamine; α-pyrrolidinopentiophenone (alpha-PVP)

[#] Inactive metabolite
*These compounds can be parent drugs or active metabolites of other drugs.
^Heroin can only be definitively detected by the presence of the 6-AM metabolite

A parent drug is the original compound that is ingested, insufflated, or injected, and metabolites are products of the biological process of breaking down the parent drug to excrete it from the body. Some metabolites remain active and can potentially have deleterious effects on driving performance until further metabolism is complete. Other metabolites are inactive (i.e., do not impact cognitive or motor functions) but serve as an indicator of recent drug consumption. The time it takes the body to metabolize a substance varies by drug and by the condition of the individual. The presence of an inactive metabolite

in the blood indicates the parent drug was used at some time in the past, but for virtually all drugs it is not possible to calculate with any certainty when that exposure occurred. Unless otherwise stated, the results presented in the next section are based only on the analyses for parent drugs and any active metabolites. The presence of these compounds can be confidently considered an indication that an active form of the drug was in the tested individual at the time of their involvement in the crash or was administered therapeutically after the crash. If a drug positive result could possibly be attributed to therapeutic administration (e.g., there was a record that fentanyl was given by EMS during transport), it was coded as negative in the study analysis because there was no way to determine if the drug was already present (e.g., patient had used fentanyl recreationally) when the crash occurred.

Each individual drug has a generic name and, sometimes, numerous brand/trade names. For studies such as this one, drugs and metabolites can be classified/categorized in a variety of ways. The results reported herein use the general drug classes/categories described below.

Alcohol

Alcohol (ethyl alcohol) has a well-established impairing effect on psychomotor skills. Alcohol works as a central nervous system depressant and affects cognitive and motor functions.

Cannabinoids

Tetrahydrocannabinol (THC) is a natural cannabinoid and the major psychoactive component of cannabis. THC can have a stimulative, sedative, or hallucinogenic effect depending on the individual consuming the drug. The parent drug delta-9-tetrahydrocannabinol (Δ-9-THC or delta-9-THC) or the active metabolite 11-hydroxy-Δ^9-tetrahydrocannabinol (11-OH-THC or hydroxy-THC) are potentially impairing. 11-nor-9-carboxy-Δ9-tetrahydrocannabinol (11-COOH-THC or carboxy-THC) is a further-metabolized substance and does not have known impairing effects. The 11-COOH-THC metabolite could be an indicator of recent use, but for heavy users the compound can remain in a person's system for several days or even weeks.

Opioids/Narcotic Analgesics

Opioids are generally utilized to treat acute pain. This class of drugs can have negative effects on psychomotor function due to sedation, respiratory depression, fatigue, lightheadedness, and pupillary constriction. Continued use of narcotic analgesics may allow the body to adapt to the effects and experience withdrawal when the ingestion of the drug stops. The initial use period and times of withdrawal have the highest risk for impairment.

Sedatives

Sedatives work in different ways to depress/slow down the central nervous system. Several types of drugs including benzodiazepines, barbiturates, muscle relaxants, and sleep aids can be classified as sedatives. Benzodiazepines are prescribed to treat anxiety, seizure disorders, and sleep-related disorders and can cause cognitive and motor function impairments. In addition, benzodiazepines may produce side effects such as weakness, clumsiness, loss of balance, dizziness, and distorted vision. Barbiturates are used to manage anxiety, seizures, and insomnia. Barbiturates can cause sedation and reduced coordination, but these drugs have largely been replaced therapeutically by benzodiazepines. Muscle relaxants are used to treat muscle spasms or muscle spasticity caused by nervous system damage. These drugs may cause drowsiness, ataxia, or blurred vision. Hypnotics are generally prescribed as sleep aids for people who suffer from insomnia. These drugs may cause dizziness or mild to extreme drowsiness.

Antidepressants

Selective serotonin reuptake inhibitors (SSRIs), serotonin, and norepinephrine reuptake inhibitors (SNRIs), tricyclic, monoamine oxidase inhibitors (MAOIs), and noradrenaline and specific serotoninergic antidepressants (NASSAs) are commonly prescribed to treat depression, anxiety, personality disorders, and a wide variety of other conditions. During the first weeks of use, these drugs can cause dizziness and other side effects. Similar side effects may be experienced when stopping use.

Stimulants

Stimulants act on the central nervous system and generally increase alertness for short periods of time. Side effects of stimulants include dizziness, sleep problems, headaches, and irritability.

Over-the-Counter Drugs

A variety of drugs can be purchased without a prescription, but these drugs can still be impairing. Over-the-counter drugs of interest for this study include antihistamines, which work to stop allergy symptoms, and cough suppressants that aim to suppress the coughing reflex. These drugs can have sedating effects, although tolerance can develop after use for several days.

Other Drugs

Other drugs of interest included phencyclidine (PCP), which was originally created to serve as an anesthetic, but its severe side effects led to it being disallowed for human use. Ketamine is a drug generally used for anesthesia but can be used for other purposes. When used recreationally, however, these two drugs may cause hallucinations, dizziness, diminished reflexes, and nystagmus (rapid involuntary movements of the eyes). A new drug, α-pyrrolidinopentiophenone (commonly known as Flakka) is said to cause bizarre behavior, agitation, paranoia, and delusions of superhuman strength.

Drug Toxicology Testing

All drug toxicology analyses were conducted by the Immunalysis Corporation research laboratory. Samples were first screened for the presence of the drugs of interest using enzyme-linked immunosorbent assays except alcohol which used a similar enzyme-based screen. As the term implies, screening is a relatively quick and inexpensive, first-level chemical test to determine whether a given drug or group of drugs is likely present in the sample. The cutoff threshold (the minimum drug level at which the screen will return a positive result) for each screen is set to optimize the tradeoff between assured detection and minimizing the number of false positives.[2] Those specimens screened as "positive" then underwent a second stage of testing. This confirmatory testing used liquid chromatography-tandem mass spectral detection (LC-MS/MS) for all drugs except alcohol which used headspace gas chromatography with flame ionization detection (HS-GC-FID). Confirmation testing provided a quantitative drug concentration measurement for the individual drugs and metabolites of interest. The detection and confirmation thresholds set for various drug tests are presented in the Appendix. **Figure 4** provides an example of the screening and confirmation process with results for three different hypothetical samples.

[2] A false positive is when a test incorrectly indicates a drug is present when it is not.

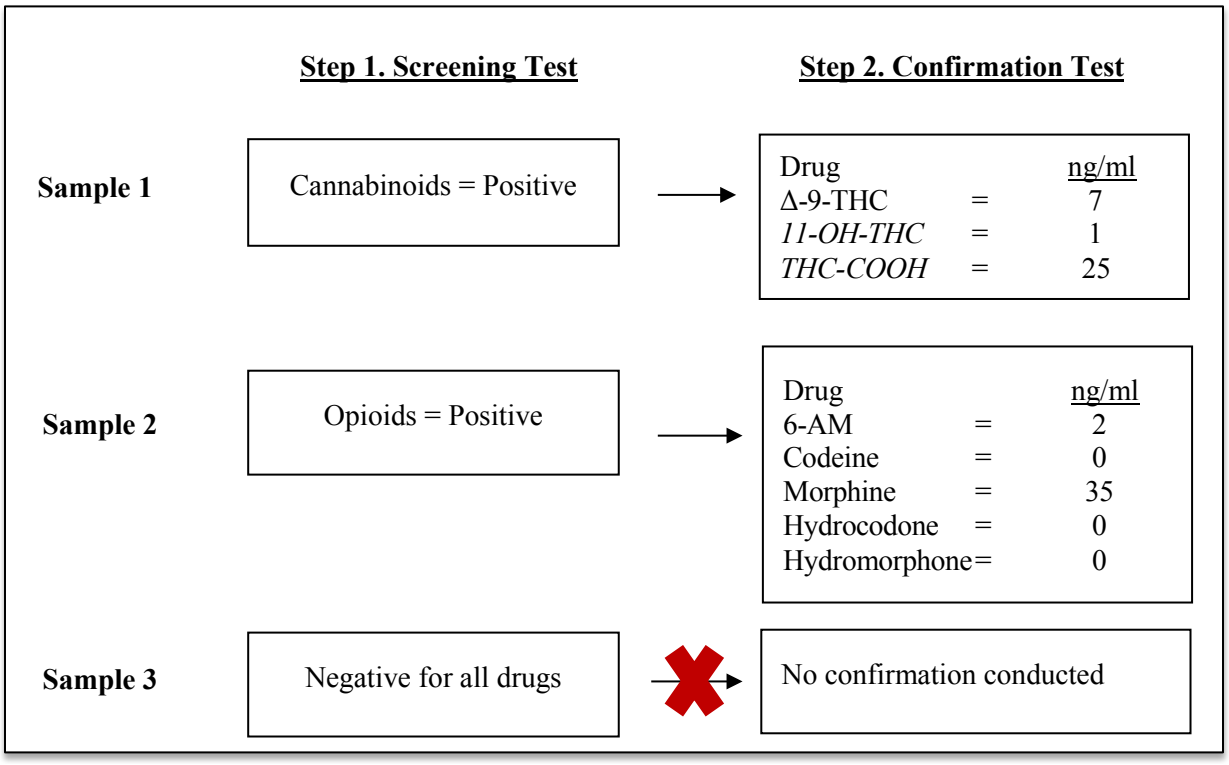

Figure 4. Examples of Drug Screening and Confirmation

Procedure

The sequence below demonstrates how a typical participant entered the study and resulted in a sample included in the analyses.

