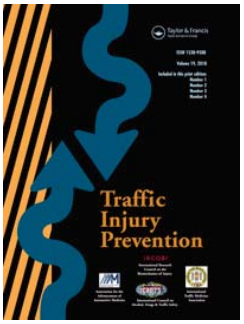

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Surveillance of traffic incident management–related occupational fatalities in Kentucky, 2005–2016

T. L. Bunn, S. Slavova, M. Chandler, N. Hanner, and M. Singleton

Kentucky Injury Prevention and Research Center, bona fide agent for Kentucky Department for Public Health, University of Kentucky, College of Public Health, Lexington, Kentucky

ABSTRACT

Objective: Traffic incidents occurring on roadways require the coordinated effort of multiple responder and recovery entities, including communications, law enforcement, fire and rescue, emergency medical services, hazardous materials, transportation agencies, and towing and recovery. The objectives of this study were to (1) identify and characterize transportation incident management (TIM)-related occupational fatalities; (2) assess concordance of surveillance data sources in identifying TIM occupations, driver vs. pedestrian status, and occupational fatality incident location; and (3) determine and compare U.S. occupational fatality rates for TIM industries.

Methods: The Kentucky Fatality Assessment and Control Evaluation (FACE) program analyzed 2005–2016 TIM occupational fatality data using multiple data sources: death certificate data, Collision Report Analysis for Safer Highways (CRASH) data, and media reports, among others. Literal text analysis was performed on FACE data, and a multiple linear regression model and SAS proc sgpanel were used to estimate and visualize the U.S. TIM occupational mortality trend lines and confidence bounds.

Results: There were 29 TIM fatalities from 2005 to 2015 in Kentucky; 41% of decedents were in the police protection occupation, and 21% each were in the fire protection and motor vehicle towing industries. Over one half of the TIM decedents were performing work activities as pedestrians when they died. Media reports identified the majority of the occupational fatalities as TIM related (28 of 29 TIM-related deaths); the use of death certificates as the sole surveillance data source only identified 17 of the 29 deaths as TIM related, and the use of CRASH data only identified 4 of the 29 deaths as TIM related. Injury scenario text analysis showed that law enforcement vehicle pursuit, towing and recovery vehicle loading, and disabled vehicle response were particular high-risk activities that led to TIM deaths. Using U.S. data, the motor vehicle towing industry had a significantly higher risk for occupational mortality compared to the fire protection and police protection industries.

Conclusions: Multiple data sources are needed to comprehensively identify TIM fatalities and to examine the circumstances surrounding TIM fatalities, because no one data source in itself was adequate and undercounted the total number of TIM fatalities. The motor vehicle towing industry, in particular, is at elevated risk for occupational mortality, and targeted mandatory TIM training for the motor vehicle towing industry should be considered. In addition, enhanced law enforcement roadside safety training during vehicle pursuit and apprehension of suspects is recommended.

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KEYWORDS
Traffic incident; occupational fatality rate; motor vehicle towing; fire protection; police protection; pedestrian

Background

According the Bureau of Labor Statistics (BLS), there were 2,054 transportation incident–related occupational fatalities in year 2015; of those, 1,264 were road incidents involving motorized vehicles, and 289 were pedestrian vehicular incidents (BLS 2016b). Transportation incidents occurring on the roadway elicit responses from multiple responder and recovery, industries, and occupations, including communications industries and occupations such as 911 call taking, dispatch, and media, as well as law enforcement, fire and rescue services, emergency medical services, hazardous materials cleanup, transportation agencies including highway clearance and repair, and towing and recovery, industries, and occupations (Federal Highway Administration [FHWA] 2017). These traffic management entities are critical for optimum response to traffic incidents and rapidly clearing highways so that normal traffic patterns are restored in a timely manner.

FHWA's Emergency Transportation Operations provide differing definitions of traffic incidents based on emergency responder and transportation agency missions. A traffic incident has been defined as (1) "any non-recurring event that causes a reduction of roadway capacity or an abnormal increase in demand"; (2) "an unplanned randomly occurring traffic event that adversely effects normal traffic operations"; and (3) "any occurrence on a roadway that impedes normal traffic flow" (FHWA 2000, 2017; National Research Council 2000). These definitions differ on planned and unplanned highway activities; whether an event required a dispatch and emergency response;

CONTACT T. L. Bunn tlbunn2@uky.edu Kentucky Injury Prevention and Research Center, 333 Waller Ave., Suite 242, Lexington, KY 40504.
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criminal activity such as robbery, criminal assault, and kidnapping; disabled vehicle; traffic control; traffic hazard, highway maintenance and reconstruction; etc.

