May 30, 2024 Highway Investigation Report HIR-24-04

Intersection Crash Between Passenger Car and Combination Vehicle

Tishomingo, Oklahoma
March 22, 2022

Abstract: On the afternoon of March 22, 2022, at 12:19 p.m. central daylight time, a 2015 Chevrolet Spark four-passenger car, occupied by a 16-year-old driver and five teen passengers, was traveling east on Oklahoma State Highway 22 (SH-22) approaching US Highway 377 (US-377) in Tishomingo, Oklahoma. The flow of traffic on SH-22 was controlled by a stop sign, and vehicles on US-377 had no traffic controls. At the same time, a 1994 Peterbilt truck-tractor in combination with a 2017 Travis semitrailer (combination vehicle) was traveling south on US-377 at a calculated speed of 51–53 mph and approaching the intersection with SH-22. The car driver slowed her vehicle in advance of the intersection (behind another vehicle) but did not come to a complete stop at the stop sign or yield to the oncoming combination vehicle. Instead, the car driver sped up to make a left turn in front of the combination vehicle. The combination vehicle driver applied braking and steered to try to avoid the collision, but the combination vehicle struck the driver's side of the car; all six occupants in the car were fatally injured. The combination vehicle driver was not injured in the crash. Safety issues identified in this investigation include the car driver's distraction from transporting multiple teen passengers, inexperience with driving, and likely impairment due to recent cannabis use. Additional safety issues include the need for public awareness, effective communication, and access to resources about the impairing effects of cannabis use on driving. The NTSB issues new safety recommendations to the Oklahoma State Department of Education, Oklahoma Highway Safety Office, Service Oklahoma, Governors Highway Safety Association, National Conference of State Legislatures, National Association of State Boards of Education, and American Association of Motor Vehicle Administrators. The NTSB also reiterates an existing safety recommendation to the state of Oklahoma and another one to 19 states, the District of Columbia, and the commonwealth of Puerto Rico.

NOTE: This report was reissued on September 13, 2024, with corrections to text referring to ownership of the *Oklahoma Driver Manual*. Text was corrected on pages ix, 17, 18, 20, 38, 43, and 48.

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Acronyms and Abbreviations

AAA	American Automobile Association
AAMVA	American Association of Motor Vehicle Administrators
AASHTO	American Association of State Highway and Transportation Officials
CFR	*Code of Federal Regulations*
CVSA	Commercial Vehicle Safety Alliance
DPS	Department of Public Safety
EDR	event data recorder
11-OH-THC	11-hydroxy-delta-9-tetrahydrocannabinol
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
GDL	graduated driver licensing
GHSA	Governors Highway Safety Association
IIHS	Insurance Institute for Highway Safety
NCSL	National Conference of State Legislatures
ng/mL	nanograms per milliliter
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
OAS	Oklahoma Academic Standards
ODOT	Oklahoma Department of Transportation
OHSO	Oklahoma Highway Safety Office
OSCN	Oklahoma State Courts Network
OSDE	Oklahoma State Department of Education

SH-22	Oklahoma State Highway 22
SUV	sport utility vehicle
THC	delta-9-tetrahydrocannabinol
THC-COOH	carboxy-delta-9-tetrahydrocannabinol
US-377	US Highway 377
USDOE	US Department of Education

Executive Summary

What Happened

On the afternoon of March 22, 2022, at 12:19 p.m., a 2015 Chevrolet Spark four-passenger car, occupied by a 16-year-old driver and five teen passengers, was traveling east on Oklahoma State Highway 22 (SH-22) approaching US Highway 377 (US-377) in Tishomingo, Oklahoma. The car's two front-seat occupants were wearing seat belts, but the seat belt status of the four back-seat occupants is unknown. The flow of traffic on SH-22 was controlled by a stop sign, and vehicles on US-377 had no traffic controls. At the same time, a 1994 Peterbilt truck-tractor in combination with a 2017 Travis semitrailer (combination vehicle) was traveling south on US-377 at a calculated speed of 51–53 mph and approaching the intersection with SH-22. Both US-377 and SH-22 had posted speed limits of 50 mph. The car driver slowed her vehicle in advance of the intersection to about 1 mph (behind another vehicle) but did not come to a complete stop at the stop sign or yield to the oncoming combination vehicle. Instead, the car driver sped up to make a left turn in front of the combination vehicle. The combination vehicle driver applied braking and steered to try to avoid the collision, but the combination vehicle struck the driver's side of the car; all six occupants in the car were fatally injured. The combination vehicle driver was not injured in the crash.

What We Found

We determined that the car driver's transportation of multiple teen passengers, limited driving experience, and likely impairment from effects of cannabis at the time of the crash adversely affected her judgment of the danger of entering the intersection in front of the approaching combination vehicle.

We found that teen drivers and the public largely misunderstand the legal status of cannabis use and do not fully recognize the risks of cannabis-impaired driving. We also found that because of the prevalence of cannabis in serious and fatal crashes, the changes in state laws regarding its legal use, and the public's misconceptions about its impairing effects on driving, educating drivers on the impairing effects of cannabis use and the illegality of driving under its influence is critical to highway safety. We identified school and driver education curricula; driver manuals; state highway, advocacy, and school board organization activities; parental engagement; and warning labels on cannabis products as opportunities to raise awareness and prevent future crashes associated with cannabis-impaired driving. We also found that Oklahoma can use the National Highway Traffic Safety Administration's (NHTSA) Drug-Impaired Driving Criminal Justice Evaluation Tool to improve its efforts to address drug-impaired driving.

We determined that the probable cause of the Tishomingo, Oklahoma, collision was the teen driver's acceleration through the intersection after briefly slowing without stopping, due to distraction from having five teen passengers in the car, limited driving experience, and likely impairment from cannabis.

What We Recommended

As a result of this investigation, we recommended that the Oklahoma State Department of Education develop a drug and alcohol abuse curriculum with content that covers the risks of cannabis-impaired driving and disseminate it to local school boards. We also recommended that the Oklahoma Highway Safety Office incorporate the topic of cannabis impairment into its student outreach programming on driving safety. Further, we recommended that Service Oklahoma update its *Oklahoma Driver Manual* to reflect the state's zero-tolerance law and to indicate that, although the state has legalized cannabis for some medical purposes, it impairs driving performance, and it is illegal for anyone to drive with any detectable level of cannabis in their system.

Further, we recommended that the Governors Highway Safety Association, the National Conference of State Legislatures, the National Association of State Boards of Education, and the American Association of Motor Vehicle Administrators (AAMVA) inform their members about this crash and the need for information in school and driver education curricula and manuals on understanding the risks of and avoiding cannabis-impaired driving. Additionally, we recommended that AAMVA update its *Model Driver's License Manual* to reflect that, although cannabis may be legal for medical purposes or recreational use in some states, it impairs driving performance, and it is illegal to drive while under the influence of cannabis.

Finally, we reiterated a recommendation to Oklahoma to complete an assessment using NHTSA's Drug-Impaired Driving Criminal Justice Evaluation Tool, and, if gaps are identified, apply to NHTSA for support in establishing programs to reduce drug-impaired driving. We also reiterated a recommendation to 19 states, the District of Columbia, and the Commonwealth of Puerto Rico to require a warning label on cannabis products about the impairing effects of cannabis on driving.

Factual Information

1.1 Crash Description

On Tuesday, March 22, 2022, about 12:19 p.m. central daylight time, an intersection crash occurred between a 2015 Chevrolet Spark four-passenger car and a 1994 Peterbilt truck-tractor in combination with a 2017 Travis semitrailer (combination vehicle) within the city limits of Tishomingo, Johnston County, Oklahoma.[1] The combination vehicle was loaded with gravel, traveling south on US Highway 377 (US-377), and approaching the intersection with Oklahoma State Highway 22 (SH-22). At the same time, the passenger car, occupied by a 16-year-old driver with an intermediate driver's license and five teen passengers, was traveling east on SH-22. The car driver and passengers were heading back to their high school campus after lunch and approaching the intersection of SH-22 and US-377.[2] The flow of traffic on SH-22 was controlled by a stop sign, and vehicles on US-377 had no traffic controls. There was no precipitation, and the roadways were dry.

According to the combination vehicle driver and a witness traveling behind the crash-involved car, the car was traveling behind a sport utility vehicle (SUV), which was at the intersection before it turned left (northbound) onto US-377. Although the car slowed before the intersection, the driver did not stop at the stop sign and instead pulled out into the intersection to turn left (northbound) immediately behind the SUV, across the combination vehicle's travel path. The combination vehicle struck the driver's side of the car; all six occupants in the car were fatally injured. The combination vehicle driver was not injured in the crash.

The crash occurred at the intersection of SH-22 and US-377, which crosses at a 65° angle (see figure 1).[3] The crash intersection slopes downward about 1% on US-377. US-377 is a two-lane highway with one northbound and one southbound lane. SH-22 is an east–west highway with a single travel lane in each direction on approach to and within the Tishomingo city limits. Both highways had posted speed limits of 50 mph at the time of the crash.

[1] Visit ntsb.gov to find additional information in the public docket for this National Transportation Safety Board investigation (case no. HWY22FH008). Use the CAROL Query to search safety recommendations and investigations.

[2] Tishomingo High School had an "open campus," meaning that students were free to get lunch on their own because the school did not have a cafeteria. According to the school district's superintendent, the lunch period was scheduled from 11:52 a.m. to 12:31 p.m.

[3] For more information about the intersection angle, see the *Highway Attachment – ODOT Construction Plans* in the public docket for this investigation (case no. HWY22FH008).

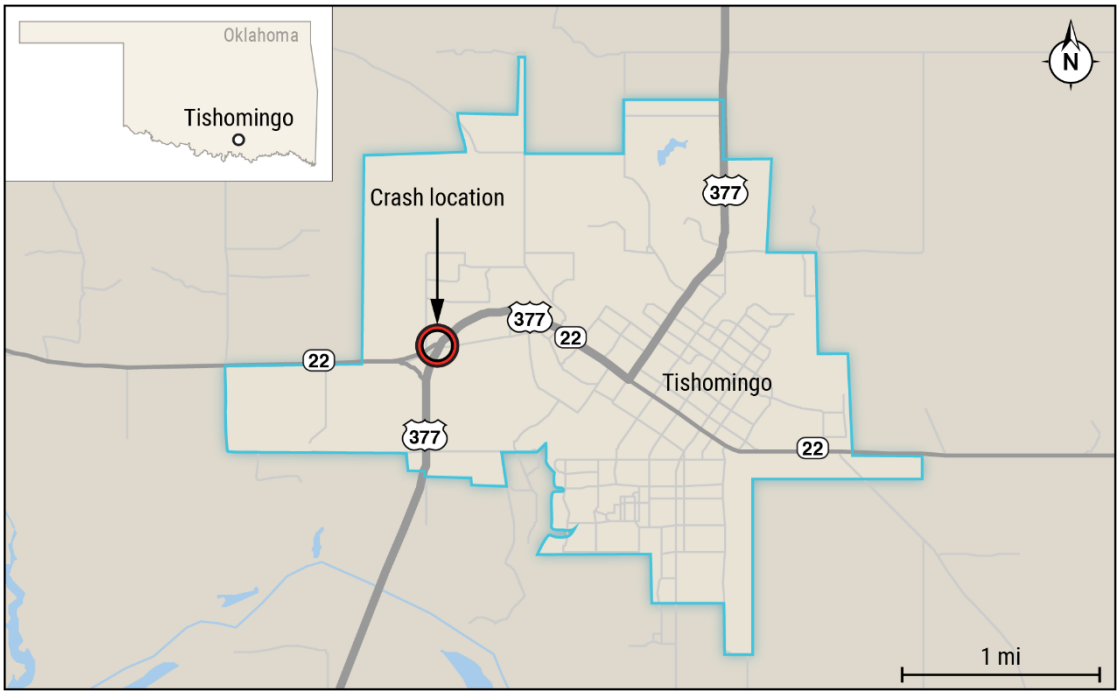

Figure 1. Map showing crash location at SH-22 and US-377 intersection.

Based on the data recorded by the car's event data recorder (EDR), the car had slowed and was traveling about 1 mph about 80 feet from impact, within 32 feet of the stop line on SH-22. A momentary brake application was recorded for the car 3.5 seconds before the crash; however, there was no sustained brake application and the recorded speed of the vehicle (7 mph) was unchanged. Beginning about 3 seconds before impact, the car's EDR data indicated a significant increase in accelerator pedal application and engine throttle, reaching 99% throttle application over the next 1.5 seconds. The car did not stop at the stop line and was traveling at 9–12 mph when it crossed the stop line, 48 feet from impact. The car's final speed was about 21–25 mph when it was struck by the combination vehicle.[4]

The combination vehicle driver applied braking and steered leftward away from the car, as evidenced by the combination vehicle's tire friction marks within 14 to 38 feet of impact (see figure 2). The combination vehicle was traveling at an estimated speed of 51–53 mph and impacted the car at 47–49 mph.[5] The impact redirected the car southward along the combination vehicle's heading. The car rotated clockwise across the front of the combination vehicle, and then the two

[4] The maximum speed before impact was calculated based on EDR data, which recorded the car speed 0.5 seconds before the EDR activated and factored in the car's maximum throttle application.