1. Injured in a crash as a driver, passenger, pedestrian, bicyclist, or other roadway user
2. Transported by EMS to trauma center (or morgue if deceased at the crash scene)
3. Trauma team activated by EMS or treating physicians
4. Blood samples gathered by clinical staff during normal treatment or autopsy procedures and other data collected (all de-identified)
5. Samples refrigerated
6. Before public health emergency - samples shipped directly from sites to toxicology lab. During public health emergency – total sample shipped to central processing lab, divided, and portion sent to toxicology lab

Blood Sample Collection

As part of their routine treatment procedures, the participating trauma centers collected blood for clinical purposes from virtually all patients for whom the trauma team was activated. The MEs also collected blood as part of their standard autopsy procedures. The trauma centers and MEs made available to this study small volumes of blood from the total collected during their normal activities. Trauma samples were collected as soon as possible upon arrival for treatment. Patient transfers from other medical facilities were accepted for inclusion in the study if the crash occurred within six hours of arrival at the study

sampling sites, and information on drugs administered therapeutically was readily available from the first treating hospital and transporters. Samples from the ME cases were collected at the time of the autopsy, which could be hours-to-days after death. Collection of samples from trauma victims and ME cases conformed with Federal, State, and local policies regarding collection of fluid samples for research purposes. Samples were refrigerated at 2 to 4 °C until shipped.

Shipping

Samples were packaged according to DOT/IATA standards for biological substances. Before the public health emergency, overnight shipments were made twice per week directly from each site to the toxicology laboratory. During the public health emergency, sites made daily overnight shipments to KIYATEC (Greenville, SC), the central processing laboratory, when possible so samples could be processed for plasma. Samples collected over the weekend sometimes had to be stored for an extra day or two because no shipping company would deliver on Sundays and some holidays. The central laboratory then shipped samples twice weekly to the toxicology laboratory.

Sample Processing During the Public Health Emergency

This study was deemed "critical research" and allowed to restart at the study sites during the public health emergency because NHTSA and the NIH agreed to share samples for SARS-CoV-2 antibody testing in addition to the toxicology testing. The study IRBs approved the request to use the samples for both purposes. To provide viable plasma for the antibody testing (and to protect the integrity of the toxicological analyses), blood from the lavender-top tubes needed to be processed as quickly as possible after collection. Upon receipt of the daily shipments from the sites, KIYATEC immediately transferred 3 to 5 ml of blood from the lavender-top tubes to the gray-top tubes, which were labeled with matching study identification numbers. The gray tops were then refrigerated until they were shipped to the toxicology laboratory. When sufficient additional blood was available, the lab processed it to extract plasma, which was then stored per NIH requirements.

Participant and Crash Information Data Entry

Authorized study staff at the sites logged in to the tablets or data entry portal and manually entered the de-identified information from the data collection cards, hospital records, and crash reports as the information matured in the various systems. No personal identifiers ever entered the central study database. Crash reports had all potentially identifying information redacted before they were uploaded to the study database.

Toxicology Testing

The toxicology laboratory processed the samples in batches as they were received from sites or the central processing laboratory. Those samples that screened positive for any of the drug classes were subjected to confirmation testing. The results were recorded by blood tube ID and sent to the central database where the information was merged with the de-identified patient and crash information. No drug toxicology results were ever returned to the trauma centers or MEs, nor was participation in the study ever recorded in the trauma center or ME records.

Results

Preliminary analyses focused on determining if it was appropriate to combine data across sites to increase the statistical power of the before versus during public health emergency comparisons of interest. This was an important first step given there are known regional differences in substance use disorder prevalence, and because of the different data collection start dates at each site. Given the similarities in drug prevalence and directionality of changes over time at the sites (see the appendix for a table of site-specific results), the data from all sites were combined for the analyses and results presented in this report.

The results presented here focus on comparing drug class/category prevalence combined across sites from before to during the public health emergency through the use of chi-Square tests of independence and z-tests of proportions as appropriate. These analyses indicate whether prevalence for a given drug or drug category was significantly different ($p < .05$) during the public health emergency than before. Results for specific drugs or metabolites can be found in the appendix. The tables presented below are also reproduced in the appendix with 95% confidence intervals included.[3]

Inactive metabolites (e.g., *11-COOH-THC, BZE, norfentanyl, EDDP*), even though included in the confirmation testing, were specifically excluded from the drug-positive counts presented below unless otherwise noted. For example, cannabinoids exposure was only identified through active THC.[4] Given the delay from time of crash to blood draw that is inherent in a study of this type, and the greatly varying times that metabolites can remain in the blood (e.g., the inactive metabolites of THC and cocaine can be detected for days or even weeks after use), it is not possible to conclude from the presence of an inactive metabolite when the corresponding drug was active. The presence of an inactive metabolite indicates with assurance that the person used the drug at some time in the past. It does not, however, provide evidence that the person had the active drug in their blood at the time of the crash. Therefore, the prevalence results in the body of this report focus on confirmed positives for the active parent drugs or active metabolites.

The study results also account for drugs administered therapeutically by EMS and the trauma centers or other treating hospitals (if a patient was transferred to the trauma centers) between the time of the crash and the time the sample was drawn. A drug positive result that could possibly be attributed to therapeutic administration (e.g., there was a record that fentanyl was given by EMS during transport) was considered to be negative because there was no way to determine if the drug was already present (e.g., patient had used fentanyl recreationally) when the crash occurred. Excluding inactive metabolites and drugs administered as part of medical treatment results in a conservative estimate of whether the potentially impairing components of a drug were present in a road user's system at the time a crash occurred.

[3] Some tables are large and split across pages when confidence intervals are included

[4] Delta-9-tetrahydrocannabinol (Δ-9-THC) and *11-hydroxy-Δ^9-tetrahydrocannabinol (11-OH-THC)*

Drug Category Prevalence

Table 6 shows significantly higher prevalence of alcohol, cannabinoids (active THC), and opioids among all road users included in the study during the public health emergency compared to before. Prevalence of antidepressants was significantly lower during the public health emergency. In addition, there was a significant increase in the proportion of people testing positive for more than one category of drugs during the public health emergency.

Table 6. All Road Users: Positive for Drug Category

	Before (N= 1,880)		During (N= 1,123)	
Drug Category	**n**	**%**	**n**	**%**
Alcohol	400	21.3	302	26.9*
Cannabinoids	402	21.4	350	31.2*
Stimulants	190	10.1	115	10.2
Sedatives	158	8.4	95	8.5
Opioids	142	7.6	145	12.9*
Antidepressants	37	2.0	5	0.4*
Over-the-Counter	43	2.3	18	1.6
Other Drugs	27	1.4	20	1.8
At Least 1 Category	959	51.0	714	63.6*
Multiple Categories	341	18.1	267	23.8*

*Significantly different ($p < .05$) from Before period.

Table 7 provides prevalence rates for inactive metabolites that were detected across the entire sample of road users. The inactive metabolites of cannabis and fentanyl showed significantly higher prevalence during the public health emergency compared to before.

Table 7. All Road Users: Positive for Inactive Metabolite

	Before (N= 1,880)		During (N= 1,123)	
Inactive Metabolite (Parent Drug)	**n**	**%**	**n**	**%**
11-COOH-THC (Δ-9-THC)	511	27.2	427	38.0*
BZE (Cocaine)	183	9.7	127	11.3
Norfentanyl (Fentanyl)	53	2.8	73	6.5*
EDDP (Methadone)	12	0.6	5	0.4

*Significantly different ($p < .05$) from Before period.

As shown in **Table 8**, males showed significantly higher prevalence of alcohol, cannabinoids (active THC), and opioids during the public health emergency. Females showed significantly higher prevalence of alcohol, cannabinoids, and stimulants during the public health emergency compared to before. Both sexes showed significantly lower prevalence for antidepressants during the public health emergency. Both sexes showed significantly higher use of multiple drug categories during the public health emergency compared to before.

