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List of Terms and Abbreviations

AAA	American Automobile Association
BLL	blood lead level
BLS	Bureau of Labor Statistics
CFOI	Census of Fatal Occupational Injuries
CMVS	Center for Motor Vehicle Safety
CSTE	Council of State and Territorial Epidemiologists
DC	death certificate
DWC	Department of Workers' Claims
ED	emergency department
ERC	Education and Research Center
FACE	Fatality Assessment and Control Evaluation
FARS	Fatality Analysis Reporting System
FBW	foreign-born worker
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FROI	first report of injury
FTE	full-time equivalent
GECHS	Governor's Executive Committee on Highway Safety
GHSA	Governors Highway Safety Association
HIM	highway incident management
HRI	heat-related illness
ICD	International Classification of Diseases
IH	inpatient hospitalization
KDPH	Kentucky Department for Public Health
KHA	Kentucky Hospital Association
KIPRC	Kentucky Injury Prevention and Research Center
KOHS	Kentucky Office of Highway Safety
KOSHS	Kentucky Occupational Safety and Health Surveillance
KSHN	Ky Safety and Health Network
KSP	Kentucky State Police
KSPAN	Ky Safety and Prevention Alignment Network
KTA	Kentucky Trucking Association
KVIPP	Kentucky Violence and Injury Prevention Program
Ky TAC	Ky Trauma Advisory Committee
ME	medical examiner
MVC	motor vehicle crash
NBW	native-born worker
NHTSA	National Highway Traffic Safety Administration
NRM	natural resources and mining
NSC	National Safety Council
NTA	National Truckers Association
NTDB	National Trauma Data Bank
NTSB	National Traffic Safety Board

OH	occupational health
OHI	occupational health indicator
OOIDA	Owner-Operator Independent Drivers Association
OSHA	Occupational Safety and Health Administration
SouthON	Southeastern Occupational Health Network
SQI	surveillance quality improvement
SUN News	Safety Unlimited News Service
TBI	traumatic brain injury
TIM	traffic incident management
TR	Trauma Registry
TRAA	Towing and Recovery Association of America
TTU	trade, transportation, and utilities
UK CARERC	University of Kentucky Central Appalachian Region Education and Resource Center
WC	workers' compensation
WIT	Women in Trucking

Abstract

Project Title: Kentucky Occupational Safety and Health Surveillance Program
Principal Investigator: Terry Bunn, PhD
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The Kentucky Occupational Safety and Health Surveillance (KOSHS) program expanded its technical and research capabilities, and reached agency stakeholders to effect change. County profiles of worker injuries were developed and implemented: https://kiprc.uky.edu/programs/kentucky-occupational-safety-and-health-surveillance-koshs-program/worker-injury-county-profiles. A KOSHS sleeper berth study (Bunn TL, Slavova S, Robertson M. Motor vehicle injuries among semi-truck drivers and sleeper berth passengers. *J Saf Res*, 2013;44:51-5) was used as a justification for a **2016** Federal Motor Carrier Safety Administration (FMCSA) revised rule that requires commercial vehicle passenger seat belt use (49 CFR 392.16). A Safety Defect Investigator with the National Highway Traffic Safety Administration (NHTSA) *used our dump truck fatality report #14KY064 to justify the formation* of a committee to *redesign or eliminate dump truck tandems due to fatalities*. Tow truck fatality report #16KY052 was incorporated into a Federal Highway Administration (FHWA) first responder training offered to tow truck operators who are required to complete traffic incident management training to be considered for the interstate towing list; training was delivered to over 10,000 employees. The National Traffic Safety Board (NTSB) used a KOSHS study (Bunn TL, Slavova S, Robertson M. Crash and burn? Vehicle, collision and driver factors that influence motor vehicle collision fires. *Accid Anal Prev* 2012;47:140–145) for their research on commercial vehicle fuel tank integrity/standards. The 2017 NTSB final report contained 13 recommendations including one based on the KOSHS report and NTSB work that stated, “The FMCSA has authority over regulations contained in 49 CFR Part 393 regarding fuel tank integrity standards… the NTSB recommends that SAE International work with FMCSA and NHTSA to improve truck-tractor side-mounted fuel tank crashworthiness… and develop and promulgate an updated standard.” A KOSHS towing study (Chandler M, Bunn T. Analysis of roadside injuries in motor vehicle towing. *J Saf Res.* Dec 2019;71:191–200) was used by the Towing and Recovery Association of America (TRAA) to create an infographic reaching over 10,000 followers. TRAA said, “….when we saw your study, we felt it provided such valuable insights we just had to share with our members! The infographic was sent via e-blast to our full membership... we immediately heard from a VA company member who is going to share it during their next safety meeting.” A KOSHS trucking study (Chandler MD, Bunn TL, Slavova S. Narrative and quantitative analyses of Workers’ Compensation-covered injuries in short-haul vs. long- haul trucking industries. *Int J Inj Control Saf Prom* 2017;24[1]:120–130) was used to develop and disseminate four safety training videos with the leading causes of nondriving-related truck driver injuries. The videos are featured by the Vertical Alliance Group, which services over 1,100 companies. In June 2021, the four videos had over 100,000 downloads and views. The KOSHS program goal reduced occupational injury morbidity and mortality. There was a statistically significant decrease (52%) in Ky occupational fatality rates from 1995–2019 compared to a 30% decrease in the U.S. occupational fatality rate; occupational injury morbidity rates decreased as well but are still 7% above the national rate.

SECTION 1

Kentucky Occupational Safety and Health Surveillance (KOSHS) Program- Fundamental Component

KOSHS Fundamental Program Key Findings

The KOSHS fundamental program has a robust occupational injury surveillance program, and an established record of accomplishment. The KOSHS fundamental program expanded its technical and research capabilities, and reached agency stakeholders in critical positions to effect change. The KOSHS fundamental program collaborated with its industry stakeholders (e.g., Kentucky Trucking Association [KTA]); and organizational stakeholders (e.g., Ky Chamber of Commerce [CC]) on the development of interventions and outputs for adoption by industries. The KOSHS fundamental program disseminated its findings to appropriate stakeholders and underserved worker populations through trade association publications and other targeted dissemination strategies; conducted research studies to improve and enhance worker safety and health standards and policies; and collaborated with agencies and organizations on the translation of KOSHS fundamental program findings into promising practices and evidence. The KOSHS fundamental program identified new and emerging risk factors and issues that set occupational health priorities, and informed and enhanced programs, policies, and standards to address them.

County profile of worker injuries based on emergency department visit data and death certificate data were developed and implemented. The county profiles are posted on the Kentucky Injury Prevention and Research Center (KIPRC) KOSHS website: bit.ly/3DY3ZFI.

There is ongoing concern at the national level about the availability of adequate commercial vehicle rest areas and truck stops for commercial vehicle drivers to rest or to wait for a delivery window. The KOSHS fundamental program performed a retrospective case-control study utilizing CRASH data to determine the association between the occurrence of sleepiness/fatigue-related versus all other human factor-related commercial vehicle driver at-fault crashes and proximity to rest areas, weigh stations with rest havens, and truck stops (Bunn TL, Slavova S, Rock PJ. Association between commercial vehicle driver at-fault crashes involving sleepiness/fatigue and proximity to rest areas and truck stops. *Accident Analysis and Prevention*. 2017 Nov 22[126]:3–9). Our results showed that commercial vehicle driver at-fault crashes involving sleepiness/fatigue were more likely to occur on roadways where the nearest rest areas/weigh stations with rest havens/truck stops were located 20 miles or more from the commercial vehicle crash site, and commercial vehicle driver at-fault crashes involving sleepiness/fatigue were more likely to occur on parkways compared to interstates. We recommended that implementation and evaluation of commercial vehicle employer policies and interventions such as increased parking availability and the use of commercial vehicle driver fatigue alert systems may help to reduce fatigue and sleepiness in commercial vehicle drivers. Our study results were used by the Ky Transportation Cabinet to inform and increase commercial vehicle parking availability in the state.

KOSHS Fundamental Program Translation of Findings

Level 3 truck driver inspection online training. Collaborating with the KTA, KOSHS developed a series of six modules in 2017 communicating the complex regulations governing a roadside driver inspection. Employers could request a personalized e-learning portal allowing managers to track the progress and scores of their individual commercial truck drivers. Four employers requested personalized e-learning portals, with a combined 122 drivers registered. Not included in this total were e-learners who completed the training directly from the KOSHS website without registering.

Truck driver safety training videos. Narrative text analyses of Kentucky short-haul and long-haul trucking workers' compensation first reports of injuries (FROIs) was performed based on analysis of our occupational motor vehicle crash occupational health indicator (OHI) #26 (Chandler MD, Bunn TL, Slavova S. Narrative and quantitative analyses of Workers' Compensation-covered injuries in short-haul vs. long- haul trucking industries. *International Journal of Injury Control and Safety Promotion*. 2017;24[1]:120–130. Based on the study results, we developed and disseminated four safety training videos addressing the leading causes of nondriving-related injuries to truck drivers: 1) truck cab ingress and egress; 2) cranking the trailer landing gear; 3) opening and closing the trailer door; and 4) trailer ingress and egress. The videos are featured by the Vertical Alliance Group, which services over 1,100 companies. In June 2021, the four videos had over 100,000 downloads and views. The Vertical Alliance Group stated, "Your videos have gotten great traction on our system. Over 35k views per year is strong. I can also tell you that the look/production value of your videos are some of the best received on our platform. Any time I hear feedback about the look and feel of videos on our system, the Preventing Injuries modules are in the 'good examples' portions." In addition, Tyson Foods used two of the KOSHS-produced safety videos to train over 2,200 Tyson Food drivers.

American Automobile Association (AAA) Towing Research Projects. Our study on tow truck driver injuries (Chandler M, Bunn T. Analysis of roadside injuries in motor vehicle towing. *Journal of Safety Research.* Dec 2019;71:191–200) was used by the Towing and Recovery Association of America (TRAA) to create an infographic that was shared on their Facebook page reaching 10,123 followers. When contacted, they stated, "As the towing industry's only national association, we prioritize educational content that can help save the lives of operators. Therefore, when we saw your study, we felt it provided such valuable insights we just had to share with our members! The infographic was sent via e-blast to our full membership list including state towing associations, towing company owners/managers, and manufacturers. After sending, we immediately heard from a Virginia company member who is going to share it during their next safety meeting." The AAA stated that AAA was preparing to conduct two research projects and asked permission to use our study to "look at roadside fatalities involving tow service providers and then develop countermeasures." KOSHS participated in a AAA Foundation for Traffic Safety expert roundtable in June 2021 on improving roadside responder crash data with the goal of developing a white paper addressing collection, accuracy and utility of crash related data sets.

KOSHS Fundamental Program Outcomes/Impact

FMCSA revised rule on commercial motor vehicle passenger safety belt usage. A KOSHS sleeper berth research study informed a *new industry standard*. Our study (Bunn TL, Slavova S, Robertson M. Motor vehicle injuries among semi-truck drivers and sleeper berth passengers. *Journal of Safety Res*earch, 2013;44:51-5) showed increased odds of a semi-truck crash injury when no occupant restraint was used by the sleeper berth passenger. The study results were used as a justification for the **2016** Federal Motor Carrier Safety Administration (FMCSA) revised rule (49 CFR 392.16) that now requires commercial vehicle passenger seat belt use. Previously, only the driver was required to wear an occupant restraint. The revised rule became effective August 8, 2016.

Truck tandems. In October 2015, the National Highway Traffic Safety Administration (NHTSA) Office of Defects Investigation – Med/Heavy Duty Vehicles division used our fatality report #14KY064, Semi Truck Team Driver Pinned and Killed while Adjusting Tandems, Kentucky, to justify the formation of a committee to redesign or eliminate dump truck tandems due to fatalities.

Mandated towing training. In 2018, our tow truck fatality report #16KY052, Tow Truck Driver Struck and Killed by Passenger Vehicle While Securing Disabled Vehicle onto Flatbed Tow Truck, Kentucky, was incorporated into a Federal Highway Administration (FHWA) first responder training course offered to towing operators throughout the state on an ongoing basis; tow truck operators are now required to complete traffic incident management (TIM) training to be considered for the interstate towing list in Ky. To date, the training has been delivered to 10,441 employees in Ky, with a goal of training all 18,000 TIM responders in the state.

Fuel tank standards. The National Transportation Safety Board (NTSB) used the KOSHS published work on fuel tank fires for its research on fuel tank integrity and standards for commercial vehicles. The NTSB final report was adopted by the board in November 2017 with 13 recommendations, including one based on the KOSHS fatality report and NTSB work that says, "The FMCSA has authority over regulations contained in 49 CFR Part 393 regarding fuel tank integrity standards. The National Highway Traffic Safety Administration (NHTSA) is responsible for developing crashworthiness standards. Therefore, the NTSB recommends that SAE International work with FMCSA and NHTSA to improve truck-tractor side-mounted fuel tank crashworthiness to prevent catastrophic tank ruptures, limit post collision fuel spillage, and develop and promulgate an updated standard."

The long-term outcome of the KOSHS fundamental program is to reduce occupational injury morbidity and mortality in Ky. There was a statistically significant decrease (52%) in Kentucky occupational fatality rates from 1995–2019 compared to a 30% decrease in the US occupational fatality rates over the study period. Similar to occupational fatality rates, Kentucky's occupational injury morbidity rates have decreased over the last decade but are still 7% above the national occupational injury morbidity rate. It is impossible to eliminate or take into account all the possible influences on occupational injury reduction, but the KOSHS fundamental program has been effective in the surveillance of injuries among workers and in collaborating with agencies, organizations, and industries to reduce worker injuries in Kentucky. The KOSHS fundamental program is fulfilling its objective of identifying and describing industries and occupations at elevated risk for traumatic injuries and using occupational injury surveillance data to inform the development and implementation of workplace interventions and policies.

Kentucky Occupational Safety and Health Surveillance (KOSHS) Program- Occupational Health Indicator (OHI) Component

KOSHS OHI Program Key Findings

The KOSHS OHI program has a robust occupational injury indicator surveillance program. The KOSHS OHI program expanded its surveillance improvement and research capabilities, and reached agency stakeholders in critical positions to effect change. The KOSHS OHI program collaborated with its industry stakeholders and organizational stakeholders, disseminated its findings to appropriate stakeholders and underserved worker populations, conducted research studies, and collaborated with agencies and organizations on the translation of KOSHS OHI program findings into promising practices and evidence.

Based on KOSHS OHI program data surveillance, three new Kentucky (Ky)-specific OHIs were established: a) OHI #28—work-related traumatic injuries treated in Ky trauma centers using Trauma Registry (TR) data was developed and implemented to track severe traumatic occupational injuries by industry and occupation. A gap in work-related inpatient hospitalization (IH) data is that IH data do not contain industry and occupation; the use of TR data addresses this gap since it contains both industry and occupation data fields. The work-related traumatic injury rate increased from 16.4/100,000 employed persons in 2008 to 24/100,000 in 2019 using TR data; b) OHI #29—work-related traumatic brain injuries (TBI) using IH data is a modification of CDC's TBI indicator that uses diagnosis codes, expected payer of workers' compensation (WC), and ICD-10-CM E-codes. In 2019 there were 72 work-related TBI hospitalizations at a rate of 3.6/100,000 employed persons; and c) OHI #30—work-related concussions using workers' compensation (WC) nature of injury data. In 2017, there were 338 occupational concussion claims and first reports of injuries (FROIs). The number of concussion injuries reported to the Department of Workers' Claims (DWC) steadily increased over the past decade, which could be partially due to increased awareness and better recognition of concussion injuries.

The Ky OHI program collaborated with the Southeastern Occupational Health Network (SouthON) and with NIOSH on three multi-state collaborative studies during this funding cycle:

1) Work-related hyperthermia emergency department (ED) visits were analyzed in five participating southeastern US states, and results showed that ~46% of the ED visits occurred on heat index days that the Occupational Safety and Health Administration (OSHA) designates as low or moderate heat risk (Shire J, Vaidyanathan A, Lackovic M, Bunn T: [2020] Association between Work-Related Hyperthermia Emergency Department Visits and Ambient Heat in Five Southeastern States, 2010–2012. GeoHealth4[8]). For every 1°F increase in average daily mean temperature, we observed a 14% increase in work-related hyperthermia ED visits. We recommended that the existing OSHA policy related to heat-risk levels for ambient temperatures be reviewed.
2) A study on heat-related illness (HRI) utilized ED and IH data from nine southeastern states to identify occupational HRI ED visits (6.5/100,000 workers) and IHs (0.61/100,000) in the southeast over the study period (Harduar Morano L, Bunn TL, Lackovic M, Lavender A, Dang GT, Chalmers JJ, Li Y, Zhang L, Flammia DD: [2015] Occupational Heat-Related Illness Emergency Department Visits and Inpatient Hospitalizations in the Southeast Region, 2007–2011. American Journal of Industrial Medicine 58[10]:1114–25). ED visit and IH rates were significantly elevated in males and blacks, and older workers had higher IH rates. This was the first study to evaluate occupational HRI ED visits and IHs in the southeast region.
3) Census of Fatal Occupational Injury (CFOI) data were analyzed to compare worker fatalities in the southeast region to the rest of the US. Our study results showed that the annual fatality rate for work-related injuries from the 12 states in SouthON was 37% higher than the rate for the entire US, particularly motor vehicle crashes (MVCs) (Brinker K, Jacobs T, Shire J, Bunn T, Chalmers J, Dang G, Flammia D, Higgins S, Lackovic M, Lavender A, Lewis JS, Li Y, Harduar Morano L, Porter A, Rauscher K, Slavova S, Watkins S, Zhang L, Funk R: [2016] Fatal Work-Related Injuries: Southeastern United States, 2008–2011). Workplace Health & Safety 64[4]:135–40).

KOSHS OHI Program Translation of Findings

Evaluation of fatal occupational injuries (OHI #3). Assessment of electronic death certificate (DC) records for fatal occupational injury surveillance identified that the field "Injury Description" did not have adequate length in the death certificate (DC) extract layout, leading to occasional truncation of injury description text. OHI personnel worked with Vital Stats to address the issue. The Vital Stat Information Technology (IT) team programmed changes to expand the size of the field. KOSHS OHI staff rewrote the SAS programming code to

read the new layout of DC records and updated all DC historical files. The benefit of this improvement is beyond the OHI programs, as many CDC-funded injury surveillance programs use the narrative on the DC to improve specificity of injury surveillance data.

Blood Lead Level Surveillance. KOSHS performs case follow-up public health interventions for persons age 16 years or older with blood lead levels (BLL) ≥10 micrograms per deciliter (µg/dL) and referral to Ky OSHA for follow-back site investigations of cases with BLL ≥20 µg/dL; The KOSHS OHI program identified a company with 22 employees that had elevated BLLs and made a referral to OSHA for an on-site investigation. During the investigation, the coffee vending machine buttons tested positive for lead. The industrial hygienist speculated that lead exposure was likely due to the construction of the coffee machine's button display. The buttons were surrounded by a raised edge that allowed lead dust to accumulate and not be easily wiped away. The company cleaned the buttons to remove the lead residue.

KOSHS OHI Program Outcomes/Impact

SouthON. The KOSHS OHI program was instrumental in the establishment of SouthON, which includes 1) NIOSH occupational safety and health surveillance-funded and unfunded states; 2) NIOSH Education and Research Centers (ERCs); 3) Southeast Agricultural Health Centers; 4) worker organizations; 5) NIOSH; and 6) OSHA. Our participation in SouthON (Bunn was SouthON PI from 2015–2020) achieved a number of accomplishments: 1) Occupational heat-related illnesses and deaths were identified by SouthON partners at the 2015 in-person meeting as a work-related illness of primary concern. Two SouthON peer-reviewed studies generated during this funding cycle (2015–2020) were based on collaborations that were formed during SouthON meetings. 2) A 2017 SouthON thematic meeting on potential exposures of first responders to fentanyl led to UK Central Appalachian Region ERC funding of four southeastern states (GA, Ky, MS, VA) in 2017 to develop and administer a survey to first responders to assess exposures to fentanyl and their knowledge and use of personal protective equipment. The survey was disseminated through developed partnerships with state firefighter associations, Ky State Police, and other first responder agencies and organizations. The survey results were published in *Health Science Reports* in 2021, and 2018 SouthON meeting follow-up discussions and workshops resulted in minigrant funding awarded to GA in 2018 for a follow-up survey. A collaborative HRI OHI was developed by LA, NC, KY, and FL for state-based OH surveillance based on discussions initiated at the 2013 SouthON meeting; the OHI was implemented by NIOSH Occupational Health and Safety-funded states in 2016.

OHI #2 on work-related hospitalizations. The KOSHS OHI program leveraged resources via 1) collaborative work at the national level in the Council of State and Territorial Epidemiologists (CSTE) "General" Injury ICD-10-CM Transition Workgroup and CSTE ICD-10-CM Poisoning Indicators Workgroup; and 2) Ky-specific work funded by the Kentucky Violence and Injury Prevention (KVIPP) Injury Surveillance Quality Improvement (SQI) grant. A Ky medical coder survey was developed by the KOSHS OHI and KVIPP SQI programs in 2017 and was administered to understand issues related to the ICD-9-CM to ICD-10-CM external cause of injury coding transition that occurred in October 2015 and its effect on medical coders' productivity, need for additional training, and continuing education. The survey included questions specific to the coding of work-related injuries; 86% of respondents reported that they did not receive training on coding of cases where the expected payer was workers' compensation (WC), and one-third of coders said that insufficient information in the medical record was an obstacle for coding the activity and place of injury, 79% of coders said that if a case was coded with WC as expected payer, they routinely assign codes for place and activity of injury. The following question was asked: "Codes Y92, Y93, Y99 are used by epidemiologists to identify work-related injuries. Please, discuss how you use these codes". These two responses are representative of the general tone in the coders' answers: 1) "These are coded on all encounters per our hospital policy. The issue is provider documentation. It may not always be there and, if so, it is very vague and not documented to the highest level of specificity. The provider should be documenting this information."; and 2) "Used every time. Always use Y99.9 since that is never documented. Y92.9 and Y93.3 are used most often, as this info is rarely given". Based on the survey results, a continuing education course for medical coders and for physicians was developed in collaboration with the SQI program that includes ICD-10-CM coding of occupational injuries.

The long-term outcome of the KOSHS OHI program is to reduce occupational injury morbidity and mortality. There was a statistically significant decrease (52%) in Ky occupational fatality rates from 1995–2019 compared to a 30% decrease in the U.S. occupational fatality rate. Similar to the occupational fatality rates, Ky's occupational injury morbidity rates decreased over the last decade but were still 7% above the national occupational injury morbidity rate.