[5] The pre-impact speed of the combination vehicle was calculated using the velocity of the car (including the initial speed, change in velocity, and calculated principal direction of force), both vehicle weights, calculated values for moments of inertia, vehicle headings, impact orientation, and the vehicle damage interface plane.

vehicles' paths diverged. The car continued southward on the roadway and departed the pavement to the west of US-377. The combination vehicle continued along an arcing path and departed to the east of US-377. The combination vehicle and car came to final rest about 244 and 359 feet, respectively, south of the area of impact (see figure 2).

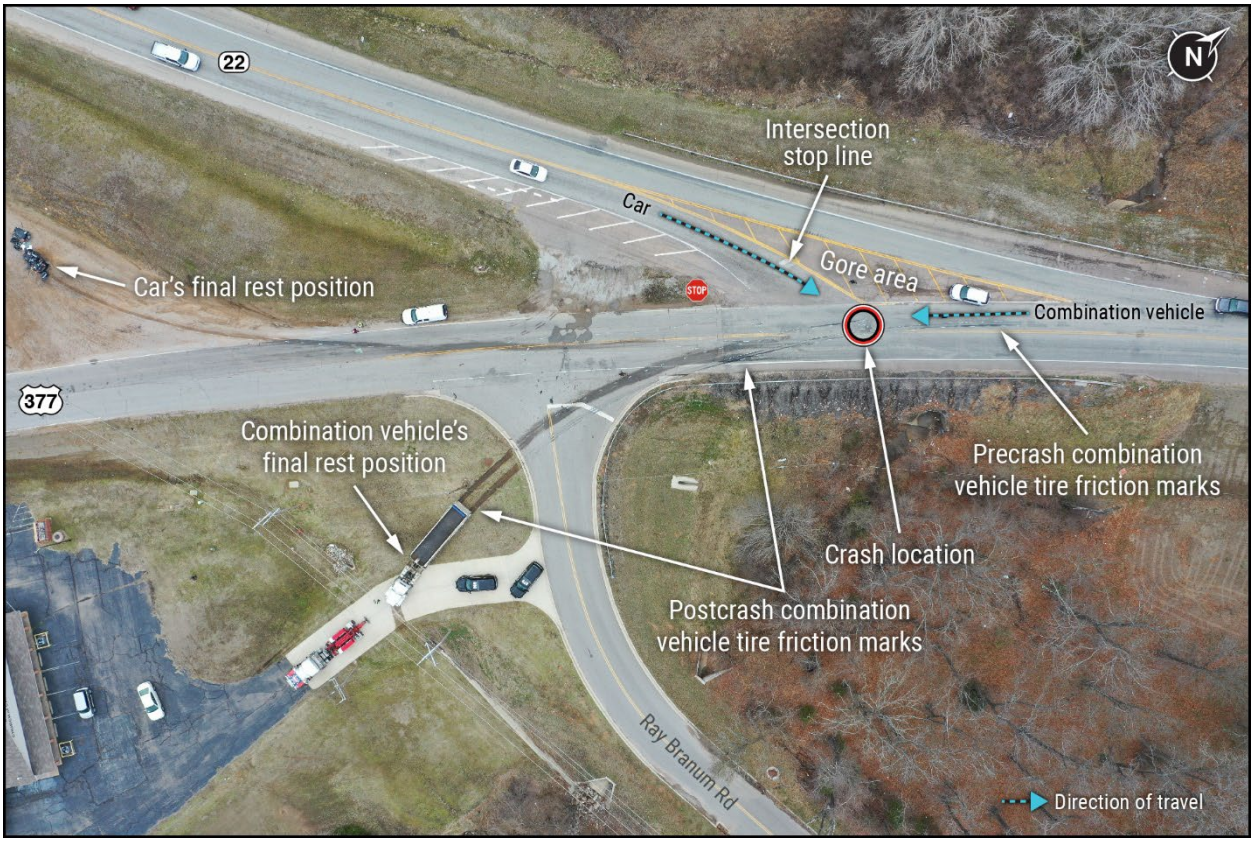

Figure 2. Aerial view of crash scene with final rest positions of car and combination vehicle. (Source: Oklahoma Highway Patrol; annotated by the National Transportation Safety Board).

1.2 Injuries and Occupant Protection

1.2.1 Injuries

A total of seven vehicle occupants were involved in the collision. All six occupants of the car were fatally injured; none of them were ejected. According to the Oklahoma Office of the Chief Medical Examiner, the cause of death for each of the six car occupants was multiple blunt-force injuries. The combination vehicle driver was not injured in the crash.

1.2.2 Occupant Protection

The car, a 2015 Chevrolet Spark, had a seating capacity for two occupants in the front and two occupants in the rear, and these four seating positions were equipped with lap/shoulder belts. According to the Tishomingo Police Department crash report, the driver and the front passenger were restrained with lap/shoulder belts, but restraint use was unknown for the four rear passengers. Data from the car's EDR, which recorded the seat belt buckle status only for the two front seats (driver and passenger), confirmed that both front seat belts were buckled at the time of the crash. The car had supplemental airbag restraints, including first-row driver and passenger frontal and knee airbags as well as first- and second-row side airbags and side-curtain airbags. The EDR data indicated that the driver-side and front passenger-side seat belt pretensioners and frontal airbags, as well as the side airbags on both the driver and passenger sides of the car, were deployed. Oklahoma has a primary enforcement seat belt use law that applies only to front-seat occupants.[6]

The National Transportation Safety Board (NTSB) was unable to determine the seating arrangement of the four passengers in the rear of the car. According to postcrash documentation, both rear seating position belts appeared intact and unused during the crash, with the webbing stowed against the seat backs/C-pillars. The latch plates were visible and attached to the webbing.

1.3 Emergency Response

The first call to 911 emergency dispatch occurred at 12:19 p.m. Personnel from the Johnston County Sheriff's Office arrived on scene at 12:21 p.m. The Tishomingo Police Department and Johnston County Emergency Medical Services arrived at 12:23 p.m. The Tishomingo Fire Department arrived on scene at 12:26 p.m., and personnel from the Ravia Fire Department arrived at 12:31 p.m. Four of the passenger car occupants were fatally injured on scene, including the driver and front-seat passenger. Two passengers occupying the rear seat were transported to Mercy Hospital Tishomingo, where they were pronounced dead.

The Oklahoma Highway Patrol found vaping mouthpieces and cannabis buds in the car on scene.[7]

[6] 47 *Oklahoma Statutes* 12-417 (2014) states that the driver and front-seat vehicle occupant must wear seat belts. According to the Oklahoma Mandatory Seat Belt Use Act, Oklahoma has a primary seat belt law, which allows for law enforcement officers to pull over and ticket a driver or front-seat passenger for this violation with no other cause.

[7] The Oklahoma Highway Patrol identified the cannabis buds based on appearance, without chemical testing.

1.4 Highway Factors

1.4.1 Roadway Design

US-377 had two 12-foot-wide lanes, one in each direction and each with a 5-foot-wide paved shoulder. The southbound and northbound lanes were delineated by a double-yellow pavement stripe. SH-22 also had two 12-foot-wide lanes, one eastbound and one westbound, delineated by a double-yellow pavement stripe, with 8-foot-wide paved shoulders on each side. On eastbound SH-22 approaching the intersection with US-377, a 48-inch-wide stop-ahead sign was posted about 750 feet from the intersection, and a 48-inch-wide stop sign was posted about 9 feet from the intersection. Eastbound SH-22 also had a stop line that was set back from the US-377 pavement edge about 14 feet on the right and 36 feet on the left for drivers approaching the intersection; this variation was due to the intersection angle and curved approach of US-377. The stop line had a faded appearance but remained visible. The immediate approach to the intersection had a gore area with channelizing pavement markings arranged with diagonal hash marks to separate the eastbound and westbound lanes of SH-22.

The crash intersection was between SH-22 and US-377, which was part of a larger junction with SH-22, Wrecker Road, and US-377, forming a triangle (see figure 3). In 1965, SH-22 was realigned at US-377, forming an intersection with an approximately 65° angle. As of the date of this report, the Oklahoma Department of Transportation (ODOT) policy for geometric design of roadways and bridges is in general conformance with American Association of State Highway and Transportation Officials (AASHTO) guidance and US Department of Transportation requirements. The most recent AASHTO design guidance, published in 2018, recommends not less than 75° for acute-angle intersections (AASHTO 2018).[8] If the SH-22 and US-377 intersection were built today, the intersection would not meet the AASHTO guidance; however, pre-existing highway infrastructure is not required to be redesigned to match current standards unless there is a safety or other issue.[9]

[8] In 2018, AASHTO changed its design guidance for new construction to indicate that intersection skew angles should not be less than 75°. The guidance states that "when roadways cross one another at an angle that is substantially different from 90 degrees, it is desirable to realign one or both roadways to reduce the skew angle. Drivers may have difficulty seeing cross traffic at an intersection with a severe skew because of the added difficulty in turning their heads and the reduced visibility often created by parts of the vehicle. Older drivers have difficulty with skewed intersections, due to restricted range of motion and diminished reaction time" (AASHTO 2018).

[9] ODOT uses the Federal Highway Administration's *Highway Safety Improvement Program Manual* guidance to states, local agencies, and stakeholders who implement highway safety improvements using Highway Safety Improvement Program funding. The guidance states that if a roadway does not

Figure 3. Junction of SH-22, Wrecker Road, and US-377 with crash location circled in red.

1.4.2 Crash History

According to data from the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis and Reporting System, a total of 42,514 traffic fatalities occurred in 2022.[10] Of these fatalities, 10,629 occurred at an intersection, representing 25% of all traffic fatalities. A Federal Highway Administration (FHWA) analysis of 2021 Fatality Analysis and Reporting System data showed that there were 11,799 fatalities in intersection crashes (FHWA 2024). Of those fatalities, 66% (7,752) were at unsignalized intersections where the right-of-way is determined by the presence of a yield or stop sign or is uncontrolled by any signal or sign.

Crash records from the Tishomingo Police Department showed 13 crashes occurring at the US-377 and SH-22 intersection between September 2011 and May 2024, not including the subject crash of this report. Twelve of the crashes were categorized as either a rear-end crash or a failure-to-yield crash. As a result of the twelve crashes, five people sustained injuries. The thirteenth crash occurred on November 1, 2021, when a vehicle entered the southbound lane of US-377.

meet nominal safety based on design standards, substantive safety is determined based on roadway safety performance and may be quantified in terms of crash frequency (number of crashes for a given road segment or intersection over a specified time period), crash rate (normalized to account for exposure), crash type, and/or crash severity (categorized as fatality, injury, or property damage only). For more information, see FHWA 2010.

[10] See Fatality and Injury Reporting System Tool (FIRST).

According to the police crash report, a car traveling east on SH-22 failed to negotiate the right-hand curve that led to the stop sign at the intersection of SH-22 and US-377, continued straight into the gore area, and struck the southbound car on US-377. The southbound driver died in the crash, and the injuries to the eastbound driver were not listed in the crash report. According to ODOT, the intersection of SH-22 and US-377 was not considered a high-crash location when compared to other rural, unsignalized intersections over this period; however, based on the recent crash and review of the crash history, the intersection has been designated in Oklahoma's 2024-2031 construction work plan for a redesign (ODOT 2023).

1.4.3 Traffic Information

According to ODOT, in 2022, the annual average daily traffic was 4,200 vehicles for SH-22 and 7,000 vehicles for US-377. In 2023, the annual average daily traffic was 4,500 for SH-22 and 7,700 for US-377. ODOT conducted a speed study in 2019, which indicated that the average speed on US-377 was 47 mph on the approach to the intersection with SH-22 in the 50-mph speed zone.[11] In June 2022, 4 months after the subject crash and at the request of the Oklahoma Highway Safety Office (OHSO) Traffic Division, the Oklahoma Transportation Commission lowered the speed limits on portions of SH-22 and US-377 from 50 mph to 45 mph due to the two fatal crashes. (See section 1.10, Postcrash Actions, for additional information.)

1.4.4 Intersection Sight Distance

Intersection sight distance is the length of roadway visible to a driver such that the driver has a clear view of the intersection and intersecting roadway to anticipate and avoid potential collisions (AASHTO 2011). For safe traffic operations, intersection sight distances should be greater than the time it takes for vehicles traveling on the intersecting roadways to stop before a collision occurs. For AASHTO, the time gap for sight-distance tests for a passenger vehicle at an intersection is 7.5 seconds.

The NTSB conducted an intersection sight-distance test in accordance with AASHTO guidance to measure viewing distance for drivers who have come to a stop at an intersection. This test was conducted at the intersection of US-377 and SH-22 using an exemplar combination vehicle positioned on US-377.[12] The results of this test indicated that the intersection met AASHTO standards for sight distance.