Table 8. All Road Users: Positive for Drug Category by Sex

	Male				Female			
	Before (N=1,234)		During (N=793)		Before (N=636)		During (N=294)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	305	24.7	231	29.1*	91	14.3	60	20.4*
Cannabinoids	285	23.1	262	33.0*	113	17.8	74	25.2*
Stimulants	141	11.4	80	10.1	48	7.5	34	11.6*
Sedatives	104	8.4	57	7.2	52	8.2	33	11.2
Opioids	96	7.8	109	13.7*	45	7.1	32	10.9
Antidepressants	17	1.4	3	0.4*	20	3.1	2	0.7*
Over-the-Counter	22	1.8	9	1.1	21	3.3	9	3.1
Other Drugs	17	1.4	16	2.0	10	1.6	4	1.4
At Least 1 Category	675	54.7	519	65.4*	277	43.6	169	57.5*
Multiple Categories	241	19.5	197	24.8*	96	15.1	62	21.1*

*Significantly different ($p < .05$) from Before period.

Note: Sex was unknown for 10 cases Before and 36 cases During.

Table 9 shows that cannabinoids (active THC) prevalence was significantly higher during the public health emergency for most of the age groups. While alcohol prevalence was higher among all age groups, the increases were only statistically significant for the 55–to-64 and 65+ age groups. Opioid prevalence was significantly higher during the public health emergency, compared to before, for the 18-to-34-year-olds, 35-to-44-year-olds, and 55-to-64-year-olds. Only the 35-to-44-year-olds showed a statistically significant increase in testing positive for multiple categories of drugs during the public health emergency.

Table 9. All Road Users: Positive for Drug Category by Age Group

	18-34				35-44				45-54				55-64				65+			
	Before (N=762)		During (N=470)		Before (N=307)		During (N=186)		Before (N=278)		During (N=156)		Before (N=248)		During (N=162)		Before (N=257)		During (N=114)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**N**	**%**	**N**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	183	24.0	123	26.2	80	26.1	60	32.3	64	23.0	44	28.2	50	20.2	49	30.2*	12	4.7	16	14.0*
Cannabinoids	259	34.0	212	45.1*	64	20.8	58	31.2*	40	14.4	25	16.0	19	7.7	32	19.8*	10	3.9	11	9.6*
Stimulants	88	11.5	41	8.7	32	10.4	32	17.2*	35	12.6	13	8.3	26	10.5	23	14.2	6	2.3	5	4.4
Sedatives	51	6.7	28	6.0	28	9.1	20	10.8	25	9.0	15	9.6	35	14.1	14	8.6	15	5.8	13	11.4
Opioids	44	5.8	45	9.6*	21	6.8	29	15.6*	27	9.7	22	14.1	25	10.1	33	20.4*	24	9.3	12	10.5
Antidepressants	7	0.9	1	0.2	4	1.3	1	0.5	1	0.4	3	1.9	11	4.4	0	0.0	14	5.4	0	0.0
Over-the-Counter	6	0.8	7	0.5	8	2.6	2	1.1	8	2.9	4	2.6	10	4.0	3	1.9	11	4.3	2	1.8
Other Drugs	6	0.8	6	1.3	7	2.3	7	3.8	8	2.9	4	2.6	4	1.6	3	1.9	1	0.4	0	0.0
At Least 1 Category	453	59.4	325	69.1*	172	56.0	124	66.7*	140	50.4	90	57.7	111	44.8	108	66.7*	65	25.3	44	38.6*
Multiple Categories	154	20.2	112	23.8	52	16.9	63	33.9*	51	18.3	32	20.5	51	20.6	40	24.7	23	8.9	12	10.5

*Significantly different ($p < .05$) from Before period.

Note: Age was unknown for 28 cases Before and 35 cases During

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Table 10 shows significantly higher prevalence of alcohol, cannabinoids (active THC), and opioids for trauma center cases during the public health emergency compared to before. Trauma center cases also showed a higher rate of patients testing positive for multiple categories of drugs during the public health emergency than before. For medical examiner cases, only cannabinoids showed significantly higher levels during the public health emergency compared to before.

Table 10. All Road Users: Positive for Drug Category by Case Source

	Trauma Center				Medical Examiner			
	Before (N=1,724)		During (N=951)		Before (N=156)		During (N=172)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	341	19.8	233	24.5*	59	37.8	69	40.1
Cannabinoids	368	21.3	290	30.5*	34	21.8	60	34.9*
Stimulants	164	9.5	90	9.5	26	16.7	25	14.5
Sedatives	136	7.9	80	8.4	22	14.1	15	8.7
Opioids	123	7.1	118	12.4*	19	12.2	27	15.7
Antidepressants	33	1.9	4	0.4*	4	2.6	1	0.6
Over-the-Counter	34	2.0	13	1.4	9	5.8	5	2.9
Other Drugs	22	1.3	12	1.3	5	3.2	8	4.7
At Least 1 Category	860	49.9	592	62.3*	99	63.5	122	70.9
Multiple Categories	286	16.6	202	21.2*	55	35.3	65	37.8

*Significantly different ($p < .05$) from Before period.

To be consistent with the FARS definition of night and day, nighttime was defined as 6:00 p.m. to 5:59 a.m. and daytime from 6:00 a.m. to 5:59 p.m. **Table 11** shows that alcohol, cannabinoids (active THC), and opioid prevalence were higher for both daytime and nighttime during the public health emergency compared to before. Nighttime cases also showed a higher rate of testing positive for multiple categories of drugs during the public health emergency than before.

Table 11. All Road Users: Positive for Drug Category by Time of Day

	Daytime				Nighttime			
	Before (N=982)		During (N=544)		Before (N=896)		During (N=574)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	102	10.4	77	14.2*	296	33.0	225	39.2*
Cannabinoids	180	18.3	153	28.1*	221	24.7	194	33.8*
Stimulants	75	7.6	51	9.4	114	12.7	64	11.1
Sedatives	85	8.7	53	9.7	73	8.1	42	7.3
Opioids	84	8.6	83	15.3*	58	6.5	61	10.6*
Antidepressants	27	2.7	4	0.7*	10	1.1	1	0.2*
Over-the-Counter	30	3.1	10	1.8	13	1.5	8	1.4
Other Drugs	15	1.5	8	1.5	12	1.3	12	2.1
At Least 1 Category	408	41.5	311	57.2*	549	61.3	399	69.5*
Multiple Categories	147	15.0	99	18.2	192	21.4	168	29.3*

*Significantly different ($p < .05$) from Before period.

Note: Time of day was unknown for 2 cases Before and 5 cases During.

Consistent with FARS, this study defined the weekend as from 6:00 p.m. Friday to 5:59 a.m. on Monday. Weekday was defined as 6:00 a.m. Monday to 5:59 p.m. on Friday. As shown in **Table 12** alcohol, cannabinoids (active THC), and opioid prevalence were higher for weekdays during the public health emergency. Weekdays also saw an increase during the public health emergency in the rate of cases testing positive for multiple categories of drugs. Weekends showed an increase during the public health emergency in prevalence for cannabinoids and opioids.

Table 12. All Road Users: Positive for Drug Category by Weekday/Weekend

	Weekday				Weekend			
	Before (N=1,210)		During (N=709)		Before (N=668)		During (N=408)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	169	14.0	155	21.9*	229	34.3	146	35.8
Cannabinoids	250	20.7	219	30.9*	151	22.6	129	31.6*
Stimulants	110	9.1	75	10.6	79	11.8	40	9.8
Sedatives	111	9.2	51	8.6	47	7.0	34	8.3
Opioids	98	8.1	97	13.7*	44	6.6	46	11.3*
Antidepressants	33	2.7	3	0.4*	4	0.6	2	0.5
Over-the-Counter	34	2.8	13	1.8	9	1.3	5	1.2
Other Drugs	18	1.5	13	1.8	9	1.3	7	1.7
At Least 1 Category	568	46.9	427	60.2*	389	58.2	282	69.1*
Multiple Categories	196	16.2	167	23.6*	143	21.4	100	24.5

*Significantly different ($p < .05$) from Before period.
Note: Weekday/weekend was unknown for 2 cases Before and 6 cases During.

As can be seen in **Table 13**, drivers showed significantly higher prevalence of alcohol, cannabinoids (active THC), and opioids during the public health emergency compared to before. Drivers also showed higher rates of testing positive for multiple categories of drugs during the public health emergency than before. Pedestrians showed significantly higher prevalence for cannabinoids during the public health emergency.