Kentucky Occupational Safety and Health Surveillance (KOSHS) Program- Fatality Assessment and Control Evaluation (FACE) Program

KOSHS FACE Program Key Findings

The Kentucky (Ky) FACE program has conducted occupational safety and health surveillance since 1994, and has collaborated with industry stakeholders on interventions (e.g., semi-truck driver safety training videos, developed in collaboration with the Kentucky Trucking Association [KTA] based on FACE surveillance data analyses). The Ky FACE program informed new industry standards, and policies. From 2015-2020, the Ky FACE program conducted 58 worker fatality investigations and produced 46 final reports: 12 truck transportation, nine construction, five manufacturing, four public administration, four highway incident management (HIM), two landscaping, and five others. The causes of fatal injury were 16 motor vehicle crashes, 10 falls, 5 electrocutions, 3 crushes, 3 suffocations, two struck byes, two caught in/between, one burn, one machine- related, one drowning, one homicide, and one suicide.

From 2015-2021, the Ky FACE program produced 12 trucking transportation fatality reports that were disseminated to our general and trucking listservs (n=2,338), as well as targeted dissemination to the National Transportation Safety Board (NTSB), KTA, and Federal Motor Carrier Safety Administration (FMCSA). Harbor Freight USA used semi truck report #15KY001 “Semi-Truck Driver Fatally Struck by Falling Flatbed Cage Door, Kentucky” in their employee cargo safety training (February 2016). The Cincinnati Insurance Company used FACE materials, including semi truck report #15KY001, for internal training of Cincinnati Insurance personnel and insured (n=270). Truck transportation fatality reports were used to develop a truck crash prevention toolkit and the Trucking 101 online training program (in collaboration with the KTA) to address the lack of Ky-specific safety training materials. The training program was utilized by CoreTrans, Inc. for 50 drivers, by Edward’s Moving and Rigging for 27 Class A drivers, and by Sallee Horse Vans for 36 semi-truck drivers.

During the grant cycle, the Ky FACE program produced four HIM FACE reports – three tow truck drivers; and one traffic control worker. Report #16KY052 “Tow Truck Driver Struck and Killed by Passenger Vehicle While Securing Disabled Vehicle onto Flatbed Tow Truck” was incorporated into a Federal Highway Administration (FHWA) traffic incident management responder training course offered to towing operators throughout the state on a regular basis.

A study conducted on injuries among commercial tow truck operators engaged in roadside assistance (Chandler M, Bunn T. Analysis of roadside injuries in motor vehicle towing. Journal of Safety Research. 2019;71:191–200) was used by the Towing & Recovery Association of America (TRAA) to create an infographic that reached 10,123 followers. When contacted, TRAA stated, “We’re so glad to hear that you approve of the infographic! As the towing industry’s only national association, we prioritize educational content that can help save the lives of operators. So, when we saw your study, we felt it provided such valuable insights we just had to share with our members! The infographic was sent via e-blast to our full membership list including state towing associations, towing company owners/managers, and manufacturers. After sending, we immediately heard from a Virginia company member who will share it during their next safety meeting.” The American Automobile Association (AAA) contacted Ky FACE and stated that AAA was conducting two research projects and asked permission to use our study to “look at roadside fatalities involving tow service providers and then develop countermeasures.”

KOSHS FACE Program Translation of Findings

Truck Safety Training Videos. A study of truck transportation first reports of injuries (FROIs) was performed that showed a higher percentage of lifting and cranking injuries in short-haul trucking compared with long-haul trucking that had a higher percentage of tarping, trailer door handling, and cab slippage injuries “Chandler MD, Bunn TL, Slavova S. Narrative and quantitative analyses of workers' compensation-covered injuries in short-haul vs. long-haul trucking. Int J Inj Contr Saf Promot. 2017 Mar;24(1):120-130”. The study was used by FACE staff, in collaboration with Midwest Insurance, to develop four studio-quality safety training videos to prevent injuries involving entering and exiting semi-trailers; opening and closing swinging doors; cranking landing gear; and getting in and out of truck cabs. The videos were uploaded to YouTube and shared to the trucking listserv. The KOSHS FACE program entered into an agreement with the Vertical Alliance Group, a training company that serves over 1,100 companies, to host the videos on their platform for companies to use. The Vertical Alliance Group stated, “I can tell you that your videos have gotten great traction

on our system… I can also tell you that the look/production value of your videos are some of the best received on our platform. Any time I hear feedback about the look and feel of videos on our system, the Preventing Injuries modules are in the 'good examples' portions." As of June 30, 2021, the videos were viewed over 100,000 times. Tyson Foods used two of the videos to train over 2,200 Tyson Food drivers.

Level 3 truck driver inspection online training. Partnering with the KTA, the FACE program developed a series of six modules in 2017 communicating the complex regulations governing a roadside driver inspection. Employers were provided the option of a personalized e-learning portal to be established by KOSHS through Moodle.com that allows managers to track the progress and scores of their individual commercial truck drivers; 4 employers requested personalized e-learning portals, and a combined 122 drivers registered. Not included in this total were e-learners who completed the training directly from the KOSHS website without registering.

Air Spring Installation Training. Based on a recommendation in FACE semi truck *report 16KY039*, the company implemented mechanic training on correct removal and installation of air springs.

Arborist Training. Based on recommendations in FACE tree trimmer *report 16KY013*, the company purchased insulating equipment to use when within the minimum approach distance of uninsulated power lines and instituted a policy that a second employee act as a spotter when a coworker is performing work near power lines.

KOSHS FACE Program Outcomes/Impacts

FMCSA revised rule on commercial motor vehicle passenger safety belt usage. Our KOSHS sleeper berth study (Bunn TL, Slavova S, Robertson M, Motor vehicle injuries among semi-truck drivers and sleeper berth passengers; *Journal of Safety Research*; 2013;44:51–55) that showed increased odds of a semi-truck crash injury when no sleeper berth occupant restraint was worn was used as justification for a final revised FMCSA rule that now requires occupant restraint use by semi-truck passengers. Previously, only the driver was required to wear an occupant restraint. 49 CFR 392.16, which became effective August 8, 2016, requires passenger safety belt usage in commercial motor vehicles.

Truck tandems. In October 2015, the KOSHS program was contacted by a safety defect investigator with the National Highway Traffic Safety Administration (NHTSA) Office of Defects Investigation—Med/Heavy Duty Vehicles division regarding our fatality report #14KY064. NHTSA *used our FACE report to justify the formation of a committee* to *redesign or eliminate dump truck tandems due to fatalities.*

Mandated towing training. In 2018, our tow truck fatality report #16KY052 was incorporated into an FHWA first responder training course offered to towing operators throughout Ky on an ongoing basis; tow truck operators are now required to complete traffic incident management (TIM) training in order to be considered for the interstate towing list in Ky. FHWA has delivered the training to 10,441 employees in Ky, with a goal of training all 18,000 TIM responders within the state.

Fuel tank standards. The NTSB used KOSHS published work on fuel tank fires (Bunn TL, Slavova S, Robertson M. Crash and burn? Vehicle, collision and driver factors that influence motor vehicle collision fires. *Accident Analysis and Prevention*. 2012;47:140–145) for their research on fuel tank integrity and standards for commercial vehicles. The final report, adopted in November 2017, contained 13 recommendations and stated, "The FMCSA has authority over regulations contained in 49 CFR Part 393 regarding fuel tank integrity standards. NHTSA is responsible for developing crashworthiness standards. Therefore, the NTSB recommends that SAE International work with the FMCSA and NHTSA to improve truck-tractor side-mounted fuel tank crashworthiness to prevent catastrophic tank ruptures and limit post collision fuel spillage and develop and promulgate an updated standard."

Trench safety policies. FACE report 15KY031"19-year-old construction laborer crushed in trench collapse while laying sewage pipe" was produced, and the recommendations informed key company policy changes: 1) hiring an external safety service to evaluate company OSHA compliance; 2) a requirement that all employees performing trench work receive competent person training; and 3) increased enforcement of PPE usage.

Texting and seat belt policy. Report 19KY013 on an Information Technology consultant death resulted in one company implementing no-texting-while-driving and mandatory seat-belt usage policies and another company installing electronic logging devices to monitor driver compliance to hours of service regulations.

There was a statistically significant decrease (52%) in Ky occupational fatality rates from 1995–2019, compared to a 30% decrease in the U.S. occupational fatality rate over the study period.

SECTION 2

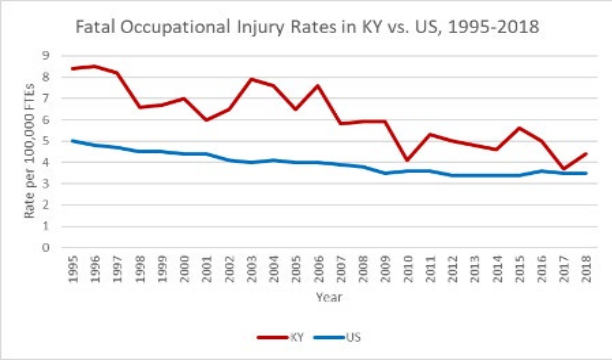
Scientific Report: Kentucky Occupational Safety and Health Surveillance Program—Fundamental Component.

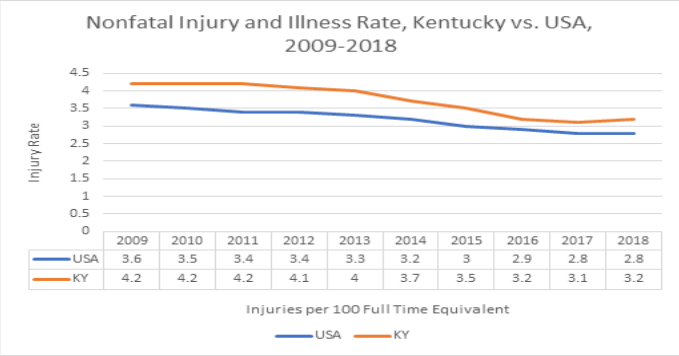
A. Background

In 2018, 5,250 fatal work-related injuries were reported nationwide, for a fatality rate of 3.5/100,000 full-time equivalent (FTE) workers.[1] Work-related unintentional injury costs totaled $170.8 billion, including wage and productivity losses of $52.4 billion, medical expenses of $35 billion, and motor vehicle damage at $4.9 billion; the cost per worker death was $1,190,000.[2] In 2018, 13.5% of Kentucky workers were employed in high-risk industries for occupational mortality, 10% above the US percentage of 12.3%.

The Ky Occupational Safety and Health Surveillance (KOSHS) program collects data to generate 20 occupational health indicators (OHIs) of worker injuries and illnesses using Council of State and Territorial Epidemiologists (CSTE)/NIOSH guidelines as well as six state-specific indicators. OHI data show that, although Ky's fatal and nonfatal work-related injury and illness incidence rates have generally decreased over the last decade, Ky's injury and illness incidence rates for many indicators remain significantly above US rates. Ky's occupational fatality rate was 20% above the nation's rate of 4.2 deaths/100,000 workers in 2018.[1] Ky's nonfatal private industry worker injury rate was also 14% higher at 3.2/100 full-time workers; the 2018 US rate was 2.8/100.[3] The 2018 Ky motor vehicle death rate per 100 million miles traveled (1.46) was 29% above the US rate (1.13).[4]

In 2018, Ky was the 12th worst state for nonfatal occupational injury and illness incidence rates (3.2/100 FTE), the 20th worst state for overall fatal occupational injury rates (4.2/100,000 FTE), and the 26th worst for the transportation and utilities industry sector (11/100,000 FTE).[1] In the Southeastern States Occupational Network (SouthON) region (12 states), Ky ranked worst for nonfatal injury rates and 7th worst for overall occupational fatality rates.





	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
USA	3.6	3.5	3.4	3.4	3.3	3.2	3	2.9	2.8	2.8
KY	4.2	4.2	4.2	4.1	4	3.7	3.5	3.2	3.1	3.2

There was a notable decrease in both US and Ky occupational fatality rates over the last two decades. In Kentucky, there was a 48% statistically significant decrease in fatal occupational injury rates from a high of 8.5/100,000 in 1995 to 4.4/100,000 in 2018, compared to a 30% decrease in the US occupational fatality rate, from 5.0/100,000 in 1995 to 3.5/100,000 in 2018.[1] Similarly, Ky's occupational injury morbidity rates have decreased over the last decade but are still 14% above the national occupational injury morbidity rate. These elevated rates reflect the concentration of Ky workers in high-risk industry sectors and are clear indications of the need to continue efforts to lower the state's burden of occupational injury morbidity and mortality.

From 1995–2019, 2,690 Ky workers were killed on the job, averaging 108 per year.[5] In 2019, there were 80 Ky worker deaths; the highest percentages were in the trade, transportation, and utilities industry sector (33%); natural resources and mining industry sector (20%); and the construction industry sector (19%). Motor vehicle collisions (MVCs) are the leading cause of Ky work-related deaths (31% from 1995–2019). Fatal and nonfatal occupational MVCs are a state-specific indicator included in our KOSHS fundamental project. Of the 828 occupational MVC deaths in Ky from 1995–2019, 72% involved Ky residents and 50% were in the transportation and materials moving occupations. Semi-trucks were most frequently involved in transportation MVC deaths, comprising 44% of fatal crashes. According to 2018 CRASH data (Ky OHI #26), there were 4,561 truck tractor and semi-trailer vehicles involved in collisions (nonfatal and fatal); this represents 62% of all commercial vehicles involved in collisions in 2018. The second highest percentage of all commercial vehicle crashes was for single unit trucks such as furniture trucks, dump trucks, etc. (22%; n=1,590).

In 2018, Kentucky had the ninth highest drug overdose fatality rate in the nation.[6] Ky Fatality Assessment and Control Evaluation (FACE) project data show that, from 1995–2019, 37 Ky workers died due to drug overdoses in the workplace; 51% of the deaths occurred from 2017–2019.[5]

While there has been significant progress in reducing Ky occupational injury morbidity and mortality rates

by the KOSHS fundamental and FACE programs, other occupational health stakeholders, and other influences (e.g., changes in economy and in organization of work) over the past two decades, there is still a significant need for continued KOSHS program funding to reduce the Ky occupational injury morbidity and mortality rates to the US mean through surveillance and research to inform targeted interventions and through communication of Ky fundamental program findings to industry stakeholders who can inform and enhance worker safety programs and policies.

B. Specific Aims for Overall KOSHS Program (2015-2021)

The specific aims for the overall KOSHS expanded program are to:

1) perform cohesive Ky *population-based occupational injury and illness surveillance* using 21 NIOSH-recommended OHI, six Ky-specific OHI, FACE, and other surveillance data, as well as surveillance data quality improvement and evaluation of new data sources;
2) perform Ky *case-based occupational injury and illness surveillance* through FACE program on-site fatality investigations and OHI program follow-up public health interventions of adults with blood lead levels (BLLs) of ≥10 micrograms per deciliter (µg/dL) and referral to Ky OSHA of adults with BLLs of >20µg/dL;
3) conduct integrated KOSHS fundamental, FACE, and OHI *epidemiological analyses of occupational injury and illness surveillance and investigation data* to inform workplace interventions, policies, and practices;
4) *establish and maintain unified KOSHS fundamental, FACE, and OHI program partnerships and collaborations* with state partners, agencies, organizations (e.g., National Safety Council [NSC]), NIOSH, and other stakeholders that integrate KOSHS results with partners' intervention and outreach activities;
5) participate in the *KOSHS advisory committee* and attend semiannual *grantee meetings* to inform occupational injury and illness surveillance, interventions, and policies;
6) *disseminate overall KOSHS expanded program data and research results* through annual surveillance and other reports, annual OHI data submission to NIOSH, newsletters, KOSHS website postings, the NIOSH State-based Occupational Health Clearinghouse, presentations, trade journals, peer-reviewed publications, NIOSH CDC alerts, Morbidity and Mortality Weekly Reports, Workplace Solutions, and social media, for impact at state, regional, and national levels; and
7) Perform a process, impact, and outcome *evaluation* of the major activities conducted to assess effectiveness and impact of the overall KOSHS expanded program.

C. Methods for KOSHS Fundamental Program (2015-2021)

KOSHS Fundamental Initiatives

County Profiles of Worker Injuries. KIPRC's CDC-funded Kentucky Violence and Injury Prevention Program (KVIPP) and NSC-funded Safe Communities' local recruitment program work with communities to build local injury prevention capacity. Local businesses and key stakeholders express interest in county-level work-related injury surveillance to track Safe Community injury prevention progress and to attract businesses with lower community- and work-related injury rates. The KOSHS fundamental program will produce county-level profiles of worker injuries based on worker's compensation (WC), inpatient hospitalizations (IH), and emergency department (ED) data for presentation to local communities by the KVIPP and Safe Community recruitment teams and via our website; profiles include ED, IH and WC data by mechanism (e.g., falls versus MVCs), manner of injury (e.g., unintentional versus intentional), total numbers/ rates, sex, discharge status, total/average charges, comparison with other Ky counties, industry, and occupation.

ED-IH-CRASH Data Linkage To Identify Medical and Financial Effects of Sleeper Berth MVC Injuries. A 2013 KOSHS study found that nonuse of occupant safety restraints by drivers or sleeper berth passengers significantly increased MVC injury odds. We recommended that trucking companies mandate sleeper berth occupant restraint use policies. The study was well received by the Federal Motor Carrier Safety Administration (FMCSA) and the trucking industry; a number of companies implemented sleeper berth occupant restraint use policies. To date, there still is no FMCSA regulation that requires sleeper berth occupant restraint use, although driver occupant restraint use is mandated (Federal Motor Carrier Safety Regulations, Part 392.16). To provide FMCSA with medical outcome and financial burden evidence to support a sleeper berth restraint use regulation, we will collaborate with the NIOSH Center for Motor Vehicle Safety (CMVS)to probabilistically link 2008–2014 CRASH, ED, and IH data to obtain additional information on hospital stay length, total charges, discharge status, Total Worker Health® (TWH) indicators (e.g., drug dependence, smoking, comorbid conditions), and crash characteristics (e.g., at-fault status and single versus multiple-vehicle collision). The study will be submitted for peer-reviewed publication and disseminated to NIOSH, FMCSA, Ky Trucking Association (KTA) and other trucking stakeholders.

Trauma Registry-CRASH Data Linkage of Severe Commercial Driver Injury Cases to Assess Concordance. Previous studies by the overall KOSHS expanded program showed that commercial drivers are at high risk for injuries due to fires, sleepiness and fatigue, and non-use of occupant restraints. An epidemiological study using 2013–2014 probabilistically linked Trauma Registry (TR)-CRASH data assessed data set concordance for injury severity, MVC person type (driver versus passenger), presence of drugs, industry, occupation, and restraint use, as well as provide medical outcome information on commercial driver MVC injuries. Results will be submitted for peer-reviewed publication, inform trainings for improved variable completion in CRASH reports by law enforcement and in the trauma registry by trauma registrars and be disseminated to trucking stakeholders.

Truck Driver Safety Trainings (see KTA and Midwest LOS). The KOSHS Program is collaborating with KTA to develop two series of truck driver safety training modules and videos for the trucking industry. These materials will be made available to industry workers and KTA members. First, the KOSHS Program will create a Department of Transportation 101 Training Course that covers all aspects of safety inspection for commercial motor vehicles and drivers. This course will be split into approximately nine modules that contain slides and demonstration videos and cover all points of pre-trip and post-trip inspections with a fully interactive navigable interface. Quizzes and engaging activities will be distributed to assess the viewer's progress. KOSHS will also collaborate with KTA and Midwestern Insurance on developing training videos that highlight common activities within trucking that lead to worker injuries. As a basis for these videos, 2012 WC data analysis determined the top 10 trucking activities that resulted in injuries: 1) moving cargo; 2) cab ingress/egress; 3) securing tarp straps; 4) struck from behind; 5) dolly operation; 6) trailer door operation; 7) standing on trailer; 8) pulling 5th wheel pin; 9) walking around truck; and 10) squatting. Within the videos, viewers will be quizzed using interactive click-and-choose selection of correct systematic activities.

D. Results and Discussion

County Profiles of Worker Injuries

County profile of worker injuries based on emergency department visit data and death certificate data were developed and implemented. The county profiles are posted on the Kentucky Injury Prevention and Research Center (KIPRC) KOSHS website: https://kiprc.uky.edu/programs/kentucky-occupational-safety-and-health-surveillance-koshs-program/worker-injury-county-profiles. The worker injury profiles contain data on the crude worker injury rate per 10,000 employed residents; number of cases; median ED charges; total ED charges; and work-related injury ED visits by manner of injury and mechanism of injury.

Epidemiological Studies

Association between commercial vehicle driver at-fault crashes involving sleepiness/fatigue and proximity to rest areas and truck stops. There is ongoing concern at the national level about the availability of adequate commercial vehicle rest areas and truck stops for commercial vehicle drivers to rest or to wait for a delivery window. In an expanded analysis of OHI #26, the KOSHS fundamental program performed a retrospective case-control study utilizing CRASH data to determine the association between the occurrence of sleepiness/fatigue-related versus all other human factor-related commercial vehicle driver at-fault crashes and proximity to rest areas, weigh stations with rest havens, and truck stops. Our results showed that commercial vehicle driver at-fault crashes involving sleepiness/fatigue were more likely to occur on roadways where the nearest rest areas/weigh stations with rest havens/truck stops were located 20 miles or more from the commercial vehicle crash site and commercial vehicle driver at-fault crashes involving sleepiness/fatigue were more likely to occur on parkways compared to interstates.[17] Our innovative use of statewide CRASH data analysis coupled with ArcGIS mapping capabilities provided the opportunity to both statistically determine and visualize the association between rest area/weigh station with rest haven/truck stop distance and the occurrence of commercial vehicle driver at-fault crashes involving sleepiness/fatigue. We recommended that implementation and evaluation of commercial vehicle employer policies and interventions such as the use of commercial vehicle driver fatigue alert systems might help to reduce fatigue and sleepiness in commercial vehicle drivers. These results were used by the Ky Transportation Cabinet to inform and increase truck-parking availability. The study was featured in the May 2018 edition of NIOSH's monthly newsletter 'Research Rounds'. It was also featured in the August 2018 edition of NSC's *Safety+Health* magazine (monthly audience of 386,000). The Kentucky Office of Highway Safety (KOHS) stated, "With regards to the application of your paper on commercial vehicles and rest stops, it is the intention of the KOHS to utilize the research and analysis you conducted for the paper, "Association between commercial vehicle driver at-fault crashes involving sleepiness/fatigue and proximity to rest areas and truck stops". Utilizing the information provided, we will

develop a media campaign along nighttime hours for drivers of commercial vehicles as a reminder to pull over and rest. Targeting the age ranges you indicated of 25–54 being primary and 55+ secondary group. Tractor-trailer will be primary focus with truck and trailer secondary focus. This information will be used in a grant application from GHSA [the Governors Highway Safety Association] to the KOHS to increase the awareness and need of CMV [commercial motor vehicle] drivers to pull over and rest. The application will be submitted to GHSA no later than March 9."

