HHS Public Access

Author manuscript

J Safety Res. Author manuscript; available in PMC 2019 June 01.

Published in final edited form as:

J Safety Res. 2018 June ; 65: 161–167. doi:10.1016/j.jsr.2018.03.006.

Ability to monitor driving under the influence of marijuana among non-fatal motor-vehicle crashes: An evaluation of the Colorado electronic accident reporting system☆,☆☆,★

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Abstract

Introduction—As more states legalize medical/recreational marijuana use, it is important to determine if state motor-vehicle surveillance systems can effectively monitor and track driving under the influence (DUI) of marijuana. This study assessed Colorado's Department of Revenue motor-vehicle crash data system, Electronic Accident Reporting System (EARS), to monitor non-fatal crashes involving driving under the influence (DUI) of marijuana.

Methods—Centers for Disease Control and Prevention guidelines on surveillance system evaluation were used to assess EARS' usefulness, flexibility, timeliness, simplicity, acceptability, and data quality. We assessed system components, interviewed key stakeholders, and analyzed completeness of Colorado statewide 2014 motor-vehicle crash records.

Results—EARS contains timely and complete data, but does not effectively monitor non-fatal motor-vehicle crashes related to DUI of marijuana. Information on biological sample type collected from drivers and toxicology results were not recorded into EARS; however, EARS is a flexible system that can incorporate new data without increasing surveillance system burden.

Conclusions—States, including Colorado, could consider standardization of drug testing and mandatory reporting policies for drivers involved in motor-vehicle crashes and proactively address the narrow window of time for sample collection to improve DUI of marijuana surveillance.

☆The *Journal of Safety Research* has partnered with the Office of the Associate Director for Science, Division of Unintentional Injury Prevention, National Center for Injury Prevention and Control at the CDC in Atlanta, Georgia, USA, to briefly report on some of the latest findings in the research community. This report is the 51st in a series of "From the CDC" articles on injury prevention.

☆☆Disclaimer: The findings and conclusions in this paper are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

★Declarations of Interest: Declarations of interest: none.

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Practical applications—The evaluation of state motor-vehicle crash systems' ability to capture crashes involving drug impaired driving (DUID) is a critical first step for identifying frequency and risk factors for crashes related to DUID.

Keywords

Motor-vehicle crashes; Marijuana; Driving under the influence of drugs; Surveillance; Drugged driving

1. Introduction

In 2014, an estimated 22.2 million or 8.4% of Americans, aged 12 and older, reported using marijuana in the past month (Center for Behavioral Health Statistics and Quality, 2015a). The 2014 percentage (8.4%) is significantly higher than percentages reported annually from 2002 (6%) to 2013 (7.5%) (Center for Behavioral Health Statistics and Quality, 2015a). Increased marijuana use could be due to changes in state laws that allow legal medical and/or recreational use, as well as changing perceptions of risk surrounding use (Center for Behavioral Health Statistics and Quality, 2015b). As of November 2016, 28 states and the District of Columbia (DC), Guam, and Puerto Rico permit legal use of marijuana for medical purposes while 8 states (National Conference of State Legislatures, 2016a) and DC allow adult recreational use (National Conference of State Legislatures, 2016b). Twenty-one states and DC have decriminalized possession of small personal-consumption amounts (ranging from one ounce to less than 10 g) of marijuana (National Conference of State Legislatures, 2016a, 2016b). Therefore, possessing small personal-consumption amounts would typically result in civil or local infraction without the possibility of jail time (National Conference of State Legislatures, 2016a, 2016b). Unintended negative and positive consequences in population health and safety related to these policy changes are of interest for states that have already passed such policy, as well as states considering enacting such legislative changes. One consequence of interest has been the impact of driving under the influence (DUI) of marijuana.