Table 13. Positive for Drug Category by Type of Roadway User

	Driver				Passenger				Bicyclist				Pedestrian				E-Scooter Rider, Other, or Unknown			
	Before (N=1,157)		During (N=699)		Before (N=276)		During (N=133)		Before (N=72)		During (N=38)		Before (N=274)		During (N=142)		Before (N= 101)		During (N=111)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	252	21.8	198	28.3*	40	14.5	26	19.5	15	20.8	5	13.2	67	24.5	43	30.3	26	25.7	30	27.0
Cannabinoids	241	20.8	227	32.7*	77	27.9	42	31.6	13	18.1	4	10.5	51	18.6	44	31.0*	20	19.8	33	29.7
Stimulants	106	9.2	64	9.2	28	10.1	18	13.5	7	9.7	3	7.9	33	12.0	23	16.2	16	15.8	7	6.3*
Sedatives	93	8.0	61	8.7	22	8.0	10	7.5	2	2.8	2	5.3	25	9.1	13	9.2	16	15.8	9	8.1
Opioids	87	7.5	97	13.9*	24	8.7	18	13.5	3	4.2	6	15.8*	22	8.0	17	12.0	6	5.9	7	6.3
Antidepressants	26	2.2	3	0.4*	2	0.7	0	0.0	2	2.8	0	0.0	5	1.8	1	0.7	2	2.0	1	0.9
Over-the-Counter	25	2.2	10	1.4	8	2.9	2	1.5	1	1.4	0	0.0	8	2.9	6	4.2	1	1.0	0	0.0
Other Drugs	17	1.5	15	2.1	3	1.1	2	1.5	1	1.4	1	2.6	4	1.5	2	1.4	2	2.0	0	0.0
At Least 1 Category	588	50.8	452	64.7*	138	50.0	84	63.2*	35	48.6	17	44.7	139	50.7	94	66.2*	59	58.4	67	60.4
Multiple Categories	204	17.6	177	25.3*	52	18.8	26	19.5	7	9.7	4	10.5	54	19.7	40	28.2	24	23.8	20	18.0

*Significantly different ($p < .05$) from Before period.

Alcohol and Cannabis Combined With Other Drug Categories

Table 14 shows increases in alcohol being combined with cannabinoids (active THC), sedatives, opioids, and over-the-counter drugs during the public health emergency.

Table 14. All Road Users: Positive for Alcohol Combined With Other Drugs

	Before (N=1,880)		During (N=1,123)	
Drug Category	**n**	**%**	**n**	**%**
Alcohol only	218	11.6	144	12.8
Alcohol + 1 Other Category	128	6.8	122	10.9*
Cannabinoids	80	4.2	75	6.7*
Stimulants	28	1.5	16	1.4
Sedatives	8	0.4	13	1.1*
Opioids	7	0.3	11	1.0*
Antidepressants	1	0.1	0	0.0
Over-the-Counter	1	0.1	4	0.4*
Other Drugs	3	0.2	3	0.3
Alcohol + 2 or More Other Categories	54	2.9	36	3.2

*Significantly different ($p < .05$) from Before period.

Table 15 shows increases in cannabinoids being combined with alcohol or opioids during the public health emergency. There was also an increase during the public health emergency in cannabinoids being combined with two or more other categories of drugs.

Table 15. All Road Users: Positive for Cannabinoids Combined With Other Drugs

	Before (N=1,880)		During (N=1,123)	
Drug Category	**n**	**%**	**n**	**%**
Cannabinoids only	214	11.4	180	16.0*
Cannabinoids + 1 Other Category	138	7.3	123	11.0*
Alcohol	80	4.2	75	6.7*
Stimulants	22	1.2	16	1.4
Sedatives	16	0.9	7	0.6
Opioids	12	0.6	23	2.1*
Antidepressants	0	0.0	0	0.0
Over- the-Counter	4	0.2	1	0.1
Other Drugs	4	0.2	1	0.1
Cannabinoids + 2 or More Categories	50	2.7	47	4.2*

*Significantly different ($p < .05$) from Before period.

Blood Alcohol Concentration

Table 16 shows that, among those with a positive BAC result, the average BAC increased slightly during the public health emergency. The increase, however, was not statistically significant ($t(700) = 1.513$, $p = .13$).

Table 16. All Road Users: Descriptive Statistics for Alcohol Positives

	Before (N=400)	During (N=302)
Mean (g/dL)	0.181	0.193
Standard Deviation (g/dL)	0.094	0.115
Median (g/dL)	0.177	0.182
Maximum (g/dL)	0.548	0.624

Table 17 shows that during the public health emergency there was an increase in the prevalence of BACs over .15 g/dL as well as BACs in the .02 - .049 g/dL range.

Table 17. All Road Users: BAC Ranges

	Before (N= 1,880)		During (N=1,123)	
BAC Range	**n**	**%**	**n**	**%**
.02 - .049	25	1.3	27	2.4*
.05 - .079	38	2.0	24	2.1
.08 - .149	97	5.2	64	5.7
.15 +	240	12.8	187	16.7*

*Significantly different ($p < .05$) from Before period.

Discussion

This study examined the prevalence of alcohol and other drugs in the systems of seriously or fatally injured roadway users at five sites before and during the COVID-19 public health emergency. The results indicate that drug prevalence was high among seriously and fatally injured roadway users before the public health emergency began and was even higher during, especially for alcohol, cannabinoids (active THC), and opioids. The increases in drug prevalence were not isolated to one sex or age group, although some groups showed greater increases than others for particular categories of drugs. Increases in drug prevalence were observed for weekdays and weekends, as well as during both day and night hours.

Drivers, in particular, showed significantly higher overall drug prevalence during the public health emergency with 64.7% testing positive for at least one active drug compared to 50.8% before the public health emergency began. Drivers also showed an increase in testing positive for two or more categories of drugs going from 17.6% before the public health emergency to 25.3% during. Of particular note, active THC was more prevalent among drivers during the public health emergency than alcohol (32.7% versus 28.3%), and opioid use among drivers almost doubled going from 7.5% to 13.9%. Other roadway user groups (e.g., pedestrians, passengers) also showed increases in prevalence for some drugs, but the sample sizes of these groups were small relative to drivers which limited the power of the analyses.

The observed increases in drug prevalence could be a function of a variety of factors including:

- Normal seasonal differences in drugged driving,
- Differential driving patterns for drug users and non-drug users during the public health emergency, and
- Drug use, and subsequently drugged driving, increased during the public health emergency due to factors such as stress.

Without similar toxicology data for these populations from prior years, it is not possible to determine if the observed effects are recurring seasonal fluctuations. Similarly, without driving exposure data for drug users versus non-drug users, it is not possible to know if one group is driving more or less during the public health emergency and subsequently being injured at a higher or lower frequency than before. It is important to note, however, that the age and sex distributions for this study only showed relatively minor differences before and during the public health emergency. It should also be noted that over-the-counter and antidepressant use was unchanged or decreased during the same period indicating potential

compliance with stay-at-home orders by users of these drugs while other intoxicants were associated with continued at-risk behavior.

Overall, the results of this study suggest the highway safety community should be concerned about the potential impact of drugs and alcohol independent of the current public health emergency. Additionally, the observed cannabis and opioid prevalence rates before and during the public health emergency could be indicative of a growing or new problem. It is important to note the drug results obtained here cannot be used to assess impairment at the time of the crash or to make any assessment of crash risk relative to drug use. Additional research is needed to determine whether consuming drugs such as cannabis and opioids may increase the risk of being seriously or fatally injured in a motor vehicle crash.

Limitations

This study included a convenience sample of seriously or fatally injured drivers and other roadway users from multiple sites. Because of the rolling start to data collection, some sites contributed more cases than others during each period studied which could have impacted the observed results. The small sample sizes for some classes of roadway users limit the ability to make any statements about drug prevalence among these populations at this point. It is important to note the findings in this report are not representative of the entire United States. All of the sites were on the East Coast, which limits the geographic generalizability of the findings.

Fourteen results screened as positive could not be confirmed due to insufficient volumes of blood available. It is unclear if other unconfirmed positive screening results were actual false positives (i.e., no drug actually present), an artifact of the detection thresholds set (i.e., some low level of drug present but not reliably detectable), or a result of the effects of the presence of other drugs not included in the panel (e.g., new licit or illicit drugs in a given class that were not specifically included on the testing panel).

This study's results can only be used to estimate the prevalence of drug use among the specific populations sampled and with full awareness of the effects of the limited sample sizes on the precision of the estimates presented. Also, without a matched control group or other basis for comparison to similar, non-injured, non-crash-involved roadway users, it is not possible to determine if any of the drugs are associated with an increased risk of being seriously injured or killed in a motor vehicle crash. The study results should not be used to imply impairment or increased risk associated with drug use.