Motor vehicle towing: An analysis of injuries in a high-risk yet understudied industry. Our previous study showed that national fatality rates for commercial tow truck operators exceeded those of other first responders who also perform traffic incident management (TIM) services.[21] We utilized US Occupational Safety and Health Administration (OSHA) investigation files to analyze environmental factors for injuries in which commercial tow truck operators were struck by roadway traffic. Our results identified two major event types that accounted for the bulk of the injuries: 'struck-by' incidents resulting from contact with traffic, rolling vehicles, and equipment or other non-motorized objects and 'caught-in or -between' incidents.[18] We recommended that the towing industry provide initial and refresher safety training on vehicle loading and unloading, defensive techniques when exposed to traffic on roadways, and proper wheel chocking and braking procedures.

Narrative and quantitative analyses of workers' compensation-covered injuries in short-haul versus long-haul trucking. Narrative text analyses of Ky short-haul and long-haul trucking WC FROIs was performed based on analysis of our Ky-specific occupational motor vehicle crash (MVC) occupational health indicator (OHI) #26. We identified a high percentage of lifting and cranking injuries in short-haul trucking compared with long-haul trucking, which had a higher percentage of securing/opening/closing/adjusting injuries involving tarping, trailer door handling, and cab slippage.[21] We recommended enhanced driver safety training and safe freight handling in short-haul trucking, as well as tarping, trailer safety, and cab safety in long-haul trucking. The article was published in May 2016 and disseminated to Kentucky State Police (KSP), Governor's Executive Committee on Highway Safety (GECHS), Federal Motor Carrier Safety Administration (FMCSA), Federal Highway Administration (FHWA), Kentucky Trucking Association (KTA), Owner-Operator Independent Drivers Association (OOIDA), Women in Trucking, National Institute for Occupational Safety and Health (NIOSH), other Fatality and Assessment Control Evaluation (FACE) states, and the trucking listserv (n=567). We developed and disseminated four safety training videos based on the leading causes of nondriving-related injuries to truck drivers: 1) truck cab ingress and egress; 2) cranking the trailer landing gear; 3) opening and closing the trailer door; and 4) trailer ingress and egress. The Vertical Alliance Group, a training company that services over 1,100 companies, features our training videos. In June 2021, the four videos had over 100,000 downloads and views. Global Risk Solutions, North America, sought permission to use the trucking safety videos. The article was cited in the article "Physical workload and psychosocial working conditions in Swedish pig transport drivers" published in the International Journal of Industrial Ergonomics May 2021 edition.

Interventions

Trucking. Level 3 driver inspection online training. Collaborating with KTA, KOSHS developed a series of six modules in 2017 communicating the complex regulations governing a roadside driver inspection. Employers could request a personalized e-learning portal to be established by KOSHS through Moodle.com, allowing managers to track the progress and scores of their individual commercial truck drivers. Four employers requested personalized e-learning portals, with a combined 122 drivers registered. Not included in this total were e-learners who completed the training directly from the KOSHS website without registering.

Construction Falls Toolkit. The KOSHS program developed and disseminated a Construction Falls Toolkit containing multiple resources. The contents included 1) a statistics report, "Construction Sector Injuries in Kentucky, 2008–2015"; 2) four worker safety flyers; 3) a Falls in Construction Workbook; 4) a Falls in Construction—Case Studies PowerPoint presentation; 5) a Falls in Construction Hazard Alert; and 6) four Fatality Reports. The toolkit was disseminated to the general (n=1908) and construction (n=246) listservs and promoted on the KOSHS Facebook and Twitter social media pages. The Center for Construction Research and Training featured the Construction Falls Workbook in its online construction safety resource library eLCOSH. An occupational safety and health (OSH) professional employed in the private industry commented "*great job, much needed for training and awareness. I can use this in some of my training classes.*"

Trench Collapse Hazard Alert. A Hazard Alert titled "Construction Workers Killed in Trench Collapses" was disseminated to the general (n=1908) and construction (n=223) listservs. The hazard alert was featured in the online edition of JJ Keller's *Compliance Focus* newsletter on March 12, 2018, and in the print edition on March

28, 2018. The two formats have a combined subscription of over 4,100 individuals. It was also featured in the April 2018 edition of the NSC's *Safety+Health* magazine. The online and print version have a monthly subscription base of 124,000 readers. In addition, it was featured on workerscompensation.com; rhoadsandrhoads.com; billyjohnsonlaw.com; safetycontrolstech.com; unitedrentals.com; constructiondive.com; durabilityanddesign.com; zorninsight.com; lifelinestrategies.com; and diadonenterprises.com.

Electrocution Hazard Alert. A Hazard Alert titled "Electrocutions in the Construction Industry" was released on February 24, 2021 and was disseminated to the KY FACE construction listserv (n=225) and featured on OSHA's New Safety and Health Resources for FY 2021 Q3.

Tow Truck Driver Hazard Alert. The Hazard Alert "Pedestrian Tow Drivers Struck and Killed" was disseminated to 1,908 subscribers on the general listserv, 167 subscribers on the towing listserv, and 54 nationwide towing associations. The hazard alert was featured in the March 2018 NIOSH Transportation, Warehousing, and Utilities newsletter. A towing association leader in New Hampshire who received the Hazard Alert made the following comments: "It added material to be used to educate towers and the general public," and, when asked if they had additional safety recommendations to add, "Greater enforcement efforts need to be done by ALL LAW ENFORCEMENT," and "Continue supplying the field operators as many statistics as possible. We need this information to support our efforts with legislators." A private industry employer in Montana had the following comments: "As an owner-operator of a towing company and a traffic incident management trainer, the case study information is valuable information to use to emphasize the points we are teaching in our traffic incident management classes. Thank you for sharing!!!" and, in response to the recommendations, "In rural areas, the assistance of law enforcement personnel is not possible. Need to emphasize that the tow truck operator has to take responsibility for the safety of his customer and himself." When asked for suggestions for improvement, "While the U Tube [sic] video [Digital FACE Story] is entertaining, the written scene report is more useful for training and reference purposes."

Convenience Store Hazard Alert. The Hazard Alert "Convenience Store Robberies" produced in 2016 was disseminated to 2,137 subscribers and 5 major convenience store chains. One business owner stated, "I hadn't realized that the placement of the register in proximity to the door was so important."

Flooding Hazard Alert. The Hazard Alert "Patrolling in Flood-Prone Areas: Staying Safe While Performing Your Duties" was produced in 2019 and featured in the February 2019 edition of *Police Chief* magazine that has an average monthly readership of over 21,000. KY3 & KSPR News in Springfield, Missouri, based on this Hazard Alert, interviewed the KOSHS program manager. It was also featured in OSHA's *New Safety and Health Resources* quarterly newsletter in 2019.

Self-Harm Hazard Alert. The Hazard Alert "Intentional Self Harm in the Workplace" was released on April 29, 2020, and was disseminated to the general listserv (n=1739). It was disseminated to the Coordinator for State Suicide Prevention at the Suicide Prevention Resource Center, who said, "There are some great recommendations and resources listed. Michael Turner, thank you for highlighting the need for suicide prevention plans within workplaces." A manager at Communicare in Elizabethtown, Ky, said, "I sent these out to all Ky Career Centers in our region to share with their partner agencies." A certified prevention specialist at the Pennyroyal Regional Prevention Center in Hopkinsville, Ky, said, "I forwarded this information out to around 15 community members in the Pennyrile Region. I previously read over this information, I thought it was very well put together. I also wanted to tell you that I think you are doing a great job getting suicide prevention messages out."

Workplace Violence Hazard Alert. The Hazard Alert "Women as Victims of Workplace Violence" was developed on July 6, 2020, and was disseminated to the general listserv (n=1793) as well as the Ky Commission on Women, American Association of University Women, Fairness Campaign, Federally Employed Women, Ky Environmental Foundation, General Foundation of Women's Clubs, Ky Health Justice Network, Ky League of Women Voters, Professional Women's Forum, Women for Women, and Women Leading Ky. The Hazard Alert was featured on EHS Today's website in July 2020 (monthly audience of 471,000). The KOSHS project manager was a guest on Women in Trucking's weekly radio show on Sirius XM Radio's 'Road Dog' channel to discuss the Hazard Alert. The 45-minute interview show, which took place on August 15, 2020, discussed the Hazard Alert and what companies can do to protect women employees. In July 2020, the

Hazard Alert was also featured in 'The Synergist', an online workbook produced by the American Industrial Hygiene Association.

Cleaning and Disinfecting University Fleet Vehicles. KOSHS staff collaborated with the University of Kentucky's Department of Occupational Health and Safety on the development of a guidance document on the proper cleaning and disinfecting of the university's fleet vehicles and equipment in response to the Covid-19 pandemic. The guide was disseminated to all university employees who use powered equipment for campus operations and fleet vehicles for travel as well as to the KOSHS general list serv (n=1908).

KOSHS Fundamental Program Impacts on Policy Development

FMCSA revised rule on commercial motor vehicle passenger safety belt usage. Our KOSHS study (Bunn TL, Slavova S, Robertson M. Motor vehicle injuries among semi-truck drivers and sleeper berth passengers. *Journal of Safety Res*earch, 2013;44:51-5) that showed increased odds of a semi-truck crash injury when no sleeper berth occupant restraint was worn was used as justification for a final revised FMCSA rule that now requires occupant restraint use by semi-truck passengers. Previously, only the driver was required to wear an occupant restraint. 49 CFR 392.16 now requires passenger safety belt usage in commercial motor vehicles, and the revised rule became effective August 8, 2016.

Truck tandems. In October 2015, the National Highway Traffic Safety Administration (NHTSA) Office of Defects Investigation – Med/Heavy Duty Vehicles division used our fatality report #14KY064, "Semi Truck Team Driver Pinned and Killed while Adjusting Tandems, Kentucky" to justify the formation of a committee to redesign or eliminate dump truck tandems due to fatalities.

Mandated towing training. In 2018, our tow truck fatality report #16KY052, "Tow Truck Driver Struck and Killed by Passenger Vehicle While Securing Disabled Vehicle onto Flatbed Tow Truck", was incorporated into a FHWA first responder training course offered to towing operators throughout the state on an ongoing basis; tow truck operators are now required to complete TIM training to be considered for the interstate towing list in Ky. To date, the training was delivered to 10,441 employees in Ky, with a goal of training all 18,177 TIM responders within the state.

Fuel tank standards. The NTSB used KOSHS published work[26] on fuel tank fires for its research on fuel tank integrity and standards for commercial vehicles. The final report was adopted by the board in November 2017 with 13 recommendations, including one based on KOSHS and NTSB work that says, "The FMCSA has authority over regulations contained in 49 CFR Part 393 regarding fuel tank integrity standards. NHTSA is responsible for developing crashworthiness standards. Therefore, the NTSB recommends that SAE International work with FMCSA and NHTSA to improve truck-tractor side-mounted fuel tank crashworthiness to prevent catastrophic tank ruptures, limit post collision fuel spillage, and develop and promulgate an updated standard." The NTSB said, "Thank you, Terry and KIPRC. Your work was extremely helpful!"

Impact Examples Based on KOSHS Fundamental Program Intervention Development and Implementation

Towing. Our study on tow truck driver injuries[18] was used by the Towing and Recovery Association of America (TRAA) to create an infographic that was shared on their Facebook page, reaching 10,123 followers. We reached out to TRAA to thank them and ask about their dissemination. TRAA replied, "As the towing industry's only national association, we prioritize educational content that can help save the lives of operators. Therefore, when we saw your study, we felt it provided such valuable insights we just had to share with our members! The infographic was sent via e-blast to our full membership list, including state towing associations, towing company owners/managers, and manufacturers. After sending, we immediately heard from a Virginia company member who is going to share it during their next safety meeting." The American Automobile Association (AAA) contacted Ky FACE and stated that AAA was preparing to conduct two research projects and asked permission to use our study to "look at roadside fatalities involving tow service providers and then develop countermeasures." The study results were also featured in an article on The Horton Group, an insurance, employee benefits, and risk advisory firm, at https://www.thehortongroup.com/resources/tow-trucking-fatalities-and-serious-injuries.

Truck driver safety training videos. We developed and disseminated four safety training videos based on the leading causes of nondriving-related injuries to truck drivers: 1) truck cab ingress and egress; 2) cranking the trailer landing gear; 3) opening and closing the trailer door; and 4) trailer ingress and egress. The videos are featured by the Vertical Alliance Group, which services over 1,100 companies. In June 2021, the four videos had been downloaded and viewed more than 100,000 times. The Vertical Alliance Group stated, "Your videos have gotten great traction on our system. Over 35,000 views per year is strong. I can also tell you that

the look/production value of your videos are some of the best received on our platform. Any time I hear feedback about the look and feel of videos on our system, the Preventing Injuries modules are in the 'good examples' portions." A Tyson Foods safety compliance director contacted us in November 2020 to use the cranking video in their learning system, saying, "I found the video below on YouTube and thought the content was good and the video was well-produced. I am looking for the ok to be able to load this content into our learning system to show our drivers. Cranking trailers is one of our highest incidents of injury and we are looking to do whatever we can to keep our driers safe during this task. I believe that adding this video into our learning system could assist us in keeping one more driver from getting injured."

KOSHS Fundamental Program Evaluation

A process, impact, and outcome evaluation was performed to assess KOSHS fundamental program efficiency.

Engaging stakeholders. The KOSHS fundamental program has enhanced state agency partnerships. Memorandums of understanding were re-signed with major data owners, such as 1) Office of Vital Statistics; 2) the Office of Health Data and Analytics (IH and ED data); 3) the Department of Workers' Claims (DWC) (WC data); 4) the Lead Poisoning Prevention Program (BLL data); 5) the Ky Board of Emergency Medical Services (EMS data); 6) Kentucky State Police (KSP) (CRASH, drug-related crimes, and drug submission data); 7) NIOSH Total Worker Health; 8) Pan-Pacific Safe Communities; and 9) the Ky Poison Control Center. We improved OHI data quality, coding, analysis, and interpretation collaboratively; stakeholders provided continuous input on data collection, data quality improvement, and detailed indicator analysis and identified new data sources. Active communication was maintained with stakeholders through emails, newsletters, conference calls, and in-person meetings, and ideas were generated for surveillance quality improvement, dissemination, outreach, and research.

Evaluation outcomes. KOSHS fundamental program's short- and medium-term outcomes and impact examples are mentioned above; 12 peer-reviewed publications were produced in the 2015–2021 funding cycle on surveillance improvement, occupational MVCs, surveillance of occupational injuries, and TWH, among others.

E. Conclusion

The long-term outcome of the KOSHS fundamental program is to reduce occupational injury morbidity and mortality in Ky. There was a statistically significant decrease (52%) in Ky occupational fatality rates from 1995–2019, compared to a 30% decrease in the US occupational fatality rate over the study period (Figure 1). Similar to occupational fatality rates, Ky's occupational injury morbidity rates have decreased over the last decade but are still 7% above the national occupational injury morbidity rate (Figure 2). It is impossible to eliminate or consider all the possible influences on occupational injury reduction, but the KOSHS fundamental program has been effective in the surveillance of injuries among workers and collaborating with agencies, organizations, and industries to reduce worker injuries in Ky. The KOSHS fundamental program is fulfilling its objective of identifying and describing industries and occupations at elevated risk for traumatic injuries and using surveillance data to inform the development and implementation of interventions. KOSHS fundamental program prevention materials have been used to inform targeted interventions and policies in Ky's workplaces.

Figure 1. Fatal Work-Related Injury Rates per 100,000 FTEs, US vs. KY, 2010–2019

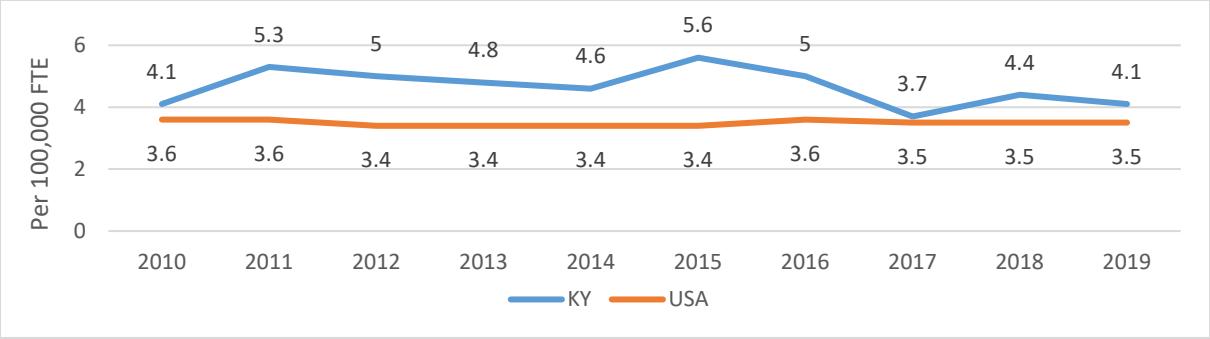
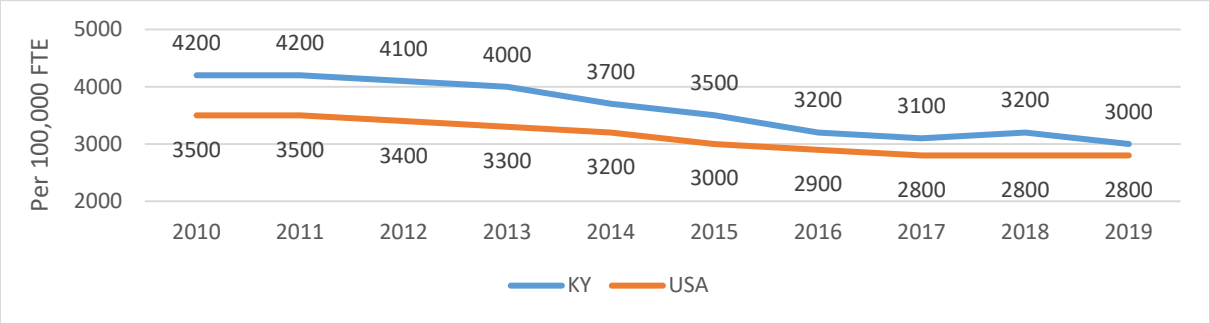


Figure 2. Nonfatal Work-Related Injury and Illness Incidence Rates in Private Industry per 100,000 FTEs, US vs. KY, 2010–2019



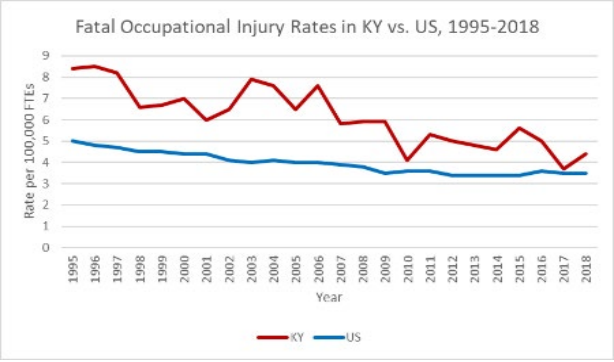
Scientific Report: Kentucky Occupational Safety and Health Surveillance Program—Occupational Health Indicator (OHI) Component

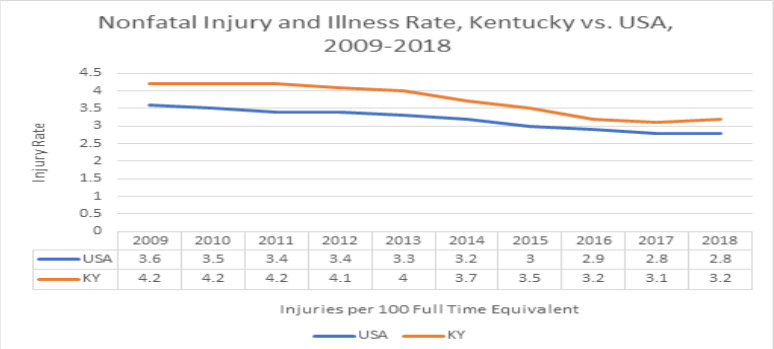
A. Background

In 2018, 5,250 fatal work-related injuries were reported nationwide, for a fatality rate of 3.5/100,000 full-time equivalent (FTE) workers.[1] Work-related unintentional injury costs totaled $170.8 billion, including wage and productivity losses of $52.4 billion, medical expenses of $35 billion, and motor vehicle damage at $4.9 billion; the cost per worker death was $1,190,000.[2] In 2018, 13.5% of Kentucky workers were employed in high-risk industries for occupational mortality, 10% above the US percentage of 12.3%.

The Ky Occupational Safety and Health Surveillance (KOSHS) program collects data to generate 20 occupational health indicators (OHIs) of worker injuries and illnesses using Council of State and Territorial Epidemiologists (CSTE)/NIOSH guidelines, as well as six state-specific indicators. OHI data show that, although Ky's fatal and nonfatal work-related injury and illness incidence rates have generally decreased over the last decade, Ky's injury and illness incidence rates for many indicators remain significantly above US rates. Ky's occupational fatality rate was 20% above the nation's rate of 4.2 deaths/100,000 workers in 2018.[1] Ky's nonfatal private industry worker injury rate was also 14% higher at 3.2/100 full-time workers; the 2018 US rate was 2.8/100.[3] The 2018 Ky motor vehicle death rate per 100 million miles traveled (1.46) was 29% above the US rate (1.13).[4]

In 2018, Ky was the *12th worst state for nonfatal occupational injury and illness incidence rate*s (3.2/100 FTE), the *20th worst state for overall fatal occupational injury rates* (4.2/100,000 FTE), and the 26th worst for the transportation and utilities industry (11/100,000 FTE).[1] In the Southeastern States Occupational Network (SouthON) region (12 states), Ky ranked *worst for nonfatal injury rates* and *7th worst for overall occupational fatality rates.*





	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
USA	3.6	3.5	3.4	3.4	3.3	3.2	3	2.9	2.8	2.8
KY	4.2	4.2	4.2	4.1	4	3.7	3.5	3.2	3.1	3.2

There was a notable decrease in both US and Ky occupational fatality rates over the last two decades. In Kentucky, there was a 48% statistically significant decrease in fatal occupational injury rates from a high of 8.5/100,000 in 1995 to 4.4/100,000 in 2018, compared to a 30% decrease in the US occupational fatality rate, from 5.0/100,000 in 1995 to 3.5/100,000 in 2018.[1] Similarly, Ky's occupational injury morbidity rates have decreased over the last decade but are still 14% above the national occupational injury morbidity rate. These elevated rates reflect the concentration of Ky workers in high-risk industry sectors and are clear indications of the need to continue efforts to lower the state's burden of occupational injury morbidity and mortality.