Driving under the influence of drugs (DUID) can cause motor-vehicle (MV) crashes and places the driver, passengers, and other road users at risk for injury or death (Hartman & Huestis, 2013; Li, Brady, & Chen, 2013). The 2013/2014 National Roadside Survey reported a 47% increase in nighttime weekend drivers that tested positive for marijuana (12.6%) compared with survey results from 2007 (8.6%; Berning, Compton, & Wochinger, 2015). It is important to note that a positive test for marijuana is indicative of use and not a reliable source to denote marijuana impairment (Berning & Smither, 2014; Hartman & Huestis, 2013). Consumption of marijuana has been shown to impair driving ability in some studies (Hartman et al., 2015; Hartman & Huestis, 2013; Lenné et al., 2010), while others have shown moderate to no effect during on-road driving and simulator studies (Robbe, 1998; Smiley, 1986). Levels of marijuana impairment will differ in individuals depending on route of administration (e.g., smoking, eating, dabbing), body mass index, absorption into the bloodstream, and marijuana use frequency (Azofeifa, Mattson, & Lyerla, 2015). However, given the increasing prevalence of marijuana use in the United States, state motor-vehicle crash surveillance systems need to be positioned to effectively monitor crashes involving

DUI of marijuana. Currently, states vary in methodology for data collection, data linkage (Milani et al., 2015), laws related to driving under the influence of marijuana, and toxicology testing/reporting when marijuana is suspected as a contributing factor for a motor-vehicle crash.

This study focuses on the state of Colorado (CO), which legalized marijuana for adult recreational use in 2012 (Governors Safety Highway Administration, 2015). In Colorado, it is illegal to drive with 5 nanograms (ng) or more of delta-9 tetrahydrocannabinol (THC), the main psychoactive component of marijuana (Maccarrone et al., 2015), per milliliter (mL) of whole blood and can result in prosecution for DUI (Senate Bill 16-132). During 2016, the Colorado Department of Public Health and Environment (CDPHE) published a public health framework for legalized marijuana including assessment and monitoring of health effects with a focus on systematic collection of accurate numbers for suspected and confirmed marijuana-related/impaired driving (Ghosh et al., 2016). The evaluation of state motor-vehicle crash systems' ability to capture crashes involving drug impaired driving is a critical first step for identifying frequency and risk factors for crashes related to DUID. The purpose of this study was to conduct a formal evaluation of Colorado's motor-vehicle crash data system, Electronic Accident Reporting System (EARS), for the ability to monitor DUI of marijuana in non-fatal crashes. EARS is a Colorado state specific crash data records system that houses statewide Colorado law enforcement (LE) MV crash reports.

2. Methods

2.1. Evaluation design

This surveillance evaluation occurred in August and September 2015. Updated guidelines for evaluating public health surveillance systems (CDC, 2001) were used to assess the ability of Colorado's motor-vehicle crash reporting system, EARS, to monitor non-fatal crashes involving DUI of marijuana in Colorado during 2014. These updated guidelines focus on assessment of surveillance system attributes including usefulness, flexibility, timeliness, simplicity, acceptability, sensitivity, predictive value positive, and data quality (CDC, 2001). Based on these guidelines, we developed a semi-structured questionnaire to guide interview discussions with key stakeholders from Colorado Department of Public Health and Environment (CDPHE), Colorado Department of Transportation (CDOT), Colorado Department of Revenue (CDOR), forensic toxicology, and the Data and Evaluation subcommittee of the Colorado Task Force on Drunk and Impaired Driving (CTFDID). Interviews focused solely on policies and procedures employed by each stakeholder group for their role in surveillance of driving under the influence of marijuana. Follow-up questions were answered through secure email correspondence. To supplement stakeholder perspectives on system attributes and description, we reviewed LE crash report data dictionary and key documents (Colorado's Investigating Officer's Traffic Accident Reporting Manual, 2006; Colorado Office of the Governor Marijuana Data Discovery and Gap Analysis Report, 2014; Legalization of Marijuana in Colorado Impact Report, 2015; CTFDID's Annual Report, 2014; National Highway Traffic Safety Administration [NHTSA] Technical Assessment Team-State of CO Traffic Records Assessment Report, 2015) identified by CDPHE staff. IRB approval was not sought as this study included de-identified crash data supplied by the state and the use of existing publically accessible documents.