Because witness statements indicated that the car was behind an SUV and because the car did not fully stop at the stop sign, the NTSB conducted a second

[11] For more information, see the *Highway Attachment – ODOT Speed Studies* in the public docket for this investigation (case no. HWY22FH008).

[12] See AASHTO 2011, page 9-46, Table 9-7, "Design Intersection Sight Distance."

sight-distance test with a 7.5-second gap acceptance time to examine the visibility of the exemplar combination vehicle as the car approached the stop line. Results of this second sight-distance test indicated that there were no external sight obstructions to prevent a car driver approaching the intersection from being able to see the exemplar combination vehicle on US-377.

1.4.5 Safe System Approach

The Safe System Approach incorporates the five elements of a safe transportation system—safe road users, safe vehicles, safe speeds, safe roads, and post-crash care—in an integrated and holistic manner. Although states can use the number of serious crashes in an area (among other metrics) to help determine risk and prioritize projects, other measures such as road safety audits and road safety assessments can proactively identify safety issues before crashes occur by considering the riskiness of the roadway comprehensively.[13] The existing practice of using high-crash areas to help identify intersections for redesign relies on crashes to occur, and when they do, only a fraction of fatalities may occur in less traveled areas. Roads may not receive remedial action because they lack the sufficient number of crashes to be identified as "high-crash" locations. The Safe System Approach calls for road designs that will proactively prevent crashes.[14]

1.5 Vehicle Factors

1.5.1 Passenger Car

1.5.1.1 General Description. The 2015 Chevrolet Spark M300, a four-door subcompact sedan, had an automatic transmission, was equipped with a 1.2-liter gasoline engine, and was designed to seat a driver and three passengers. The car had a curb weight of 2,303 pounds.[15]

1.5.1.2 Damage. The entire front portion and driver's side of the car sustained collision damage with evidence of direct contact by the combination vehicle on the left-front quarter panel and A-pillar (see figure 4). There was rearward displacement of the vehicle engine, and the engine compartment components were also damaged.

[13] See the World Road Association (PIARC) *Road Safety Manual*, Part III: Planning, Design & Operation, and the FHWA's *Road Safety Audit Guidelines*.

[14] The NTSB held a series of roundtable events in 2021 and 2022 to discuss the Safe System Approach, including a Safe System Roundtable on July 7, 2021, and a Safe Roads Roundtable on October 6, 2021.

[15] *Curb weight* is the weight of the vehicle including a full tank of fuel and all standard equipment. It does not include the weight of any passengers, cargo, or optional equipment.

First responders removed the roof, rear hatch, passenger-side front and rear doors, and driver-side front and rear doors.

Figure 4. Postcrash photograph of damage to passenger car. The photograph was taken after the car had been moved to a garage. (Source: Oklahoma Department of Public Safety)

1.5.1.3 Mechanical Systems. The NTSB did not conduct a postcrash mechanical inspection of the passenger car.

1.5.1.4 Maintenance and Safety Recalls. There were no unfulfilled NHTSA safety recalls for this vehicle before the crash (NHTSA 2023). A safety recall regarding corrosion of the secondary hood latch lever was announced in August 2022. This reported safety defect would have had no detrimental influence given the circumstances related to this crash.

1.5.1.5 Event Data Recorders. The NTSB and Tishomingo Police Department investigators retrieved EDR data from the car.[16] The EDR recorded parameters such as vehicle speed and application of the brake and accelerator pedals preceding the supplemental restraint system (airbag) activation, as well as crash-related information such as longitudinal and lateral accelerations. The car's EDR recorded 5 seconds of data before the activation of the supplemental restraint system. Figure 5 shows the

[16] 49 *Code of Federal Regulations* 563, "Event Data Recorders," specifies the uniform, national requirements for vehicles equipped with EDRs.

car's speeds and locations as it accelerated through the intersection. For complete precrash EDR data from the passenger car, see Appendix C.

The car was in motion throughout the 5 seconds before the crash. A momentary brake application occurred about 3.5 seconds before impact.[17] About 2.5 seconds before impact, there was an increase in both the accelerator pedal and engine throttle percent data. Between 1.5 and 1.0 seconds before impact, both the accelerator pedal and engine throttle percentage showed full throttle application, and the final reported vehicle speed, 0.5 seconds before impact, was 21 mph, indicating that the car was responsive to driver inputs leading up to the crash.

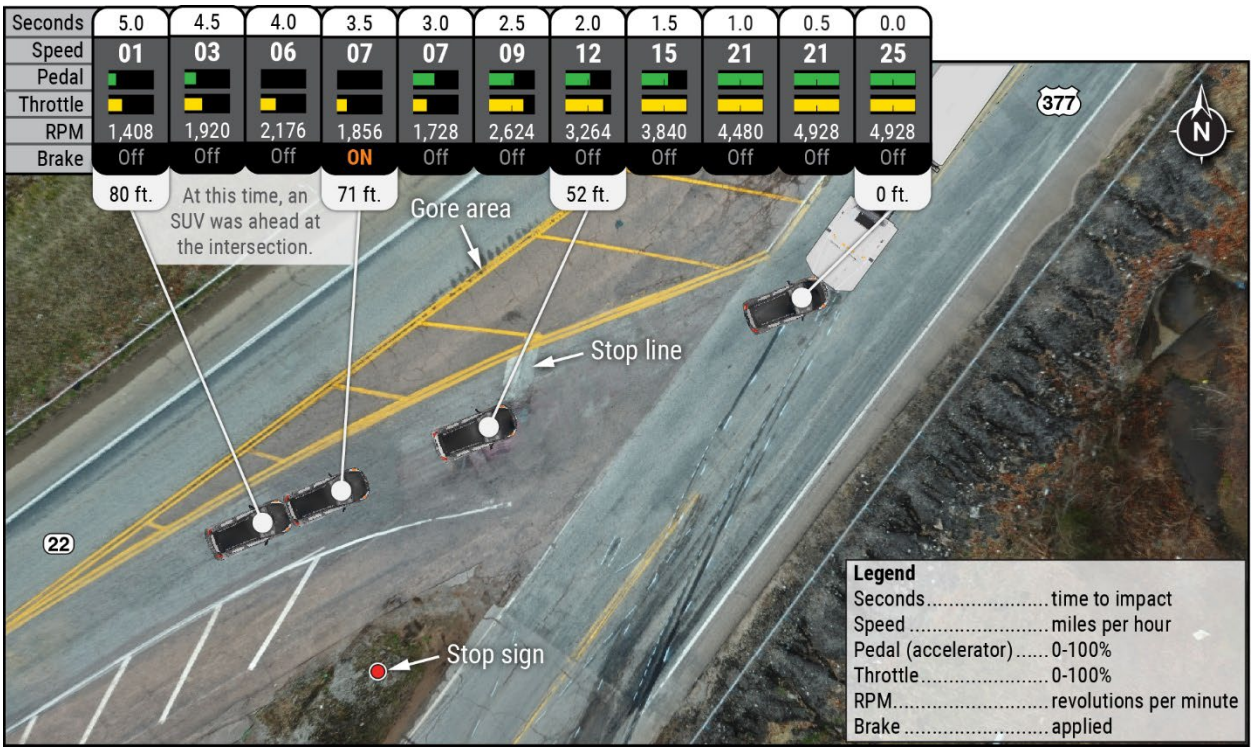

Figure 5. Graphical depiction of passenger car speeds, acceleration statuses, and locations in the 5 seconds before the crash, based on EDR data.

1.5.2 Combination Vehicle

1.5.2.1 General Description. The combination vehicle consisted of a 1994 Peterbilt 397 three-axle truck-tractor coupled to a 2017 Travis S/96 end-dump body semitrailer. The Peterbilt was a conventional truck-tractor configured with a day cab and a wheelbase of about 24 feet as measured postcrash from axle 1 to a midpoint between axles 2 and 3. The trailer was a quarter-frame, end-dump body, and it was

[17] Brake switch circuit status indicates the open or closed state of the brake switch circuit and not the amount of pressure applied by the driver to the brake pedal.

30 feet long. The trailer had a three-axle configuration with one leading axle. The overall length of the combination vehicle was just under 52 feet. The gross weight of the vehicle and its load was 81,750 pounds without the driver as determined by the Oklahoma Highway Patrol in its postcrash vehicle inspection.[18]

1.5.2.2 Damage. The truck-tractor sustained contact damage across its entire front, primarily at bumper height. There was contact deformation beginning near the passenger-side frame rail attachment point and extending across the bumper to the driver's side. The face of the bumper had contact damage and was displaced at the lower edge (bottom) rearward. There was additional contact damage to the passenger side of the hood's vertical face (above the headlamps) and to the leading surface of the right-front fender. Postcrash photographs showed that the left steer axle tire was deflated; the remaining nine tires on the combination vehicle were intact and in operational condition (see figure 6).

Figure 6. Postcrash photograph showing damage sustained by combination vehicle.

1.5.2.3 Mechanical Systems. The NTSB did not conduct a postcrash mechanical inspection of the truck-tractor and semitrailer; however, the Oklahoma

[18] The legal gross weight limit for vehicles in Oklahoma is 80,000 pounds. Vehicles registered at this 80,000-pound maximum gross weight are granted an additional 5% allowable gross weight, for a total of 84,000 pounds. This additional allowance accounts for the variability in weight of certain transported materials (such as gravel, which the crash-involved combination vehicle was transporting). For more information, see 47 *Oklahoma Statutes* 14-109 (2022).

Highway Patrol conducted a postcrash inspection of the mechanical components.[19] A total of 15 violations were noted on the postcrash inspection report, including two out-of-adjustment brake pushrod lengths. None of the violations caused the vehicle to be classified as out-of-service based on Commercial Vehicle Safety Alliance (CVSA) criteria (CVSA 2023).[20] No steering deficiencies were reported by the Oklahoma Highway Patrol.

1.5.2.4 Maintenance and Safety Recalls. According to an interview with the carrier owner, the truck-tractor was purchased in June 2020, and the combination vehicle driver began driving it operationally in November 2020. The carrier's maintenance records indicated that the truck-tractor's last annual inspection, as required by federal regulations, was on December 21, 2021.[21] The carrier provided the previous year of maintenance records for the truck-tractor and the semitrailer. The last preventive maintenance for the truck-tractor was on March 11, 2022. The NTSB examined 2 months of the driver's vehicle maintenance reports for the truck-tractor, completed by the crash-involved driver; the reports did not note any maintenance deficiencies. There were no unfulfilled NHTSA safety recalls for the truck-tractor before the crash (NHTSA 2023). The driver stated that the combination vehicle was "in good shape" and was not experiencing any issues at the time of the crash.

1.5.2.5 Event Data Recorders. The combination vehicle was not equipped with an EDR, nor was this required by the *Code of Federal Regulations* (*CFR*).[22]

1.6 Driver Factors

1.6.1 Car Driver

1.6.1.1 Licensing, Education, and Experience. The car driver was a 16-year-old female with an intermediate Oklahoma driver's license. An intermediate license is

[19] For more information, see the *Supplemental Attachment – Oklahoma DPS driver and vehicle examination report* in the public docket for this investigation (case no. HWY22FH008).

[20] (a) The CVSA is a nonprofit association comprising local, state, provincial, and federal commercial vehicle safety professionals and industry safety representatives. Specialized personnel in each state inspect commercial motor vehicles based on procedures and criteria established by the CVSA. The CVSA's North American Standard Out-of-Service Criteria identify critical vehicle inspection items and detail the conditions that can prohibit a motor carrier or driver from operating a commercial motor vehicle for a specified period of time or until the condition is corrected. (b) See 49 *Code of Federal Regulations* 393.47, "Brake actuators, slack adjusters, linings/pads and drums/rotors." The two brakes exceeding these specifications were left-side axle two (forward truck-tractor drive axle) and right-side axle three (rear truck-tractor drive axle).

[21] See 49 *Code of Federal Regulations* 396.3, "Inspection, repair, and maintenance."

[22] For more information, see 49 *CFR* 563, "Event Data Recorders."

given to novice drivers who have completed the requirements for a learner's permit and passed the driver's skill test. Section 1.7 provides additional information about licensing and driving requirements for new drivers. Drivers with an intermediate license are restricted in the number of passengers they may carry and the time of day they may operate a vehicle. Motor vehicle records indicated that the car driver had no prior suspensions or convictions.

The car driver completed a parent-taught education program. According to her parents, she started driving when she was about 15 and a half years old. She obtained her intermediate driver's license in November 2021 when she was about 16 and a half years old. The intermediate license was valid until May 2025. According to her parents, the car driver was familiar with her vehicle. She learned to drive in this car and had been driving it for more than a year. She was required to hold an intermediate license for 1 year (ending in November 2022) because she did not take a classroom driver education course. She was about 4 months into the intermediate license period when the crash occurred. Her parents described her as a cautious driver who "knew what she could handle and knew what she couldn't handle." Her father stated that he would sometimes follow her to school, and she would follow the speed limit.

In Oklahoma, an intermediate license holder may not carry more than one non-family member in the vehicle unless accompanied in the front seat by a licensed driver over 21 years of age. All passengers in the car were Tishomingo High School students under age 21.