From 1995–2019, 2,690 Ky workers were killed on the job, averaging 108 per year.[5] In 2019, there were 80 Ky worker deaths; the highest percentages were in the trade, transportation, and utilities industry sector (33%); natural resources and mining industry sector (20%); and the construction industry sector (19%). Motor vehicle collisions (MVCs) are the leading cause of Ky work-related deaths (31% from 1995–2019). Fatal and nonfatal occupational MVCs are a state-specific indicator included in our KOSHS fundamental project. Of the 828 occupational MVC deaths in Ky from 1995–2019, 72% involved Ky residents and 50% were in the transportation and materials moving occupations. Semi-trucks were most frequently involved in transportation MVC deaths, comprising 44% of fatal crashes. According to 2018 CRASH data (Ky OHI #26), there were 4,561 truck tractor and semi-trailer vehicles involved in collisions (nonfatal and fatal); this represents 62% of all commercial vehicles involved in collisions in 2018. The second highest percentage of all commercial vehicle crashes was for single unit trucks such as furniture trucks, dump trucks, etc. (22%; n=1,590).

In 2018, Kentucky had the ninth highest drug overdose fatality rate in the nation.[6] Ky Fatality Assessment and Control Evaluation (FACE) project data show that, from 1995–2019, 37 Ky workers died due to drug overdoses in the workplace; 51% of the deaths occurred from 2017–2019.[5]

B. Kentucky OHI Program Specific Aims (2015-2020)

1) Collect, report, perform epidemiological analysis of, and interpret, 21 Council of State and Territorial Epidemiologists (CSTE)/NIOSH-recommended OHIs and six Kentucky-specific OHIs (three existing and three new);
2) Perform ongoing OHI surveillance quality improvement and evaluate new occupational injury and illness surveillance data sources and indicators, including NIOSH Total Worker Health®-related indicators;
3) Establish and maintain OHI program partnerships and collaborations with state partners, agencies, organizations, NIOSH, NIOSH TWH, and other stakeholders and participate in the KOSHS advisory committee and grantee meetings, to inform the collection and analysis of occupational injury and illness data and identify emerging trends;
4) Disseminate OHI data and research results widely through a variety of conduits for impact at state, regional, and national levels;
5) Perform case follow-up public health interventions for persons age 16 years or older with blood lead levels (BLLs) ≥10 µg/dL and referral to Ky Occupational Safety and Health Administration (OSHA) for follow-back site investigations of cases with BLL ≥20 µg/dL; and
6) Perform a process, impact, and outcome evaluation of the KOSHS expanded program's OHI program.

Methods for KOSHS OHI Program (2015-2020)

OHI Initiatives

New KY-specific work-related concussion OHI (OHI #25) using workers' compensation (WC) data. According to the Bureau of Labor Statistics (BLS), there were 70 nonfatal concussions in Ky in 2011 that involved days away from work for a rate of 5/100,000 FTE. A recent Ky OHI accepted manuscript on work-related concussions found that in 2011 there were 188 concussion first reports of injuries submitted to the Department of Workers" Claims (DWC), with an estimated work-related concussion rate of 11.7 concussions per 100,000 full time workers, more than double the estimated rate reported by the BLS. The BLS Survey of Occupational Injuries and Illnesses is known to underestimate the incidence of work-related injuries and illnesses due to methodology, timeliness, reporting incentives, and other issues. The Ky OHI program will track work-related concussions using WC data to identify industries and occupations at elevated risk.

Return-to-work strategies after concussions depend on injury severity, prior medical history, and the nature of the job. The recommendation for severe concussions is a few days off work, then return to work with modified or reduced hours and limited driving. Workers who experience concussions outside the work environment are also at increased risk for another injury when returning to work with post-concussive symptoms. Ky OHI staff will collaborate with the Brain Injury Alliance of Kentucky (BIAK) and the UK Multidisciplinary Concussion Program to educate workers and employers on concussion symptom recognition, when to seek medical attention, and safe return to work.

New Ky-specific work-related severe traumatic injury OHI using Trauma Registry data. In response to NIOSH's Traumatic Injury Research and Prevention Strategic Goal 6 (Increase the use of surveillance data to guide occupational traumatic injury research and prevention), we will develop and implement a new Ky-specific OHI on work-related traumatic injuries using Trauma Registry (TR) data to track occupational severe traumatic injuries by industry and occupation, as inpatient hospitalization data typically do not include industry and occupation information. Cases will be selected from TR data using the following criteria: 1) work-related indicator or WC as primary payer and 2) age 16 years or older. Our preliminary study found 415 work-related severe traumatic injury trauma cases in 2012. Results of annual indicator calculations including cause, intent, industry/occupation, age group, and geographic region will be discussed with our partner, the Ky Trauma Advisory Committee (Ky TAC), to assure correct interpretation, then disseminated to all Ky trauma centers for use by local injury prevention programs with a focus on work-related traumatic injury prevention using local OHI findings.

New Ky-specific work-related traumatic brain injury OHI using IH data. Traumatic brain injuries (TBIs) are among the most disabling traumatic injuries. CDC selection criteria will be modified to create a work-related TBI indicator. Work-related TBI hospitalizations will be identified as records with all of the following: 1) principal diagnosis of *injury* (diagnosis codes of 800–909.2, 909.4, 909.9, 910–994.9, 995.5–995.59, 995.80–995.85); 2) any diagnosis codes (principal or secondary) in the range 800.00–801.99 (Fracture of the vault or base of the skull), 803.00–804.99 (Other and unqualified or multiple fractures of the skull), 850.0–850.9 (Concussion), 851.00–854.19 (Intracranial injury, including contusion, laceration, and hemorrhage), 950.1–950.3 (Injury to the optic chiasm, optic pathways, or visual cortex), 959.01 (Head injury, unspecified), 995.55 (Shaken infant syndrome); 3) WC as primary payer; 4) ages 16 or older; and 5) Ky residence. Using this proposed definition,

our preliminary study found 489 TBI hospitalizations in 2010 billed to WC as expected primary payer; total hospitalization charges were ~$19 million. The indicator data will be analyzed by gender, age, and discharge status. When possible, hospitalization records will be supplemented with TR records to analyze TBI injury severity using the Glasgow Coma Scale and severity of other body injuries using the Injury Severity Scale. Hospitalization data do not include information on industry and occupation so when the hospital facility treating the TBI is also a trauma center reporting to the state TR, a probabilistic data linkage will add TR information to expand the reach of TBI hospitalization surveillance beyond administrative claim information. OHI staff will collaborate with BIAK to interpret and disseminate data and reports as well as develop and deliver educational materials to employers and workers for injury prevention and recovery after a TBI.

Data Linkage Examples

Work-related TBI using linked IH-TR data. Probabilistic data linkage of 2013–2015 IH and TR data (including charge information) will be performed to identify industries and occupations associated with severe TBI. Study results will be disseminated to the identified industries at highest risk for work-related TBIs and to KOSHS expanded program stakeholders, trauma centers, and BIAK to inform the development of interventions for worker populations at high risk for work-related TBIs. Study results will be submitted to the *Journal of Trauma* for peer-reviewed publication.

New OHI Surveillance Quality Improvement Initiatives

The OHI program will focus its surveillance quality improvement efforts on the following major issues elucidated through OHI data analysis during the past five years: 1) identification of medical facilities with low rates of injury records supplemented with external-cause-of-injury E-codes; 2) the transition from International Classification of Diseases (ICD) 9-CM to ICD-10-CM coding, which requires remapping and reprogramming all indicators based on hospital and emergency department (ED) data, in collaboration with state trauma registrars and the Kentucky Hospital Association (KHA); 3) the investigation of issues of E-code specificity in linked TR-CRASH commercial vehicle data in KOSHS fundamental program activities; 4) the evaluation of the accuracy and completeness of CRASH and TR records for commercial driver position in the vehicle, occupation, industry, and restraint use in collaboration with the Ky TR program; and 5) the development of trauma registrar training on E-code improvement for cause of injury, industry, and occupation.

Ky Trauma Registry data will be analyzed as a new data source to characterize work-related traumatic injuries by occupation and industry, identify high-risk occupations and industries, and inform industry-specific prevention strategies. Ky TR data collection began in 2008 with five trauma centers and expanded to 20 by 2013. By regulatory definition (902 KAR 28:040), a TR must be compatible with National Trauma Data Bank (NTDB) standards, have a secure, NTDB/HIPAA compliant online system, and upload electronic data at least quarterly. KIPRC is the statewide repository for TR data, which includes information on patient demographics, date/time of injury, work relatedness, industry and occupation for work-related injuries, cause/intent of injury, occupant position and restraint use in motor vehicle collisions, hospital transport, ED admission and discharge, diagnoses, injury by body part and nature, Injury Severity Scores (ISS), toxicology screening information, alcohol level, ICU length of stay, and discharge. Ky TR is 99.8% e-code complete and is considered a gold standard for accurate traumatic injury diagnosis coding because trauma registrars are highly trained to code traumatic diagnoses and data are used clinically and for performance improvement. In contrast, IH data are administrative claims data collected for billing purposes, so completeness and specificity of diagnosis codes are not as important if they do not affect reimbursement (currently ~90% complete). IH-TR TBI linked data will combine administrative and clinical records to identify high-risk industries and occupations associated with work-related TBI and total charges; total charge data is not available in TR data, and industry and occupation are not typically available in IH data.

NIOSH TWH-related indicators. The OHI program explores IH and ED data sources and case definitions for potential new Ky-specific OHIs to track changes in Ky TWH, and promote and evaluate NIOSH TWH activities in the state.

Trauma. BIAK, the University of Kentucky Multidisciplinary Concussion Program, and the OHI program will establish a partnership and collaborate on work-related concussions, work-related TBIs, and issues of return to work after TBI or concussion. The partnership will address research and practical solutions to problems causing workplace TBIs in response to NIOSH's *Traumatic Injury Research and Prevention Program and Strategic Goals, 2014*. The OHI program and the UK Trauma Center will collaborate to address the need for quality research on work-related traumatic injuries and practical solutions to problems causing workplace injuries, as suggested by NIOSH's *Traumatic Injury Research and Prevention Program and Strategic Goals,*

2014. We will collaborate on a study to address survival related to transport after a workplace injury to a trauma center and state trauma system expansion. A partnership with the Ky TAC will be established to collaborate on OHI data interpretation, disseminate to state trauma centers, and stimulate trauma centers' interest in enhancing their local injury prevention programs with a focus on work-related traumatic injury prevention using local OHI data.

Safe Communities. A partnership among the KOSHS expanded program, the National Safety Council-(NSC-) funded Ky Safe Community Program, and the Kentucky Violence and Injury Prevention Program (KVIPP) will provide county-level occupational injury profiles for dissemination to communities, as well as data reports, annual reports, and publications disseminated to the NSC general membership.

NIOSH TWH. The overall KOSHS expanded program, in collaboration with the CDC-funded KVIPP at KIPRC, integrates OHI outputs into the Ky TWH program. KIPRC became a NIOSH TWH affiliate upon signature of a NIOSH-KIPRC MOA in September 2014. The OHI program will contribute to KIPRC and NIOSH joint research by exploring new OHIs to track changes in Ky TWH such as drug abuse, smoking, and comorbid conditions.

Ky State Police (KSP) provides CRASH data for the Ky-specific indicator on occupational collisions. KSP will provide input on interpretation of data results related to the new Highway Incident Management surveillance initiative.

Follow-up Public Health Interventions & OSHA Referrals of Adults with High Blood Lead Levels

In 2011, 615 Ky residents, aged 16 or older, had BLL≥10 micrograms per deciliter (µg/dL) (caseload). Elevated BLL reports will be received weekly from the Ky DPH as a function of our bona fide agent status. KRS 211.902(1) mandates reporting of information on BLL ≥2.3µg/dL within seven days to the Cabinet for Health and Family Services. BLL data contains the full name of person tested, address, and employer to be used for follow-up public health interventions for adults with BLL ≥10µg/dL in collaboration with KDPH and local health departments. The OHI program provides the exposed adults with CDC/NIOSH- and OSHA-approved materials to reduce worksite exposures and contamination at home. The materials will be shared with the Division of Maternal and Child Health at the KDPH for its own investigations and follow-up of children (<16 years of age) with elevated BLL. The OHI program refers those aged 16 and older with BLL≥20µg/dL to OSHA for evaluation by the Industrial Hygiene branch and, where evidence exists, the referral will result in a follow-back site investigation.

C. Results and Discussion

OHIs

Based on KOSHS OHI program data surveillance, three new Ky-specific OHIs were established:

a) OHI #28—work-related traumatic injuries treated in Ky trauma centers: A new Ky-specific OHI on work-related traumatic injuries using Trauma Registry data was developed and implemented to track occupational severe traumatic injuries by industry and occupation. A gap in work-related hospitalization data is that IH data do not contain industry and occupation; TR data contains both industry and occupation data fields. Our results showed that the work-related traumatic injury rate reported to the Ky TR increased from 16.4/100,000 employed persons in 2008 to 24/100,000 in 2019. The majority of 2018–2019 injured workers were employed in construction (n=176; 20%), other services industry (n=156; 17%), and transportation/material moving (n=94; 10%).

b) OHI #29—work-related TBIs using IH data: This new indicator is a modification of CDC's TBI indicator. Work-related TBI hospitalization records were identified with diagnosis codes, expected payer of WC, and ICD-10-CM E-codes in Ky residents. Analyzing this OHI, in 2019 there were 72 work-related TBI hospitalizations with an associated rate of 3.6/100,000 employed persons.

c) OHI #30—work-related concussions using WC data: Cases were selected based on nature of injury equaling "concussion" or accident description mentioning "concussion." In 2017, there were 338 occupational concussion claims and first reports of injury (FROIs) filed with the Ky DWC. The number of concussion injuries reported to DWC steadily increased over the past decade, which could be partially due to increased awareness and better recognition of concussion injuries.

OHI Reports. OHI annual reports were completed in 2015, 2018, 2020, and 2021. All reports were disseminated to over 100 occupational injury and illness stakeholders around the state as well as posted on the KIPRC website and shared via social media. The KOSHS OHI program was contacted via survey by SafetyCraig Consulting, a construction training company located in Lexington, KY, concerning the 2019 OHI

report disseminated in June 2021. They stated, “We will use this data in training to help motivate employees to learn and pay attention in the workplace and during training.”

Blood Lead Levels

The KOSHS fundamental program identified a company with 22 employees that had elevated BLLs and made a referral to OSHA for an on-site investigation. During the investigation, the industrial hygienist performed lead testing in the break room. The coffee vending machine buttons tested positive for lead. The industrial hygienist speculated that lead exposure was likely due to the construction of the coffee machine’s button display. The buttons were surrounded by a raised edge that allowed lead dust to accumulate and not easily be wiped away. Because of this finding, the company used a scrub brush with bristles to clean the buttons during routine breakroom cleanings and effectively remove lead residue. The industrial hygienist commented that testing of other areas of the break room did not indicate a presence of lead.

From 2015-2020, the OHI program identified 1,189 individuals with blood lead levels that measured at or above 10 µg/dL and surveys were mailed to each of the individuals; 50 of the surveys were completed and mailed back, for a 4.2% response rate.

- 88% (n=43) of the respondents stated that they were employed by one of the two battery manufacturing plants within the state. All were sent information on cleaning procedures and how to prevent bringing lead-based paint into the home.
- One respondent was a firing range safety officer at a gun store whose employment was terminated in mid-March 2018.
- One respondent was a hydro-blaster. Information on lead-based paint was sent.
- One respondent indicated she believed her elevated BLL was due to an “old teapot that I use consistently.“ The respondent thanked the OHI program for informing her of her test results, as she would have not known about them otherwise.

In March 2016, The KOSHS Blood Lead Level Program identified 66 cases above the adult action level of 10 µg/dL (22 being ≥20 µg/dL) from a single company and subsequently made a referral for on-site investigation to OSHA. The corresponding OSHA industrial hygienist commented that the overall lead prevention program within the company was one of the best they had reviewed and that they displayed records of routinely enforcing temporary medical removal for employees above the action level until their levels returned to a safe range and they were properly re-trained.

The Hazard Alert “Elevated Blood Lead Levels in Workers” was developed and released on February 11, 2020, and disseminated to the general and construction listservs (n=1964). The Hazard Alert was featured on Safety Unlimited News Service (SUN News) on February 24, 2020. SUN News Report is an ad-free online news service provided by Safety Unlimited, Inc. and was designed to provide stories relevant to occupational safety and compliance with an emphasis on OSHA, Environmental Protection Agency, and Department of Transportation requirements. It was also featured on the American Industrial Hygiene Association’s website on February 20, 2020. One private industry employer who received the hazard alert stated, “I think there are many risks of occupational cancer and little knowledge about it”.

Epidemiological Analysis of OHI Surveillance Data

OHI Data Linkage Examples

The KOSHS OHI program performed comprehensive analysis of OHIs and linked occupational injury/illness data sources to establish baseline measures for new OHIs and tracked new and emerging trends that informed and set new priorities for the KOSHS expanded and NIOSH National Occupational Research Agenda Sector programs.

Use of multiple data sources to identify specific drugs and other factors associated with drug and alcohol screening of fatally injured motor vehicle drivers. Drugged driving crashes have significantly increased over the past two decades. Fatality Analysis Reporting System (FARS), CRASH, and mortality datasets were linked by the KOSHS OHI program to identify and characterize the drugs present in motor vehicle driver fatalities; assess concordance of the data sources in identifying drug presence; and identify demographic and crash factors associated with drug and alcohol screening in fatally injured motor vehicle drivers, including passenger vehicle drivers, light truck drivers, and commercial truck drivers. Our results showed that supplementation of FARS data with death certificate and CRASH data increased identification of specific drugs and drug classes detected among fatally injured motor vehicle drivers, although there was a low concordance among the data sources, indicating that multiple data sources are needed to assess drug involvement in MVCs.[15] This OHI-related study is a justification for the proposed expanded analyses of our OHIs using multiple data sources to

identify potential drug involvement in worker injuries, including due to MVCs.

Traffic incident management (TIM). The surveillance of TIM-related injuries was a priority focus area of the KOSHS fundamental, OHI, and FACE programs for the last five years. Traffic incidents occurring on roadways require the coordinated effort of multiple responder and recovery entities, including communications, law enforcement, fire and rescue, EMS, hazardous materials, transportation agencies, and towing and recovery. We analyzed TIM occupational fatality data in an expanded analysis of OHI #3 (occupational fatality rates) using multiple linked data sources: death certificate data, CRASH data, and media reports, among others. Our results showed that 41% of decedents were in the police protection occupation, and 21% each were in the fire protection and motor vehicle towing industries.[16] Over one-half of the TIM decedents were performing work activities as pedestrians when they died. We found that the use of DCs as the sole surveillance data source identified only 59% of the deaths as TIM-related and that the motor vehicle towing industry had a significantly higher risk for occupational mortality compared to the fire protection and police protection industries. We recommended targeted mandatory TIM training for the motor vehicle towing industry. Tow truck operators are now required to complete Federal Highway Administration (FHWA) TIM training to be considered for the interstate towing list in Ky.

Examples of OHI Single Data Source Studies

Epidemiological Study

Work-Related Injury Emergency Department Visits after the ICD-9-CM to ICD-10-CM Coding Transition. A KOSHS OHI peer-reviewed study used identified work-related emergency department visits with relevant ICD-10-CM work-related injury codes and compared them with those that had workers' compensation as the expected payer (Bush AM, Bunn TL, Liford M: [2021] Identification of work-related injury emergency department visits using International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes. Injury Prevention 27(S1):i3-i8).The ICD-10-CM work-related codes identified 36% more work-related ED injury visits than using only workers' compensation as expected payer. This study significantly expands occupational injury surveillance using ED and inpatient hospitalization data. Study results were presented at the 2021 Society for the Advancement of Violence and Injury Research Virtual Conference on Identifying Work-Related Emergency Department Visits using ICD-10 codes on April 5, 2021.

Healthcare industry injuries by patient contact status in Kentucky. The healthcare industry continues to have a high number of reported injuries. We used Ky WC FROIs in an expanded analysis of OHI #19 to categorize healthcare industry injuries by direct patient contact versus without direct patient contact and found that healthcare injuries without direct patient contact occurred more frequently among older workers in housekeeping and maintenance, resulting from falls/slips/trips and sprains/tears, whereas healthcare injuries involving direct patient contact occurred more frequently among younger workers in healthcare support occupations and resulted from lifting/handling.[20] We recommended enhanced healthcare support and nursing training related to falls and lifting.

Patterns of pneumoconiosis mortality in Kentucky: analysis of death certificate data. Mortality rates associated with total pneumoconiosis, including coal workers' pneumoconiosis, have been elevated for the past decade in Ky (OHI #10). In an expanded analysis of OHI #10 using death certificates, our results showed that total pneumoconiosis mortality rates decreased in West Virginia, Pennsylvania, Ky, and the US from 2003 to 2013. While PA rates decreased by 82% over the study period, Ky rates decreased only by 26%.[22]

We recommended pneumoconiosis surveillance improvements, including enhanced management of comorbid conditions such as chronic obstructive pulmonary disease.

Examples of OHI Multistate Collaborative Studies

The Ky OHI program collaborated with the Southeastern Occupational Health Network (SouthON) and with NIOSH on three multi-state collaborative studies during this funding cycle.

Occupational Heat-Related Illness

Association between work-related hyperthermia ED visits and ambient heat in five southeastern states, 2010–2012. Work-related hyperthermia ED visits were analyzed in five participating southeastern US states, and study results showed that ~46% of the ED visits occurred on heat index days that OSHA designates as low or moderate heat risk.[23] For every 1°F increase in average daily mean temperature, we observed a 14% increase in work-related hyperthermia ED visits. We recommended that the existing OSHA policy related to heat-risk levels for ambient temperatures be reviewed.