To evaluate system performance, we gathered evidence on EARS' usefulness, frlexibility, timeliness, simplicity, acceptability, and data quality. To assess EARS usefulness we examined its ability to contribute to the detection, prevention, and control of non-fatal crashes involving DUI of marijuana. Flexibility was assessed by evaluating the EARS response to new informational demands with minimal need for additional time, personnel, or assigned funds. Timeliness was assessed by evaluating the speed between steps in EARS data flow starting when a motor-vehicle crash occurred and ending with data entry into EARS. The ease of EARS meeting operational needs were assessed for system simplicity. For acceptability, we assessed the willingness of persons and organizations to participate in EARS.

To assess data quality, we compared the percentage of completeness (i.e., no missing or blank values) for select variables related to injury in 2014 preliminary and finalized motor-vehicle crash reports recorded into EARS. Data analyzed for this study were completely de-identified prior to author access and records remained de-identified during data analysis. Preliminary records may contain duplicate records, errors, or formatting not suitable for analysis while finalized records are cleaned and used for data analysis. Variables were selected based on state data availability and relevance to demographic characteristics, injury, and alcohol/drug use. Since Colorado's non-fatal crash reports do not capture specific drugs suspected to be a contributing factor, variables related to DUI of marijuana could not be directly assessed. Selected variables assessed were driver date of birth (DOB), age of other persons involved in the crash, injury severity (ranging from 0-property damage only to 4-fatal) for all persons, whether the driver was charged with DUI, and officer suspected driver of alcohol or drug use (yes, no, or unknown response). Suspected use of alcohol or drugs were two separate variables and completed for all persons involved in a crash, including passengers, who were contacted by the investigating officer (Colorado's Traffic Accident Reporting Manual, 2006). These variables record the officer's opinion and may or may not be supported by further evidence.

3. Results

3.1. EARS data flow description

Understanding the data flow or steps within a public health surveillance system is vital for assessing the identification of a health event, data entry/reporting, data management, and dissemination of information for public health action. In Colorado, EARS data flow (Fig. 1A) begins with LE arriving at the scene of a motor-vehicle crash and recording information on demographic, vehicle, and scene factors on Colorado's crash report form.

These crash reports are generated for all unintentional motor-vehicle crashes occurring on a public Colorado road, where there was property damage (≥$1000 USD), fatal, or non-fatal injury. LE agencies must submit paper or electronic crash reports to the CDOR, the custodian of EARS. Individuals involved in the crash may also submit a crash report online (https://crash.state.co.us/) or in-person. However, this evaluation only included crash reports submitted by LE into EARS. EARS generates a data output file containing crash information (e.g., scene description, demographic characteristics, injury severity) used by the state motor-vehicle epidemiologist. In the final stage of data flow, CDOR and the Office of Behavioral Health (OBH), housed within the Colorado Department of Human Services, share data on administrative license restrictions and substance abuse education/treatment placement for DUI offenders. DUI offenders include persons impaired due to alcohol, drugs, or both substances.

In non-fatal crashes where alcohol or drug impairment is suspected by LE (Colorado's Traffic Accident Reporting Manual, 2006), driver consent to a Standard Field Sobriety Test (SFST) is requested (Fig. 1B).