An occupational fatality is defined as a fatal work injury that involved work-related activities (BLS 2012; Higgins et al. 2001). National Institute for Occupational Safety and Health (NIOSH)-funded Fatality Assessment and Control Evaluation (FACE) programs conduct surveillance of all occupational fatalities in their respective states and perform onsite investigations of fatal incidents based on NIOSH- and state-determined priorities identified through surveillance data. FACE programs collect data from multiple sources on the pre-event, event, and postevent phases of occupational fatalities to identify root causes and risk factors that contributed to the occupational fatalities. FACE occupational fatality surveillance data results are utilized in occupational injury prevention interventions to inform and enhance occupational injury prevention policies and practices in similar occupations and industries. Seven states are currently funded by NIOSH for FACE programs.

There is global consensus that work-related injuries and diseases are underreported; it is estimated that over 1,000 workers died every day of occupational injuries in 2010 (International Labour Organization 2014). The identification and characterization of work-related motor vehicle crash fatalities (including traffic incident management [TIM]-related fatal injuries) using single data sets such as motor vehicle crash and death certificate data remain limited (Pratt 2003). To address underreporting and enhance the identification of work-related motor vehicle crash fatalities, linkage between data sets has been performed (Byler et al. 2016). For example, 2 linked data sets (Fatality Analysis Reporting System data limited to motor vehicle crashes on public roadways that resulted in deaths within 30 days of the crash and Census of Fatal Occupational Injuries [CFOI] data) increased the number of identified protective services occupational fatalities (includes corrections; police, sheriff's patrol, and detectives; fire protection; fish and game; parking enforcement; animal control; guards; transportation security screeners; and others) to 74 using the 2 linked data sets. The use of CFOI data alone only identified 34 of the 74 protective services occupational fatalities.

TIM-related response workers fall primarily within the protective services– and transportation-related industries and occupations (fire protection police protection, emergency medical services, hazardous materials cleanup, transportation agencies, and towing and recovery). Information on (1) the identification of TIM-relatedness of occupational fatalities; (2) specific activities being performed by TIM workers on the roadway (inside and outside the vehicle) at time of death (pre-event); and (3) TIM-related industries at highest risk for fatal occupational injuries is lacking. In a study of law enforcement work-related deaths using CFOI data, it was found that sheriffs and bailiffs and police and detectives in public service had (1) higher fatality rates; (2) higher percentages of homicide call response deaths; and (3) higher percentages of high-speed pursuit and driving to scene deaths, compared to guards and police not in public service and to correctional institution officers (Tiesman et al. 2010). A study of firefighter fatalities using the U.S. Fire Administration fatality database showed that the number of vehicle-related deaths increased between the 1990s and 2000s, although not significantly (Kahn et al. 2015). Last, a study of ambulance, police car, and fire truck fatalities using Fatality Analysis Reporting System data showed that fatal injury relative risk ratios were higher for ambulance occupants and for police car occupants compared to fire truck occupants (occupants could have been drivers or passengers; Becker et al. 2003). No studies on tow truck driver fatal injuries were found. The limited research that identifies elevated fatal injury rates in the protective services and transportation industries illustrate the need for identifying and characterizing TIM-related fatalities.

The Kentucky FACE program has been collecting data on occupational fatalities and performing onsite investigations of selected occupational fatalities since 1994. Similar to the overall United States, transportation incidents account for approximately 40% of all worker fatalities in Kentucky (BLS 2016c). The objectives of this current study were to (1) identify and characterize TIM-related fatalities using multiple surveillance data sources in Kentucky, a FACE state; (2) assess concordance of the occupational fatality surveillance data sources in identifying TIM occupations at time of death, identifying whether the fatal incident involved the TIM responder performing activities as a driver or as a pedestrian, and identifying the occupational fatality incident location; and (3) determine and compare U.S. fatality rates for the TIM-related motor vehicle towing, police protection, and fire protection responder and recovery industries.

Methods

Data collection

TIM occupational fatality data were obtained from the Kentucky FACE program. Multiple data sources used to identify TIM occupational fatality cases included review of applicable Collision Report Analysis for Safer Highways (CRASH) reports; death certificates; workers' compensation reports; coroner reports; media reports, and others. FACE fatal incident investigations included interviews of employers, witnesses, and others with knowledge of the fatal incident, as well as examination of the worksite and involved equipment. This study was approved by the University of Kentucky Institutional Review Board; no consent was required.