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Appendix

Table A-1. Screening and Confirmation Thresholds

Drugs/*Metabolites*: Grouped by Screening Package	**Minimum Blood Concentration Detection Thresholds (ng/ml)**	
	ELISA Screen	**LC-MS/MS Confirm**
cocaine, *benzoylecgonine, cocaethylene*	25	10
6-AM, codeine, morphine, hydrocodone, hydromorphone	25	10
amphetamine, methamphetamine, MDMA, MDA, ephedrine, pseudoephedrine, phenylpropanolamine	20	10
Δ-9-THC, *11-OH-THC, 11-COOH-THC*	5	1
phencyclidine	10	10
buprenorphine, *norbuprenorphine*	1	1
alprazolam, chlordiazepoxide, oxazepam, nordiazepam, lorazepam, diazepam, clonazepam, *7-aminoclonazepam*, temazepam, bromazepam, midazolam, flualprazolam, etizolam	20	10
phenobarbital, secobarbital, butalbital	100	100
methadone, *EDDP*	50	10
diphenhydramine, doxylamine, chlorpheniramine	25	10
fentanyl, *norfentanyl*, furanyl fentanyl, carfentanil, fluorofentanyl	1	0.5
oxycodone; oxymorphone	25	10
tramadol	50	10
carisoprodol; meprobamate	500	500
sertraline	50	10
fluoxetine	50	10
amitryptiline, nortriptyline, doxepin, imipramine, desipramine, citalopram, venlafaxine, trazadone, cyclobenzaprine	25	10
zolpidem	10	10
dextromethorphan	50	20
ketamine	10	10
α-pyrrolidinopentiophenone	5	1
ethyl alcohol	20 mg/dL	20 mg/dL

Notes: Drugs and metabolites are grouped together if a single screen could be used. Alcohol testing used an enzyme-based screen and HS-GC-FID for confirmation.

Table A-2. Drug Class Positives by Study Site

	Baltimore				Charlotte				Jacksonville				Miami				Worcester			
	Before (N=361)		During (N=473)		Before (N=902)		During (N=229)		Before (N=176)		During (N=214)		Before (N=411)		During (N=142)		Before (N=30)		During (N=65)	
Drug Category	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**	**n**	**%**
Alcohol	93	25.8	139	29.4	202	22.4	70	30.6*	20	11.4	44	20.6*	81	19.7	34	23.9	4	13.3	15	23.1
Cannabinoids	71	19.7	144	30.4*	190	21.1	84	36.7*	49	27.8	61	28.5	83	20.2	39	27.5	9	30.0	22	33.8
Stimulants	36	10.0	35	7.4	91	10.1	36	15.7*	22	12.5	21	9.8	37	9.0	16	11.3	4	13.3	7	10.8
Sedatives	32	8.9	38	8.0	76	8.4	20	8.7	9	5.1	16	7.5	39	9.5	17	12.0	2	6.7	4	6.2
Opioids	51	14.1	73	15.4	57	6.3	23	10.0*	16	9.1	34	15.9*	15	3.6	9	6.3	3	10.0	6	9.2
Antidepressants	9	2.5	3	0.6*	18	2.0	1	0.4	5	2.8	1	0.5	3	0.7	0	0.0	2	6.7	0	0.0
Over-the-Counter	17	4.7	7	1.5*	15	1.7	4	1.7	4	2.3	6	2.8	5	1.2	1	0.7	2	6.7	0	0.0
Other Drugs	8	2.2	14	3.0	16	1.8	3	1.3	1	0.6	2	0.9	2	0.5	1	0.7	0	0.0	0	0.0
At Least 1 Category	199	55.1	299	63.2*	464	51.4	156	68.1*	90	51.1	136	63.6*	189	46.0	84	59.2*	17	56.7	39	60.0
Multiple Categories	84	23.3	125	26.4	159	17.6	65	28.4*	31	17.6	40	18.7	59	14.4	25	17.6	8	26.7	12	18.5

*Significantly different ($p < .05$) from Before period.

Table A-3. Positive for Individual Drugs and Metabolites

		Before (N=1,880)		During (N=1,123)	
		n	**%**	**n**	**%**
Alcohol	Ethyl alcohol	400	21.3	302	26.9*
Cannabinoids	Δ-9-THC	398	21.2	346	30.8*
	11-OH-THC (hydroxy)	254	13.5	219	19.5*
	11-COOH-THC (carboxy)	511	27.2	427	38.0*
Stimulants	Cocaine	116	6.2	53	4.7
	Benzoylecgonine	183	9.7	127	11.3
	Cocaethylene	40	2.1	18	1.6
	Amphetamine	66	3.5	45	4.0
	Methamphetamine	49	2.6	38	3.4
	MDMA	8	0.4	1	0.1
	MDA	3	0.2	0	0.0
	Ephedrine	0	0.0	0	0.0
	Pseudoephedrine	1	0.1	0	0.0
	Phenylpropanolamine	0	0.0	1	0.1
	Phentermine	7	0.4	1	0.1
	Methylphenidate	1	0.1	0	0.0
Sedatives	Diazepam	29	1.5	13	1.2
	Nordiazepam	44	2.3	23	2.0
	Oxazepam	8	0.4	0	0.0
	Temazepam	11	0.6	4	0.4
	Clonazepam	18	1.0	13	1.2
	7-aminoclonazepam	12	0.6	1	0.1*
	Alprazolam	53	2.8	34	3.0
	Lorazepam	4	0.2	4	0.4
	Chlordiazepoxide	5	0.3	4	0.4
	Midazolam	19	1.0	15	1.3
	Bromazepam	13	0.7	0	0.0
	Butalbital	6	0.3	7	0.6
	Secobarbital	0	0.0	0	0.0
	Phenobarbital	1	0.1	0	0.0
	Carisoprodol	1	0.1	3	0.3
	Meprobamate	3	0.2	3	0.3
	Cyclobenzaprine	6	0.3	4	0.4
	Zolpidem	6	0.3	3	0.3
Opioids	Heroin (*6-Monoacetylmorphine*)	2	0.1	2	0.2
	Morphine	16	0.9	18	1.6*

		Before (N=1,880)		During (N=1,123)	
		n	%	n	%
	Codeine	3	0.2	3	0.3
	Hydrocodone	17	0.9	5	0.4
	Hydromorphone	3	0.2	0	0.0
	Oxycodone	25	1.3	26	2.3*
	Oxymorphone	3	0.2	13	1.2*
	Methadone	21	1.1	19	1.7
	EDDP	12	0.6	5	0.5
	Buprenorphine	15	0.8	13	1.2
	Norbuprenorphine	17	0.9	14	1.2
	Fentanyl	53	2.8	91	8.1*
	Norfentanyl	53	2.8	73	6.5*
	Furanylfentanyl	0	0.0	2	0.2
	Acetylfentanyl	3	0.2	6	0.5
	Carfentanil	0	0.0	0	0.0
	Fluorofentanyl	0	0.0	0	0.0
	Tramadol	12	0.6	3	0.3
	Sertraline	14	0.7	2	0.2*
	Fluoxetine	5	0.3	1	0.1
	Amitriptyline	11	0.6	1	0.1*
	Nortriptyline	13	0.7	2	0.2
Antidepressants	Imipramine	0	0.0	0	0.0
	Desipramine	0	0.0	0	0.0
	Citalopram	4	0.2	0	0.0
	Doxepin	1	0.1	0	0.0
	Venlafaxine	0	0.0	0	0.0
	Trazadone	8	0.4	1	0.1
	Dextromethorphan	11	0.6	5	0.4
Over-the-Counter	Diphenhydramine	30	1.6	13	1.2
	Chlorpheniramine	3	0.2	0	0.0
	Doxylamine	4	0.2	2	0.2
Other Drugs	Phencyclidine	5	0.3	8	0.7
	Ketamine	22	1.2	12	1.1
	Alpha-PVP	0	0.0	0	0.0

*Significantly different ($p < .05$) from Before period.

Table A-4. Drivers: Positive for Individual Drugs and Metabolites

Class	Drug/*Metabolite*	Before (N= 1,157) n	Before (N= 1,157) %	During (N=699) n	During (N=699) %
Alcohol	Ethyl alcohol	252	21.8	198	28.3*
Cannabinoids	Δ-9-THC	239	20.7	224	32.0*
	11-OH-THC	154	13.3	135	19.3*
	11-COOH-THC	300	25.9	275	39.3*
Stimulants	Cocaine	57	4.9	28	4.0
	Benzoylecgonine	93	8.0	69	9.9
	Cocaethylene	21	1.8	10	1.4
	Amphetamine	44	3.8	24	3.4
	Methamphetamine	32	2.8	19	2.7
	MDMA	5	0.4	1	0.1
	MDA	1	0.1	0	0.0
	Ephedrine	0	0.0	0	0.0
	Pseudoephedrine	0	0.0	0	0.0
	Phenylpropanolamine	0	0.0	0	0.0
	Phentermine	3	0.3	1	0.1
	Methylphenidate	0	0.0	0	0.0
Sedatives	Diazepam	15	1.3	11	1.6
	Nordiazepam	21	1.8	17	2.4
	Oxazepam	2	0.2	0	0.0
	Temazepam	4	0.3	1	0.1
	Clonazepam	10	0.9	9	1.3
	7-aminoclonazepam	5	0.4	0	0.0
	Alprazolam	36	3.1	23	3.3
	Lorazepam	1	0.1	3	0.4
	Chlordiazepoxide	1	0.1	3	0.4
	Midazolam	11	1.0	6	0.9
	Bromazepam	8	0.7	0	0.0
	Butalbital	5	0.4	5	0.7
	Secobarbital	0	0.0	0	0.0
	Phenobarbital	0	0.0	0	0.0
	Carisoprodol	1	0.1	2	0.3
	Meprobamate	2	0.2	2	0.3
	Cyclobenzaprine	3	0.3	4	0.6
	Zolpidem	6	0.5	2	0.3
Opioids	Heroin (*6-Monoacetylmorphine*)	1	0.1	0	0.0
	Morphine	10	0.9	10	1.4