Following a SFST request a driver can: (a) refuse and he/she is placed under arrest for DUI or (b) accept and SFST is administered. SFST establishes probable cause for arrest when a suspect is deemed intoxicated by alcohol and/or drugs. When drug intoxication is suspected after SFST administration, drivers are evaluated further by an Advanced Roadside Impaired Driving Enforcement (ARIDE) Peace Officer and/or taken to the police station for advanced evaluation performed by a Drug Recognition Expert (DRE). ARIDE and DRE evaluations identify the category of drug(s) likely causing driver impairment. During 2014 (the data year assessed) there were 550 ARIDE trained officers throughout Colorado LE (CO's Traffic Accident Reporting Manual, 2006). ARIDE serves as the bridge between the SFST training and the DRE program by providing officers general knowledge on drug impairment and promotes the use of DREs in the state (CDOT' ARIDE report, 2016). CTFDID recommends officers performing DUI/DUID enforcement become certified in ARIDE and maintain certification when these duties are performed CTFDID's Annual Report, 2014. In 2016, Colorado further developed capacity of officers that perform DUI/DUID law enforcement by providing 662 Colorado officers with DRE training and maintaining active DREs in 82 agencies throughout the state (https://www.codot.gov/safety/dre). If drug(s) impairment is identified during the ARIDE/DRE evaluation, the driver is arrested, and express consent for a blood draw is requested and samples are sent with a case report, to a CDPHE certified forensic toxicology laboratory. Blood samples are initially screened for cannabinoids, a group of chemical compounds found in the cannabis or marijuana plant (National Institute on Drug Abuse, NIDA, Research Report Series, 2016). Samples that test positive for cannabinoids are further analyzed to quantify THC (Urfer, Morton, Beall, Feldmann, & Gunesch, 2014). Toxicology results for non-fatal crashes are electronically submitted to the requesting LE agency and CDOR, however these results are not recorded into EARS. Drivers who refuse chemical testing following DRE/ARIDE evaluation are arrested, receive 2 months of license revocation, and 2 years of ignition interlock. Driver refusal for chemical testing is around 30% (CDOT Marijuana Presentation, 2015). In fatal crashes an autopsy is performed that includes a drug panel screen. EARS records drug test type and result for fatal crashes.

3.2. Surveillance system attributes

Table 1 summarizes key attribute definitions and strengths and weaknesses in EARS ability to monitor DUI of marijuana among non-fatal motor-vehicle crashes.

3.2.1. Usefulness—During this evaluation, EARS usefulness to monitor the prevalence of non-fatal MV crashes involving DUI of marijuana was limited. Several system weaknesses, stemming from data collection, hinder system usefulness. First, the primary data source, LE crash reports, do not have standard fields for officers to select whether alcohol and/or drug impairment was the primary cause for the DUI violation. Second, only the fatal crash supplement form includes variables to indicate if alcohol or drug testing was performed and the type of biological sample collected (i.e., blood, urine, or other fluid). Also, completion of these variables are optional. EARS data would be strengthened by including information on marijuana (cannabinoid) and THC testing requests, chemical testing refusal or acceptance by drivers, biological samples submitted, and results of tested samples. The addition of toxicology results and biological sample type is critical for EARS data to be used for monitoring non-fatal MV crashes involving DUI of marijuana. Third, EARS will not be able to capture all data as drivers can refuse chemical testing and this loss of data might be non-random.

A strength of EARS is its user-friendly capabilities allowing quick access to data on MV crashes. Specifically, CDOR users have the ability to perform web-based searches to find and view crash reports in real time. The resulting data are used in the development of highway safety planning documents and are the primary data source for the identification of crash risk factors in CO (NHTSA Traffic Records Assessment, 2015). EARS data are also used by both state and local agencies to identify areas for increased LE presence and trends in drivers receiving DUI citations, which could be used to target prevention and education efforts.

3.2.2. Flexibility—We evaluated the flexibility of data collected on the LE crash report, since it is the primary data source for EARS. In 2006, the LE crash report was revised to create a more uniform set of state crash data. Significant changes focused on driver behavior, road description, and harmful event sequence. Relevant to this evaluation was the addition of driver DUI, driving while ability impaired (DWAI), or driving under the influence of drugs (DUID) codes as a “most apparent human contributing factor” in the opinion of LE (Colorado’s Traffic Accident Reporting Manual, 2006). Colorado reports that new data fields could be added in a one year time frame. EARS is a flexible system that can incorporate new data without increases in personnel or financial burden.