Occupational heat-related illness (HRI) ED visits and inpatient hospitalizations (IH) in the southeast region. This study utilized ED and IH data from nine southeastern states to identify occupational HRI ED visits

(6.5/100,000 workers) and IHs (0.61/100,000) in the southeast over the study period.[24] ED visit and IH rates were significantly elevated in males and blacks, and older workers had higher IH rates. This was the first study to evaluate occupational HRI ED visits and IHs in the southeast region.

Fatal Occupational Injuries

Fatal work-related injuries: southeastern United States. Census of Fatal Occupational Injury data were analyzed to compare worker fatalities in the southeast region compared to the rest of the US Our study results showed that the median annual fatality rate for work-related injuries from the 12 states in SouthON was 37% higher than the rate for the entire United States.[25] This seminal southeastern state study is justification for the continuation and expansion of Ky OHI program's priority focus area on the prevention of occupational MVCs, particularly important in the southeastern US region.

Examples of OHI Evaluation Studies

Evaluation of fatal occupational injuries (OHI #3). Assessment of electronic DC records for fatal occupational injury surveillance identified that the field "Injury Description" did not have adequate length in Vital Statistics' death certificate (DC) extract layout, leading to occasional truncation of injury description text. OHI personnel worked with Vital Statistics to address the issue. The Vital Statistics' IT team worked on programming changes to expand the size of the field. The DC extracts were updated retrospectively. KIPRC rewrote the SAS programming code to read the new layout of DC records and updated all DC historical files. The benefit of this improvement is beyond the FACE and OHI programs, as many CDC-funded injury surveillance programs use the narrative on the DC to improve specificity of injury surveillance data.

Evaluation of OHI #26 on fatal/nonfatal commercial motor vehicle collision injuries. Based on data quality review, new variables on fatal work-related motor vehicle crashes were created in the FACE database based on *linked DC and CRASH data* so that extensive crash information is available within the FACE database.

Evaluation of OHI #9: hospitalization from or with pneumoconiosis. Analysis of OHI #9 showed that Ky's age-standardized rate of pneumoconiosis hospitalizations in 2018 was 434 per million residents, the highest rate since 2015. Based on the evaluation of OHI #9, the KOSHS OHI epidemiologist now serves on the CSTE surveillance workgroup and is collaborating with a CDC fellow to improve pneumoconiosis surveillance at the state level. Ky statutes require that pneumoconiosis cases be diagnosed only by independent radiologists, of which there are only two in the state. Our results show that the statute should be updated to include other physician specialists such as pulmonologists.

Selected Collaborations and Partnerships

Motor Vehicle Towing Injury Identification in Data Sets. The American Automobile Association (AAA) Foundation for Traffic Safety hosted an expert roundtable on June 11, 2021, on improving roadside responder crash data that featured KOSHS program Principal Investigator, Dr. Terry Bunn. The overall purpose of the presentation was to present limitations of current single data sets in the identification of towing industry injuries and to propose the use of multiple data sets for the identification of towing industry injuries and fatalities. Representatives from the National Transportation Safety Board, National Highway Traffic Safety Administration, Bureau of Labor Statistics, AAA National, Drexel University, and Liberty Mutual Insurance Group also participated in the discussion panel on improving the collection, accuracy, and utility of roadside responder crash and injury datasets. The KOSHS OHI program presented "Motor Vehicle Towing Injuries on the Roadside: How Do We Identify Them?" During the presentation at the roundtable, why the towing fatality rate is higher was discussed. We noted that tow truck operators spend a greater amount of time openly exposed to roadside hazards while loading vehicles, whereas police and fire protection workers may be better equipped to use their vehicles as a physical barrier to traffic during traffic incident management response. In addition, tow trucks are not classified as emergency response vehicles, so the trucks use yellow emergency lights that may not be as distinguishable to motorists as those used by other traffic incident managers such as fire, police, and emergency medical services vehicles. Flashing light bars on the top of tow trucks may become obscured to motorists while vehicles are being loaded onto the tilted flatbed. The presentation concluded with several ways to improve identifying work-related injuries to tow truck drivers. Multiple data sources are currently needed, as the use of one data source alone may not identify all towing-related injuries. Training of coders on identification of tow trucks, including coroner/medical examiner training on identification of towing industry on death certificates, is also needed. In addition, law enforcement training on identification of tow trucks in crash data is needed. The panelists discussed limitations and barriers of crash data and techniques and approaches to improve and enhance existing data sets for identifying roadside responder crashes and near-misses. A white paper will be produced from the discussion.

Work-related heat illness. The KOSHS OHI program collaborated with NIOSH; National Center for Environmental Health; Florida, Georgia, Louisiana, and Tennessee occupational health (OH) departments; and the LA Public Health Institute on the association between work-related hyperthermia ED visits and ambient temperature in five southeastern states. The peer-reviewed publication appeared in *GeoHealth* in August 2020.

The KOSHS OHI program also collaborated with the University of North Carolina at Chapel Hill and LA, GA, North Carolina, FL, TN, Mississippi, and Virginia occupational health departments on occupational heat-related illness ED Visits and IHs in the Southeast region. The peer-reviewed publication appeared in the A*merican Journal of Industrial Medicine* in 2015.

Work-related Injuries. The KOSHS OHI program collaborated with NIOSH; FL, NC, VA, LA, GA, TN, and MS OH departments; and West Virginia University on fatal work-related injuries in the southeastern United States. The peer-reviewed publication appeared in *Workplace Health and Safety* in 2016.

KOSHS/FACE/OHI advisory committee. Our advisory committee met in March 2014 and recommended Ky company partnerships to integrate worker safety and health with health promotion and form a Ky TWH program. KIPRC became a NIOSH TWH Affiliate in September 2014 to support this effort and renewed the partnership in August 2018. According to the US Census Bureau, the percentage of Ky workers employed in high-risk morbidity industries from 2013 to 2016 was 30%–40% higher than the average annual percentage for US workers, so the advisory committee launched the KY Network of Occupational Wellness and Safety survey to assess the presence and capacity of occupational safety and wellness programs within the state. The committee used the survey results and produced an infographic titled, “Total Worker Health: The Need for Worksite Wellness Programs in Kentucky,” which outlined the state’s struggles with health issues such as diabetes, obesity, high blood pressure, and high cholesterol.

CSTE OH workgroup. KOSHS OHI program staff members serve on the CSTE OH subcommittee, review and present abstracts for the CSTE meeting, and participate in developing pre-conference sessions.

SouthON. The KOSHS OHI program was instrumental in the establishment of SouthON, which includes 1) NIOSH occupational safety and health surveillance-funded and unfunded states; 2) NIOSH Education and Research Centers (ERCs); 3) Southeast Agricultural Health Centers; 4) worker organizations; 5) NIOSH; and 6) OSHA. Our participation in SouthON (Bunn was SouthON PI from 2015–2020) has achieved a number of accomplishments: 1) Occupational heat-related illnesses and deaths were identified by SouthON partners at the 2015 in-person meeting as a work-related illness of primary concern. Two SouthON peer-reviewed studies generated during this funding cycle (2015–2020) were based on collaborations that were formed during SouthON meetings. 2) A 2017 SouthON thematic meeting on potential exposures of first responders to fentanyl led to UK Central Appalachian Region ERC funding of four southeastern states (GA, Ky, MS, VA) in 2017 to develop and administer a survey to first responders to assess exposures to fentanyl and their knowledge and use of personal protective equipment. The survey was disseminated through developed partnerships with state firefighter associations, Ky State Police (KSP), and other first responder agencies and organizations. The survey results were published in *Health Science Reports* in July 2021, and 2018 SouthON meeting follow-up discussions and workshops resulted in mini-grant funding awarded to GA in 2018 for a follow-up survey. A collaborative HRI OHI was developed by LA, NC, KY, and FL for state-based OH surveillance based on discussions initiated at the 2013 SouthON meeting; the OHI was implemented by NIOSH Occupational Health and Safety-funded states in 2016.

Transportation partnerships. KOSHS OHI program outputs are shared with the Federal Motor Carrier Safety Administration and the National Transportation Safety Board. First, collaborating with the Kentucky Trucking Association, KOSHS developed a series of six driver safety modules in 2017 communicating the complex regulations governing a roadside driver inspection. Trucking employers were provided the option to request a personalized e-learning portal established by KOSHS through Moodle.com, allowing managers to track the progress and scores of their individual commercial truck drivers. Four employers requested personalized e-learning portals, with a combined 122 drivers registered; not included in this total were e-learners who completed the training directly from the KOSHS website without registering. Second, safety training videos were developed in collaboration with Midwestern Insurance based on the four leading causes of nondriving-related injuries to truck drivers and disseminated through multiple communication channels.

Safe Communities. The Ky Safe Communities Network utilizes local community injury prevention coalitions, industries (e.g., UPS), and safety organizations (e.g., Ky Safety and Health Network [KSHN]) to reduce injury and violence morbidity and mortality. KIPRC was accredited as the International Safe Communities Support Center in 2012 and reaccredited in 2017 by the Pan Pacific Safe Communities Network. KIPRC also currently

serves as the Safe Community Support and Certifying Center in the United States since 2018. The KOSHS OHI program integrates with Safe Communities and disseminates research publications, presentations, toolkits, and other interventions to Safe Communities. There are currently five Safe Communities in Ky with another five in the application process. All of the Safe Communities include local industries in their injury prevention programming.

Ky TWH. NIOSH's TWH program integrates occupational safety and health with health promotion to increase worker safety and health both on and off the job. The KOSHS OHI program incorporates TWH through partnerships with Safe Communities, KSHN, the Ky Chamber of Commerce, the Ky Safety and Prevention Alignment Network (KSPAN), KIPRC, and other stakeholders. To support TWH, KIPRC was approved by NIOSH as a TWH Affiliate program in 2014. KOSHS OHI program-associated staff have produced presentations (e.g., in-service trainings provided to St. Joseph Women's Hospital and Special People Advocating Recovery Kentucky on our in-house-developed FindHelpNowKY.org website that provides timely access to SUD treatment facilities in Ky with available openings) and publications (e.g., Hazard Alert on Women as Victims of Workplace Violence, June 2020) on issues involving TWH. Dr. Casey Chosewood, NIOSH TWH manager, delivered a TWH presentation at our KSPAN meeting in November 2019 on worker well-being.

Examples of OHI Interventions

Traumatic Brain Injuries. In collaboration with the BIAK, a traumatic brain injury toolkit was produced in 2019 that contained a factsheet, hazard alerts, fatality reports, presentations, and safety reports. It was disseminated to our listserv and is available for download on the KOSHS website. The Traumatic Brain Injury Toolkit was developed, placed on the KOSHS website, and disseminated to the general and construction listservs (n=1967) in February 2019. The BIAK featured the toolkit on their website and Facebook page in March 2019. It was also featured in OSHA's *New Safety and Health Resources* quarterly newsletter in April 2019.

A Hazard Alert titled "Traumatic Brain Injuries in the Workplace" was developed and disseminated to the general, construction, and trucking listservs (n=2,559) in November 2108 and was featured in the NSC's *Safety+Health* magazine (340,000 monthly web hits) in December 2018. OSHA's Directorate of Cooperative and State Programs featured the Hazard Alert in their quarterly update on the 'New Safety and Health Resources' in April 2019. One private employer who received the Hazard Alert stated, "Many of these events fall under the topic of OSHA Focus Four subjects. It would be of great benefit to give details of how employers can prevent these types of injuries."

Impact Examples Based on KOSHS OHI Program Intervention Development and Implementation

OHI #2 on work-related hospitalizations. The KOSHS OHI program leveraged resources and knowledge via 1) collaborative work at the national level in the CSTE "General" Injury ICD-10-CM Transition Workgroup and CSTE ICD-10-CM Poisoning Indicators Workgroup and 2) Ky-specific work funded by the CDC KVIPP Injury Surveillance Quality Improvement (SQI) grant. A Ky medical coder survey was developed by the KOSHS OHI and KVIPP SQI programs in 2017 and was administered to understand issues related to the ICD-9-CM to ICD-10-CM external cause of injury coding transition that occurred in October 2015 and its effect on medical coders' productivity, need for additional training, and continuing education. The survey included questions specific to the coding of work-related injuries. Eighty-six percent of the respondents reported that they did not receive training on the coding of cases where the expected payer was WC, and more than one-third of coders said that insufficient information in the medical record was an obstacle for coding the activity and place of injury; 79% of coders said that if a case was coded with WC as expected payer, they do routinely assign codes for place and activity of injury. The following question was asked: "Codes Y92, Y93, Y99 are used by epidemiologists to identify work-related injuries. Please discuss how you use these codes." These two responses are representative of the general tone in the coders' answers: 1) "These are coded on all encounters per our hospital policy. The issue is provider documentation. It may not always be there and, if so, it is very vague and not documented to the highest level of specificity. The provider should be documenting this information. This is where it begins so we can code it."; and 2) "Used every time. Always use Y99.9 since that is never documented. Y92.9 and Y93.3 are used most often, as this info is rarely given". Continuing education for medical coders and for physicians that includes ICD-10-CM coding of occupational injuries was developed in collaboration with the KVIPP program (http://www.cecentral.com/activity/dev/15187).

KOSHS OHI Program Evaluation

A process, impact, and outcome evaluation was performed to assess KOSHS OHI program efficiency.

Engaging stakeholders. The KOSHS OHI program has enhanced state agency partnerships. Memorandums of understanding (MOUs) were re-signed with major data owners such as 1) Vital Statistics; 2) Office of Health Data and Analytics (IH and ED data); 3) DWC (WC data); 4) Lead Poisoning Prevention Program (BLL data); 5) Ky Board of Emergency Medical Services (EMS data); 6) KSP (CRASH, drug-related crimes, and drug submission data); 7) NIOSH TWH; 8) Pan-Pacific Safe Communities; and 9) Ky Poison Control Center. We improved OHI data quality, coding, analysis, and interpretation collaboratively; stakeholders provided continuous input on data collection, data quality improvement and detailed indicator analysis; and identified new data sources. Active communication was maintained with stakeholders through emails, newsletters, conference calls, and in-person meetings and ideas were generated for surveillance quality improvement, dissemination, outreach, and research.

Evaluation outcomes. KOSHS OHI program short- and medium-term outcomes and impact examples are mentioned above; 12 peer-reviewed publications were produced in the 2015–2021 funding cycle on surveillance improvement, occupational MVCs, surveillance of occupational injuries, and TWH, among others.

D. Conclusion

The long-term outcome of the KOSHS OHI program is to reduce occupational injury morbidity and mortality in Ky. There was a statistically significant decrease (52%) in Ky occupational fatality rates from 1995–2019, compared to a 30% decrease in the US occupational fatality rate over the study period (Figure 1). Similar to occupational fatality rates, Ky's occupational injury morbidity rates have decreased over the last decade but are still 7% above the national occupational injury morbidity rate (Figure 2). In addition, work-related hospitalization rates and amputation rate have decreased (Figures 3 and 4). It is impossible to eliminate or consider all the possible influences on occupational injury reduction, but the KOSHS OHI program has been effective in the surveillance of injuries among workers and collaborating with agencies, organizations, and industries to reduce worker injuries in Ky. The KOSHS OHI program is fulfilling its objective of identifying and describing industries and occupations at elevated risk for traumatic injuries and using surveillance data to inform the development and implementation of interventions.

Figure 1. Nonfatal Work-Related Injury and Illness Incidence Rates in Private Industry per 100,000 FTEs, US vs. KY, 2010–2019

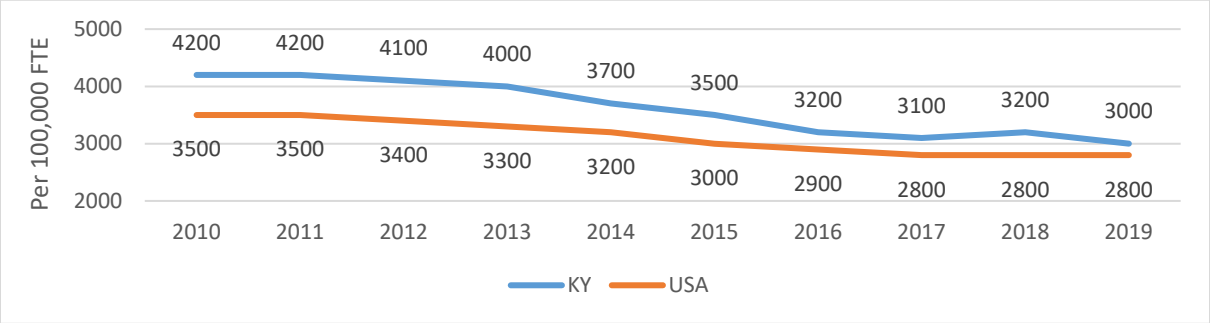


Figure 2. Fatal Work-Related Injury Rates per 100,000 FTEs, US vs. KY, 2010–2019

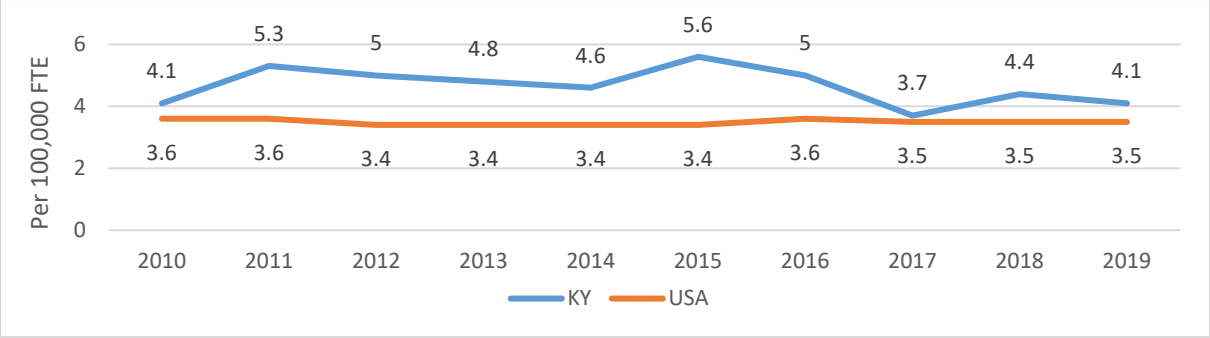


Figure 3. Work-Related Hospitalization Rates, Kentucky, 2000–2019

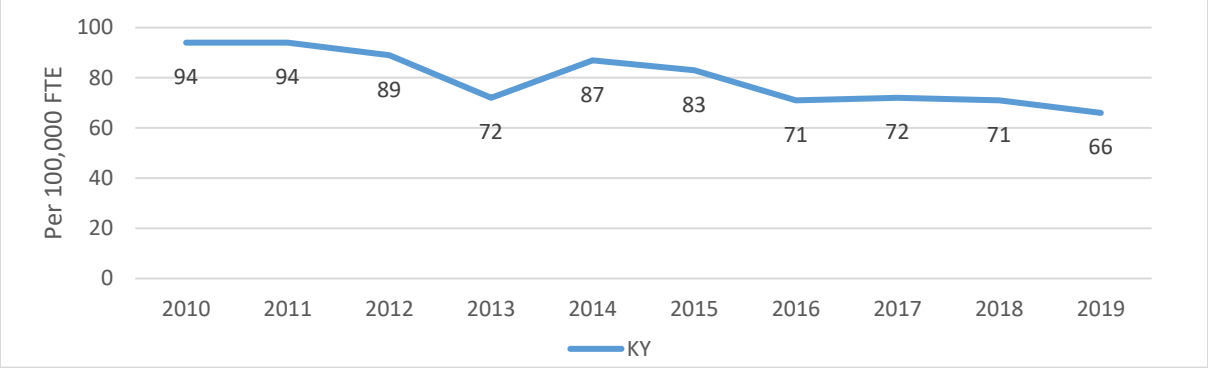
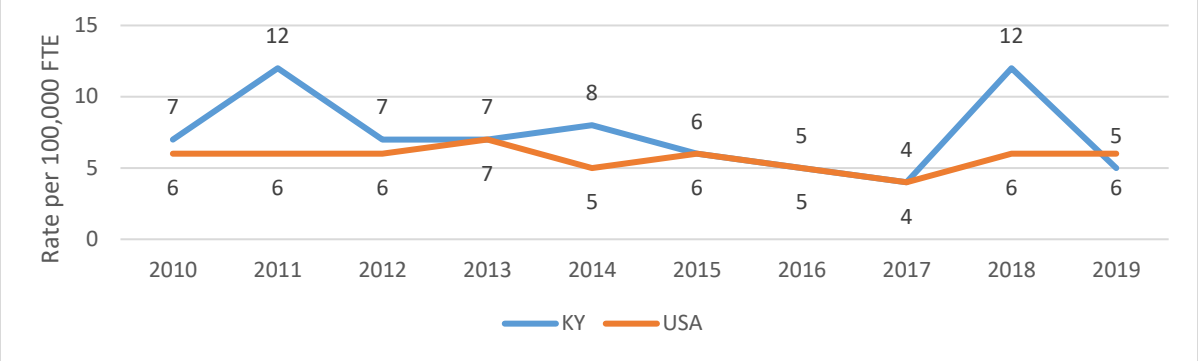


Figure 4. Work-Related Amputations with Days Away from Work, US vs. KY, 2010–2019.



Scientific Report: Kentucky Occupational Safety and Health Surveillance Program—Fatality Assessment and Control Evaluation (FACE) Program Component

A. Background

In 2018, 5,250 fatal work-related injuries were reported nationwide for a fatality rate of 3.5/100,000 full-time equivalent (FTE) workers.[1] Work-related unintentional injury costs totaled $170.8 billion, including wage and productivity losses of $52.4 billion, medical expenses of $35 billion, and motor vehicle damage at $4.9 billion; the cost per worker death was $1,190,000.[2] In 2018, Kentucky's occupational fatality rate was 20% above the nation's rate, at 4.2 deaths/100,000 workers.[1] Ky's nonfatal private industry worker injury rate is 3.2/100 full-time workers, 14% higher than the 2018 US rate of 2.8/100.[3] The 2018 Ky motor vehicle death rate per 100 million miles traveled (1.46) was 29% above the US rate (1.13).[4] These elevated rates reflect the concentration of Ky workers in high-risk industry sectors and are clear indications of the need for further efforts to lower the state's burden of occupational fatalities.