Class	Drug/*Metabolite*	Before (N= 1,157) n	%	During (N=699) n	%
	Codeine	1	0.1	1	0.1
	Hydrocodone	10	0.9	4	0.6
	Hydromorphone	2	0.2	0	0.0
	Oxycodone	18	1.6	22	3.1*
	Oxymorphone	1	0.1	9	1.3*
	Methadone	11	1.0	17	2.4*
	EDDP	6	0.5	5	0.7
	Buprenorphine	9	0.8	11	1.6
	Norbuprenorphine	10	0.9	12	1.7
	Fentanyl	33	2.9	57	8.2*
	Norfentanyl	32	2.8	47	6.7*
	Furanylfentanyl	0	0.0	2	0.3
	Acetylfentanyl	2	0.2	4	0.6
	Carfentanil	0	0.0	0	0.0
	Fluorofentanyl	0	0.0	0	0.0
	Tramadol	7	0.6	1	0.1
Antidepressants	Sertraline	9	0.8	1	0.1
	Fluoxetine	4	0.3	1	0.1
	Amitriptyline	9	0.8	1	0.1
	Nortriptyline	11	1.0	1	0.1*
	Imipramine	0	0.0	0	0.0
	Desipramine	0	0.0	0	0.0
	Citalopram	1	0.1	0	0.0
	Doxepin	1	0.1	0	0.0
	Venlafaxine	0	0.0	0	0.0
	Trazadone	5	0.4	0	0.0
Over-the-Counter	Dextromethorphan	7	0.6	3	0.4
	Diphenhydramine	17	1.5	7	1.0
	Chlorpheniramine	3	0.3	0	0.0
	Doxylamine	3	0.3	2	0.3
Other Drugs	Phencyclidine	4	0.3	7	1.0
	Ketamine	13	1.1	8	1.1
	Alpha-PVP	0	0.0	0	0.0

*Significantly different ($p < .05$) from Before period.

Table A-5. Positive for Drug Category

	Before (N= 1,880)			During (N= 1,123)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	400	21.3	[19.4, 23.2]	302	26.9*	[24.3, 29.6]
Cannabinoids	402	21.4	[19.5, 23.3]	350	31.2*	[28.5, 34.0]
Stimulants	190	10.1	[8.8, 11.6]	115	10.2	[8.5, 12.2]
Sedatives	158	8.4	[7.2, 9.8]	95	8.5	[6.9, 10.2]
Opioids	142	7.6	[6.4, 8.8]	145	12.9*	[11.0, 15.0]
Antidepressants	37	2.0	[1.4, 2.7]	5	0.4*	[0.1, 1.0]
Over-the-Counter	43	2.3	[1.7, 3.1]	18	1.6	[1.0, 2.5]
Other Drugs	27	1.4	[0.9, 2.1]	20	1.8	[1.1, 2.7]
At Least 1 Category	959	51.0	[48.7, 53.3]	714	63.6*	[60.7, 66.4]
Multiple Categories	341	18.1	[16.4, 20.0]	267	23.8*	[21.3, 26.4]

*Significantly different ($p < .05$) from Before period.

Table A-6. Positive for Inactive Metabolite

	Before (N= 1,880)			During (N= 1,123)		
Inactive Metabolite (Parent Drug)	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
11-COOH-THC (Δ-9-THC)	511	27.2	[25.2, 29.3]	427	38.0*	[35.2, 40.9]
BZE (Cocaine)	183	9.7	[8.4, 11.2]	127	11.3	[9.5, 13.3]
Norfentanyl (Fentanyl)	53	2.8	[2.1, 3.7]	73	6.5*	[5.1, 8.1]
EDDP (Methadone)	12	0.6	[0.3, 1.1]	5	0.4	[0.1, 1.1]

*Significantly different ($p < .05$) from Before period.

Table A-7. Positive for Drug Category by Sex

	Male						Female					
	Before (N=1,234)			During (N=793)			Before (N=636)			During (N=294)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	305	24.7	[22.3, 27.2]	231	29.1*	[26.0, 32.4]	91	14.3	[11.7, 17.3]	60	20.4*	[16.0, 25.5]
Cannabinoids	285	23.1	[20.8, 25.6]	262	33.0*	[29.8, 36.4]	113	17.8	[14.9, 21.0]	74	25.2*	[20.3, 30.5]
Stimulants	141	11.4	[9.7, 13.3]	80	10.1	[8.1, 12.4]	48	7.5	[5.6, 9.9]	34	11.6*	[8.1, 15.8]
Sedatives	104	8.4	[6.9, 10.1]	57	7.2	[5.5, 9.2]	52	8.2	[6.2, 10.6]	33	11.2	[7.9, 15.4]
Opioids	96	7.8	[6.3, 9.4]	109	13.7*	[11.4, 16.3]	45	7.1	[5.2, 9.4]	32	10.9	[7.6, 15.0]
Antidepressants	17	1.4	[0.8, 2.2]	3	0.4*	[0.1, 1.1]	20	3.1	[1.9, 4.8]	2	0.7*	[0.1, 2.4]
Over-the-Counter	22	1.8	[1.1, 2.7]	9	1.1	[0.5, 2.1]	21	3.3	[2.1, 5.0]	9	3.1	[1.4, 5.7]
Other Drugs	17	1.4	[0.8, 2.2]	16	2.0	[1.2, 3.3]	10	1.6	[0.8, 2.9]	4	1.4	[0.4, 3.4]
At Least 1 Category	675	54.7	[51.9, 57.5]	519	65.4*	[62.0, 68.8]	277	43.6	[39.7, 47.5]	169	57.5*	[51.6, 63.2]
Multiple Categories	241	19.5	[17.4, 21.9]	197	24.8*	[21.9, 28.0]	96	15.1	[12.4, 18.1]	62	21.1*	[16.6, 26.2]

*Significantly different ($p < .05$) from Before period.

Sex was unknown for 10 cases Before and 36 cases During.

Table A-8a. Positive for Drug Category by Age Group Before Public Health Emergency

	18-34 (N = 762)			35-44 (N = 307)			45-54 (N = 278)			55-64 (N = 248)			65+ (N = 257)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	183	24.0	[21.0, 27.2]	80	26.1	[21.2, 31.3]	64	23.0	[18.2, 28.4]	50	20.2	[15.4, 25.7]	12	4.7	[2.4, 8.0]
Cannabinoids	259	34.0	[30.6, 37.5]	64	20.8	[16.4, 25.8]	40	14.4	[10.5, 19.1]	19	7.7	[4.7, 11.7]	10	3.9	[1.9, 7.0]
Stimulants	88	11.5	[9.4, 14.0]	32	10.4	[7.2, 14.4]	35	12.6	[8.9, 17.1]	26	10.5	[7.0, 15.0]	6	2.3	[0.9, 5.0]
Sedatives	51	6.7	[5.0, 8.7]	28	9.1	[6.1, 12.9]	25	9.0	[5.9, 13.0]	35	14.1	[10.0, 19.1]	15	5.8	[3.3, 9.4]
Opioids	44	5.8	[4.2, 7.7]	21	6.8	[4.3, 10.3]	27	9.7	[6.5, 13.8]	25	10.1	[6.6, 14.5]	24	9.3	[6.1, 13.6]
Antidepressants	7	0.9	[0.4, 1.9]	4	1.3	[0.4, 3.3]	1	0.4	[0.0, 2.0]	11	4.4	[2.2, 7.8]	14	5.4	[3.0, 9.0]
Over-the-Counter	6	0.8	[0.3, 1.7]	8	2.6	[1.1, 5.1]	8	2.9	[1.3, 5.6]	10	4.0	[2.0, 7.3]	11	4.3	[2.2, 7.5]
Other Drugs	6	0.8	[0.3, 1.7]	7	2.3	[0.9, 4.6]	8	2.9	[1.3, 5.6]	4	1.6	[0.4, 4.1]	1	0.4	[0.0, 2.1]
At Least 1 Category	453	59.4	[55.9, 63.0]	172	56.0	[50.3, 61.7]	140	50.4	[44.3, 56.4]	111	44.8	[38.5, 51.2]	65	25.3	[20.1, 31.1]
Multiple Categories	154	20.2	[17.4, 23.2]	52	16.9	[12.9, 21.6]	51	18.3	[14.0, 23.4]	51	20.6	[15.7, 26.1]	23	8.9	[5.8, 13.1]

Note: Age was unknown for 28 cases.