3.2.3. Timeliness—Due to state mandate, LE agencies must submit paper or electronic crash reports to CDOR within five days of the crash or within five days after the crash investigation has been completed, a system attribute that is very timely. The need for paper crash reports to be scanned, keyed into a document management system, and then entered into the EARS database is a point where timeliness might be slowed. However, evaluators were assured by CDOR that a paper report can be entered into EARS in approximately 5 min. The data entry process would likely be improved by utilizing electronic submission for all LE crash reports. How quickly EARS data were sent to relevant external users (i.e., motor-vehicle epidemiologist at CDPHE or CDOT staff) and reviewed, could not be determined.

Timeliness between LE arriving at the scene of a crash and blood sample collection was also assessed due to the need for timely collection of blood samples as THC metabolizes rapidly (Sewell, Poling, & Sofuoglu, 2009). THC rapidly declines in the body's serum within the first 2 h after use (Sewell et al., 2009). Further research also demonstrated that time periods of >2 h from time of stop/crash to time of blood draw is associated with a significant difference in median levels of THC (ng/mL) and this difference can result in a median THC level below Colorado's legal 5 ng/mL limit (Urfer et al., 2014). In non-fatal crashes where LE have reasonable suspicion of driver intoxication, the first battery of the SFST (i.e., horizontal gaze nystagmus test) is administered which takes 5 min and administration of the complete SFST, including walk/turn and one-leg stand test, takes 10 to 20 min (Fig. 1B). Once probable cause for arrest has been established through the SFST, an advanced evaluation by a DRE occurs and this entire step takes 60–90 min. Following DRE evaluation, blood is collected by medical services personnel, which occurs within minutes upon personnel arrival; however, the exact time it took for medical personnel to arrive could not be determined. To enhance timeliness of this process, the CTFDID recommends having the blood draw done before DRE testing is complete to optimize toxicology assessment.

CDPHE certified forensic laboratories receive blood samples in 24–72 h after the blood draw, with the average time span of 48 h. Blood samples are processed through qualitative screening (i.e., drug family identification) followed by quantitative confirmation testing (i.e., amount of a positive drug screened). Drug screening and confirmation testing takes an average of five business days and processing time is dependent on drug type tested. Driver toxicology test results are sent to LE and the district attorney within 5 business days of testing completion. Although test results are recorded into EARS for fatal crashes, results are not recorded for non-fatal crashes.

Overall, transmission of LE data into EARS is timely. However, expediting the time between LE arriving at the scene of a crash and blood sample collection is imperative when assessing THC serum levels, due to the rapid metabolism of this compound.

3.2.4. Simplicity—Utilizing EARS for surveillance of DUI of marijuana would increase the complexity of the current system. Boosting surveillance completeness would require that driver toxicology results (provided by CDPHE certified forensic toxicology labs), driver alcohol and drug education/treatment placement, and driver prior offenses (both provided by OBH) be entered into one system. These two agencies have different databases that are incompatible. As of September 2016, there was not a common case identification number and currently data cannot be linked between these systems. This highlights the possible need for data linkage between systems using other demographic characteristics (e.g., driver's license or state identification number, age, gender, date of birth) if a common case identifier cannot be applied. At the time of evaluation, EARS was based on older versions of technology that hindered system linkage; however, CDOR is undergoing a complete system modernization project that might enhance the ability to link systems.

3.2.5. Acceptability—Electronic submission of LE crash reports into EARS could be improved. During 2015, only three (Colorado State Patrol, Aurora, and Longmont Police Departments) out of 246 LE agencies submitted crash reports electronically into EARS

(NHTSA's Traffic Records Assessment, 2015). All other crash reports are submitted via paper methods that are partially entered into EARS, but retained in full in the CDOR Electronic Data Warehouse; although which parts of the paper report entered into EARS could not be determined. Colorado has indicated it is moving toward increasing the percentage of crash reports received electronically from 31% during 2014 to 60% during 2015 (NHTSA's Traffic Records Assessment, 2015). Specific barriers hindering full electronic submission were not provided during this evaluation.