In 2018, Ky was the 20th worst state for overall fatal occupational injury rates (4.2/100,000 FTE), 34th worst for the construction industry (7.8/100,000 FTE), 26th worst for the transportation and utilities industry sector (11/100,000 FTE), and 12th worst for nonfatal occupational injury and illness incidence rates (3.2/100 FTE).[1] In the Southeastern States Occupational Network (SouthON) region (12 states), Ky ranked 7th worst for overall occupational fatality rates, 10th worst for the Transportation, Warehousing, and Utilities (TWU) industry sector, and 11th worst for the construction industry. Of the seven currently funded Fatality Assessment and Control Evaluation (FACE) states, Ky has the worst overall occupational fatality rate, worst TWU industry fatality rate, and 5th worst construction industry fatality rate.[1]

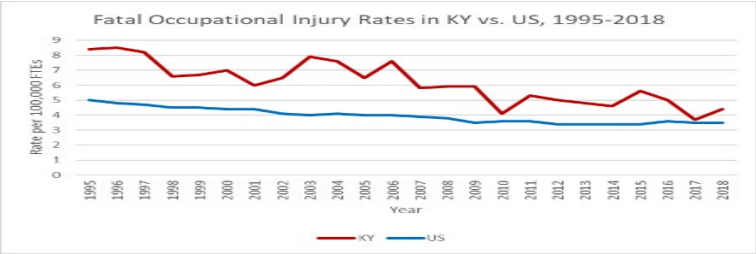


Figure 1. Ky Occupational Fatality Rates vs. US Rates

There was a notable decrease in both US and Ky fatal occupational injury rates over the last two decades. In Kentucky, there was a 48% statistically significant decrease in fatal occupational injury rates from a high of 8.5/100,000 in 1995 to 4.4/100,000 in 2018, compared to a 30% decrease in the US occupational fatality rate from 5.0/100,000 in 1995 to 3.5/100,000 in 2018.[1]

From 1995–2019, 2,690 Ky workers were killed on the job, averaging 108 per year.[5] In 2019, there were 80 Ky occupational injury fatalities; the highest percentages were in the trade, transportation, and utilities (TTU) industry sector (33%), natural resources and mining industry sector (NRM) (20%), and construction industry (19%). Motor vehicle collisions (MVCs) are the leading cause of Ky work-related deaths (31% from 1995–2019). Fatal and nonfatal occupational MVCs are a state-specific indicator included in our Kentucky Occupational Safety and Health Surveillance (KOSHS) OHI project. Of the 828 occupational MVC deaths from 1995–2019 that occurred on Ky roads, 72% involved Ky residents and 50% were in the transportation and materials moving occupations. Semi-trucks were most frequently involved in transportation MVC deaths, encompassing 44% of fatal crashes. According to 2018 CRASH data, there were 4,561 truck tractor and semi-trailer vehicles involved in collisions. This represents 62% of all commercial vehicles involved in collisions in 2018. An analysis of 2018 Ky Department of Workers' Claims (DWC) data showed that most injured drivers who filed a first report of injury (FROI) were employed in the services and transportation industries.

From 1995 to 2019, there were 53 work-related fatalities involving dump trucks (another heavy vehicle): 51% involved dump truck drivers; 32% occurred when the dump truck driver was outside the vehicle at time of death; and 17% occurred when the worker's vehicle was struck by a dump truck.[5] FACE surveillance data show that medium vehicles accounted for 134 worker deaths from 1995 to 2019, more than passenger vehicle (n=102) and pickup truck (n=114) deaths[5].

From 1995 to 2019, 113 workers died as a pedestrian in a transport incident, 14% of the total Ky FACE work-related MVC deaths.[5] The highest percentages were in the construction (25%) and TTU (24%) industry sectors.

There was an alarming number of workplace deaths by suicide in 2018–2019 (n=9). From 1995 to 2019, there were 99 Ky workers who died by suicide in the workplace; the highest percentages were in the TTU (19%) and other services (except public administration) (15%) industries. Sixty-one percent of the workplace deaths by suicide were by firearm, and the majority (92%) were male.[5]

Ky FACE data show that from 1995 to 2019, 37 Ky workers died due to drug overdose in the workplace; 51% of the deaths occurred from 2017 to 2019.[5] In 2018, Kentucky had the 9th highest drug overdose fatality rate in the nation.[6]

B. FACE Program Specific Aims (2015-2020)

The specific aims for Ky's FACE program are to:

1) Conduct comprehensive timely multi-source surveillance of *all* occupational fatalities occurring in Ky to inform intervention and prevention activities, determine priority areas and populations, identify potential cases for on-site investigations, and use for intrastate, multi-state, regional, and national (e.g., NIOSH) collaborations;

2) Perform selected case follow-up on-site occupational fatality investigations that contain prevention strategies within the following priority areas: a) trucking industry; b) construction industry; c) highway incident management (HIM); d) NIOSH priority areas (construction machine-related, foreign-born, residential- and commercial-construction fall-related, young, energy production [oil and gas extraction and green energy]); and e) worker fatality cases amenable to engineering or process changes;

3) Conduct epidemiological analyses of occupational fatality surveillance and investigation data, including: a) narrative analyses of tow truck-related fatalities and injuries and of trucking workers' compensation reports and b) occupational fatality surveillance improvement. The results will inform intervention and prevention activities, surveillance improvement, and further occupational injury research;

4) Promote the use of FACE data and findings through new and existing partnerships and collaborations that integrate FACE results with partners' outreach and educational activities, including National Truckers Association (NTA) Truck Alerts, Ky Motor Transport Association (KTA) quarterly newsletters, and others. Continued collaboration with NIOSH and other FACE states will be emphasized, and Ky FACE personnel will participate in CDC/NIOSH and FACE grantee meetings and FACE conference calls;

5) Provide worker safety evidence to state and national worker and employer groups by disseminating FACE research findings through annual reports, fatality reports, hazard alerts, newsletters, websites, social media, presentations, trade journals, the state-based occupational health clearinghouse, and peer-reviewed publications, for impact at state and national levels; and

6) Perform a process, impact, and outcome evaluation to assess effectiveness and impact of the FACE program. The FACE advisory committee, which meets semiannually, will be maintained.

C. Methods for FACE Program (2015-2020)

FACE Database

Based on the elevated number of Ky HIM deaths from 2009–2013 (n=16), new and innovative variables will be added to the FACE database from surveillance documents and coroner/medical examiner (ME) interviews: 1) HIM-related (yes or no); 2) safety vehicle positioned (yes, no, or unknown); 3) safety vest (yes, no, unknown); 4) advanced warning (yes, no, unknown); 5) HIM type (public safety, towing and recovery including emergency roadside technicians, and other); and 6) HIM incident type (law enforcement, towing and recovery, transportation. HIM fatality surveillance data will be used to inform traffic incident management (TIM) training offered by the state Federal Highway Administration (FHWA), and complements our state-specific *fatal and nonfatal occupational MVC* indicator (Occupational Health Indicator #20) included in our OHI program research strategy and our proposed commercial driver safety training in our overall KOSHS expanded program research strategy.

FACE Investigation Initiatives:

Truck transportation FACE reports. The transportation occupation comprised the highest fatality number and 2nd highest rate in 2013. Although Ky truck transportation fatality numbers have decreased from ~18/year from 2004-2008 to 10/year from 2009-2013, indicating impact by the Ky FACE program and other influences (e.g., economic factors, improved highway design, FMCSA regulations), these statistics identify *truck transportation sector-specific worker deaths* as a continued state priority area for Ky FACE investigations. This investigation focus area is well established in Ky FACE, but there is still a pressing need for new interventions and safety training for the truck driver population. Trucking gained 2,300 jobs in July 2014 alone, and is projected to grow 11% from 2012 to 2022. According to the KTA president, new companies continually enter the truck transportation industry that employ <5 drivers; development of Ky FACE trucking safety modules using FACE fatality reports and hazard alerts for KTA's Trucking 101 program will fill the gap in the lack of Ky-specific safety training materials and Ky truck drivers can directly relate to the materials (described in KOSHS research strategy). Truck transportation fatality investigations are also used as available resources by the NIOSH Center for Motor Vehicle Safety (NIOSH CMVS) and NIOSH TWU sector. Ky FACE trucking fatality

investigations have had impact on the trucking industry (e.g., new law requiring driver safety training) and will be disseminated to stakeholders named in specific aim #5. Truck transportation fatality investigations complement our state-specific indicator on *fatal and nonfatal occupational MVCs* in our *OHI* program and our proposed online trucking industry safety training in our *overall* KOSHS program to inform effective policy and prevention strategies.

HIM FACE fatality reports. From 2004-2013, 33 HIM deaths occurred on roadways, ~3.3 per year. Deaths included 13 law enforcement officers, 12 firefighters, and 6 towing and recovery operators. From 2009-2013, there were 16 HIM deaths. Based on the elevated fatality numbers, HIM deaths will be an innovative primary focus area of the Ky FACE program for fatality investigations for the new grant cycle. Firefighter deaths are investigated by the NIOSH nationwide Firefighter Fatality Investigation and Prevention program but Ky FACE will be available for collaboration. HIM fatality reports will be disseminated to various stakeholders listed under specific aim #5 related to dissemination. *Truck transportation FACE reports.* The transportation occupation had the highest number of fatalities and the second highest rate in 2013. Although Ky truck transportation fatality numbers have decreased from ~18/year from 2004–2008 to 10/year from 2009–2013, indicating impact by the Ky FACE program and other influences (e.g., economic factors, improved highway design, Federal Motor Carrier Safety Administration [FMCSA] regulations), these statistics identify truck transportation sector-specific worker deaths as a continued state priority area for Ky FACE investigations. This investigation focus area is well established in Ky FACE, but there is still a pressing need for new interventions and safety training for the truck driver population. Trucking gained 2,300 jobs in July 2014 alone and is projected to grow 11% from 2012 to 2022. According to the KTA president, new companies continually enter the truck transportation industry that employ fewer than five drivers; development of Ky FACE trucking safety modules using FACE fatality reports and Hazard Alerts for KTA's Trucking 101 program would fill the gap in the lack of Ky-specific safety training materials and Ky truck drivers can directly relate to the materials. Truck transportation fatality investigations are also used as available resources by the NIOSH Center for Motor Vehicle Safety (NIOSH CMVS) and NIOSH TWU sector. Ky FACE trucking fatality investigations have had an impact on the trucking industry (e.g., new law requiring driver safety training) and are disseminated to stakeholders named in specific aim #5. Truck transportation fatality investigations complement our state-specific indicator on fatal and nonfatal occupational MVCs in our OHI program and our proposed online trucking industry safety training in our overall KOSHS program to inform effective policy and prevention strategies.

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NIOSH- and other state-specific priorities for FACE investigations. Within the NIOSH priority areas, Ky fatal construction falls numbered 110 from 1994-2013, and continue to be a state-specific priority for fatality investigation. A Ky FACE epidemiological analysis of occupational falls showed that the construction industry incurred the highest hospitalization and workers' compensation (WC) costs for falls; falls were primarily from one level to another, and laborers and helpers had longer hospitalization stays. FACE construction fall fatality surveillance data and research results indicate the need for additional construction employer safety management practices such as 1) enforcement of worker safety practices regardless of employer-employee relationships; 2) use of personal fall protection; and 3) length of safety training and continuing education. In addition, fatality investigations will be performed on those amenable to engineering and/or process changes. Fatality reports will be disseminated to employers, employees, organizations, associations, community groups, manufacturers, and agencies.

Narrative Text Analysis of Tow Truck-Related Fatalities and Catastrophic Injuries

A literature review identified no peer-reviewed studies on surveillance of tow truck-related fatalities; little epidemiological data currently exist on highway incident management-related injuries, but the few studies provide insight into the various hazards associated with highway incident management. The Occupational Safety and Health Administration (OSHA) conducted 127 nationwide tow truck-related fatality and catastrophic injury inspections from 1984–2012. Several state FACE programs have also produced tow truck-related fatality reports (n=11), three in Ky during the 2013–2014 fiscal year. Because of elevated tow truck deaths, the Ky FACE program produced a toolkit in spring 2014 (described below) that addressed incident management

response elements such as portable emergency warning device placement, high visibility vest donning, vehicle points of securement, and maximum carrying capacity.

Like state FACE reports, OSHA summary reports provide a narrative of the incident events and causal factors leading to a fatality. The Ky FACE program collaborated with NIOSH CMVS on a novel narrative text analysis study of all 138 tow truck-related OSHA reports of fatal and critical injuries nationwide and all FACE state fatalities to identify human, organizational, and environmental factors. Common themes/scenarios to be investigated included: 1) worker's employment classification, work experience, on-the-job training; 2) pre-event: speed limit, personal protective equipment, number of lanes, presence of other HIM vehicles; 3) event: primary versus secondary crash response, traffic characteristics, pedestrian, driver, highway, shoulder; and 4) post-event: medical response, cause of death, intervention. Categorical codes will be created in NVivo software (QSR Int'l) to guide the narrative text search. Narrative text coding will be based on Haddon's matrix to analyze hazard scenarios contributing to worker injuries. We will perform descriptive statistical analysis with SAS®9.3. Study results will be used to inform engineering, policy, and interventions; improve work practices; encourage enhanced law enforcement; and change behavior and attitudes of tow truck operators, to prevent tow truck-related injuries. We will develop an employer tool kit with fact sheets, palm cards, and a hazard analysis tool to share with other states, NIOSH, and towing stakeholders. Study results will appear in our newsletter and be submitted for peer-reviewed publication. Potential study impacts include informing improved towing-related HIM response.

Descriptive and Narrative Analysis of Trucking Workers' Compensation First Reports of Injury

WC data show that vulnerable workers may have an elevated risk for transportation injuries and fatalities and that falls from trucks may be a common hazard scenario (however, the study is 11 years old). Based on the elevated number and rate of Ky transportation deaths, innovative descriptive and narrative analyses of the 2,177 Kentucky WC FROIs in the truck transportation industry from 2009–2013 will be performed. Truck transportation FROIs will be identified using the North American Industry Classification System 484 truck transportation code series. Narrative analyses will be used NVivo software to better understand injury circumstances and identify common hazard scenarios for trucking injuries such as moving cargo, cab ingress and egress, operating a dolly, securing tarps, and opening the trailer door. Descriptive analysis will identify short- versus long-haul; length of time on job; nature and cause of injury; body part injured; length of time off after injury; and award disposition. We will also analyze TWH and vulnerable worker health variables such as worker age, Appalachia versus non-Appalachia residence, and substance abuse.

The Ky FACE program will collaborate with the NIOSH Center for Motor Vehicle Safety (CMVS) on this proposed study and results will be disseminated to Kentucky State Police (KSP), Governor's Executive Committee on Highway Safety (GECHS), FMCSA, FHWA, KTA, our trucking employer listserve, Owner-Operator Independent Drivers Association (OOIDA), WIT, other funded FACE states, and NIOSH. Study results will be published in the KTA newsletter and our FACE newsletter, submitted for peer-reviewed publication, posted on our website and used to develop a tool kit. Potential study impacts include informing engineering, behavioral, and administrative interventions such as moving cargo, tarping, use of non-slip footwear, and improved vehicle ingress/egress.

Occupational Fatality Surveillance Improvement

Studies have shown that multiple sources of data are required for comprehensive surveillance of worker fatalities and that surveillance systems must be assessed routinely to assure reliability. FACE programs typically use death certificates (DCs), Census of Fatal Occupational Injury (CFOI), ME/coroner, OSHA, media, and WC data to identify and count worker fatalities. Ky FACE and other studies show that CFOI and DCs may undercount occupational fatalities. To our knowledge, trauma registry (TR), inpatient hospitalization (IH), and emergency department (ED) data have not been evaluated as occupational fatality surveillance data sources. This epidemiological study will deterministically link Ky FACE data to TR, IH, ED, WC, and DC data from 2008–2016 to assess and compare identification of work-related fatal injuries and sensitivity of each data source (proportion captured and identified as work-related) by cause of injury, demographics, and industry and occupation, where available. Ky trauma registry data is available from 2008 forward and WC, IH, ED, and DC data are available from 2000 forward. Deterministic data linkages between all data sets will be performed, enforcing a strict match on birth and death dates and gender, and allowing plausible discrepancies on residency, cause of death, and medical facility. This proposed study may be a Ky FACE-specific study or performed in collaboration with the NIOSH FACE program. Study results will be submitted for peer-reviewed publication and to the NSC for publication in their magazine. Newly identified occupational fatalities that were

not identified through the traditional FACE surveillance system will be referred to Ky OSHA. The results of this innovative study will be disseminated to other FACE states and state CFOI programs to potentially reduce fatal occupational injury undercounting and to improve FACE and CFOI surveillance systems by adding additional recommended data sources for worker fatality surveillance.

D. Results and Discussion

FACE Program Surveillance

The following data fields were added to the FACE database for surveillance of HIM fatalities: 1) HIM - related (yes [n=5] or no [n=293]); 2) safety vehicle positioned (yes [n=1], no, unknown [n=4]); 3) safety vest (yes, no [n=1], unknown [n=4]); 4) advanced warning (yes, no [n=1], unknown [n=4]); 5) HIM type (public safety [n=1], towing and recovery [n=3] including emergency roadside technicians, and other [n=1]); and 6) HIM incident type (law enforcement [n=1], towing and recovery [n=3], transportation [n=1]).

The purpose of adding these variables to the FACE database was to conduct surveillance of HIM fatalities to produce reports for TIM employers to use in their safety trainings. Based on the low frequencies, we have not produced a report yet.

The Kentucky Department of Agriculture used statistics from the 2018 Ky FACE Annual Report when Agriculture Commissioner Ryan Quarles proclaimed Sept. 15–21 as Farm Safety and Health Week. “The Kentucky Injury Prevention and Research Center reported that 14 Kentuckians engaged in agriculture, forestry, fishing, and hunting died on the job in 2018, compared with 13 in 2017 and 50 in 1995. Of the agriculture-related fatalities, four died in ATV accidents, three were killed while operating a tractor, two died while operating heavy farm equipment and one died in a fall from a barn loft. The average age of the decedents in the category was 56,” the report stated.

FACE Program Investigations

From 2015-2020, Ky FACE conducted 58 worker fatality investigations and produced 46 final reports: 12 truck transportation, 9 construction, 5 manufacturing, 4 public administration, 4 HIM, 2 landscaping, 1 wholesale trade, and 4 others. For the 46 final FACE reports, the causes of fatal injury were 16 motor vehicle crashes, 10 falls, 5 electrocutions, 3 crushes, 3 suffocations, 2 struck-byes, 2 caught in/between, 1 burn, 1 machine-related, 1 drowning, 1 homicide, and 1 suicide. FACE reports and surveillance data from these investigations are the basis for worker safety trainings, Hazard Alerts, newsletters, presentations, media releases, and peer-reviewed and non-peer reviewed articles. Fatality reports include recommendations for injury prevention and intervention (behavioral, administrative, and engineering controls) after full consideration of contributing factors.

From 2016–2020, 57 truck transportation drivers were killed while working in Kentucky (~11 per year); 82% (n=47) were due to motor vehicle crashes. From 2015–2021, Ky FACE produced and disseminated 12 trucking transportation fatality reports, which were disseminated to our general and trucking listservs (n=2,338) as well as to the National Transportation Safety Board (NTSB), National Safety Council (NSC), KTA, WIT, and the FMCSA. Harbor Freight USA (based in Newark, NJ) used report #15KY001, “Semi-Truck Driver Fatally Struck by Falling Flatbed Cage Door, Kentucky,” in their employee cargo safety training (February 2016). In addition, the Cincinnati Insurance Company used FACE materials, including report #15KY001, for internal safety training of Cincinnati Insurance personnel (n=150) as well as for training and education of Cincinnati Insurance insureds (n=120). Case #15KY063, “Semi-Truck Owner-Operator Crushed by 7.6-Ton Steel Coil While Securing Load to Flatbed Trailer,” was used by the Oregon FACE Program in training provided to the Oregon Trucking Associations’ Safety Management Council groups across the state (February 2017). Ryder Transport Company shared case #20KY040, “Truck Driver Killed After Vehicle Rollaway,” with 130 customers throughout the country (January 2021). Ky FACE truck and transportation investigations were also featured in multiple trade magazines and safety blogs. The American Society of Safety Engineers featured case #15KY030, “Driver Exits Burning Semi-Truck and Falls to His Death,” in their *Transportation Industry* blog (March 2016). Case #17KY034, “Dump Truck Driver Loses Control and Flips Truck, Resulting in Fire, Kentucky” (July 2018), #19KY033, “Commercial Truck Driver Dies on Kentucky Interstate in Single Vehicle Collision” (October 2019), and #19KY047 “Commercial Driver Dies after Overturning on Two-Lane State Highway, Kentucky” (February 2020) were featured in *EHS Today* magazine (>500,000 monthly readers). Case #17KY034, “Dump Truck Driver Loses Control and Flips Truck Resulting in Fire, Kentucky” (July 2018) and #20KY040, “Truck Driver Killed after Vehicle Rollaway” (March 2021), were featured in the NSC’s monthly *Safety+Health* magazine (>350,000 monthly readers). Case #20KY010, “Semi-Truck Driver Dies in Single Vehicle Collision after Truck Overturns, Kentucky,” was featured in the February 2020 (Volume 18 Number 10) edition of the NIOSH

eNewsletter.

Truck transportation fatality reports received 15 anonymous survey results. Respondents were asked to rate the report poor, below average, average, good, or excellent on several aspects. The following percentages of respondents rated the report good or excellent for general impression of the report (100%); objectivity of the report (93%); easy to understand (100%); usefulness of the report (93%); practical recommendations (87%); and usefulness of the recommendations (87%). Fourteen of the 15 respondents (93%) stated they would use the report in a toolbox talk with employees (12) or post the report on a workplace bulletin board (2). Only one respondent stated they would not use the report.

The truck transportation fatality reports were utilized in the development of a trucking crash prevention toolkit and the Trucking 101 online training program in collaboration with the KTA to address the lack of Ky-specific safety training materials. The training program was utilized by CoreTrans, Inc., based in Somerset, Ky, for 50 drivers, Edward's Moving and Rigging in Shelbyville, KY, for 27 Class A drivers, and Sallee Horse Vans in Lexington, Ky, for 36 semi-truck drivers.

