Journal of Safety Research xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Journal of Safety Research

journal homepage: www.elsevier.com/locate/jsr

Special Report from the CDC

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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ARTICLE INFO

Article history:
Received 8 March 2018
Accepted 8 March 2018
Available online xxxx

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

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. *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.
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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, 2014). 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, 2015). 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, 2014). 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

☆ 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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https://doi.org/10.1016/j.jsr.2018.03.006
0022-4375/© 2018 Published by Elsevier Ltd.

Please cite this article as: Peterson, A.B., et al., Ability to monitor driving under the influence of marijuana among non-fatal motor vehicle crashes: An evaluation of the Colorado electronic ..., *Journal of Safety Research* (2018), https://doi.org/10.1016/j.jsr.2018.03.006

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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, flexibility, 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.

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Please cite this article as: Peterson, A.B., et al., Ability to monitor driving under the influence of marijuana among non-fatal motor vehicle crashes: An evaluation of the Colorado electronic ..., *Journal of Safety Research* (2018), https://doi.org/10.1016/j.jsr.2018.03.006

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