3.2.6. Data quality—From January 1–December 31, 2014, there were 114,752 motor-vehicle crashes in Colorado. These included: 95,392 (83%) property damage only (non-injury); 18,909 (16.6%) injury (i.e., complaint, non-incapacitating, incapacitating injury); and 451 (0.4%) fatal crashes (at least one person died within 30 days of the crash). Of the 114,752 crashes involving 523,926 people: 244,169 (47%) people were not injured; 266,699 (51%) people had a complaint of injury; 9346 (1.3%) people had an evident non-incapacitating injury; 3224 (0.6%) people had an evident incapacitating injury; and 488 (0.1%) people had a fatal injury as reported by LE report. During 2014, EARS contained 287,718 preliminary records. After data cleaning there were 284,352 finalized records in EARS. To help determine the EARS data quality, we assessed data completeness and found variation in missing data by variable (Table 2).

During this evaluation, reporting of all study selected variables was optional. Unfortunately, not requiring the completion of the injury-related fields limits researchers' ability to confidently determine whether missing data implies the data were unavailable, LE was unsure of the answer, or whether LE simply did not get an answer to the question. Ultimately, missing data requires additional inquiry into ways LE can provide complete and high-quality information in all fields. A second limitation is using LE reported injury severity data instead of emergency department and/or hospitalization data. LE misclassification of injury severity has been documented (Burch, Cook, & Dischinger, 2014).

4. Discussion

EARS provides timely information, but is limited in its ability to monitor non-fatal MV crashes involving DUI of marijuana. Both preliminary and finalized records provided complete and timely information for driver/occupant demographics, officer suspected driver/occupant alcohol and or drug(s) use, and whether the driver was charged with DUI. Critical weaknesses identified included not recording biological sample type collected from drivers or driver toxicology results. Additionally, relying on LE determination of injury rather than medical data is a limitation. Medical data includes injury severity, medical diagnoses, medical outcomes, and costs. The findings of this study can inform Colorado as well as other states as they consider revising their own motor-vehicle crash data systems to detect and monitor DUID-related crashes and their outcomes.

Based on the results of this surveillance evaluation, we developed several specific considerations for improving EARS capacity to monitor crashes related to DUI of marijuana in Colorado. First, record driver toxicology results (initial cannabinoid screen and THC level quantification) and biological sample type into EARS with a matching case number for both fatal and non-fatal crashes. Sampling whole blood allows for an accurate analysis of prevalence and trends of drivers testing positive for cannabinoids and whether driver THC level is above or below the legal limit in Colorado (5 ng/mL whole blood). Second, performing whole blood sample collection immediately following SFST and before DRE evaluation would improve toxicological assessment. This timing is critical for accurate detection of THC due to rapid metabolism of this compound (within 30 min to 1 h) following use (Sewell et al., 2009). Third, to obtain a more complete picture of motor-vehicle crashes and their outcomes would require linking EARS, emergency department/ hospital, and judicial data together. Linked data, from these multiple sources, are valuable in determining risk factors for injury, injury severity, medical outcomes, medical costs, and legal outcomes related to DUI of marijuana. This consideration is supported by NHTSA's, 2015 Traffic Records Assessment. Lastly, interviews with key stakeholders indicated that multiple case files were duplicates within the EARS database and this is possibly due to several jurisdictions using the same type of case numbers. Standardized case number creation and use would reduce duplication and increase case matching.

4.1.1. Limitations—There were limitations to this evaluation that should be considered. First, we were unable to estimate LE financial burden for forensic toxicology testing. State law mandates LE pay for blood testing, which could affect system flexibility. Second, despite efforts to contact the state judicial agency, we were unable to determine whether policy regulations surrounding toxicology data sharing, specifically in non-fatal crashes, complicated the ability of EARS to record these data. Third, the findings presented here may not be representative of motor-vehicle crash surveillance systems in other states with/ without laws allowing legal medical and/or recreational marijuana use. Fourth, due to this study focusing on non-fatal crashes we did not account for fatal crashes that are captured by the NHTSA Fatality Analysis Reporting System (FARS). It is important to note that NHTSA has cautioned users of FARS data against inferring DUID trends or prevalence from the database (Berning & Smither, 2014) due to several limitations including FARS not being able to distinguish between impairing compounds (THC) and inactive metabolites (e.g., 11-nor 9 carboxy tetrahydrocannabinol [THC-COOH]; Wood & Salomonsen-Sautel, 2016). Recommendations for strengthening data fields in FARS related to drug testing and reporting have been previously published and demonstrate the need for standardization and mandatory toxicology testing policies across all states (Burch et al., 2014).