Inclusion and exclusion criteria

Work-related fatality inclusion criteria require that the fatal injury occur in Kentucky and that the person was performing work tasks at the time of the fatal injury. The study excluded Kentucky resident occupational fatalities where the fatal injury occurred outside the state of Kentucky. A Kentucky TIM-related occupational fatality was defined as a worker who died in the Commonwealth of Kentucky of traumatic injuries while performing TIM-related activities. The FHWA Office of Travel Management's *Traffic Incident Management Handbook* definition of "any non-recurring event that causes a reduction of roadway capacity or an abnormal increase in demand" that includes "traffic crashes, disabled vehicles, spilled cargo, highway maintenance and reconstruction projects, and special non-emergency

events" was primarily used to identify TIM fatality cases (FHWA 2000). Our TIM-related fatality case definition also included (1) responder deaths that occurred in work zones; (2) presence of disabled, pulled over, and stopped vehicles; and (3) vehicles in response to traffic incidents because FHWA (2017) says, "While there are no real clear-cut definitions of an incident, most law enforcement agency and emergency responders seem to define an 'incident' as any event to which they are dispatched or requires a 'response' or action."

FACE data sources

North American Industry Classification System (NAICS) codes were used to identify employment industry at time of fatal injury in FACE data (U.S. Census Bureau 2017); employment industry is defined as the usual employment industry. The Standard Occupational Classification System was used to code and classify occupation at time of fatal injury in FACE data (BLS 2010). Multiple media outlet reports of all occupational fatalities were reviewed regularly by FACE staff members. Media reports were available for all TIM fatalities to manually review the text for occupation, driver vs. pedestrian status at time of death, incident location, and other circumstances surrounding the TIM death. If the TIM death was investigated by a coroner, a coroner report was available for manual review. In addition, if the TIM death was received by the Kentucky Office of Workers' Claims, the workers' claims report was available for review.

Death certificate data elements

International Classification of Diseases, Tenth Revision (ICD-10) was used to code external causes of mortality (World Health Organization 2010), including fatal pedestrian injuries (ICD-10 codes V00–V09). To identify industry, occupation, incident location, and whether the TIM decedent was fatally injured as a pedestrian, literal text in the industry box, occupation box, incident location box, and transportation box coded as "pedestrian" (year 2010 forward) were analyzed.

CRASH data elements

The Kentucky electronic CRASH system is a centralized statewide data system containing all traffic collision information in the Commonwealth of Kentucky; all local law enforcement agencies submit crash data to the Kentucky State Police CRASH system (Green et al. 2014). To identify the law enforcement occupation in CRASH data, the National Crime Information Center (NCIC) vehicle type "PO" (police) code was used. To identify the fire and rescue occupation, NCIC codes "AM" (ambulance) and "FT" (fire truck) were used. There were no relevant NCIC codes to identify the TIM-related transportation agency occupation. NCIC vehicle type "FF" (flatbed) and "TT" (tow truck/wrecker) identified the towing and recovery occupation. The variables "unit type" and "person type" identified TIM pedestrian deaths. Incident location was identified with the following data variables: (a) "location of first event"; (b) "pedestrian factor"; and (c) "environmental factor" (e.g., construction work zone).

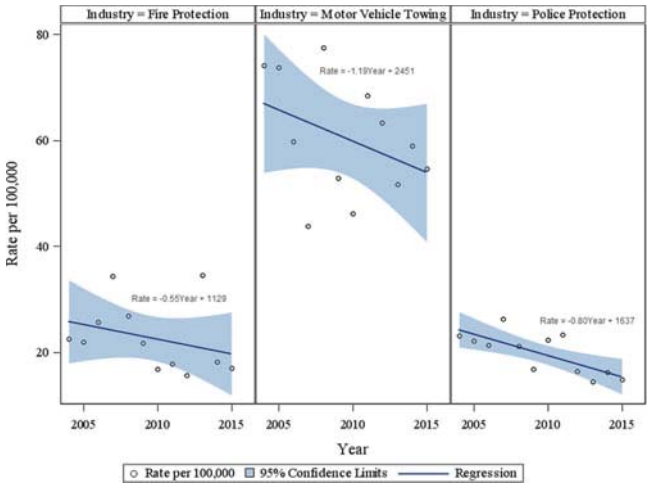

Figure 1. Traffic incident management–related occupational fatality rates in the United States, 2005–2015.