1.6.1.2 Toxicology Results. Postmortem toxicology testing of a cavity blood specimen from the car driver performed by the Oklahoma Office of the Chief Medical Examiner was positive for cannabinoids and negative for ethanol. At the request of the NTSB, the Federal Aviation Administration (FAA) Forensic Sciences Laboratory performed toxicology testing of postmortem cavity blood from the car driver. This testing detected delta-9-tetrahydrocannabinol (THC), the primary psychoactive chemical in cannabis, at 95.9 nanograms per milliliter (ng/mL).[23] THC's psychoactive metabolite 11-hydroxy-delta-9-tetrahydrocannabinol (11-OH-THC) was detected in

[23] *Cannabis* is the marijuana plant. This report uses the term "cannabis" except in instances where the term "marijuana" is used by the author or organization being cited.

this specimen at 16.7 ng/mL, and THC's inactive metabolite carboxy-delta-9-tetrahydrocannabinol (THC-COOH) was detected at 178.1 ng/mL.[24]

1.6.1.3 Precrash Activities. According to her parents, the car driver woke up between 8:00 a.m. and 8:30 a.m. the morning of the crash and left for school around 9:30 a.m. Based on the vehicle track log data from the car's Chevrolet OnStar application, the car was parked at a residence near US-377 at 9:04 a.m. At 9:33 a.m., the car was driven on US-377 (about 2.9 miles north of the SH-22 intersection) and then parked in the Tishomingo High School parking lot at 9:41 a.m. At 11:29 a.m., the car was driven and then parked at a residence at 11:43 a.m. At 12:12 p.m., the car began moving east on SH-22 about 0.62 miles west of the crash location. The data terminated at 12:16 p.m., about 3 minutes before the reported time of the crash at 12:19 p.m.[25]

1.6.1.4 Cell Phone Use. The Oklahoma Department of Public Safety (DPS) recovered the car driver's phone and provided its data to the NTSB. The NTSB examined the car driver's phone use data and determined that she was not on a call or using her phone's native texting application at the time of the crash.

1.6.2 Combination Vehicle Driver

1.6.2.1 Licensing and Experience. The combination vehicle driver was a 51-year-old male who started driving commercial vehicles in 1997. The combination vehicle driver's spouse was the owner of the motor carrier. The carrier's business consisted of hauling asphalt, sand, and gravel in intrastate commerce. The driver held an Oklahoma Class A driver's license with a tank vehicle endorsement issued in May 2021 and set to expire in May 2025.

1.6.2.2 Medical Certification. The combination vehicle driver held a commercial driver medical certificate that was issued in October 2021.[26] The driver's

[24] This specimen was collected about 7 hours after the car driver's death. The FAA Forensic Sciences Laboratory also tested a different cavity blood specimen collected from the car driver about 23 hours after her death. In that specimen, THC was detected at 1,187.4 ng/mL, 11-OH-THC at 7.4 ng/mL, and THC-COOH at 88.4 ng/mL. That specimen was considered unreliable for interpretation, as the irregularly high THC concentration may indicate specimen contamination, such as by THC from lung tissue. It is unknown from which body location(s) the cavity blood specimens were collected.

[25] The reason for the disparity between the time that the Chevrolet OnStar terminated collecting data and the time of the crash was unknown.

[26] 49 *CFR* 391.41 and 391.43 specify the medical certification requirements for commercial driver's licenses.

primary care physician qualified him for a 1-year medical certificate due to hypertension and type 2 diabetes.

1.6.2.3 Toxicology Results. Due to the fatalities resulting from the crash, the Oklahoma DPS requested that the combination vehicle driver submit blood for postcrash alcohol and drug tests, and he agreed.[27] The Oklahoma State Bureau of Investigation did not detect any ethanol or other tested-for drugs in the combination vehicle driver's blood. The NTSB requested that the FAA Forensic Sciences Laboratory test the blood sample, and no tested-for drugs were detected in the combination vehicle driver's blood.[28] A urine specimen was collected from the combination vehicle driver on March 24, 2022 (2 days after the crash date), for US Department of Transportation post-accident drug testing. The results of this testing were negative for all tested-for substances.[29]

1.6.2.4 Precrash Activities. According to the combination vehicle driver, he went to bed between 8:30 and 9:00 p.m. the night before the crash. On the morning of the crash, he woke at 4:15 a.m. and left his house around 4:45 a.m. He went to Blessings Gravel in Tishomingo, where his vehicle was loaded with gravel. He weighed out around 7:00 a.m. and headed for Love County District 2, located just south of Marietta, Oklahoma, to drop off the load. He returned twice and was traveling through Tishomingo with his third load of the day when the crash occurred.

1.6.2.5 Cell Phone Use. The combination vehicle driver provided his phone records to the NTSB. The NTSB examined the phone use data, which indicated that he was not on a call or using his phone's native texting application at the time of the crash. The records indicated data usage up until the time of the crash; however, because the phone itself was not examined, it could not be determined whether the data activity was initiated by the driver or was from an application that was passively running without input from the driver.

1.7 Teen Drivers and Graduated Driver Licensing

Although teens drive the fewest miles compared to every age group except for the oldest drivers, their incidences of crashes and crash deaths are disproportionately

[27] 49 *CFR* 382.303 specifies post-accident testing for an occurrence involving a commercial vehicle operating on a public road in commerce. It only requires the submission of urine tests; however, the Oklahoma DPS requested a blood sample from the driver, which he provided.

[28] The FAA Forensic Sciences Laboratory has the capability to test for about 1,000 substances including toxins, prescription and over-the-counter medications, and illicit drugs.

[29] Tested-for substances in US Department of Transportation urine drug testing are marijuana metabolites, cocaine metabolites, amphetamines, opioids, and phencyclidine (PCP), in accordance with 49 *CFR* 40.82, as detailed at 49 *CFR* 40.85.

high. According to the Insurance Institute for Highway Safety (IIHS), more teens, ages 13–19, died in motor vehicle crashes in both 2021 and 2022 than in any other year since 2012 (IIHS 2024). For drivers ages 16–19, their fatal crash rate per mile driven is nearly three times that of their age-20-and-older counterparts, with the risk being highest at ages 16 and 17 (IIHS 2024). According to NHTSA, in 2022, 3,615 teen drivers, ages 15–19, were involved in crashes that included fatalities (NHTSA 2024). Every state has adopted some form of graduated licensing, which phases in licensure and manages exposure to risks (IIHS 2023a). Comprehensive graduated driver licensing (GDL) systems gradually introduce novice drivers to driving by limiting their exposure to riskier situations and are proven to reduce crashes involving teen drivers. A 2015 meta-analysis reviewing research on GDL programs from 2001–2011 found that these programs showed a 16% reduction in crashes for 16-year-olds and an 11% reduction for 17-year-olds (Masten and others 2015).[30] Other studies have found that GDL reduced crashes by up to 40% and fatal crashes of 16-year-old drivers by about 11% (Williams and Shults 2010, Johns Hopkins Bloomberg School of Public Health 2006).

In 2002, the NTSB issued Safety Recommendation H-02-32 to several states, including Oklahoma, to provide teen drivers with three stages of GDL support and restrict young novice drivers with provisional or intermediate licenses from carrying more than one passenger under the age of 20 unless accompanied by a supervising adult driver and until they receive an unrestricted license or for at least 6 months (whichever is longer). The overall status of Safety Recommendation H-02-32 is "Open—Acceptable Response."[31] However, Oklahoma's status is "Closed—Acceptable Action," because in 2005, Oklahoma's governor signed legislation enacting these restrictions for drivers with intermediate licenses.

Oklahoma's GDL law has four phases, which apply to all novice drivers under 18 years old until they pass all requirements for unrestricted licensing (see table). Students taught in a classroom driving school must have an intermediate license for at least 6 months. Those who are parent-taught must have no traffic convictions on their driving record and hold an intermediate license for at least 1 year. GDL violations can result in penalties such as suspension or revocation of the learner's permit or intermediate license, or an extension of the time before full licensure.

[30] A meta-analysis is a statistical study design used to systemically summarize and combine the results of multiple previous independent studies relevant to an issue.

[31] The overall classification summarizes the classifications for each individual recipient of multi-recipient recommendations. As of the date of this report, Safety Recommendation H-02-32 is classified as Closed—Acceptable Action for Alaska, Arizona, Kentucky, Oklahoma, and Utah; Closed—Acceptable Alternate Action for Connecticut, Minnesota, and Nebraska; Open—Acceptable Alternate Response for Nevada and North Dakota; and Open—Unacceptable Response for Hawaii, Kansas, Montana, and Wyoming.

Table. Oklahoma GDL laws: classroom driving school versus parent-taught education.

License Type	Driving Privileges	Classroom Driving School Requirements	Parent-Taught Education Requirements
No License	**When**: While receiving instruction from and accompanied by a certified driver education instructor	• At least 15 years old • While receiving instruction from a certified instructor	(Not eligible)
Learner Permit Restriction 9	**When**: While accompanied in the front seat by a licensed driver at least 21 years old	✓ At least 15 ½ years old ✓ Must be enrolled in or have completed driver education ✓ Must have passed written driving exam ✓ Must have passed vision exam	✓ At least 16 years old ✓ Must have passed written driving exam ✓ Must have passed vision exam
Intermediate License Restriction G	**When**: 5 a.m. to 11 p.m., unless for activities related to school, church, or work OR Any time if accompanied in the front seat by licensed driver at least 21 years old **Passengers**: 1 passenger OR Only people who live in driver's home OR Any passenger if accompanied in the front seat by licensed driver at least 21 years old	✓ Must have a Learner Permit for at least 6 months ✓ Must have completed at least 40 hours (10 hours at night) of behind-the-wheel training from a licensed driver at least 21 years old and licensed for at least 2 years (parent must certify this) ✓ Must have no traffic convictions on driving record ✓ Must have passed driving skills exam	✓ Must have a Learner Permit at least 6 months ✓ Must have completed at least 40 hours (10 hours at night) of behind-the-wheel training from a licensed driver at least 21 years old and licensed for at least 2 years (parent must certify this) ✓ Must have no traffic convictions on driving record ✓ Must have passed driving skills exam
Unrestricted License	**When**: Unrestricted **Passengers**: Unrestricted	✓ Must have an Intermediate License for at least 6 months ✓ Must have no traffic convictions on driving record **OR** ✓ Must be at least 18 years old ✓ Must have passed all driving and vision exams	✓ Must have an Intermediate License for at least 1 year ✓ Must have no traffic convictions on driving record **OR** ✓ Must be at least 18 years old ✓ Must have passed all driving and vision exams

Source: Oklahoma Statutes, Title 47: Motor Vehicles.

1.8 Oklahoma Cannabis Laws

In June 2018, Oklahoma legalized medical marijuana, allowing those over 18 years of age to obtain a medical marijuana license with a physician's signature. Minors are also allowed to obtain a medical marijuana license but are required to have the signatures of their legal guardian and two physicians. The car driver did not hold a medical marijuana license, according to the Oklahoma Medical Marijuana Authority.[32]

Since before the legalization of medical marijuana, it has been and remains unlawful in Oklahoma for any person to operate a motor vehicle while under the influence of any intoxicating substance that may render them incapable of safe driving, or with any amount of marijuana (a state Schedule I controlled substance) or marijuana metabolites in blood or other bodily fluids (at the time of a test within 2 hours of an arrest) (OSCN 2023).[33]

1.9 Oklahoma Driving and Drug Education Programs

1.9.1 Driver Education

Parent-taught driver education is an alternative to conventional driver education that is recognized by Service Oklahoma (Service Oklahoma 2023a and 2023b). It is offered as a correspondence study through approved parent-taught driver education providers. Students must be at least 15 years old to be eligible to start the correspondence portion of the course. They cannot start any behind-the-wheel training until they have passed a written and vision examination and applied for and received a learner's permit.

The parent-taught course consists of a minimum of 30 hours of computer-based instruction from a third-party provider approved by Service Oklahoma, as well as a minimum of 55 hours of behind-the-wheel instruction under the supervision and instruction of a parent instructor. After completion, the parent or caregiver must sign an affidavit that all training was completed and mail it to Service Oklahoma. All parent-taught driver education courses are required to include, but not be limited to, instruction in the following:

[32] The Oklahoma Medical Marijuana Authority is the regulatory agency for Oklahoma's medical marijuana program. Its responsibilities include processing commercial and patient license applications, providing customer service to licensees and applicants, facilitating the rulemaking process based on state statutes, enforcing rules, and investigating possible violations of medical marijuana laws.

[33] 47 *Oklahoma Statutes* 11-902 (2022).