Table A-8b. Positive for Drug Category by Age Group <u>During</u> Public Health Emergency

	18-34 (N =470)			35-44 (N = 186)			45-54 (N = 156)			55-64 (N = 162)			65+ (N = 114)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	123	26.2	[22.3, 30.4]	60	32.3	[25.6, 39.5]	44	28.2	[21.3, 36.0]	49	30.2*	[23.3, 37.9]	16	14.0*	[8.2, 21.8]
Cannabinoids	212	45.1*	[40.5, 49.7]	58	31.2*	[24.6, 38.4]	25	16.0	[10.6, 22.7]	32	19.8*	[13.9, 26.7]	11	9.6*	[4.9, 16.6]
Stimulants	41	8.7	[6.3, 11.6]	32	17.2*	[12.1, 23.4]	13	8.3	[4.5, 13.8]	23	14.2	[9.2, 20.5]	5	4.4	[1.4, 9.9]
Sedatives	28	6.0	[4.0, 8.5]	20	10.8	[6.7, 16.1]	15	9.6	[5.5, 15.4]	14	8.6	[4.8, 14.1]	13	11.4	[6.2, 18.7]
Opioids	45	9.6*	[7.1, 12.6]	29	15.6*	[10.7, 21.6]	22	14.1	[9.1, 20.6]	33	20.4*	[14.5, 27.4]	12	10.5	[5.6, 17.7]
Antidepressants	1	0.2	[0.0, 1.2]	1	0.5	[0.0, 3.0]	3	1.9	[0.4, 5.5]	0	0.0	[0.0, 2.3]	0	0.0	[0.0, 3.2]
Over-the-Counter	7	0.5	[0.6, 3.0]	2	1.1	[0.1, 3.8]	4	2.6	[0.7, 6.4]	3	1.9	[0.4, 5.3]	2	1.8	[0.2, 6.2]
Other Drugs	6	1.3	[0.5, 2.8]	7	3.8	[1.5, 7.6]	4	2.6	[0.7, 6.4]	3	1.9	[0.4, 5.3]	0	0.0	[0.0, 3.2]
At Least 1 Category	325	69.1*	[64.8, 73.3]	124	66.7*	[59.4, 73.4]	90	57.7	[49.5, 65.6]	108	66.7*	[58.8, 73.9]	44	38.6*	[29.6, 48.2]
Multiple Categories	112	23.8	[20.0, 27.9]	63	33.9*	[27.1, 41.2]	32	20.5	[14.5, 27.7]	40	24.7	[18.3, 32.1]	12	10.5	[5.6, 17.7]

*Significantly different ($p < .05$) from Before period.

Note: Age was unknown for 35 cases.

Table A-9. Positive for Drug Category by Case Source

	Trauma Center						Medical Examiner					
	Before (N=1,724)			During (N=951)			Before (N=156)			During (N=172)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	341	19.8	[17.9, 21.7]	233	24.5*	[21.8, 27.4]	59	37.8	[30.2, 45.9]	69	40.1	[32.7, 47.9]
Cannabinoids	368	21.3	[19.4, 23.4]	290	30.5*	[27.6, 33.5]	34	21.8	[15.6, 29.1]	60	34.9*	[27.8, 42.5]
Stimulants	164	9.5	[8.2, 11.0]	90	9.5	[7.7, 11.5]	26	16.7	[11.2, 23.5]	25	14.5	[9.6, 20.7]
Sedatives	136	7.9	[6.7, 9.3]	80	8.4	[6.7, 10.4]	22	14.1	[9.1, 20.6]	15	8.7	[5.0, 14.0]
Opioids	123	7.1	[6.0, 8.5]	118	12.4*	[10.4, 14.7]	19	12.2	[7.5, 18.4]	27	15.7	[10.6, 22.0]
Antidepressants	33	1.9	[1.3, 2.7]	4	0.4*	[0.1, 1.1]	4	2.6	[0.7, 6.4]	1	0.6	[0.0, 3.2]
Over-the-Counter	34	2.0	[1.4, 2.7]	13	1.4	[0.7, 2.3]	9	5.8	[2.7, 10.7]	5	2.9	[1.0, 6.7]
Other Drugs	22	1.3	[0.8, 1.9]	12	1.3	[0.7, 2.2]	5	3.2	[1.0, 7.3]	8	4.7	[2.0, 9.0]
At Least 1 Category	860	49.9	[47.5, 52.3]	592	62.3*	[59.1, 65.3]	99	63.5	[55.4, 71.0]	122	70.9	[63.5, 77.6]
Multiple Categories	286	16.6	[14.9, 18.4]	202	21.2*	[18.7, 24.0]	55	35.3	[27.8, 43.3]	65	37.8	[30.5, 45.5]

*Significantly different ($p < .05$) from Before period.

Table A-10. Positive for Drug Category by Time of Day

	Daytime						Nighttime					
	Before (N=982)			During (N=544)			Before (N=896)			During (N=574)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	102	10.4	[8.5, 12.5]	77	14.2*	[11.3, 17.4]	296	33.0	[30.0, 36.2]	225	39.2*	[35.2, 43.3]
Cannabinoids	180	18.3	[16.0, 20.9]	153	28.1*	[24.4, 32.1]	221	24.7	[21.9, 27.6]	194	33.8*	[29.9, 37.8]
Stimulants	75	7.6	[6.1, 9.5]	51	9.4	[7.1, 12.1]	114	12.7	[10.6, 15.1]	64	11.1	[8.7, 14.0]
Sedatives	85	8.7	[7.0, 10.6]	53	9.7	[7.4, 12.5]	73	8.1	[6.4, 10.1]	42	7.3	[5.3, 9.8]
Opioids	84	8.6	[6.9, 10.5]	83	15.3*	[12.3, 18.6]	58	6.5	[5.0, 8.3]	61	10.6*	[8.2, 13.4]
Antidepressants	27	2.7	[1.8, 4.0]	4	0.7*	[0.2, 1.9]	10	1.1	[0.5, 2.0]	1	0.2*	[0.0, 1.0]
Over-the-Counter	30	3.1	[2.1, 4.3]	10	1.8	[0.9, 3.4]	13	1.5	[0.8, 2.5]	8	1.4	[0.6, 2.7]
Other Drugs	15	1.5	[0.9, 2.5]	8	1.5	[0.6, 2.9]	12	1.3	[0.7, 2.3]	12	2.1	[1.1, 3.6]
At Least 1 Category	408	41.5	[38.4, 44.7]	311	57.2*	[52.9, 61.4]	549	61.3	[58.0, 64.5]	399	69.5*	[65.6, 73.3]
Multiple Categories	147	15.0	[12.8, 17.4]	99	18.2	[15.0, 21.7]	192	21.4	[18.8, 24.3]	168	29.3*	[25.6, 33.2]

*Significantly different ($p < .05$) from Before period.

Note: Time of day was unknown for 2 cases Before and 5 cases During.

Table A-11. Positive for Drug Category by Weekday/Weekend

	Weekday						Weekend					
	Before (N=1,210)			During (N=709)			Before (N=668)			During (N=408)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	169	14.0	[12.1, 16.0]	155	21.9*	[18.9, 25.1]	229	34.3	[30.7, 38.0]	146	35.8	[31.1, 40.6]
Cannabinoids	250	20.7	[18.4, 23.1]	219	30.9*	[27.5, 34.4]	151	22.6	[19.5, 26.0]	129	31.6*	[27.1, 36.4]
Stimulants	110	9.1	[7.5, 10.9]	75	10.6	[8.4, 13.1]	79	11.8	[9.5, 14.5]	40	9.8	[7.1, 13.1]
Sedatives	111	9.2	[7.6, 10.9]	51	8.6	[6.6, 10.9]	47	7.0	[5.2, 9.2]	34	8.3	[5.8, 11.5]
Opioids	98	8.1	[6.6, 9.8]	97	13.7*	[11.2, 16.4]	44	6.6	[4.8, 8.7]	46	11.3*	[8.4, 14.8]
Antidepressants	33	2.7	[1.9, 3.8]	3	0.4*	[0.1, 1.2]	4	0.6	[0.2, 1.5]	2	0.5	[0.1, 1.8]
Over-the-Counter	34	2.8	[2.0, 3.9]	13	1.8	[1.0, 3.1]	9	1.3	[0.6, 2.5]	5	1.2	[0.4, 2.8]
Other Drugs	18	1.5	[0.9, 2.3]	13	1.8	[1.0, 3.1]	9	1.3	[0.6, 2.5]	7	1.7	[0.7, 3.5]
At Least 1 Category	568	46.9	[44.1, 49.8]	427	60.2*	[56.5, 63.8]	389	58.2	[54.4, 62.0]	282	69.1*	[64.4, 73.6]
Multiple Categories	196	16.2	[14.2, 18.4]	167	23.6*	[20.5, 26.9]	143	21.4	[18.4, 24.7]	100	24.5	[20.4, 29.0]

*Significantly different ($p < .05$) from Before period.