Analysis

Annual U.S. TIM fatality rates for the towing and recovery, police protection, and fire protection industries were calculated for years 2005–2015; no Kentucky TIM-related fatality rates were calculated due to small numbers. TIM-related motor vehicle towing, police protection, and fire protection industry fatality numerators for the United States were identified using BLS CFOI data (BLS 2016a). CFOI, similar to FACE, compiles annual counts of all fatal work-related injuries that occurred in the United States and collects demographic, incident, and employment information, including occupation and industry.

Employment data for the U.S. motor vehicle towing, police protection, and fire protection industry fatality rate denominators in Figure 1 were derived from the BLS Quarterly Census of Employment and Wages (QCEW) data. QCEW data are based on quarterly employer tax reports that are reported by state agencies to the BLS. The QCEW program provides detailed worker industry data at national, state, and local levels for interindustry comparisons and excludes self-employed workers. For the motor vehicle towing industry (NAICS 48841), only private ownership employment data were available. For the police protection industry (NAICS 922120), state, local, and federal government employment data were available. For the fire protection industry (NAICS 922160), state and local government data were available. Kentucky-specific TIM towing and recovery, police protection, and fire protection industry fatality rates could not be calculated due to small numbers that would result in calculation of unstable rates.

TIM occupational fatal injury scenario examples were derived from personal review of individual CRASH reports, FACE case investigations, media reports, and coroner investigation reports. A linear regression model and SAS proc sgpanel were used to estimate and visualize occupational mortality trend lines and confidence bounds for the 3 different TIM-related industries for the study period 2005–2015. Poisson regression was used to estimate the average relative risk (RR) for occupational fatalities and its 95% confidence interval (CI) for fatally injured workers in the motor vehicle towing industry compared to fatally injured workers employed in other TIM industries (fire protection and police protection).

Table 1. Kentucky traffic incident management–related occupational fatalities by external cause of mortality and crash characteristics, 2005–2016.

External cause of mortality	Number (%)
Pedestrian injured in transport accident (V00–V09)	
Pedestrian on foot injured in collision with car, pickup truck, or van in non-traffic accident, initial encounter (V03)	8 (28)
Pedestrian injured in collision with heavy transport vehicle or bus in non-traffic accident (V04)	6 (21)
Car occupant injured in transport accident (V40–V49)	
Car occupant injured in collision with truck, pickup truck, or van (V43)	5 (17)
Car occupant injured in noncollision transport accident (V48)	5 (17)
Assault (X92–Y08)	
Assault by firearm	5 (17)
Crash characteristics	
Number of vehicles involved in crash	
1	16 (55)
2 or more	13 (45)
Pedestrian vs. driver status of decedent at time of death	
Pedestrian	17 (59)
Driver	12 (41)
Posted speed limit	
<55 mph	6 (21)
55 mph	11 (38
>55 mph	12 (41)
Number of traffic lanes	
≤2	16 (55)
>2	13 (45)
Land use	
Limited access	9 (31)
Business/residential	4 (14)
Rural	16 (55)
Substance use involvement/drug paraphernalia present?	
Yes	7 (24)
No	22 (76)

Results

There were 29 TIM fatalities identified through FACE surveillance data for years 2005–2016 (see Appendix, online supplement). The mean age of TIM decedents was 44 years. Corresponding to the Kentucky general population, the majority of the TIM decedents was white, non-Hispanic, and spoke English as their first language; most were male and two thirds were married (66%). Almost one half of all TIM decedents completed at least some college courses, and three quarters completed high school.

About 40% of TIM occupational fatalities occurred in the police protection industry; approximately 20% each of the total TIM fatalities occurred in the motor vehicle towing and fire protection industries. According to identified occupation at death, within the protective services occupational group, the police and sheriff patrol officers' occupation accounted for 38% of the TIM occupational fatalities and 21% were in the firefighter occupation. Almost one third of the TIM occupational fatalities were in the heavy and tractor-trailer driver occupational group that included towing and recovery drivers, transportation department drivers, as well as heavy truck drivers. Over one half of TIM decedents were public industry employees, one quarter were private industry employees, and 17% were self-employed (primarily towing and recovery decedents; data not shown).