- Signs, signals, highway markings, and highway design
- Rules of the road, state laws, and local ordinances
- Driving attitude toward motorcyclists, bicyclists, and pedestrians
- Basic driving maneuvers
- Operation of motor vehicle on streets and highways
- Familiarity with the *Oklahoma Driver Manual*
- Insurance laws of the state
- Financial responsibility
- Seat belt use and laws
- Effects of natural laws on driving[34]
- Alcohol and drug substance abuse and the effect on driving
- Basic vehicle maintenance, including fluid levels, tire pressure, and lighting systems
- Driving skills

As part of the computer-based instruction, Oklahoma requires a module on "Alcohol and drug substance abuse and the effect on driving." Although it is unknown which parent-taught driver education course the car driver completed, the NTSB reviewed the American Automobile Association (AAA) of Oklahoma driver education course as an example of one of the 13 approved programs in Oklahoma, for sample content.[35]

The AAA course included 30-minute modules titled "Alcohol and its effects," "Alcohol elimination and refusal," and "Effects of illness, disabilities, drugs." The "Effects of illness, disabilities, drugs" module contained several slides on cannabis, stating that the drug can make it more difficult to judge distances, slows decision-making and reaction time, can cause difficulties paying attention, and reduces

[34] The natural laws of driving refer to the Newtonian forces of physics, such as gravity, inertia, potential energy, kinetic energy, friction, centrifugal and centripetal forces, and momentum, which help drivers to anticipate how to handle their vehicle and react to various situations.

[35] See Approved Parent-Taught Driver Education Providers for the full list of approved providers in Oklahoma.

coordination. The module also stated that the impact of cannabis can be the greatest on new users who are often new drivers. Although other modules discussed the length of time it takes to eliminate alcohol from the body, there is also research that addresses the length of time needed before it is safe to drive after using cannabis (for example, see Huestis and others 1992 and Kosnett and others 2023). This information about the time it takes to eliminate the effects of cannabis was not presented in the module.

1.9.2 Driver Manual and Education Resources on Drug-Impaired Driving

In addition to approving driver education courses, Service Oklahoma provides a driver manual to help students become safe drivers and qualify for Oklahoma driver's licenses. Although it is not an official legal reference to Oklahoma traffic laws, the driver manual explains the knowledge and skills drivers need to drive safely and legally on Oklahoma's roads and highways. When the crash occurred, the *Oklahoma Driver's Manual* had last been revised in 2017, and it provided some information about marijuana (Oklahoma DPS 2017). The 2017 manual stated that both legal and illegal drugs can alter driving behavior. It included marijuana in its Illegal Drugs section, stating that, "illegal drugs are not good for your health and affect your ability to drive safely. For example, research shows that people who use marijuana make more driving mistakes than other drivers, have more trouble adjusting to glare, and have more arrests for traffic violations."

Although marijuana has been legalized for approved medical uses in Oklahoma, the state has a zero-tolerance drug law for driving, meaning that it is unlawful for any driver to have any measurable amount of specified drugs, including marijuana, in their body.[36] License revocation for the first offense is 6 months, increasing to 12 months for the second offense and 36 months for the third offense. Additional fines and penalties may also be levied.

The 2024 revised version of the *Oklahoma Driver Manual*, published after the crash, categorizes marijuana separately from illegal drugs and prescription and over-the-counter drugs in its chapter on alcohol, drugs, and driving. In the same chapter, the manual states that, "it is unlawful and punishable . . . for any person under 21 years of age to drive, operate or be in actual physical control of a motor vehicle . . . who exhibits evidence of being under the influence of any other intoxicating substance" (Service Oklahoma 2024). The manual includes a separate section within the same chapter called "'Zero Tolerance' for Drivers Under 21." Like the other portions of the manual, this section does not specify that Oklahoma's zero-

[36] 47 *Oklahoma Statutes* 11-902.

tolerance law for controlled substances, including marijuana, applies to all drivers rather than only those under 21 years of age (Service Oklahoma 2024).

1.9.3 Oklahoma Highway Safety Office

The OHSO, within the Oklahoma DPS, works to manage safety programs designed to reduce traffic-related fatalities and serious injuries through its work with NHTSA, the FHWA, the Federal Motor Carrier Safety Administration, and other national and local safety partners. The OHSO publishes an annual *Highway Safety Plan* as a framework to help strategically guide its efforts. The 2023 *Highway Safety Plan* projected an increase in drug-related crashes from 223 in 2019 to 283 in 2023.[37] The office's countermeasures for impaired driving include high-visibility enforcement, judicial education, laboratory testing equipment, law enforcement training, public education and information (including paid media campaigns to prevent impaired driving), and law enforcement outreach liaisons.

The primary role of the OHSO law enforcement outreach liaisons is to inform the public about traffic safety through the OHSO statewide behavioral highway safety program.[38] Two full-time deputy sheriffs from the Oklahoma County Sheriff's Office are assigned to set up and conduct public awareness events across Oklahoma as part of the OHSO's traffic safety outreach plan. Among the OHSO's sponsored activities is the Oklahoma Challenge, a traffic safety outreach program that engages students in middle and high school as well as technical school and college students. The Oklahoma Challenge was created in 1984 to address teen drunk driving and seat belt use but has expanded in scope to include hands-on traffic safety experiences with safety professionals to educate young drivers on alcohol impairment, truck safety, distracted driving, all-terrain vehicle safety, seat belt use, and work zone safety (Oklahoma Challenge 2023). In 2023, the Oklahoma Challenge conducted 20 distinct traffic safety events that were attended by an estimated 582 schools and 9,888 participants (Oklahoma Challenge 2024). The Oklahoma Challenge does not include information on cannabis impairment as part of its program.

Aside from the Oklahoma Challenge, the OHSO website also provides the public with information on cannabis. This information includes safety and intervention tips, guidance on its impairing effects, references and links to NHTSA's research and cannabis impairment public awareness campaigns, guidance on how long the impairing effects of cannabis last, and cannabis impairment campaigns that have

[37] Oklahoma Highway Safety Office, *FY2023 Oklahoma Highway Safety Plan* | oklahoma.gov.

[38] Federal funds from NHTSA are administered to state and local entities and funds through the state of Oklahoma.

been developed for the Oklahoma audience and refined using focus groups (OHSO 2023).

1.9.4 Oklahoma State Department of Education

The Oklahoma State Department of Education (OSDE) is charged with determining the policies and directing the administration and supervision of its public school districts, including elementary through high schools.[39] In 1972, Oklahoma passed the Drug Abuse Education Act, which authorized "the development of a comprehensive drug abuse education program for children and youth in kindergarten and grades one through twelve in the public school districts of this state which choose to participate."[40] The Oklahoma Alcohol and Drug Abuse Prevention and Life Skills Education Act was added in 1987.[41] The intent of the 1987 legislation is that "all Oklahoma school districts develop and implement a curriculum for drug and alcohol abuse prevention for all grade levels" and that the OSDE "establish objective criteria, guidelines, and a comprehensive integrated curriculum for substance abuse programs and the teaching of life skills in local schools and school districts." The OSDE should also serve as a resource for schools and school districts. Although Oklahoma schools are not currently required to teach the drug abuse curriculum, the OSDE is required to make this curriculum available to them.

The OSDE publishes the Oklahoma Academic Standards (OAS), which serve as the foundation for curriculum and outline the concepts, content, and skills that students should master by the end of each year.[42] For the subject of health, the OAS support "an effective health education program [that] offers all students the opportunity to gain the needed skillfulness, knowledge and dispositions toward healthy lifestyles." The OAS for Health Education encompass eight standards. Standard one is Essential Knowledge, which focuses on basic concepts and knowledge of healthy behaviors and is to be used in conjunction with the other seven standards (Analyze Influences, Access Information, Interpersonal Communication, Decision Making, Goal Setting, Self-Management, and Advocacy), which focus on skills that help students identify methods to enhance healthy behaviors. The OSDE also provides a curriculum framework containing age-appropriate materials and resources to be used to translate the OAS for Health Education into classroom practice.[43]

[39] See 70 *Oklahoma Statutes* 1-106.

[40] See 70 *Oklahoma Statutes* 1210.221.

[41] See 70 *Oklahoma Statutes* 1210.229-1.

[42] See Oklahoma Academic Standards | Oklahoma State Department of Education.

[43] See Oklahoma Health and Physical Education Framework.

The topic of substance use and abuse prevention is contained within the Essential Knowledge standard and includes age-appropriate references to 1) safe and unsafe use, risks, and effects; and 2) rules and laws of medicine, alcohol, and other drugs. For example, the OAS curriculum framework for students in pre-kindergarten through grade 2 offers resources concentrating on medicine, whereas the curriculum framework for grades 9–12 includes resources for learning about the effects of alcohol and other drugs on school or performance, job loss, and absenteeism. Neither the OAS for Health Education nor the curriculum frameworks discuss the impairing effects of drugs on driving or the illegality of their use while driving.

In addition to developing the OAS for Health Education and curriculum framework, the OSDE is required to provide resources related to life skills and drug and alcohol abuse prevention.[44] The OSDE website included resources related to substance abuse and mental health services.[45] As of May 18, 2024, there were three links to pages related to marijuana: "Marijuana: Facts for Teens," "Marijuana: Facts Parents Need to Know," and "Tips for Teens: Marijuana." When the NTSB attempted to access these links, they did not direct the user to the specified resource when clicked.

1.9.5 Tishomingo High School Drug Education Activities

Before the crash, Tishomingo High School had several drug, alcohol, and tobacco education activities for its students, including (1) Youth Action for Health Leadership, which engages and educates students on important issues related to tobacco and nutrition; and (2) National Red Ribbon Week, which focuses on "keeping kids drug free."[46] Additionally, Tishomingo High School partners with the Chickasaw Nation for the "Define Your Direction" event, which teaches all students to have a vision of their drug-free future and to set goals that match their lifestyle choice.

[44] See 70 *Oklahoma Statutes* 1210.229-5.

[45] See the OSDE's Substance Abuse Resources | Oklahoma State Department of Education (ok.gov).

[46] Youth Action for Health Leadership is a youth-led health initiative, funded by the Tobacco Settlement Endowment Trust, that focuses on smoking prevention. National Red Ribbon Week is sponsored by the National Family Partnership and focuses on drug use prevention.

1.10 Postcrash Actions

1.10.1 Oklahoma Highway Safety Office

In July 2022, 5 months after the crash, the OHSO reached out to Tishomingo High School to offer to host the Oklahoma Challenge. Before this outreach, the school district's superintendent and Tishomingo High School's principal said that they were unaware of the OHSO's resources on traffic safety. Likewise, to the OHSO director's knowledge, Tishomingo High School had not reached out to the OHSO before the crash. After their discussion, Tishomingo High School participated in the Oklahoma Challenge on September 8, 2022, at the Murray State College campus. At that event, the Oklahoma County Sheriff's Office spoke to the students about impairment.

1.10.2 Tishomingo High School

Tishomingo High School had a lunch policy that allowed students to drive off campus. According to the superintendent of the Tishomingo Public School District, lunch was scheduled between 11:27 a.m. and 12:31 p.m.[47] Tishomingo High School had an open campus, primarily because the school did not have a cafeteria. Students could either be bused to the cafeteria at the elementary school or could leave campus to get lunch. According to her parents, the car driver would usually drive to a friend's house during the lunch break.

Before the crash, there was no guidance or policy on student conduct related to off-campus travel procedures in the student handbook. On August 24, 2022, as a result of the crash and the NTSB's investigation, school officials reported that off-campus policies had been established. These new policies included the terms of the state's GDL restrictions (including passenger limits), limiting the number of passengers to the number of seat belts available in a vehicle, and prohibiting students from traveling "outside of town" for lunch. The school principal covered these new policies with all students in a back-to-school assembly held in 2022 and reported that this content would be subsequently covered at annual back-to-school meetings with each grade level.

Additionally, after the crash, Tishomingo High School held a student assembly at the school on January 12, 2023, where the local police department spoke to the student body about drug-impaired driving (including cannabis).

[47] Students are required to attend tutoring from 11:27 a.m. to 11:52 a.m. on certain days. This tutoring was not required of the car driver or her passengers on the day of the crash.

Tishomingo High School also approved plans to update its surveillance video system for its parking lot to better monitor student drivers. At the time of the crash, the surveillance video system did not cover the entire parking lot.

1.10.3 Oklahoma Department of Transportation

After the crash, ODOT updated its maintenance on the SH-22 and US-377 intersection and made several changes to improve traffic control. As of May 2022:

- The pavement striping on all approaches to the intersection was refreshed.
- The stop line on eastbound SH-22 at US-377 was re-striped.
- Flags were added to the stop-ahead sign and stop sign on SH-22.
- Flashing beacons were added to the stop sign on SH-22.
- Two sets of transverse rumble strips were added to eastbound SH-22 on the approach to the stop sign.
- New no-left-turn signs were added for northbound US-377.
- New no-right-turn signs were added to eastbound SH-22.

In addition to these actions, ODOT proposed a realignment of the SH-22 and US-377 intersection to improve safety and submitted a project initiation report on October 18, 2022, for the next 8-year cycle of projects, which focuses on addressing Oklahoma's greatest transportation needs. The transportation commissioner is working with ODOT's field division engineers and staff to identify the most critical highway and bridge projects and create a balanced statewide plan with anticipated federal and state funding. Although ODOT did not initially identify the US-377 and SH-22 intersection as a high-crash area based on a review of annual crash rankings, a redesign of the intersection was proposed because of the two fatal crashes in 2021 and 2022 (the subject crash). ODOT indicated in correspondence with the NTSB that the crash rankings are not the only method by which intersections may be targeted for improvement; each division may also request action based on recent crashes or local appeal. ODOT reassessed the intersection and proposed that an engineering traffic and safety study be conducted to redesign the intersection for safety improvements. In October 2022, the project was approved by ODOT, and the construction is planned for fiscal year 2026.