From 2015-2020, the Ky FACE program produced four HIM FACE reports: three on tow truck drivers and one on a traffic control worker. Report #14KY033, "Pedestrian Tow Truck Operator Struck and Killed by Drunk Driver While Rendering Assistance on Highway Roadside, Kentucky," was disseminated to 227 towing companies, to 2,145 recipients on the general listserv, and to the Towing and Recovery Association of America, Inc. (TRAA). The president of the Professional Towing and Recovery Operators of Illinois contacted the FACE program to inform us that he thought the report was very useful and that he had sent it to the 250 towing members in the organization. The TRAA of Ohio also featured the report in their March 2016 newsletter. Report #16KY055, "Tow Truck Driver Struck and Killed by Van While Entering His Tow Truck, Kentucky," was disseminated to 1,908 employers and employees and 170 towing companies and was featured in *Tow Times* magazine in July 2017, reaching more than 35,000 monthly subscribers. Report #17KY057, "Traffic Control Worker Struck and Killed by Vehicle While Setting up Cones on Interstate," was featured in *EHS Today*'s August 2019 edition, reaching over 554,000 monthly subscribers. Report #16KY052, "Tow Truck Driver Struck and Killed by Passenger Vehicle While Securing Disabled Vehicle onto Flatbed Tow Truck," was disseminated to 170 towing companies; in 2018, the fatality report was incorporated into an FHWA traffic incident management responder training course offered to towing operators throughout the state on a regular basis; tow truck operators are now required to complete TIM training in order to be considered for the interstate towing list in Ky. From 2015–2020, FHWA delivered the training to 10,441 employees in Ky, with a goal of training all 18,177 TIM responders within the state.

Worker fatality investigations were performed on those amenable to engineering and/or process changes. The FACE reports were disseminated to employers, employees, organizations, associations, community groups, manufacturers, trade magazines, and agencies, including 1,908 on the general listserv, 244 on the construction listserv, and 46 on the roofing contractor listserv. Construction fall investigations were also featured in a number of trade magazines and on various websites. Case #15KY078, "Commercial Roofer Falls 30 Feet through a Skylight While Installing Roof Insulation," was featured in the NSC's *Safety+Health* magazine (July 2017). Case #17KY007, "Dry Wall Supervisor Falls from Unsecured Plank, Kentucky," was featured in the US Department of Labor's Quarterly Update on Compliance Assistance Resources (Q2 2018). Case #17KY037, "Gutter Installer Dies after Falling from Ladder Placed on Roof While Taking Measurements," was featured in *Occupational Health and Safety* magazine (over 80,000 subscribers) (June 2018); the FACE report was also featured in a safety blog on lawyers.com; hg.com, a website for legal resources; and on Safety Unlimited News Service. FACE fatality reports and surveillance data have been used for the annual NIOSH construction stand-down campaign, a construction workbook produced in 2016, and in-person trainings (2017–2020) on practices such as the use of personal fall protection. Based on our construction industry injury prevention efforts, the Ky FACE project manager and investigator were featured in the CDC/NIOSH-produced video, "A Five-Year Look-Back, National Safety Stand-Down to Prevent Falls in Construction," on our FACE construction fatality investigations and past presentations to Messer Construction spanning several years. The video can be found at www.youtube.com/watch?v=39-uf25NfhM&feature=youtu.be

Ky FACE reports concerning falls in the construction industry received 56 anonymous survey responses. Respondents were asked to rate the report poor, below average, average, good, or excellent on several aspects. The following percentages of respondents rated the report good or excellent for general impression of the report (71%); objectivity of the report (73%); easy to understand (79%); usefulness of the report (79%); were the recommendations practical (77%); and usefulness of the recommendations (77%); 98% of

respondents stated that the reports raised awareness of the hazards presented. Respondents were also asked how they would use the report in their worksite: distribute to coworkers (23%); post on workplace bulletin board (11%); use for toolbox talks (25%); keep for future reference (34%); and do not intent to use (9%).

Dr. David Stumbo, associate professor at Eastern Kentucky University, emailed the FACE program in 2018 and asked, “I'm looking around for information on interviewing techniques. In the sense of interview employees, witnesses, etc., in an occupational safety setting.” KOSHS staff sent the FACE interview techniques to Dr. Stumbo to use in an upcoming class.

Epidemiological Studies

Narrative Text Analysis of Tow Truck-Related Fatalities and Catastrophic Injuries. The study was performed to characterize the causal factors associated with injuries among commercial tow truck operators engaged in roadside assistance through analysis of coded and free text data obtained from OSHA investigation files and from supplemental data sources to analyze environmental factors for injuries where commercial tow truck operators were struck by roadway traffic. The methods included searches of OSHA’s online IMIS database to identify investigations of incidents in which tow truck operators were injured while performing roadside assistance duties. Freedom of Information Act (FOIA) requests were submitted to obtain full investigation files for each case. Coded and narrative text analyses were performed to identify causal themes across the identified cases. One-hundred and six cases of tow truck operators being killed or severely injured were identified in IMIS; 41 FOIA requests for related investigation documents were fulfilled. T, identified two major event type themes: (1) struck-by incidents, which were primarily injuries resulting from contact with roadway traffic, rolling vehicles, and equipment or other nonmotorized objects, and (2) caught-in or -between incidents, which were primarily injuries resulting from being pinned beneath and between vehicles and being caught in moving parts. The study, “Analysis of roadside injuries in motor vehicle towing,” was published in the *Journal of Safety Research* in December 2019. Study findings were cited by Fang Z, Chiu YH, Lin TY, Chang TH: [2020] Economic, Social, Medical, Work Injury, and Environmental Efficiency Assessments (Inquiry 57:46958020972211). In addition, the study was forwarded to TRAA, who used the information from the study to develop an infographic. The TRAA director of education replied, “As the towing industry’s only national association, we prioritize educational content that can help save the lives of operators. So, when we saw your study, we felt it provided such valuable insights we just had to share with our members! The infographic was sent via e-blast to our full membership list including state towing associations, towing company owners/managers, and manufacturers. After sending, we immediately heard from a Virginia company member who will share it during their next safety meeting.” In addition, the American Automobile Association (AAA) contacted the Ky FACE program and stated that AAA was conducting two research projects and asked permission to use the study to “look at roadside fatalities involving tow service providers and then develop countermeasures.”

Descriptive and Narrative Analysis of Trucking Workers’ Compensation First Reports of Injury. Analysis of truck transportation FROIs was performed using NVivo software to better understand injury circumstances and identify common hazard scenarios for trucking injuries such as moving cargo, cab ingress and egress, operating a dolly, securing tarps, and opening the trailer door. The results showed a higher percentage of lifting and cranking injuries in short-haul trucking compared with long-haul trucking that had a higher percentage of securing/opening/closing/adjusting injuries involving tarping, trailer door handling, and cab slippage. In addition, a higher proportion of short-haul trucking injury scenarios involved roadway departures and rear-end collisions. The study, “Narrative and quantitative analyses of workers' compensation-covered injuries in short-haul versus long-haul trucking,” was published in the *International Journal of Injury Control and Safety Promotion* in March 2017. The study results were disseminated to KSP, GECHS, FMCSA, FHWA, KMTA, OOIDA, WIT, NIOSH, other FACE states, and the trucking listserv (n=567). The study was used by KOSHS staff, in collaboration with Midwest Insurance, to develop four studio-quality safety training videos to prevent the most common injuries to truckers not involving operating the semi: entering and exiting semi-trailers; opening and closing swinging doors; cranking landing gear; and getting in and out of truck cabs. The videos were uploaded to YouTube and shared to the trucking listserv. KOSHS entered into an agreement with the Vertical Alliance Group, an online training company that serves over 1,100 companies based in Texarkana, TX to host the videos on their platform for companies to use. The Vertical Alliance Group stated, “I can tell you that your videos have gotten great traction on our system. Over 35k views per year is strong. I can also tell you that the look/production value of your videos are some of the best received on our platform. Any time I hear feedback about the look and feel of videos on our system, the Preventing Injuries modules are in the ‘good

examples' portions." As of June 30, 2021, the videos have been viewed over 100,000 times. In addition, Greg Knight, the safety compliance director for Tyson Foods, requested permission to use one of the four KOSHS-produced safety videos. Per his email, "I found the video below on YouTube and thought the content was good and the video was well produced. I am looking for the ok to be able to load this content into our learning system to show our drivers. Cranking trailers is one of our highest incidents of injury and we are looking to do whatever we can to keep our driers safe during this task. I believe that adding this video into our learning system could assist us in keeping one more driver from getting injured." Tyson Foods used both the cranking video and the entering/exiting video to train over 2,200 drivers.

The occupational fatality surveillance improvement study was slated to be performed in 2019-2020 but could not be conducted since a new government administration was installed and the data owners would not agree to a deterministic linkage of so many data sources; they all agreed to probabilistic data linkage but we did not feel that probabilistic data linkage was the appropriate approach for this study.

FACE Program Partnerships and Collaborations

The FACE project established innovative partnerships with organizations and agencies such as the NSC on worker safety and Total Worker Health® (TWH) topics and publication of FACE reports; CDC National Center for Injury Prevention and Control-funded Kentucky Violence and Injury Prevention Program (KVIPP) on Safe Communities (the Kentucky Injury Prevention and Research Center [KIPRC] is the US Safe Communities Certifying Center), suicide prevention, and drug overdose prevention; the NIOSH-funded TWH program on TWH initiatives (KIPRC became a TWH Affiliate in 2014); NIOSH CMVS on occupational motor vehicle safety; and KTA on transportation safety. The NTSB and FMCSA have used FACE reports to promulgate new standards in commercial motor vehicle and driver safety. Within the University of Kentucky, the FACE project established partnerships with the NIOSH-funded Central Appalachian Regional Education and Research Center and the Southeast Center for Agricultural Health & Injury Prevention on occupational safety and health student projects and the use of FACE surveillance data for their program interventions and evaluations.

An example of FACE and state, regional, and national agencies/organization working relationships include the Southeastern Occupational Health Network (SouthON). FACE outputs are disseminated through presentations at annual SouthON meetings that include state health department occupational health representatives, at NIOSH-funded education and research centers and agricultural centers, and at worker organizations in the southeast region. The 2021 SouthON Conference, co-organized by the FACE principal investigator, had 405 registrants, the most in the conference's history.

The Ky OSHA Division of Compliance is an advisory committee member and partners with the Ky FACE program on fatality investigations by providing industry contacts and consulting on report recommendations; Ky OSHA education and training uses FACE data and outputs. The Department of Workers' Claims is an advisory committee member and supports DWC data use in epidemiological analyses. KIPRC has memorandums of understanding with the DWC to access and analyze WC data; with the KSP to access and analyze CRASH and drug-related data; with the Kentucky Board of Emergency Medical Services to access and analyze EMS data; and with the Ky Cabinet for Health & Family Services to access inpatient hospitalizations, emergency department, and death certificate data. The Ky FACE program collaborates with NIOSH and other FACE states. Ky FACE personnel attend annual FACE meetings and conference calls. FACE personnel are NORA II TWU sector members and participate in NIOSH CMVS activities.

The FACE program collaborated with multiple heavy vehicle and medium vehicle partners: 1) KTA collaborates on quarterly newsletters and worker safety training and is an advisory committee member and 2) WIT, KTA, OHS, FMCSA, FHWA, Network of Employers for Traffic Safety, trucking and transportation employers, and insurance agency partners inform and use FACE findings.

Construction industry partnerships with the Association of General Contractors, National Association of Homebuilders, and the National Association of Women in Construction, as well as with construction contractors, were formed and/or enhanced to inform FACE findings and disseminate prevention materials.

FACE Program Output Dissemination

FACE research findings (reports, hazard alerts, newsletters, and peer-reviewed publications) are communicated through websites, social and general media, presentations, toolbox talks, trade journals, Council of State and Territorial Epidemiologists (CSTE) Occupational Health Success Stories, NIOSH e-news, and the NIOSH State-Based Occupational Health Surveillance Clearinghouse. Ky FACE personnel participate in FACE grantee meetings and FACE conference calls.

The KY FACE program disseminates outputs to target audiences with greatest state and national potential impact. An annual report containing industry, occupation, and cause of death is produced that includes current year data and historical data for trend analysis. KY FACE maintains a stakeholder listserv by industry and occupation for disseminating digital FACE stories, FACE fatality reports, hazard alerts, newsletters, and other publications, based on the nature of the incident (industry, occupation, and cause of death). We distribute Ky FACE outputs by direct mail, our website, e-mail, and social media (Facebook, YouTube, and Twitter). Digital FACE stories and other safety trainings are made available on our website as well as our social media and YouTube accounts. UK Public Relations produces news releases of FACE outputs for website and newspaper articles and television segments. FACE outputs are shared with KIPRC's CDC-funded KVIPP and with the NIOSH TWH program.

FACE trucking outputs are disseminated to our 4,200-person trucking employer and employee listserv; the FACE advisory committee consisting of OSHA, DWC, FMCSA, KTA, and others; the NIOSH State-Based Occupational Health Surveillance Clearinghouse; and stakeholders such as OOIDA, WIT, National Minority Trucking Association, NTA, and WC insurance agencies. They are also posted to our social media accounts. FACE HIM fatality reports and other outputs are disseminated to: 1) the 1,100-person HIM listserv; 2) social media; 3) NIOSH State-Based Occupational Health Surveillance Clearinghouse; and 4) stakeholders such as statewide HIM responder associations and businesses. Towing outputs were disseminated to the Towing and Recovery Association of Ky, Towing Recovery Association of America, Ky towing companies, towing associations nationwide, and towing safety professionals. Law enforcement outputs are disseminated to KSP, Kentucky Law Enforcement Council, National Association of Police Organizations, Eastern Kentucky University College of Justice and Safety, Ky Sheriffs' Association, and Ky police departments.

FACE motor vehicle outputs are disseminated to: 1) OHS, the KSP, FMCSA, KTA, FHWA, Kentucky Transportation Center; 2) our motor vehicle employer listserv; 3) social media and FACE advisory workgroup members; 4) NIOSH State-Based Occupational Health Surveillance Clearinghouse; 5) stakeholders such as WIT, NTSB, and WC insurance agencies; 6) NSC; 7) KSPAN; and 8) Kentucky Safety and Health Network (KSHN).

FACE construction industry outputs were disseminated to: 1) 285 company listserv; 2) FACE Advisory committee, NIOSH, and CPWR; 3) Ky OSHA; 4) Ky Homebuilders Association, Association of General Contractors, National Association of Women in Construction, Ky Roofing Contractors Association, IN/Ky Chapter Association Builders and Contractors, Ky Plantmix Asphalt Industry, National Association of Home Builders, Builders' Association, National Roofing Contractors Association; and 5) NIOSH State-Based Occupational Health Surveillance Clearinghouse.

FACE Program Impacts on Policy Development.

Federal Motor Carrier Safety Administration (FMCSA) revised rule on commercial motor vehicle passenger safety belt usage. Our KOSHS study (Bunn TL, Slavova S, Robertson M, Motor vehicle injuries among semi-truck drivers and sleeper berth passengers; *Journal of Safety Research*; 2013;44:51–55) that showed increased odds of a semi-truck crash injury when no sleeper berth occupant restraint was worn was used as justification for a final revised FMCSA rule that now requires occupant restraint use by semi-truck passengers. Previously, only the driver was required to wear an occupant restraint. 49 CFR 392.16, which became effective August 8, 2016, requires passenger safety belt usage in commercial motor vehicles.

Truck tandems. In October 2015, the KOSHS program was contacted by a safety defect investigator with the National Highway Traffic Safety Administration (NHTSA) Office of Defects Investigation—Med/Heavy Duty Vehicles division regarding our fatality report #14KY064. They used our FACE report to justify the formation of a committee to redesign or eliminate dump truck tandems due to fatalities.

Mandated towing training. In 2018, our tow truck fatality report #16KY052 was incorporated into a Federal Highway Administration (FHWA) first responder training course offered to towing operators throughout the state on an ongoing basis; tow truck operators are now required to complete traffic incident management (TIM) training in order to be considered for the interstate towing list in Ky. To date, FHWA has delivered the training to 10,441 employees in Ky, with a goal of training all 18,000 TIM responders within the state.

Fuel tank standards. The National Traffic Safety Board (NTSB) used KOSHS published work[22] on fuel tank fires for their research on fuel tank integrity and standards for commercial vehicles. The final report, adopted by the board in November 2017, contained 13 recommendations including one, based on KOSHS and NTSB work, that says, "The FMCSA has authority over regulations contained in 49 CFR Part 393 regarding fuel tank integrity standards. NHTSA is responsible for developing crashworthiness standards. Therefore, the NTSB

recommends that SAE International work with the FMCSA and NHTSA to improve truck-tractor side-mounted fuel tank crashworthiness to prevent catastrophic tank ruptures and limit post collision fuel spillage and develop and promulgate an updated standard." NTSB said, "Thank you, Terry and KIPRC. Your work was extremely helpful!"

Examples of Ky FACE Project Impacts and Outcomes

Report 15KY031. The FACE report "19-year-old construction laborer crushed in trench collapse while laying sewage pipe" was provided to the victim's employer. The recommendations aided in the development of several key policy changes, including hiring an external safety service to evaluate company policies for OSHA compliance; training policy inclusion of excavation and confined space entry safety; a requirement requiring that all employees performing trench work receive competent person training; and increased enforcement of PPE usage. Additionally, a full-time safety manager was hired and confined space entry/rescue equipment was purchased.

Based on a recommendation in FACE *report 16KY039*, the company implemented mechanic training on correct removal and installation of air springs. The company also collaborated with the manufacturer on employee internet access to installation procedures in the event that a replacement part does not include instructions.

Based on recommendations in FACE *report 16KY013*, the company purchased insulating equipment to use when within the minimum approach distance of uninsulated power lines and instituted a policy that a second employee act as a spotter when a coworker is performing work near power lines.

Report 19KY013 resulted in one company implementing a no-texting-while-driving and mandatory seat-belt usage policies and another company installing electronic logging devices to monitor driver compliance to hours of service regulations.

Report 19KY034 resulted in a company mandating a job hazard analysis on all new job sites.

Impact Examples Based on FACE Project Intervention Development and Implementation

Trucking. Level 3 driver inspection online training. Collaborating with the KTA, we developed a series of six modules in 2017 communicating the complex regulations governing a roadside driver inspection. Employers were provided the option of a personalized e-learning portal to be established by KOSHS through Moodle.com that allows managers to track the progress and scores of their individual commercial truck drivers. Four employers requested personalized e-learning portals, and a combined 122 drivers registered. Not included in this total were e-learners who completed the training directly from the KOSHS website without registering.

Towing. Our study on tow truck driver injuries[25] was used by the Towing & Recovery Association of America (TRAA) to create an infographic that was shared on their Facebook page, reaching 10,123 followers. We reached out to TRAA to thank them and ask about their dissemination. The TRAA Director of Education replied, "We're so glad to hear that you approve of the infographic! As the towing industry's only national association, we prioritize educational content that can help save the lives of operators. So, when we saw your study, we felt it provided such valuable insights we just had to share with our members! The infographic was sent via e-blast to our full membership list including state towing associations, towing company owners/managers, and manufacturers. After sending, we immediately heard from a Virginia company member who will share it during their next safety meeting." The American Automobile Association (AAA) contacted Ky FACE and stated that AAA was preparing to conduct two research projects and asked permission to use our study to "look at roadside fatalities involving tow service providers and then develop countermeasures."

Truck driver safety training videos. Safety training videos were developed and disseminated, in collaboration with Midwestern Insurance Alliance, that are based on the four leading causes of non-driving-related injuries to truck drivers: 1) truck cab ingress and egress; 2) cranking the trailer landing gear; 3) opening and closing the trailer door; and 4) trailer ingress and egress. The Vertical Alliance Group, a training company in Texarkana, TX, features the videos that services over 1,100 companies. The Vertical Alliance Group stated, "I can tell you that your videos have gotten great traction on our system. Over 35k views per year is strong. I can also tell you that the look/production value of your videos are some of the best received on our platform. Any time I hear feedback about the look and feel of videos on our system, the Preventing Injuries modules are in the 'good examples' portions."

KY TWH. NIOSH's TWH program is a holistic program that integrates occupational safety and health with health promotion to increase worker safety and health both on and off the job. The Ky FACE project incorporates TWH through partnerships with Safe Communities, Ky Safety and Health Network (KSHN), the Ky

Chamber of Commerce, the Ky Safety and Prevention Alignment Network (KSPAN), KIPRC, and other stakeholders. FACE project-associated staff members have produced presentations (e.g., in-service trainings provided to St. Joseph Women's Hospital and to Special People Advocating Recovery Kentucky on our in-house developed FindHelpNowKY.org that provides timely access to substance use disorder treatment facilities in Ky with available openings) and publications (e.g., Hazard Alert on Women as Victims of Workplace Violence, June 2020) on issues involving TWH. Dr. Casey Chosewood, NIOSH TWH manager, delivered a TWH presentation at our KSPAN meeting in November 2019 on worker well-being.

Safe Communities America. The Ky Safe Communities Network utilizes local community injury prevention coalitions, industries (e.g., UPS), and safety organizations (e.g., KSHN) to reduce injury and violence morbidity and mortality. KIPRC was accredited as the International Safe Communities Support Center in 2012 and reaccredited in 2017 by the Pan Pacific Safe Communities Network. KIPRC also currently serves as the Safe Community Certifying Center since 2018 in the US. Ky FACE integrates with Safe Communities and disseminates research publications, presentations, FACE fatality reports, Hazard Alerts, and toolkits to Safe Communities. There are currently five Safe Communities in Ky, with another five in the application process. All of the Safe Communities include local industries in their injury prevention programming.

FACE Project Evaluation

FACE surveillance system evaluation. The Ky FACE surveillance system is evaluated for flexibility, data quality, sensitivity, positive predictive values, representativeness, and stability. Recent recommended improvements include a new electronic FACE database entry system to facilitate easy entry of cases, assessment of data completeness, and calculation of descriptive statistics in a timely user-friendly environment. FACE adopted and transferred all FACE fatality surveillance data from an Access database to a REDCap database in summer 2020 to accomplish these objectives and improve FACE surveillance.

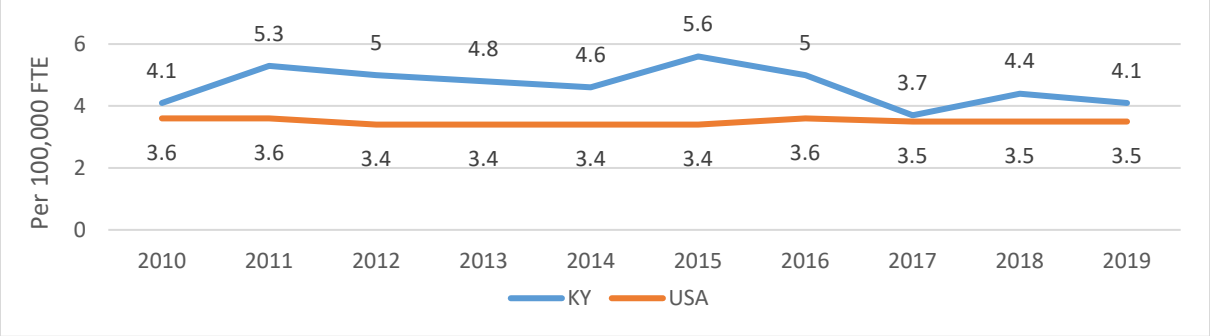
Investigation evaluation. The cost of performing worker fatality investigations in terms of personnel and financial resources was tracked, and the percentage of in-scope cases investigated and completed was documented. The primary barrier to FACE fatality investigation is lack of right of access to the workplace upon a worker death since the FACE project is a voluntary project. In contrast, OSHA has right of access to the workplace upon a worker death. The FACE program has a 75% success rate in entering workplaces for an on-site investigation. From 1994–2020, of the 217 complete FACE reports, fatality root cause was determined in 87% of fatality reports. The average FACE investigation cost is $3,250; contact interview time was three hours.