Note: Weekday/weekend was unknown for 2 cases Before and 6 cases During.

Table A-12a. Positive for Drug Category by Type of Roadway User Before Public Health Emergency

	Driver (N =1,157)			Passenger (N = 276)			Bicyclist (N = 72)			Pedestrian (N = 274)			E-Scooter, Other, Unknown (N = 101)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	252	21.8	[19.4, 24.3]	40	14.5	[10.6, 19.2]	15	20.8	[12.2, 32.0]	67	24.5	[19.5, 30.0]	26	25.7	[17.6, 35.4]
Cannabinoids	241	20.8	[18.5, 23.3]	77	27.9	[22.7, 33.6]	13	18.1	[10.0, 28.9]	51	18.6	[14.2, 23.7]	20	19.8	[12.5, 28.9]
Stimulants	106	9.2	[7.6, 11.0]	28	10.1	[6.8, 14.3]	7	9.7	[4.0, 19.0]	33	12.0	[8.4, 16.5]	16	15.8	[9.3, 24.4]
Sedatives	93	8.0	[6.5, 9.8]	22	8.0	[5.1, 11.8]	2	2.8	[0.3, 9.7]	25	9.1	[6.0, 13.2]	16	15.8	[9.3, 24.4]
Opioids	87	7.5	[6.1, 9.2]	24	8.7	[5.7, 12.7]	3	4.2	[0.9, 11.7]	22	8.0	[5.1, 11.9]	6	5.9	[2.2, 12.5]
Antidepressants	26	2.2	[1.5, 3.3]	2	0.7	[0.1, 2.6]	2	2.8	[0.3, 9.7]	5	1.8	[0.6, 4.2]	2	2.0	[0.2, 7.0]
Over-the-Counter	25	2.2	[1.4, 3.2]	8	2.9	[1.3, 5.6]	1	1.4	[0.0, 7.5]	8	2.9	[1.3, 5.7]	1	1.0	[0.0, 5.4]
Other Drugs	17	1.5	[0.9, 2.3]	3	1.1	[0.2, 3.1]	1	1.4	[0.0, 7.5]	4	1.5	[0.4, 3.7]	2	2.0	[0.2, 7.0]
At Least 1 Category	588	50.8	[47.9, 53.7]	138	50.0	[43.9, 56.1]	35	48.6	[36.7, 60.7]	139	50.7	[44.6, 56.8]	59	58.4	[48.2, 68.1]
Multiple Categories	204	17.6	[15.5, 20.0]	52	18.8	[14.4, 24.0]	7	9.7	[4.0, 19.0]	54	19.7	[15.2, 24.9]	24	23.8	[15.9, 33.3]

Table A-12b. Positive for Drug Category by Type of Roadway User During Public Health Emergency

	Driver (N =699)			Passenger (N = 133)			Bicyclist (N = 38)			Pedestrian (N = 142)			E-Scooter, Other, Unknown (N = 111)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol	198	28.3*	[25.0, 31.8]	26	19.5	[13.2, 27.3]	5	13.2	[4.4, 28.1]	43	30.3	[22.9, 38.5]	30	27.0	[19.0, 36.3]
Cannabinoids	227	32.7*	[29.0, 36.1]	42	31.6	[23.8, 40.2]	4	10.5	[2.9, 24.8]	44	31.0*	[23.5, 39.3]	33	29.7	[21.4, 39.1]
Stimulants	64	9.2	[7.1, 11.5]	18	13.5	[8.2, 20.5]	3	7.9	[1.7, 21.4]	23	16.2	[10.6, 23.3]	7	6.3*	[2.6, 12.6]
Sedatives	61	8.7	[6.7, 11.1]	10	7.5	[3.7, 13.4]	2	5.3	[0.6, 17.7]	13	9.2	[5.0, 15.1]	9	8.1	[3.8, 14.8]
Opioids	97	13.9*	[11.4, 16.7]	18	13.5	[8.2, 20.5]	6	15.8*	[6.0 31.3]	17	12.0	[7.1, 18.5]	7	6.3	[2.6, 12.6]
Antidepressants	3	0.4*	[0.1, 1.2]	0	0.0	[0.0, 2.7]	0	0.0	[0.0, 9.3]	1	0.7	[0.0, 3.9]	1	0.9	[0.0, 4.9]
Over-the-Counter	10	1.4	[0.7, 2.6]	2	1.5	[0.2, 5.3]	0	0.0	[0.0, 9.3]	6	4.2	[1.6, 9.0]	0	0.0	[0.0, 3.3]
Other Drugs	15	2.1	[1.2, 3.5]	2	1.5	[0.2, 5.3]	1	2.6	[0.1, 13.8]	2	1.4	[0.2, 5.0]	0	0.0	[0.0, 3.3]
At Least 1 Category	452	64.7*	[61.0, 68.2]	84	63.2*	[54.4, 71.4]	17	44.7	[28.6, 61.7]	94	66.2*	[57.8, 73.9]	67	60.4	[50.6, 69.5]
Multiple Categories	177	25.3*	[22.1, 28.7]	26	19.5	[13.2, 27.3]	4	10.5	[2.9, 24.8]	40	28.2	[20.9, 36.3]	20	18.0	[11.4, 26.4]

*Significantly different ($p < .05$) from Before period.

Table A-13. Alcohol Combined With Other Drug Use

	Before (N= 1,880)			During (N=1,123)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Alcohol only	218	11.6	[10.2, 13.1]	144	12.8	[10.9, 14.9]
Alcohol + 1 Other Category	128	6.8	[5.7, 8.0]	122	10.9*	[9.1, 12.8]
Cannabinoids	80	4.2	[3.4, 5.3]	75	6.7*	[5.3, 8.3]
Stimulants	28	1.5	[1.0, 2.1]	16	1.4	[0.8, 2.3]
Sedatives	8	0.4	[0.2, 0.8]	13	1.1*	[0.6, 2.0]
Opioids	7	0.3	[0.1, 0.8]	11	1.0*	[0.5, 1.7]
Antidepressants	1	0.1	[0.0, 0.3]	0	0.0	[0.0, 0.3]
Over-the-Counter	1	0.1	[0.0, 0.3]	4	0.4*	[0.1, 0.9]
Other Drugs	3	0.2	[0.0, 0.5]	3	0.3	[0.1, 0.8]
Alcohol + 2 or More Other Categories	54	2.9	[2.2, 3.7]	36	3.2	[2.3, 4.4]

*Significantly different ($p < .05$) from Before period.

Table A-14. THC Combined With Other Drug Use

	Before (N= 1,880)			During (N=1,123)		
Drug Category	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
Cannabinoids only	214	11.4	[10.0, 12.9]	180	16.0*	[13.9, 18.3]
Cannabinoids + 1 Other Category	138	7.3	[6.2, 8.6]	123	11.0*	[9.2, 12.9]
Alcohol	80	4.2	[3.4, 5.3]	75	6.7*	[5.3, 8.3]
Stimulants	22	1.2	[0.7, 1.8]	16	1.4	[0.8, 2.3]
Sedatives	16	0.9	[0.5, 1.4]	7	0.6	[0.3,1.3]
Opioids	12	0.6	[0.3, 1.1]	23	2.1*	[1.3, 3.1]
Antidepressants	0	0.0	[0.0, 0.2]	0	0.0	[0.0, 0.3]
Over-the-Counter	4	0.2	[0.1, 0.5]	1	0.1	[0.1, 0.5]
Other Drugs	4	0.2	[0.1, 0.5]	1	0.1	[0.1, 0.5]
Cannabinoids + 2 or More Categories	50	2.7	[2.0, 3.5]	47	4.2*	[3.1, 5.5]

*Significantly different ($p < .05$) from Before period.

Table A-15. BAC Ranges

	Before (N= 1,880)			During (N=1,123)		
BAC Range	**n**	**%**	**95% CI**	**n**	**%**	**95% CI**
.02 - .049	25	1.3	[0.9, 2.0]	27	2.4*	[1.6, 3.5]
.05 - .079	38	2.0	[1.4, 2.8]	24	2.1	[1.4, 3.2]
.08 - .149	97	5.2	[4.2, 6.3]	64	5.7	[4.4, 7.2]
.15 +	240	12.8	[11.3, 14.4]	187	16.7*	[14.5, 19.0]

*Significantly different ($p < .05$) from Before period.

DOT HS 812 018
October 2020

U.S. Department
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**National Highway
Traffic Safety
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14968-092920-v6