1.10.4 Oklahoma State Department of Education

In December 2023, the OSDE published a one-page Prevention Playbook on its website in recognition of National Drunk and Drugged Driving Prevention Month.[48] This document included some information about marijuana and teen driving behaviors, including that marijuana users are more likely to be involved in a crash than drivers with no evidence of marijuana use.

[48] See Prevention Playbook: December 2023.

2. Analysis

2.1 Introduction

On the afternoon of March 22, 2022, a Chevrolet Spark was being driven by a 16-year-old driver with an intermediate driver's license. She was traveling with five teen passengers—for a total of six occupants—in a car with only four seating positions on highway SH-22 in Tishomingo, Oklahoma. She slowed her car to 1 mph 32 feet before reaching the stop line for the intersection with US-377, then began to accelerate. The flow of traffic on SH-22 was controlled by a stop sign, and traffic on US-377 had no traffic control devices or signs. The car driver did not stop her car at the stop sign, and instead of yielding to an oncoming combination vehicle traveling south on US-377, she accelerated while turning left in front of the combination vehicle. As a result, the car was struck. All six occupants in the car died; the combination vehicle driver was uninjured. Toxicological testing of the car driver's blood was positive for cannabis's primary psychoactive compound, THC.

This analysis first examines factors that can be excluded as causal or contributory to the crash and then discusses the dynamics of the crash (section 2.2). Next, it evaluates the following safety issues:

- The car driver's distraction from transporting multiple teen passengers, inexperience with driving, and likely impairment due to recent cannabis use (section 2.3).

- The need for public awareness, effective communication, and access to resources about the impairing effects of cannabis use on driving (section 2.4).

As a result of our investigation, the NTSB established that the following factors did not cause or contribute to the crash:

- *The combination vehicle driver's licensing, medical certification, and experience:* The combination vehicle driver had a commercial driver's license with appropriate endorsements, a valid medical certificate, and 25 years of experience driving commercial motor vehicles.

- *Impairment of the combination vehicle driver from alcohol or other drugs:* Postcrash toxicology test results revealed no evidence that the combination vehicle driver had used alcohol or other tested-for drugs before the crash.

- *Cell phone use by the car driver or combination vehicle driver:* Cell phone records indicated that neither the car driver nor the combination vehicle

driver was engaged in texting or cell phone conversations at the time of the crash.

- *The mechanical condition of the combination vehicle or passenger car:* The postcrash examination of the combination vehicle did not identify any pre-existing mechanical conditions that might have contributed to the crash. Despite two of the combination vehicle's brake pushrods being out of adjustment, the number of out-of-adjustment brakes did not exceed the out-of-service limits for the vehicle. Data from the passenger car's EDR indicated that the car was actively responding to driver inputs before the crash.

- *Highway signage and sight distance:* The intersection had appropriate regulatory and warning signs and was compliant with AASHTO standards for sight distance. Further, there were no external sight obstructions on the approach to the intersection. Although highway signage and sight distance were not factors in the crash, ODOT is planning to redesign the intersection for safety improvements (as discussed in section 1.10.3).

The NTSB therefore concludes that none of the following were factors in the crash: (1) the combination vehicle driver's licensing, medical certification, and experience; (2) impairment of the combination vehicle driver from alcohol or other drugs; (3) cell phone use by the car driver or combination vehicle driver; (4) the mechanical condition of the combination vehicle or passenger car; or (5) highway signage and sight distance.

2.2 Crash Discussion

As the car driver approached the intersection of SH-22 and US-377, she briefly slowed her vehicle 32 feet before the intersection (refer to figure 5). The combination vehicle driver and a witness traveling behind the car driver both indicated that she was traveling behind an SUV that was in front of her at the stop sign. The car driver did not come to a stop at the intersection, instead accelerating to make a left turn in front of the oncoming combination vehicle traveling south on US-377.

The combination vehicle was traveling at 51–53 mph on US-377 before the crash occurred. Assuming that it was traveling at a constant approach speed, the combination vehicle was about 220 feet and 2.5 seconds from impact as the car began increasing speed and then crossed the stop line, which was 48 feet from the point of impact. This scenario provided little time for the combination vehicle driver to detect that the car was not stopping and would instead cross in front of his vehicle. The tire mark evidence on scene was consistent with the combination vehicle driver executing braking 14 to 38 feet before impact and making an evasive steering

maneuver as a response to the imminent impact. The NTSB concludes that although the combination vehicle driver reacted to the car crossing into his travel lane by braking and steering, he did not have enough time to avoid the collision.

2.3 Car Driver Actions

2.3.1 Transporting Multiple Teen Passengers

At the time of the crash, the car driver was transporting five non-family members under the age of 21 (for a total of six occupants). This number of occupants not only violated the restriction of the Oklahoma GDL program but also exceeded the seating capacity of the car, which only provided seats and seat belts for four occupants.

The reason for the GDL restriction on the number of non-family, non-adult passengers is that a higher number of teen passengers increases the likelihood of risky behavior and distracted driving. According to NHTSA, a teen driver is 2.5 times more likely to engage in one or more risky behaviors when driving with one teen peer than when driving alone; when driving with multiple teen peers, that likelihood increases to 3 times. Distractions are also more common when multiple teen peers are present, with loud conversation five times more likely and horseplay nine times more likely than when driving with a parent or adult (NHTSA 2012). Oklahoma's GDL law limits the number of passengers to one non-family member if the driver is not accompanied by a licensed driver at least 21 years old sitting in the front seat. In this crash, the number of passengers exceeded the number permitted by Oklahoma's GDL laws for a driver with an intermediate license, thereby putting the driver at increased risk of a crash. Therefore, the NTSB concludes that the teen car driver's transportation of five teen passengers violated Oklahoma's intermediate license requirements and likely resulted in distraction and increased risky driving behavior.

2.3.2 Inexperience and Decision to Make a Left Turn Without Stopping

Before accelerating toward the intersection, the car driver had adequate line of sight to see the approaching combination vehicle without any objects obstructing her view; therefore, her decision not to stop and instead accelerate into a left turn represented an unsafe and inaccurate evaluation of the amount of time she needed to clear the intersection. According to NHTSA, making a left turn is more dangerous than making a right turn. Left turns are a contributing factor in about 61% of all crashes that occur while a vehicle is crossing an intersection and in 22% of all motor vehicle crashes. Conversely, right turns are a factor in only 3.1% of intersection-crossing crashes and 1.2% of overall crashes (Choi 2010).

To safely execute a left turn, a driver must make a series of complex decisions within a short period of time. The driver must look for and identify potential hazards such as oncoming traffic, look around blind spots, and follow traffic signs. If other vehicles are present, the driver must determine that there is a sufficient time gap to safely clear the other vehicles' paths. Left-turn maneuvers are difficult for all drivers but can present additional challenges for drivers with limited experience. The crash driver had obtained her intermediate driver's license in November 2021, about 4 months before the crash occurred. She had been driving for about 1 year. Research by the Children's Hospital of Philadelphia found that left turns ranked among the top five crash scenarios for teen drivers (McDonald and others 2014). The NTSB concludes that the teen car driver's decision not to stop at the intersection and to make a left turn in front of the oncoming combination vehicle was likely due, in part, to limited driving experience.

2.3.3 Recent Cannabis Use

The car driver's postmortem toxicology testing detected THC and its metabolites, indicating that she had used cannabis. Her toxicology results could not be used to establish the dose or route of her cannabis use.

When cannabis is inhaled (smoked or vaped), the blood THC concentration peaks rapidly (this peak is delayed and flattened when cannabis is consumed orally). For a given dose of THC, vaping may produce higher peak blood THC concentrations than smoking (Spindle and others 2018). Subsequent decline in the blood THC concentration is hastened by diffusion of THC into fatty tissues. An occasional cannabis user's blood THC concentration may fall to a very low or undetectable level within hours after use, whereas a frequent cannabis user's blood THC concentration may remain detectable at low levels for days or weeks of abstinence, as THC sequestered in fatty tissues redistributes into blood (Huestis 2007, Bergamaschi and others 2013, Spindle and others 2019). Acute impairing effects of cannabis can be felt within minutes and typically last at least 1–2 hours after use, with return to baseline within about 3–7 hours, although some residual effects may persist longer, and the duration of acute effects may be increased at higher cannabis doses or when cannabis is used orally (NHTSA 2014, McCartney and others 2021).

A person's instantaneous blood concentration of THC does not directly predict that person's impairment (Compton 2017). Attempts at predicting impairment from measured concentrations of THC and its metabolites often focus on estimating whether the time of last cannabis use was recent enough to indicate likely persistence of acute psychoactive effects (Huestis and others 1992, Kosnett and others 2023).

A THC concentration of 95.9 ng/mL was measured in a cavity blood specimen from the car driver. This concentration represented a similar numeric range as peak

blood THC concentrations that might be found in some living individuals during or just after inhaling cannabis (Baselt 2017). If such a THC concentration were measured in a living person's blood (particularly along with similar concentrations of THC metabolites as were measured in the car driver's specimen), this would indicate a high likelihood that the person had used cannabis very recently, and therefore was likely still experiencing acute impairing cannabis effects (Kosnett and others 2023, NHTSA 2014).

Unlike results obtained from a living person, the car driver's toxicology results were obtained from cavity blood. Cavity blood specimens sometimes may be contaminated by other bodily fluids or by THC diffusion from tissues, including lung tissue that may contain high concentrations of THC (Kemp and others 2013). This limitation to the interpretation of cavity blood prevented the NTSB from determining the car driver's time of last cannabis use with certainty. However, considering the THC and THC metabolite concentrations that were generally consistent with very recent cannabis use, the opportunity available to the car driver for cannabis use within the hour before the crash, and the typical expected duration of acute impairment from cannabis use, the NTSB concludes that the teen car driver likely was impaired by effects of cannabis at the time of the crash.

As reported in the 2022 NTSB safety research report *Alcohol, Other Drug, and Multiple Drug Use Among Drivers*, although alcohol continues to be the drug with the most detrimental impact on traffic safety, cannabis and other potentially impairing drugs contribute to the problem of impaired driving crashes (NTSB 2022). Alcohol and cannabis are the most commonly detected potentially impairing drugs for drivers on US roadways (NTSB 2022, Thomas and others 2022). Cannabis use can impair important skills needed for driving, including cognition, motor coordination, and reaction time. The use of cannabis can also impair the abilities to judge time, estimate distance, maintain sustained and divided attention, and make decisions, all of which are important aspects of driving performance (Hartman and others 2015, Hartman and Huestis 2013, NHTSA 2014).

In summary, the car driver had obtained her intermediate license 4 months before the crash and was at increased risk of being involved in a crash for several reasons, including driving with multiple teen passengers, which has been shown to increase the likelihood of distraction, incidence of risky behavior, and crash risk for novice drivers; inexperience and the complexity of executing a left-turn maneuver; and likely impairment from cannabis, which negatively affects basic motor controls, timing, and judgment. The NTSB concludes that the combined effects of the teen car driver's distraction, inexperience, and likely impairment from cannabis led to the crash.

As discussed in section 1.7, graduated driver licensing supports teen drivers by helping them to learn under safer, provisional conditions before being permitted

to drive with full privileges. Since 2005, Oklahoma has had robust, multi-stage licensing legislation in effect. The remainder of this report will focus on safety issues related to cannabis and driving impairment.

2.4 Need for Awareness, Effective Communication, and Access to Resources About Cannabis-Impaired Driving

2.4.1 Legal Status and Impairing Effects of Cannabis

Survey research shows that teen drivers as well as their parents have misconceptions about the legality and impairing effects of using cannabis in combination with driving. A survey of 2,800 teens and 1,000 parents was conducted to better understand their perceptions of driving under the influence of cannabis; the survey found the following:

- 33% of all teens surveyed thought that driving under the influence of cannabis was legal in states where it was legal for adult recreational use.
- 27% of parents surveyed also believed that driving under the influence of cannabis was legal in these states.
- 93% of parents believed that driving under the influence of alcohol was dangerous, but only 76% said the same about cannabis.
- 88% of teens agreed that drinking and driving was dangerous, but only 68% thought that driving under the influence of cannabis was dangerous (Liberty Mutual 2023).

Other research comparing the risk perception of alcohol- and cannabis-impaired driving found that although alcohol use was generally perceived to impair driving ability, the effect of cannabis use was perceived to depend on other factors such as the individual's characteristics and behaviors and the drug itself (such as the form and strength of cannabis). In general, focus group participants were more knowledgeable about alcohol-related policies and the risks of alcohol-impaired driving than the corresponding policies and risks related to cannabis (Greene 2018).