4.1.2. Practical applications—The findings of this evaluation are timely as the percentage of the U.S. population currently using marijuana is rising and states are changing their policies around marijuana use. Increased marijuana use has implications for impaired driving, public health and safety, and injury prevention. Additionally, the findings presented here may be applicable to other states, especially those that have legalized medical and/or recreational marijuana use, and/or might legalize it in the future. Overall motor-vehicle injury prevention has been identified by CDC as one of its six "Winnable Battles." In Colorado, there is a statewide goal to reduce all injury-related morbidity and mortality among Coloradans and is one of the state's "Winnable Battles." Motor-vehicle injury related to DUI is preventable. This evaluation provides an example of leveraging a state specific surveillance system to monitor an emerging issue (DUI of marijuana) and discusses opportunities for improvement. Surveillance systems, especially those that use linked data from multiple sources, allow for a better understanding of what happens before, during, and after a crash. Comprehensive data can be used to enhance state capacity to monitor and prevent motor-vehicle crashes, including those related to alcohol and drugs.

Acknowledgments

We thank Nicole Richmond, Ali Maffey, Lindsey Myers (Colorado Department of Public Health and Environment), Sarah Urfer (ChemaTox Laboratory), and Glenn Davis (Colorado Department of Transportation) for providing critical information necessary for the completion of this surveillance system evaluation. We thank Lindsey Myers, Nicole Richmond (Colorado Department of Public Health and Environment), and Glenn Davis for their revisions and in-depth review of this manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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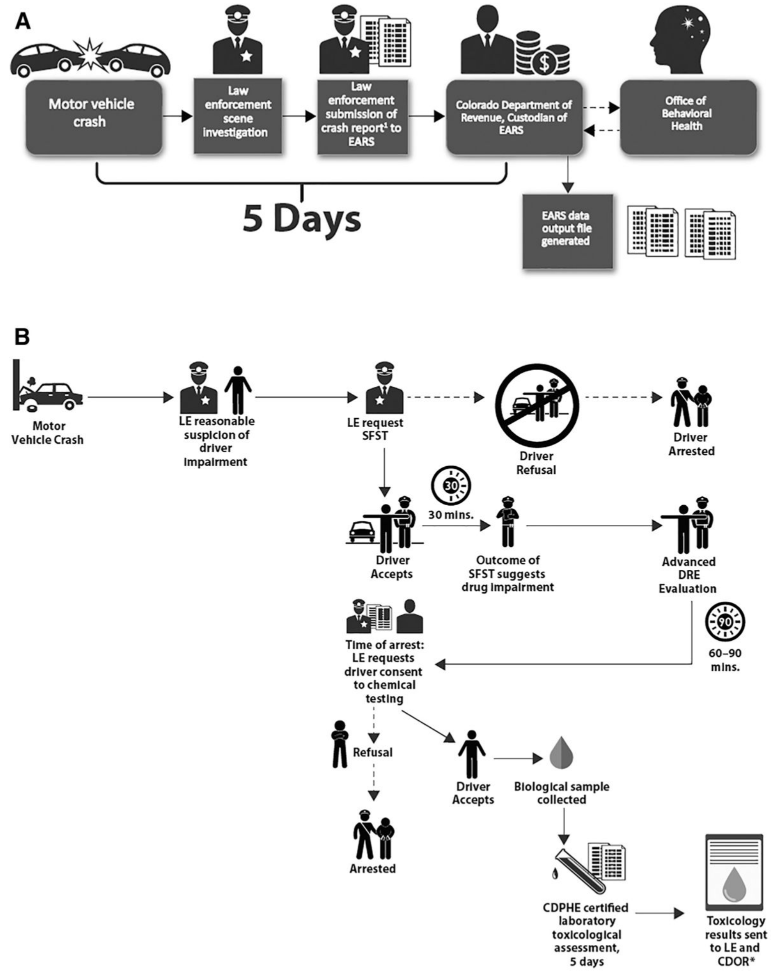

Fig. 1.