Approximately 55% of TIM occupational fatalities involved only one vehicle, the vehicle that the decedent was driving while responding to the traffic incident (Table 1). Seventeen (59%) of the TIM decedents were out of their vehicles and died while performing job activities as pedestrians; 41% of TIM decedents were in the vehicle driver's seat when they died. Of the 17 TIM deaths where the decedent was performing job activities as a pedestrian, over half were struck by cars, pickup trucks, or vans. Twenty-three (79%) of the TIM deaths occurred on highways with posted speed limits of ≥55 mph, and over one half were on rural roadways with ≤2 travel lanes (55%). Seventeen percent of TIM deaths were due to firearm assaults along the highway. Substance use (alcohol and/or drugs) by vehicle drivers who either struck TIM responders in their vehicles or struck TIM responders as pedestrians accounted for 24% of all TIM deaths.

Table 2 assessed the concordance of the primary surveillance data sources (death certificates, CRASH data, and media reports) in identifying the TIM occupation, pedestrian vs. driver status, and incident location at time of death. Media reports correctly identified almost all of the TIM decedent occupations (28 of 29 deaths). Death certificates alone identified 17 of 29 TIM decedent occupations (55%) at time of death. Death certificates only correctly identified one TIM fire and rescue decedent occupation; 5 of the 6 fire and rescue occupational deaths were not correctly identified using death certificates. Death certificates were not the optimum data source for identifying the towing and recovery occupation; death certificate data were either not specific enough or did not correctly identify 4 of 6 towing and recovery decedent occupations. CRASH data alone only identified 4 TIM deaths. Of the 7 CRASH reports completed for the 12 TIM law enforcement deaths, none was specific enough to identify the TIM law enforcement occupation within CRASH data variables. CRASH reports identified 50% of the towing and recovery occupational deaths ($n = 3$), none of the 5 transportation agency occupational deaths, and only one of the 6 fire and rescue occupational deaths.

In assessing the concordance of the 3 surveillance data sources in identifying pedestrian incidents, media reports were the best source for identifying TIM decedents who died while working as pedestrians; all 17 (100%) TIM decedents were correctly identified as pedestrians (Table 3) using media reports. CRASH data and death certificate data each correctly identified 12 (71%) of the 17 TIM pedestrian fatalities; only 3 (43%) of the 7 law enforcement pedestrian decedents and 4 (80%) of the 5 towing and recovery pedestrian decedents were correctly identified as pedestrians using CRASH data. Death certificates only correctly identified 2 of the 7 law enforcement pedestrian decedents. The towing and recovery occupation had the highest percentage of pedestrian deaths (83%).

When TIM fatal incident location was compared among all 3 surveillance data sources, all 3 surveillance data sources were necessary to identify TIM fatal incident locations in a meaningful way (Table 3). For example, death certificates added unique information on vehicle pursuits after traffic stops for 3 TIM law enforcement fatalities. CRASH data provided additional information that (1) one TIM law enforcement fatality and one towing and recovery fatality occurred in a construction work zone; (2) 2 TIM law enforcement fatalities occurred while walking on roadways; (3) one TIM fire and rescue death occurred in the median; and (4) one fire and rescue death occurred in the crossing island. Media reports identified all 29 TIM occupational fatalities as motor vehicle related and/or highway related and identified 8 TIM pedestrian deaths occurring on highways

Table 2. Traffic incident management–related occupational fatality injury scenario examples, 2005–2016.

Law enforcement ($n = 12$)
Police chief killed when his police cruiser was rear-ended while blocking construction crew working on highway
Police officer killed in motor vehicle crash while in pursuit of suspect with stolen vehicle
Police officer shot on side of highway by suspect while responding to hit-and-run crash
Constable struck by vehicle on highway shoulder while apprehending suspect
Police officer shot while checking on vehicle stopped in middle of highway
Police officer struck by vehicle on highway while responding to roadside vehicle complaint
Fire and rescue ($n = 6$)
Fire chief crashed after responding to downed power lines and primary crash
Volunteer firefighter struck by vehicle on roadside while fighting fire from primary crash
Volunteer firefighter struck by fire truck on roadside while responding to house fire
Transportation ($n = 5$)
Emergency roadside technician struck by single-unit truck on highway shoulder while in disabled vehicle response
Emergency roadside technician crashed while in disabled vehicle response
Highway worker struck while placing cones for highway crew replacing guard rails after a primary crash
Towing and recovery ($n = 6$)
Tow truck owner-operator was struck by a vehicle while entering tow truck cab after loading a vehicle on rollback wrecker on side of highway
Tow truck owner-operator was struck by a vehicle while loading vehicle on rollback wrecker on side of road
Tow truck owner-operator was hauling two vehicles on his rollback wrecker, approached traffic slowing for one-car-width construction area, swerved to avoid a collision, and struck a rock wall and tree in the median
Tow truck owner-operator was struck by a vehicle while checking securement of a vehicle on a rollback wrecker on side of highway

Table 3. Concordance of data sources in the identification of traffic incident management–related occupational fatalities, 2005–2016.