Cannabis use among drivers is a growing concern in part due to its current rapidly changing legal statuses across states (IIHS 2023b). In Oklahoma, for example, there are two separate designations for the regulatory status of cannabis: (1) legality of cannabis use for medical purposes with a license, and (2) illegality of driving after cannabis use. As of the time of the crash, Oklahoma had legalized cannabis for medical purposes if the user held a medical marijuana license; however, it was illegal for a driver to have any amount of marijuana, or one of its metabolites or analogs, in

their blood or bodily fluid when driving (OSCN 2023). Some states have "per se" cannabis driving laws, which are laws that prohibit driving with a level of THC or its metabolites in the body that exceeds a legal limit (in certain states, this is any detectable level). Other states have no cannabis-specific driving laws. Regardless, all 50 states—along with Washington, DC, and the commonwealth of Puerto Rico—prohibit driving while impaired by drugs, including cannabis (GHSA 2024).

As medical and recreational cannabis laws have changed in some states, the information about the drug and its effects on driving has not been well communicated to the public, as both adult and teen drivers have trouble understanding cannabis's impairing effects and whether using it is legal in combination with driving. Although drivers are generally aware of the dangers of driving after alcohol use, they are less likely to perceive driving after cannabis use to be dangerous. The NTSB concludes that the public's misconceptions about the legality of driving under the influence of cannabis and the extent of its impairing effects on driving are widespread; thus, it is essential to increase awareness among teen drivers and the general public about the illegality and detrimental effects of cannabis-impaired driving in order to reduce the incidence of driving under the influence of cannabis.

A multipronged approach to addressing this issue provides multiple avenues for increasing drivers' awareness about the illegality and detrimental effects of cannabis-impaired driving. Opportunities to influence attitudes, dispel misconceptions, and encourage safe driving behaviors in teens, young adults, and parents include school curricula, driver education programs and resources, parental engagement, and public legislation. The following sections discuss the educational curriculum available to Oklahoma students and the resources provided by Tishomingo High School before the crash, as well as an assessment of the areas where communication and awareness about cannabis-impaired driving can be strengthened, both in Oklahoma and throughout the United States.

2.4.2 Student and Driver Education

2.4.2.1 Oklahoma. Oklahoma school districts are encouraged to implement a curriculum for drug and alcohol abuse prevention for all grade levels, as developed by the OSDE (USDOE 2023).[49] Although the OSDE website provided age-specific OAS and curriculum framework for health education and included "substance use and abuse prevention" with information on the safe and unsafe use, risks, effects, and rules and laws of medicine, alcohol, and other drugs, it focused on the potential

[49] See the Oklahoma Alcohol and Drug Abuse Prevention and Life Skills Education Act, Section 885: Powers and Duties.

negative impacts on school or job performance. There was no information on the effects of impaired driving in either the OAS or the curriculum framework.

The OSDE website contained multiple external links listed under the Substance Abuse heading, but several of the links—including those related to marijuana—did not direct the user to the intended resource. Although Tishomingo High School provided students with educational activities promoting drug abstinence and good life choices, these activities did not specifically include information on the risks of cannabis-impaired driving. Refer to section 1.9.5 for a summary of these activities.

Based on the NTSB's review of the OSDE's OAS, curriculum framework, and other online resources, there was a lack of available material on the impairing effects of drugs, specifically cannabis or marijuana, on driving performance at the time of the crash. In December 2023, the OSDE released a one-page *Prevention Playbook* in recognition of National Drunk and Drugged Driving Awareness Month, outlining the scope of the problem and dispelling some of the myths. Although this playbook provides useful information about marijuana-impaired driving, it does not constitute a curriculum as specified by Oklahoma's Alcohol and Drug Abuse Prevention and Life Skills Education Act or an academic standard as required by Oklahoma statutes. The NTSB determined that Tishomingo High School had provided its students with some education and training opportunities related to alcohol and drug impairment before the crash; however, that training focused on committing to a drug-free life, refraining from alcohol use, and making good lifestyle choices. The impairing effects of cannabis on driving represented a topic area that was missing from these activities.

Providing information to children at earlier ages can prepare them to handle decisions they may be faced with later in life. Educational resources for students about the risks of cannabis impairment can be tailored for age-appropriate discussions. Learning at a young age about the impairing effects of cannabis on driving can help prepare future drivers to make responsible decisions.

The NTSB concludes that students from elementary through high school would benefit from education about cannabis and the risks of cannabis-impaired driving; however, relying on schools to develop educational programs that address the risks of cannabis-impaired driving, or depending on students or their parents to seek the information themselves using web-based or other outside resources, may not result in successfully connecting students to the proper information, as would be accomplished with a uniform curriculum framework that includes material on cannabis impairment and driving. Therefore, the NTSB recommends that the OSDE develop a drug and alcohol abuse prevention curriculum framework with content that covers the risks of impaired driving—including cannabis-impaired driving—and disseminate this curriculum framework to local school boards in a format that can be taught in elementary through high school classrooms.

The OHSO provides schools with the Oklahoma Challenge, a co-curricular, week-long program designed to engage students on traffic safety topics through interactive demonstrations, discussions led by law enforcement officers, and hands-on activities. The Oklahoma Challenge is another valuable resource for teaching traffic safety to teens but does not cover cannabis impairment as part of its safety topics. Therefore, the NTSB recommends that the OHSO incorporate information on the risks of cannabis-impaired driving into the Oklahoma Challenge and clarify that driving under the influence of cannabis is illegal.

The Oklahoma Challenge is one of several OHSO programs developed to address traffic safety issues, including the projected increase in drug-related fatalities. The NTSB's research report *Alcohol, Other Drug, and Multiple Drug Use Among Drivers* examined the Drug-Impaired Driving Criminal Justice Evaluation Tool for state, local, territorial, or tribal government agencies (NTSB 2022).[50] The research report concluded that this tool can provide valuable guidance to help states and communities identify opportunities to improve efforts to address drug-impaired driving. We recommended that the District of Columbia, the commonwealth of Puerto Rico, and the 50 states:

> Complete an assessment using the National Highway Traffic Safety Administration's (NHTSA) Drug-Impaired Driving Criminal Justice Evaluation Tool, and, if gaps are identified, apply to NHTSA for support in establishing programs to reduce drug-impaired driving. (H-22-39)

Oklahoma has not yet responded to this recommendation, and it is classified Open–Await Response for Oklahoma.[51] Although the OHSO describes multiple programs that address impaired driving in its annual *Highway Safety Plan*, including educational programs such as the Oklahoma Challenge, given Oklahoma's increasing number of drug-related fatalities, using the NHTSA Drug-Impaired Driving Criminal Justice Evaluation Tool would aid in evaluating and improving the safety outcomes of its existing programs. The NTSB concludes that NHTSA's Drug-Impaired Driving Criminal Justice Evaluation Tool can provide valuable guidance to help Oklahoma identify opportunities to improve efforts to address drug-impaired driving. Therefore, the NTSB reiterates Safety Recommendation H-22-39 to Oklahoma.

2.4.2.2 Other States' Activities. As an increasing number of states begin to legalize cannabis for medical and recreational purposes, a new generation of student drivers is obtaining licenses with these laws in effect. In December 2022, Massachusetts became the first state to require a driver education curriculum on

[50] For more information, see Drug-Impaired Driving Criminal Justice Evaluation Tool | NHTSA.

[51] The recommendation's overall status is Open—Await Response because the majority of the recommendation's recipients have not yet responded.

cannabis-impaired driving (WCVB Boston 2022).[52] The cannabis impairment curriculum was developed by AAA Northeast in partnership with the Massachusetts Registry of Motor Vehicles and the state's Cannabis Control Commission. The driver education course was amended to include information on how THC, the chemical in cannabis that psychologically affects users, impairs cognition, vision, reaction time, and perception of time and distance. The curriculum also provides information on potential safety hazards of driving under the influence of cannabis, such as veering into other lanes, speeding, and being unable to stop suddenly.

Although Massachusetts provides one example of how a state has implemented a program to address the issue of cannabis-impaired driving, only a small number of states have begun to address the ways in which new cannabis laws will affect highway safety measures. On June 19, 2023, Rhode Island passed a law requiring curriculum related to the dangers of marijuana-impaired driving to be added to driver education once it has been approved by the Board of Education.[53] Connecticut has also proposed a bill that requires 16- and 17-year-olds seeking a driver's license to complete a course on the effects of driving while under the influence of cannabis, but the bill has not yet passed.[54] The risks of cannabis-impaired driving are factually established but not always widely understood. A few states have begun to create policies aimed at preventing cannabis-impaired driving, which indicates that such progress is possible but also that there are considerable opportunities for improvement. Educating students on the risks of cannabis-impaired driving is critical to improving highway safety, particularly as states continue to legalize cannabis and thereby remove barriers to its access and use. The NTSB concludes that public officials responsible for highway safety and student education would benefit from learning about the issues related to the risks of cannabis-impaired driving so that they can incorporate this information into policy and education.

Two organizations that play important roles in influencing highway safety policy are the Governors Highway Safety Association (GHSA) and National Conference of State Legislatures (NCSL). The GHSA represents state highway offices in implementing federal grant programs that address safety issues, among which are drug-impaired driving and teen driver safety.[55] The NCSL promotes legislative effectiveness through interstate cooperation and includes all state legislators and

[52] Massachusetts has legalized the medicinal and recreational use of marijuana for adults age 21 and over. For additional information, see Marijuana Laws in Massachusetts | Mass.gov.

[53] See Rhode Island General Assembly, "An Act Relating to Motor and Other Vehicles - Operators' and Chauffeurs' Licenses."

[54] See Connecticut General Assembly, "An Act Concerning Driver Education on the Dangers of Driving Under the Influence of Cannabis."

[55] For more information, see Current Highway Safety Issues | GHSA.

staffers among its membership.[56] The NTSB recommends that the GHSA and the NCSL inform their members about the Tishomingo, Oklahoma, crash and about the need for information in driving curricula for future and novice drivers to understand the risks of and to avoid cannabis-impaired driving.

In addition, the National Association of State Boards of Education (NASBE) works on behalf of state school board members to advocate for national and state education policies that benefit students and the public. NASBE includes substance abuse education among its areas of advocacy and aims to prevent youth and adolescent drug use by strengthening health education curricula nationwide.[57] The NTSB recommends that NASBE inform its members about the Tishomingo, Oklahoma, crash and about the need for information in school curricula for future and novice drivers to understand the risks of and to avoid cannabis-impaired driving.

2.4.2.3 Parental Engagement. In addition to receiving information from their driver and scholastic education courses, student drivers learn about safe driving practices and are guided through the process by their parents. Although educational programs and courses should provide some information on cannabis, it is also helpful for parents or caregivers to have access to this information so that they can understand the importance of this topic and reinforce to their teen drivers the facts and risks of cannabis-impaired driving. Transportation safety advocates and state and federal agencies, including the NTSB, regularly conduct outreach to increase awareness of the dangers of marijuana-impaired driving, specifically for teen drivers. The NTSB is issuing Safety Alert SA-093 on this topic (see Safety Alerts [ntsb.gov]).

2.4.3 Driver Manuals

Both alcohol and cannabis are prevalent factors in serious and fatal crashes (Tefft and Arnold 2020, Thomas and others 2022). Although they both present serious risks of impairment when used in combination with driving, the impairing effects of alcohol are better understood by the public than the impairing effects of cannabis.

The 2017 *Oklahoma Driver's Manual* (which was the most recent version at the time of the crash) discussed cannabis and categorized it as an illegal drug (Oklahoma DPS 2017). Although cannabis use remains illegal in combination with operating a vehicle, the manual has not been updated to indicate the regulatory status change of this drug statewide in 2018 for medical use. Given the misconceptions about cannabis-impaired driving, it is particularly important to present clear and accurate

[56] For more information, see About Us (ncsl.org).

[57] For more information, see Supporting School Efforts to Combat Substance Abuse – NASBE – National Association of State Boards of Education.

information indicating that although cannabis may be legal for some users for medical purposes, it remains illegal for anyone to use cannabis in combination with driving. A revised *Oklahoma Driver Manual* was released in 2024 (2 years after the crash) which lists marijuana separately from illegal drugs but does not clarify either the legal status change in Oklahoma or the fact that Oklahoma's zero-tolerance law for drug use and driving applies to all drivers, rather than only those under the age of 21 (Service Oklahoma 2024).

Although there are no standardized driver's license requirements for all states, the American Association of Motor Vehicle Administrators (AAMVA)—through its standing committees, subcommittees, and working groups—has developed guidance for states in its *Model Driver's License Manual*.[58] States can use the information in the *Model Driver's License Manual* and customize its language to match their legislation (AAMVA 2022). The AAMVA manual was last updated in 2022 and includes information on the effects of alcohol and other impairing drugs. However, the AAMVA manual does not individually address cannabis, instead leaving it to be covered under the category of "other impairing drugs." In the 2022 NTSB safety research report, *Alcohol, Other Drug, and Multiple Drug Use Among Drivers*, cannabis was identified as second only to alcohol among the most detected potentially impairing drugs in all datasets.