A) Flowchart of motor vehicle crash surveillance system, Electronic Accident Reporting System (EARS): Colorado, 2014 Note. Dotted arrows indicate shared data on administrative license restrictions and alcohol and drug education/treatment placement for DUI offenders. [1]Paper and electronic crash reports. B) FB Flowchart of data collection from motor vehicle crash to toxicology testing: Colorado, 2014 Note, **LE** = law enforcement; **DRE** = Drug Recognition Expert; **CDPHE** = Colorado Department of Public Health and Environment, **SFST** = Standard Field Sobriety Test; **CDOR** = Colorado Department of Revenue Dotted line indicates driver(s) moving out of the data flow. *Toxicology results electronically submitted to LE and CDOR for all crashes; however, test results among persons involved in non-fatal crashes are not recorded In EARS.

Table 1

Key attribute definitions used to evaluate the Colorado Electronic Accident Reporting System on strengths and weaknesses in its ability to monitor driving under the influence of marijuana among non-fatal motor vehicle crashes.

Evaluation attribute	Definition[a]	EARS strengths	EARS weaknesses
Usefulness	Contribution to the detection, prevention, and control of adverse health related event	Web based search capabilities for internal users; Data used to identify crash risk factors, areas for increased LE presence, and trends in drivers charged with Driving Under the Influence, as a primary violation	Data are not collected on specific drugs suspected as a contributing factor to a crash; toxicology results not recorded within EARS for non-fatal crashes
Flexibility	Adaptation to changing information needs	Ability to add new data fields to LE crash report (EARS primary data source)	Takes approximately 1 year to add new data fields to LE crash report
Timeliness	Speed between steps in a surveillance system	Mandatory paper and electronic crash report submission within 5 days to CDOR	Since most crash reports are submitted by paper methods, manual entry into EARS may slow Timeliness
Simplicity	Ease of meeting operational needs of the system	Current EARS modernization project to update technology and business rules to increase ease of reporting ongoing as of 2015	EARS created with older versions of technology and reliant on paper (faxes, copies, handwritten) reports
Acceptability	Willingness of persons and organizations to participate in a surveillance system	State statute requires LE submission of crash reports to CDOR for entry into EARS	As of September 2015 only 3 of 246 LE agencies submitted electronic crash reports
Data quality	Completeness and validity of data recorded in a surveillance system	Majority of select non-fatal injury related variables were complete in 100% of finalized records	Lack of data fields for toxicology test type and results for non-fatal crashes. Reliance of LE report for injury severity.

Note. LE = law enforcement; CDOR = Colorado Department of Revenue; EARS = Electronic Accident Reporting System.

[a]Based on Centers for Disease Control and Prevention's "Updated Guidelines for Evaluating Public Health Surveillance Systems: Recommendations from the Guidelines Working Group, 2001".

Table 2

Completeness of Preliminary and Finalized Electronic Accident Reporting System Records: Colorado, January 1–December 31, 2014.

	Completeness[a], count (%)	
Select injury-related fields	**Preliminary (N = 287,718)**	**Finalized (N = 284,352)**
Driver date of birth	174,720 (60.7)	170,665 (60)
Age of involved parties	287,713 (99.9)	249,320 (87.6)
Injury severity (Range 0–4)	278,983 (96.6)	284,352 (100)
Suspected driver alcohol use (yes/no)	270,337 (93.5)	284,352 (100)
Suspected driver drug(s) use (yes/no)	270,323 (93.5)	284,352 (100)
Driving under the influence (checkbox)	276,117 (94)	284,350 (99.9)

[a]Completeness is an aspect of data quality and refers to the absence of missing or unknown values for a select field.