	Identification of occupation at time of death?			Identification of driver vs. pedestrian incidents?			Identification of incident location?		
Category	Death certificate	CRASH report	Media report	Death certificate	CRASH report	Media report	Death certificate	CRASH report	Media report
Law enforcement ($n = 12$)	Yes (10/12)	Yes (0/7)	Yes (12/12)	Yes– Pedestrian (2/7)	Yes– Pedestrian (3/7)	Yes– Pedestrian (7/7)	Vehicle pursuit/traffic stop (3/12)	Construction work zone (1/7)	Highway (5/12)
	No (2/12)	No (7/7)	No (0/12)	Yes– Driver (5/5)	Yes–Driver (4/7)	Yes–Driver (5/5)	Highway (6/12)	Walking in roadway (2/7)	Traffic stop (2/12)
		No crash report completed (5/12)		No (5/12)	No (0/7)	No (0/12)	Pedestrian vs. vehicle on highway (3/12)	No crash report completed (5/12)	Motor vehicle crash on highway (3/12)
					No crash report completed (5/12)				Pedestrian struck on roadway (2/12)
Fire and rescue ($n = 6$)	Yes (1/6)	Yes (1/6)	Yes (6/6)	Yes– Pedestrian (2/2)	Yes– Pedestrian (2/2)	Yes– Pedestrian (2/2)	Pedestrian struck on highway (2/6)	Median (1/6)	Roadway departure and overturn (1/6)
	No (5/6)	No (5/6)	No (0/6)	Yes– Driver (1/4)	Yes–Driver (4/4)	Yes– Driver (4/4)		Crossing island (1/6)	Motor vehicle crash on highway (3/6)
				No (3/6)	No (0/6)	No (0/6)			Struck on highway (2/6)
Transportation ($n = 5$)	Yes (4/5)	Yes (0/5)	Yes (4/5)	Yes– Pedestrian (3/3)	Yes– Pedestrian (3/3)	Yes– Pedestrian (3/3)	Struck by vehicle (3/5)	Working in roadway (2/5)	Highway crash (3/5)
	No (1/5)	No (5/5)	No (1/5)	Yes– Driver (2/2)	Yes–Driver (2/2)	Yes– Driver (1/2)			Pedestrian struck on highway (2/5)
				No (0/5)	No (0/5)	No (0/5)			
Towing and recovery ($n = 6$)	Yes (2/6)	Yes (3/6)	Yes (6/6)	Yes– Pedestrian (5/5)	Yes– Pedestrian (4/5)	Yes– Pedestrian (5/5)	Pedestrian struck by vehicle (5/6)	Construction work zone (1/6)	Highway (1/6)
	No (4/6)	No (3/6)	No (0/6)	Yes– Driver (1/1)	Yes–Driver (2/5)	Yes– Driver (1/1)		Working in roadway (1/6)	Motor vehicle crash on highway (1/6)
				No (0/6)	No (0/6)	No (0/6)		Not in roadway (1/6)	Pedestrian struck on highway (4/6)
								None (3/6)	

and one fire and rescue death involving roadway departure and overturn.

TIM fatal injury scenarios derived from interviews with coroners, witnesses, etc., provided additional information on the type of traffic incident related activity being performed at the time of death (Table 2). Towing and recovery owner operators were most frequently killed as pedestrians during vehicle loading onto their wreckers. TIM law enforcement fatalities occurred during responses to disabled roadside vehicles and while pursuing suspects. TIM fire and rescue fatalities involved secondary crashes while responding to primary crashes. Transportation agency–related emergency roadside technician crashes occurred during disabled vehicle response and during guardrail repair after a crash.