Therefore, the NTSB concludes that because of the prevalence of cannabis in serious and fatal crashes, the changes in state laws regarding its legal use, and the public's misconceptions about its impairing effects on driving, educating drivers on the impairing effects of cannabis use and the illegality of driving under its influence, even if it is legal for medical purposes or recreational use in some states, is critical to highway safety. The NTSB recommends that Service Oklahoma update its *Oklahoma Driver Manual* to reflect Oklahoma's zero-tolerance law and to indicate that, although the state has legalized cannabis for some medical purposes, it impairs driving performance, and it is illegal for anyone to drive with any detectable level of cannabis in their system.

The NTSB also recommends that AAMVA update its *Model Driver's License Manual* to reflect that, although cannabis may be legal for medical purposes or recreational use in some states, it impairs driving performance, and it is illegal to drive while under the influence of cannabis.

Although individual states are responsible for developing their driver manuals and highway programs, they can look to guidance from AAMVA to develop model

[58] AAMVA includes state, provincial, and territorial administrators and officials in the United States and Canada. AAMVA's programs encourage uniformity and reciprocity among the states and provinces. For more information, see About - American Association of Motor Vehicle Administrators - AAMVA.

programs in motor vehicle administration, law enforcement, and highway safety. These programs are not required to be implemented, but AAMVA's guidance can create uniformity across states by providing baseline information for driver manuals and GDL parent instruction guides (AAMVA 2023). Therefore, the NTSB also recommends that AAMVA inform its members about the Tishomingo, Oklahoma, crash and about the need for information in driver manuals on the risks of and the need to avoid cannabis-impaired driving.

2.4.4 Labels on Cannabis Products

The 2022 NTSB safety research report *Alcohol, Other Drug, and Multiple Drug Use Among Drivers* examined the crash risk associated with different drugs, including alcohol; the prevalence of their use among drivers; and countermeasures to reduce impairment-related crashes. The report concluded that including driving-related warnings on cannabis products, like those on alcohol and many prescription and over-the-counter drugs, would increase awareness of the risks of cannabis-impaired driving (NTSB 2022). We recommended that the District of Columbia, the commonwealth of Puerto Rico, and the 21 states where cannabis use is legal but where driving-related warning labels on cannabis products are not required or are inadequate:

> Require a warning label on cannabis products advising users not to drive after cannabis use due to its impairing effects. (H-22-42)

The NTSB has received correspondence from 12 of the 23 recipients of Safety Recommendation H-22-42; Oklahoma has not yet responded.[59] Although it was not determined whether the driver in this crash had used a cannabis product that was purchased legally, given the findings of the NTSB's safety research report and the fact that medical marijuana in Oklahoma is not required to be labeled with a driving warning, providing this information on cannabis packaging would help to promote understanding of the impairing effects of cannabis. Further, including a warning label would be consistent with the need for a multipronged approach to increasing awareness about cannabis-impaired driving as well as the guidance found in AAMVA's *Model Driver's License Manual* for drivers to "check the label on the prescription and packaging before you take a drug for warnings about its effect" (AAMVA 2022). The NTSB concludes that adding a warning label on cannabis products would provide information that is consistent with driver manuals' instructions to check drug labels for impairing effects related to operating a vehicle and would therefore promote public awareness of the risks of cannabis-impaired driving. Therefore, the NTSB reiterates Safety Recommendation H-22-42 to the

[59] This recommendation is classified Open—Await Response overall and to the state of Oklahoma.

District of Columbia, the Commonwealth of Puerto Rico, and the 19 states with an open status.

3. Conclusions

3.1 Findings

1. None of the following were factors in the crash: (1) the combination vehicle driver's licensing, medical certification, and experience; (2) impairment of the combination vehicle driver from alcohol or other drugs; (3) cell phone use by the car driver or combination vehicle driver; (4) the mechanical condition of the combination vehicle or passenger car; or (5) highway signage and sight distance.
2. Although the combination vehicle driver reacted to the car crossing into his travel lane by braking and steering, he did not have enough time to avoid the collision.
3. The teen car driver's transportation of five teen passengers violated Oklahoma's intermediate license requirements and likely resulted in distraction and increased risky driving behavior.
4. The teen car driver's decision not to stop at the intersection and to make a left turn in front of the oncoming combination vehicle was likely due, in part, to limited driving experience.
5. The teen car driver likely was impaired by effects of cannabis at the time of the crash.
6. The combined effects of the teen car driver's distraction, inexperience, and likely impairment from cannabis led to the crash.
7. The public's misconceptions about the legality of driving under the influence of cannabis and the extent of its impairing effects on driving are widespread; thus, it is essential to increase awareness among teen drivers and the general public about the illegality and detrimental effects of cannabis-impaired driving in order to reduce the incidence of driving under the influence of cannabis.
8. Students from elementary through high school would benefit from education about cannabis and the risks of cannabis-impaired driving; however, relying on schools to develop educational programs that address the risks of cannabis-impaired driving, or depending on students or their parents to seek the information themselves using web-based or other outside resources, may not result in successfully connecting students to the proper information, as would be accomplished with a uniform curriculum framework that includes material on cannabis impairment and driving.
9. The National Highway Traffic Safety Administration's Drug-Impaired Driving Criminal Justice Evaluation Tool can provide valuable guidance to help Oklahoma identify opportunities to improve efforts to address drug-impaired driving.

10. Public officials responsible for highway safety and student education would benefit from learning about the issues related to the risks of cannabis-impaired driving so that they can incorporate this information into policy and education.
11. Because of the prevalence of cannabis in serious and fatal crashes, the changes in state laws regarding its legal use, and the public's misconceptions about its impairing effects on driving, educating drivers on the impairing effects of cannabis use and the illegality of driving under its influence, even if it is legal for medical purposes or recreational use in some states, is critical to highway safety.
12. Adding a warning label on cannabis products would provide information that is consistent with driver manuals' instructions to check drug labels for impairing effects related to operating a vehicle and would therefore promote public awareness of the risks of cannabis-impaired driving.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the Tishomingo, Oklahoma, collision was the teen driver's acceleration through the intersection after briefly slowing without stopping, due to distraction from having five teen passengers in the car, limited driving experience, and likely impairment from cannabis.

4. Recommendations

4.1 New Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations:

To the Oklahoma State Department of Education:

1. Develop a drug and alcohol abuse prevention curriculum framework with content that covers the risks of impaired driving—including cannabis-impaired driving—and disseminate this curriculum framework to local school boards in a format that can be taught in elementary through high school classrooms. (H-24-12)

To the Oklahoma Highway Safety Office:

2. Incorporate information on the risks of cannabis-impaired driving into the Oklahoma Challenge and clarify that driving under the influence of cannabis is illegal. (H-24-13)

To Service Oklahoma:

3. Update your *Oklahoma Driver Manual* to reflect Oklahoma's zero-tolerance law and to indicate that, although the state has legalized cannabis for some medical purposes, it impairs driving performance, and it is illegal for anyone to drive with any detectable level of cannabis in their system. (H-24-14)

To the Governors Highway Safety Association and the National Conference of State Legislatures:

4. Inform your members about the Tishomingo, Oklahoma, crash and about the need for information in driving curricula for future and novice drivers to understand the risks of and to avoid cannabis-impaired driving. (H-24-15)

To the National Association of State Boards of Education:

5. Inform your members about the Tishomingo, Oklahoma, crash and about the need for information in school curricula for future and novice drivers to understand the risks of and to avoid cannabis-impaired driving. (H-24-16)

To the American Association of Motor Vehicle Administrators:

6. Update your *Model Driver's License Manual* to reflect that, although cannabis may be legal for medical purposes or recreational use in some states, it impairs driving performance, and it is illegal to drive while under the influence of cannabis. (H-24-17)
7. Inform your members about the Tishomingo, Oklahoma, crash and about the need for information in driver manuals on the risks of and the need to avoid cannabis-impaired driving. (H-24-18)

4.2 Previously Issued Recommendations Reiterated in This Report

The National Transportation Safety Board reiterates the following safety recommendations:

To the State of Oklahoma:

Complete an assessment using the National Highway Traffic Safety Administration's (NHTSA) Drug-Impaired Driving Criminal Justice Evaluation Tool, and, if gaps are identified, apply to NHTSA for support in establishing programs to reduce drug-impaired driving. (H-22-39)

This recommendation is reiterated in section 2.4.2 of this report.

To the District of Columbia, the Commonwealth of Puerto Rico, and the States of Alabama, Arizona, Arkansas, Colorado, Florida, Illinois, Louisiana, Maine, Maryland, Mississippi, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, Virginia, and West Virginia:

Require a warning label on cannabis products advising users not to drive after cannabis use due to its impairing effects. (H-22-42)

This recommendation is reiterated in section 2.4.4 of this report.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

JENNIFER HOMENDY
Chair

MICHAEL GRAHAM
Member

THOMAS CHAPMAN
Member

ALVIN BROWN
Member

J. TODD INMAN
Member

Report Date: May 30, 2024

Appendixes

Appendix A: Investigation

The National Transportation Safety Board (NTSB) received notification of the Tishomingo, Oklahoma, crash on March 22, 2022, and launched investigators from the Office of Highway Safety to address highway factors, motor carrier operations, and human performance. The team included staff from the NTSB's Transportation Disaster Assistance Division. The NTSB's Office of Research and Engineering participated in the investigation.

The Federal Motor Carrier Safety Administration, Oklahoma Department of Transportation, and Oklahoma Department of Public Safety were parties to the investigation.

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* 1117(b) requires the following information on the recommendations in this report.

For each recommendation—

(1) a brief summary of the Board's collection and analysis of the specific accident investigation information most relevant to the recommendation;

(2) a description of the Board's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert; and

(3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To Oklahoma State Department of Education:

H-24-12
Develop a drug and alcohol abuse prevention curriculum framework with content that covers the risks of impaired driving—including cannabis-impaired driving—and disseminate this curriculum framework to local school boards in a format that can be taught in elementary through high school classrooms.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in 2.4.2, Student and Driver Education. Information supporting (b)(1) and (b)(2) can be found on pages 33–34; (b)(3) is not applicable.

To the Oklahoma Highway Safety Office:

H-24-13
Incorporate information on the risks of cannabis-impaired driving into the Oklahoma Challenge and clarify that driving under the influence of cannabis is illegal.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in 2.4.2, Student and Driver Education. Information supporting (b)(1) and (b)(2) can be found on page 35; (b)(3) is not applicable.

To Service Oklahoma:

H-24-14
Update your *Oklahoma Driver Manual* to reflect Oklahoma's zero-tolerance law and to indicate that, although the state has legalized cannabis for some medical purposes, it impairs driving performance, and it is illegal for anyone to drive with any detectable level of cannabis in their system.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in 2.4.3, Driver Manuals. Information supporting (b)(1) and (b)(2) can be found on pages 37–38; (b)(3) is not applicable.

To the Governors Highway Safety Association and the National Conference of State Legislatures:

H-24-15
Inform your members about the Tishomingo, Oklahoma, crash and about the need for information in driving curricula for future and novice drivers to understand the risks of and to avoid cannabis-impaired driving.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in 2.4.2, Student and Driver Education. Information supporting (b)(1) and (b)(2) can be found on pages 35–37; (b)(3) is not applicable.

To National Association of State Boards of Education:

H-24-16
Inform your members about the Tishomingo, Oklahoma, crash and about the need for information in school curricula for future and novice drivers to understand the risks of and to avoid cannabis-impaired driving.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in 2.4.2, Student and Driver Education. Information supporting (b)(1) and (b)(2) can be found on pages 35–37; (b)(3) is not applicable.

To American Association of Motor Vehicle Administrators

H-24-17
Update your *Model Driver's License Manual* to reflect that, although cannabis may be legal for medical purposes or recreational use in some states, it impairs driving performance, and it is illegal to drive while under the influence of cannabis.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in 2.4.3, Driver Manuals. Information supporting (b)(1) and (b)(2) can be found on pages 37–38; (b)(3) is not applicable.

H-24-18

Inform your members about the Tishomingo, Oklahoma, crash and about the need for information in driver manuals on the risks of and the need to avoid cannabis-impaired driving.

Information that addresses the requirements of 49 USC 1117(b), as applicable, can be found in 2.4.3, Driver Manuals. Information supporting (b)(1) and (b)(2) can be found on pages 37–39; (b)(3) is not applicable.

Appendix C: Precrash Electronic Data Recorder Information from Passenger Car

Time (seconds before impact)	Speed (mph)	Accelerator Pedal (% full deflection)[a]	Engine Throttle (% full)[b]	Engine RPM	Service Brake-Brake Switch
5	1	17	30	1,408	Off
4.5	3	25	39	1,920	Off
4	6	0	33	2,176	Off
3.5	7	0	22	1,856	**On**
3	7	47	30	1,728	Off
2.5	9	54	75	2,624	Off
2	12	54	83	3,264	Off
1.5	15	58	99	3,840	Off
1	17	99	99	4,480	Off
0.5	21	99	99	4,928	Off

[a] Indicates the position of the accelerator as a percent of full application.

[b] Indicates the actual position of the engine throttle blade as a percent of full application.

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