Figure 1 shows the observed mortality rates by industry and the estimated trends (based on linear regression models) over the study period with estimated 95% confidence limits. The average annual occupational fatality rate over the study period for workers employed in the motor vehicle towing industry was 60.4 deaths/100,000 motor vehicle towing workers, significantly higher ($P < .0001$) than the corresponding rates for fatally injured fire protection industry workers (22.8/100,000), as well as for fatally injured police protection industry workers (19.9/100,000). There was a significant annual decline in occupational mortality rates among police protection industry workers, with an average annual decrease of 0.8/100,000 ($P = .006$). The average annual decline was not statistically significant for fatally injured workers in the other 2 TIM industries. The results from the Poisson regression showed that the estimated average risk of occupational mortality for workers in the motor vehicle towing industry was 3 times the risk for occupational mortality among workers in the police protection industry (RR = 3.04, 95% CI, [2.66, 3.48]) and almost 3 times the risk for fatally injured workers in the fire protection industry (RR = 2.66, 95% CI, [2.17, 3.25]). There was no significant difference in the risk for occupational mortality between police protection and fire protection industry workers (RR = 1.15, 95% CI, [0.97, 1.36]).

Discussion

Using multiple data sources, the motor vehicle towing industry was identified as an emerging TIM industry at elevated risk for occupational fatalities. The U.S. motor vehicle towing industry fatality rate was more than double the fatality rates of the U.S. police protection and U.S. fire protection industries for years 2005–2015. Though the fatality rates for all 3 U.S. TIM-related industries declined from 2005 to 2015, fatality rates for all 3 U.S. TIM-related industries were still highly elevated compared to the overall U.S. occupational fatality rate (BLS 2016c). Though elevated law enforcement and fire and rescue fatal injury risk has been known for some time, this is the first study that identifies the motor vehicle towing industry at high risk for fatal injuries.

The use of one surveillance data source alone was not sufficient to adequately identify TIM occupational fatalities; multiple data sources are needed for comprehensive surveillance of TIM occupational fatalities. One data source alone did not identify all 29 TIM occupational fatalities in Kentucky. The most reliable surveillance data source for identification of TIM occupational fatalities was media reports associated with the deaths. Death certificates only identified about one half of the TIM deaths, and CRASH data were the least useful for identifying TIM occupational fatalities. Though traditional print journalism has declined over the last several years concurrent with declining revenues, participatory journalism (viewer videos and reports) and digital sound bites have increased (Sacco 2016). It is important for occupational fatality surveillance to have media reports (digital, print, TV, and radio) available to identify TIM fatalities. In the absence of future available media articles on TIM fatalities, state agencies that collect traffic crash data and that collect death certificates may consider new strategies to improve overall data collection on TIM-related fatalities.

Specific CRASH data variables are lacking for identification of TIM occupations in electronic CRASH data systems that states utilize to store CRASH data. The Model Minimum Uniform Crash Criteria (MMUCC), produced by the U.S. Department of Transportation (DOT), is a standardized data collection system that many states have adapted and utilize that contains comprehensive data variables on vehicles, persons, and circumstances surrounding motor vehicle crashes (DOT 2012). MMUCC currently has 110 data elements and the data set is updated approximately every 5 years. To improve identification of TIM injuries and fatalities, it is recommended that MMUCC update TIM occupation–related codes (NCIC vehicle type codes) and that states use the fifth edition of MMUCC (NM2) that includes the TIM pedestrian code "Working in Trafficway (Incident Response)." Currently, 7 states use this data set variable.

In Kentucky, the county coroners are the official certifiers of deaths requiring death investigations. Kentucky also has medical examiners that provide consultations to coroners and perform autopsies when requested. The coroners interview family members, witnesses, coworkers, and others to collect information necessary to complete death certificates. Only about one half of the death certificates adequately identified the TIM occupations at time of death, but death certificates were better at identifying whether TIM decedents were performing job activities as a pedestrian when fatal incidents occurred, because death certificates have data elements for pedestrian-related ICD-10 codes, injury narratives, and a transportation-related injury check box; all fire and rescue and transportation pedestrians were identified, but death certificates were lacking in the identification of all TIM towing and recovery (5/6 were identified) and law enforcement pedestrians (2/7 were identified). Annual new coroner and regular refresher training is provided to coroners on a number of topics, and identification of TIM fatalities should be included in future coroner trainings to improve the capture of TIM fatalities on death certificates.

The U.S. occupational fatality rate in year 2015 was 3.4 deaths per 100,000 full-time equivalent workers (BLS 2016b). Comparatively, the occupational fatality rates for all 3 U.S. TIM-related industries were substantially higher: Motor vehicle towing was 54.6/100,000 workers, police protection was 14.8/100,000 workers, and fire protection was 17.0/100,000 workers. Although the TIM-related total worker and full-time equivalent denominators are not directly comparable, the elevated occupational fatality risk for these 3 TIM-related industries cannot be understated, especially for those TIM responders who were fatally injured as pedestrians and those in the motor vehicle towing industry.

The motor vehicle towing industry had the highest fatal injury rate compared to the police protection and fire protection industries; the elevated motor vehicle towing industry fatality rate may be underestimated because QCEW excludes self-employed workers and most of Kentucky's motor vehicle towing decedents were self-employed. The reasons for the elevated fatality risk in the motor vehicle towing industry may be due to many factors. First, towers may spend a greater amount of time on the roadway while loading vehicles, resulting in elevated road hazard exposures, compared to fire protection and police protection industry workers, and blocking of traffic incidents may be better for police protection and fire protection because their emergency vehicles can be used as traffic blocks during traffic incident management. In addition, whereas other emergency response vehicles (fire, emergency medical services, and police) utilize red and blue flashing lights, towing vehicles are considered nonemergency response vehicles and utilize orange flashing lights that may not adequately alert vehicle drivers to slow down on highways or that may blend in with surroundings. Additionally, the orange flashing lights on towing vehicles may be obstructed during the vehicle loading process. Motor vehicle towing personnel may benefit from enhanced TIM training, routinely available from FHWA, that addresses prevention strategies while working roadside. Last, motor vehicle towers may be the only traffic incident response vehicle at the incident site, with no other responders present, and this incident scene type may present an increased fatal injury risk. The increased motor vehicle towing fatality rate needs to be further investigated with a national study of motor vehicle towing deaths.

Injury scenario text analysis showed that law enforcement vehicle pursuit, towing and recovery vehicle loading, and disabled vehicle response were particular high-risk activities that resulted in TIM deaths. Over one half of TIM fatalities occurred on rural highways with ≤2 travel lanes with posted speed limits of 55 mph and higher. To increase the safety of traffic incident managers, FHWA TIM worker safety training includes injury prevention strategies such as use of high-visibility vests, exiting vehicles on the side away from traffic lanes, maintaining distance from travel lanes while working roadside by remaining on the non-traffic side of vehicles, utilizing traffic control devices, and pursuing vehicles safely, which should be mandated. The TIM training program is currently being evaluated for effectiveness by FHWA (FHWA, personal communication, December 6, 2017) but it was reported by the Strategic Highway Research Program that a traffic management program in Georgia reduced secondary crashes by 69% in a 12-month period, saved first responder lives, and reduced traffic delays that were estimated to be $1 million (Guin et al. 2006, 2007). Prior to TIM training implementation in states, traffic incident response agencies trained in silos and there were no established TIM best practices to reduce TIM-related injuries and the potential for secondary crashes. With the implementation of the new standardized TIM training, best practices are utilized when traffic incidents occur and TIM responders integrate communication and coordination to rapidly clear traffic incidents and improve TIM responder and motorist safety, reducing congestion as well. Currently, TIM training is recommended for law enforcement, fire and rescue, transportation, and towing and recovery first responders but is not mandated.

The number of Kentucky TIM fatalities combined with elevated U.S. fatality rates for the 3 TIM-related occupations (fire and rescue, police protection, and towing and recovery) identifies elevated occupational mortality risk for TIM-related workers responding to traffic incidents and illustrates the need for enhanced TIM training.

Through multisource occupational fatality surveillance, the motor vehicle towing industry was identified as the TIM industry at elevated risk for TIM fatalities, and targeted mandatory TIM training for the motor vehicle towing industry should be considered. Multiple data sources were needed to comprehensively identify TIM fatalities and to examine the circumstances surrounding these fatalities because no one data source in itself was adequate and undercounted the total number of TIM fatalities occurring in the United States. Continued availability of TIM-related media reports, a standard TIM-related variable now available in state CRASH data systems, and enhanced coroner education will help improve identification of TIM deaths in the future.

Compliance with ethical standards

This article has not been published or submitted elsewhere. All authors declare no conflicts of interest. All procedures performed in this study involving human participants were in accordance with the ethical standards of the University of Kentucky research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. All subjects in the study were deceased so informed consent was not necessary. This study was approved by the University of Kentucky Institutional Review Board.

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Author contributions

Terry Bunn implemented the methods and prepared the article. Terry Bunn developed the methods and co-wrote the article. Nancy Hanner collected the worker fatality data and performed quality control checks. Svetla Slavova and Michael Singleton provided surveillance data quality analysis, as well as statistical analysis expertise. Mark Chandler provided information on the fatality narratives and contributed to the tables and figures. All authors have reviewed the submitted article and approve the article for submission.

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