E. Conclusion

FACE short- and medium-term outcomes and impact examples are mentioned above. The long-term outcome of the Ky FACE project is a reduction in occupational injury mortality in Ky. There was a statistically significant decrease (52%) in Ky occupational fatality rates from 1995–2019, compared to a 30% decrease in the US occupational fatality rate over the study period (Figure 1). It is impossible to eliminate or consider all the possible influences on fatal occupational injury reduction, but the Ky FACE project—in collaboration with agencies, organizations, and industries—has been effective in the surveillance and reduction of fatal traumatic injuries to workers in Ky.

The Ky FACE project is fulfilling its objective of identifying industries and occupations at elevated risk for traumatic injuries, investigating targeted worker deaths, and using surveillance data to inform the development and implementation of interventions. FACE prevention materials have been used to inform engineering, behavioral, and administrative interventions and policies in Ky's workplaces.

Figure 1. Fatal Work-Related Injury Rates per 100,000 FTEs, US vs. KY, 2010–2019.



KENTUCKY OCCUPATIONAL SAFETY AND HEALTH SURVEILLANCE PUBLICATIONS

Bush AM, Bunn TL, Liford M: [2021] Identification of Work-Related Injury Emergency Department Visits Using International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) Codes. Injury Prevention 27(S1):i3-i8.

Shire J, Vaidyanathan A, Lackovic M, Bunn T: [2020] Association between Work-Related Hyperthermia Emergency Department Visits and Ambient Heat in Five Southeastern States, 2010–2012. GeoHealth 4(8).

Sagar S, Stamatiadis N, Wright S, Cambron A: [2020] Identifying High-Risk Commercial Vehicle Drivers Using Sociodemographic Characteristics. Accident Analysis & Prevention 143:105582.

Slavova S, Quesinberry D, Costich JF, Pasalic E, Martinez P, Martin J, Eustice S, Akpunonu P, Bunn TL: [2020] ICD-10-CM-Based Definitions for Emergency Department Opioid Poisoning Surveillance: Electronic Health Record Case Confirmation Study. Public Health 135(2):262–269.

Ward PJ, Rock PJ, Slavova S, Young AM, Bunn TL, Kavuluru R: [2019] Enhancing Timeliness of Drug Overdose Mortality Surveillance: A Machine Learning Approach. PLoS One 14(10):e0223318.

Chandler M, Bunn T: [2019] Analysis of Roadside Injuries in Motor Vehicle Towing. Journal of Safety Research 71:191–200.

Bunn TL, Slavova S, Rock PJ: [2019] Association between Commercial Vehicle Driver At-Fault Crashes Involving Sleepiness/Fatigue and Proximity to Rest Areas and Truck Stops. Accident; Analysis and Prevention 126:3–9.

Bunn T, Singleton M, Chen IC: [2019] Use of Multiple Data Sources To Identify Specific Drugs and Other Factors Associated with Drug and Alcohol Screening of Fatally Injured Motor Vehicle Drivers. Accident; Analysis and Prevention 122:287–294.

Horsely N, Slavova S, Bunn T, Sanderson W: [2019] Occupational Exposure to Airborne Particulate Matter and Chronic Obstructive Pulmonary Disease in Kentucky. American Thoracic Society: Effects of the Environment on Pulmonary Health A4917.

Baker C, Browning S, Charnigo R, Bunn T, Sanderson W: [2018] Factors Related to Return to Play after Knee Injury in High School Football Athletes. Annals of Epidemiology 28(9):629-634.

Bunn T, Slavova S, Chandler M, Hanner N. Singleton S: [2018] Surveillance of Traffic Incident Management-Related Occupational Fatalities in Kentucky, 2005–2016. Traffic Injury Prevention 19(4):446-453.

Cruz Y, Bunn TL, Hanner N, Slavova S: [2018] Characterization of Foreign-Born versus Native-Born Worker Fatalities in Kentucky, 2001–2014. Journal of Immigrant and Minority Health 20(2):448–455.

Witt WS, Bunn TL, Slavova S: [2018] Workers' Compensation-Reported Injuries among Security and Law Enforcement Personnel in the Private versus Public Sectors. Injury Epidemiology 5(1):27.

Chandler MD, Bunn TL, Slavova S: [2017] Narrative and Quantitative Analyses of Workers' Compensation-Covered Injuries in Short-Haul versus Long-Haul Trucking. International Journal of Injury Control and Safety Promotion 24(1):120–130.

Bunn TL, Slavova S, Rock PJ: [2017] Association between Commercial Vehicle Driver At-Fault Crashes Involving Sleepiness/Fatigue and Proximity to Rest Areas and Truck Stops. Accident Analysis & Prevention 126:3-9.

Ranzenberger K, Bunn TL, Slavova S: [2016] Healthcare Industry Injuries by Patient Contact Status in Kentucky, 2012–2014. Southern Medical Journal 109(10):599-605.

Brinker K, Jacobs T, Shire J, Bunn T, Chalmers J, Dang G, Flammia D, Higgins S, Lackovic M, Lavender A, Lewis JS, Li Y, Harduar Morano L, Porter A, Rauscher K, Slavova S, Watkins S, Zhang L, Funk R: [2016] Fatal Work-Related Injuries—Southeastern United States, 2008-2011. Workplace Health and Safety. 64(4):135-40.

Beggs JA, Slavova S, Bunn TL: [2015] Patterns of Pneumoconiosis Mortality in Kentucky: Analysis of Death Certificate Data. American Journal of Industrial Medicine 58(10):1075–82.

Harduar Morano L, Bunn TL, Lackovic M, Lavender A, Dang GT, Chalmers JJ, Li Y, Zhang L, Flammia DD: [2015] Occupational Heat-Related Illness Emergency Department Visits and Inpatient Hospitalizations in the Southeast Region, 2007–2011. American Journal of Industrial Medicine 58(10):1114–25.

KOSHS FUNDAMENTAL AND OHI PROGRAM REFERENCES

1. Bureau of Labor Statistics: [2020] Census of Fatal Occupational Injuries, 2018. Washington, DC: United States Department of Labor.
2. National Safety Council: [2020] 2018 Injury Facts. https://www.nsc.org/membership/member-resources/injury-facts
3. Bureau of Labor Statistics: [2014] Survey of Occupational Injuries and Illnesses, 2012. Washington, DC: US Department of Labor.
4. Retrieved from: https://www.iihs.org/topics/fatality-statistics/detail/state-by-state#fn1ref1.
5. Kentucky FACE project data. Lexington, KY: Kentucky Injury Prevention and Research Center, University of Kentucky.
6. Retrieved from: https://www.cdc.gov/nchs/pressroom/sosmap/drug_poisoning_mortality/drug_poisoning.htm.
7. Bunn TL, Slavova S, Robertson M: [2013] Motor Vehicle Injuries among Semi Truck Drivers and Sleeper Berth Passengers. Journal of Safety Research 44:51–5.
8. Ward PJ, Rock PJ, Slavova S, Young AM, Bunn TL, Kavuluru R: [2019] Enhancing Timeliness of Drug Overdose Mortality Surveillance: A Machine Learning Approach. PLoS ONE. 14(10):e0223318. https://doi.org/10.1371/journal.pone.0223318
9. Bunn T, Singleton M, Chen IC: [2019] Use of Multiple Data Sources To Identify Specific Drugs and Other Factors Associated with Drug and Alcohol Screening of Fatally Injured Motor Vehicle Drivers. Accident; Analysis and Prevention 122:287–294. doi: 10.1016/j.aap.2018.10.012. Epub 2018 Nov 2.
10. Council of State and Territorial Epidemiologists. Retrieved from: https://www.cste.org/page/OHIndicator.
11. Tamers SL, Goetzel R, Kelly KM, Luckhaupt S, Nigam J, Pronk NP, Rohlman DS, Baron S, Brosseau LM, Bushnell T, Campo S, Chang C, Childress A, Chosewood LC, Cunningham T, Goldenhar LM, Huang T, Hudson H, Linnan L, Newman LS, Olson R, Ozminkowski RJ, Punnett L, Schill A, Scholl J, Sorensen G: [2018] Research Methodologies for Total Worker Health®: Proceedings from a Workshop. Journal of Occupational and Environmental Medicine 60(11): 968–978. doi: 10.1097/JOM.0000000000001404.
12. Stone DM, Holland KM, Bartholow B, Crosby AE, Davis S, and Wilkins N: [2017]. Preventing Suicide: A Technical Package of Policies, Programs, and Practices. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.
13. Centers for Disease Control and Prevention: [2020] Data Science Strategy for Injury and Violence Prevention. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.
14. Centers for Disease Control and Prevention: [2019] Linking Information for Nonfatal Crash Surveillance (LINCS). Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/motorvehiclesafety/linkage/Linking-Information-Nonfatal-Crash-Surveillance.html
15. Bunn T, Singleton M, Chen IC: [2019] Use of Multiple Data Sources To Identify Specific Drugs and Other Factors Associated with Drug and Alcohol Screening of Fatally Injured Motor Vehicle Drivers. Accident Analysis & Prevention 122:287–294. doi:10.1016/j.aap.2018.10.012. Epub 2018 Nov 2.
16. Bunn T, Slavova S, Chandler M, Hanner N. Singleton S. Surveillance of Traffic Incident Management-Related Occupational Fatalities in Kentucky, 2005-2016. Traffic Injury Prevention 19;19(4):446-453.
17. Bunn TL, Slavova S, Rock PJ: [2019] Association between Commercial Vehicle Driver At-Fault Crashes Involving Sleepiness/Fatigue and Proximity to Rest Areas and Truck Stops. Accident Analysis & Prevention 126:3–9. doi: 10.1016/j.aap.2017.11.022. Epub 2017 Nov 22.
18. Chandler M, Bunn T: [2019] Analysis of Roadside Injuries in Motor Vehicle Towing. Journal of Safety Research 71:191–200.
19. Cruz Y, Bunn TL, Hanner N, Slavova S: [2018] Characterization of Foreign-Born versus Native-Born Worker Fatalities in Kentucky, 2001–2014. Journal of Immigrant and Minority Health 20(2):448–455. doi: 10.1007/s10903-017-0550-3.
20. Ranzenberger K, Bunn TL, Slavova S: [2016] Healthcare Industry Injuries by Patient Contact Status in Kentucky, 2012–2014. Southern Medical Journal 109(10):599-605. doi: 10.14423/SMJ.0000000000000544.

21. Chandler MD, Bunn TL, Slavova S: [2017] Narrative and Quantitative Analyses of Workers' Compensation-Covered Injuries in Short-Haul versus Long-Haul Trucking. International Journal of Injury Control and Safety Promotion 24(1):120–130.
22. Beggs JA, Slavova S, Bunn TL: [2015] Patterns of Pneumoconiosis Mortality in Kentucky: Analysis of Death Certificate Data. American Journal of Industrial Medicine 58(10):1075–82. doi: 10.1002/ajim.22511. Epub 2015 Aug 25.
23. Shire J, Vaidyanathan A, Lackovic M, Bunn T: [2020] Association between Work-Related Hyperthermia Emergency Department Visits and Ambient Heat in Five Southeastern States, 2010–2012. GeoHealth 4(8). e2019GH000241. https://doi.org/10.1029/2019GH000241.
24. Harduar Morano L, Bunn TL, Lackovic M, Lavender A, Dang GT, Chalmers JJ, Li Y, Zhang L, Flammia DD: [2015] Occupational Heat-Related Illness Emergency Department Visits and Inpatient Hospitalizations in the Southeast Region, 2007–2011. American Journal of Industrial Medicine. 58(10):1114–25. doi: 10.1002/ajim.22504. Epub 2015 Aug 25.
25. Brinker K, Jacobs T, Shire J, Bunn T, Chalmers J, Dang G, Flammia D, Higgins S, Lackovic M, Lavender A, Lewis JS, Li Y, Harduar Morano L, Porter A, Rauscher K, Slavova S, Watkins S, Zhang L, Funk R: [2016] Fatal Work-Related Injuries: Southeastern United States, 2008–2011. Workplace Health & Safety 64(4):135–40. doi: 10.1177/2165079915607873. Epub 2015 Oct 14. PMID: 26467194.
26. Bunn TL, Slavova S, Robertson M: [2012] Crash and Burn? Vehicle, Collision and Driver Factors that Influence Motor Vehicle Collision Fires. Accident Analysis &Prevention 47:140–145.
27. Slavova S, Quesinberry D, Costich JF, Pasalic E, Martinez P, Martin J, Eustice S, Akpunonu P, Bunn TL: [2020] ICD-10-CM-Based Definitions for Emergency Department Opioid Poisoning Surveillance: Electronic Health Record Case Confirmation Study. Public Health 135(2):262–269. doi: 10.1177/0033354920904087.
28. Retrieved from: https://www.bls.gov/opub/geographic-profile/archive.htm.
29. Retrieved from: https://wwwn.cdc.gov/wisards/cps/.
30. Retrieved from: https://www.bls.gov/cps, Labor Force Statistics from the Current Population Survey.
31. Bush AM, Bunn TL, Liford M: The Capture and Identification of Work-Related Injury Emergency Department Visits after the ICD-9-CM to ICD-10-CM Coding Transition. Conditionally accepted to Injury Prevention.
32. Ward PJ, Rock PJ, Slavova S, Young AM, Bunn TL, Kavuluru R: [2019] Enhancing Timeliness of Drug Overdose Mortality Surveillance: A Machine Learning Approach. PLoS One 14(10):e0223318. doi: 10.1371/journal.pone.0223318. eCollection 2019.
33. Harduar Morano L, Richardson D, Proescholdbell S: [2019] Descriptive Evaluation of Methods for Identifying Work-Related Emergency Department Injury Visits. American Journal of Industrial Medicine 62(7):568–579. doi: 10.1002/ajim.22984.
34. Bureau of Labor Statistics. 2019. Census of Fatal Occupational Injuries, 2018.
35. Retrieved from: https://afdc.energy.gov/data/10381.
36. Retrieved from: https://afdc.energy.gov/data/10380.
37. Zheng Z, Lu P, Lantz B: [2018] Commercial Truck Crash Injury Severity Analysis Using Gradient Boosting Data Mining Model. Journal of Safety Research 65:115–124. doi: 10.1016/j.jsr.2018.03.002. Epub 2018 Mar 17.
38. McKnight AJ, Bahouth GT: [2009] Analysis of Large Truck Rollover Crashes. Traffic Injury Prevention 10(5):421–426. doi: 10.1080/15389580903135291. PMID: 19746305.
39. Pratt SG, Bell JL: [2019] Analytical Observational Study of Nonfatal Motor Vehicle Collisions and Incidents in a Light-Vehicle Sales and Service Fleet. Accident Analysis &Prevention 129:126–135. doi: 10.1016/j.aap.2019.05.009. Epub 2019 May 28. PMID: 31150919.
40. Stuckey R, Glass DC, LaMontagne AD, Wolfe R, Sim MR: [2010] Risk Factors for Worker Injury and Death from Occupational Light Vehicles Crashes in New South Wales (Australia). American Journal of Industrial Medicine 53(9):931–939. doi: 10.1002/ajim.20854. PMID: 20698024.
41. Chen GX, Amandus HE: [2014] Occupational Fatalities among Driver/Sales Workers and Truck Drivers in the United States, 2003-2008. American Journal of Industrial Medicine 57(7):800–809. doi: 10.1002/ajim.22320. Epub 2014 May 8.
42. Kentucky Society for Human Resource Management: [2017] The Graduate! Network Bridging the Talent Gap Project.
43. Kentucky Chamber of Commerce: [2018] Kentucky's Workforce: Progress and Challenges.

44. Maryland Department of Health: [2019] Opioids in the Maryland Workplace: Challenges and Solutions.

KOSHS FACE PROGRAM REFERENCES

1. Bureau of Labor Statistics: [2020] Census of Fatal Occupational Injuries, 2018. Washington, DC: US Department of Labor.
2. National Safety Council: [2020] 2018 Injury Facts.
3. Bureau of Labor Statistics: [2014] Survey of Occupational Injuries and Illnesses, 2012. Washington, DC: US Department of Labor.
4. Retrieved from: https://www.iihs.org/topics/fatality-statistics/detail/state-by-state#fn1ref1.
5. Kentucky FACE project data. Kentucky Injury Prevention and Research Center, University of Kentucky, Lexington, KY.
6. Retrieved from: https://www.cdc.gov/nchs/pressroom/sosmap/drug_poisoning_mortality/drug_poisoning.htm.
7. Bunn TL, Slavova S, Robertson M: [2013] Motor Vehicle Injuries among Semi Truck Drivers and Sleeper Berth Passengers. Journal of Safety Research 44:51–5.
8. Ward PJ, Rock PJ, Slavova S, Young AM, Bunn TL, Kavuluru R: [2019] Enhancing Timeliness of Drug Overdose Mortality Surveillance: A Machine Learning Approach. PLoS ONE 14(10): e0223318. https://doi.org/10.1371/journal.pone.0223318
9. Bunn TL, Slavova S, Hall L: [2008] Narrative Text Analysis of Kentucky Tractor Fatality Reports. Accident Analysis & Prevention 40(2):419–25.
10. Bunn T, Singleton M, Chen IC: [2019] Use of Multiple Data Sources To Identify Specific Drugs and Other Factors Associated with Drug and Alcohol Screening of Fatally Injured Motor Vehicle Drivers. Accident Analysis & Prevention 122:287–294. doi: 10.1016/j.aap.2018.10.012. Epub 2018 Nov 2.
11. Runyan CW: [2015] Using the Haddon Matrix: Introducing the Third Dimension. Injury Prevention 21(2):126-30. doi: 10.1136/ip.4.4.302rep.
12. Tamers SL, Goetzel R, Kelly KM, Luckhaupt S, Nigam J, Pronk NP, Rohlman DS, Baron S, Brosseau LM, Bushnell T, Campo S, Chang C, Childress A, Chosewood LC, Cunningham T, Goldenhar LM, Huang T, Hudson H, Linnan L, Newman LS, Olson R, Ozminkowski RJ, Punnett L, Schill A, Scholl J, Sorensen G: [2018] Research Methodologies for Total Worker Health®: Proceedings from a Workshop. Journal of Occupational and Environmental Medicine 60(11): 968–978. Doi: 10.1097/JOM.0000000000001404.
13. Stone DM, Holland KM, Bartholow B, Crosby AE, Davis S, and Wilkins N: [2017]. Preventing Suicide: A Technical Package of Policies, Programs, and Practices. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.
14. Centers for Disease Control and Prevention: [2020] Data Science Strategy for Injury and Violence Prevention. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.
15. Centers for Disease Control and Prevention: [2019] Linking Information for Nonfatal Crash Surveillance (LINCS). Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention. Available at: https://www.cdc.gov/motorvehiclesafety/linkage/Linking-Information-Nonfatal-Crash-Surveillance.html
16. Centers for Disease Control and Prevention: [2001] Updated Guidelines for Evaluating Public Health Surveillance Systems. Morbidity and Mortality Weekly Report 50(RR13):1–35.
17. Bunn TL, Slavova S, Struttmann TW, Browning SR: [2005] Sleepiness/Fatigue and Distraction/Inattention as Factors for Fatal versus Nonfatal Commercial Motor Vehicle Driver Injuries. Accident Analysis & Prevention 37:862–869.
18. Bunn TL, Struttmann TW: [2003] Characterization of Fatal Occupational versus Nonoccupational Motor Vehicle Collisions in Kentucky, 1998–2000. Traffic Injury Prevention 4:270–275.
19. Bunn TL, Yu L, Slavova S, Bathke A: [2009] The Effects of Semi Truck Driver Age and Gender and the Presence of Passengers on Collisions with Other Vehicles. Traffic Injury Prevention 10(3):266–272.
20. Bunn TL, Singleton M, Slavova S, Nicholson V: [2013] Concordance of Identified Drugs in Injured Motor Vehicle Drivers Using Linked Motor Vehicle Crash, Emergency Department, and Inpatient Hospitalization Datasets. Traffic Injury Prevention 14(7):680–9.
21. Bunn TL, Slavova S, Robertson M: [2013] Motor Vehicle Injuries among Semi Truck Drivers and Sleeper Berth Passengers. Journal of Safety Research 44:51–5.

22. Bunn TL, Slavova S, Robertson M: [2012] Crash and Burn? Vehicle, Collision and Driver Factors that Influence Motor Vehicle Collision Fires. Accident Analysis & Prevention 47:140–145.
23. Green MK, Harrison R, Leinenkugel K, Nguyen CB, Towle M, Schoonover T, Bunn T, Northwood J, Pratt SG, Myers JR: [2011] Occupational Highway Transportation Deaths—United States, 2003–2008. Morbidity and Mortality Weekly Report 60(16):497–502.
24. Bunn TL, Slavova S, Tang M: [2011] Injuries among Solid Waste Collectors in the Private versus Public Sector. Waste Management and Research 29(10):1043–52.
25. Chandler M, Bunn T: [2019] Analysis of Roadside Injuries in Motor Vehicle Towing. Journal of Safety Research 71:191–200.
26. Bunn T, Singleton M, Chen I: [2019] Use of Multiple Data Sources To Identify Specific Drugs and Other Factors Associated with Drug and Alcohol Screening of Fatally Injured Motor Vehicle Drivers. Accident Analysis & Prevention 122:287–294.
27. Bunn T, Slavova S, Chandler M, Hanner N. Singleton S: [2018] Surveillance of Traffic Incident Management-Related Occupational Fatalities in Kentucky, 2005–2016. Traffic Injury Prevention 19(4):446–453.
28. Bunn TL, Slavova S, Rock PJ: [2017] Association between Commercial Vehicle Driver At-Fault Crashes Involving Sleepiness/Fatigue and Proximity to Rest Areas and Truck Stops. Accident Analysis & Prevention 126:3–9.
29. Chandler MD, Bunn TL, Slavova S: [2017] Narrative and Quantitative Analyses of Workers' Compensation-Covered Injuries in Short-Haul versus Long-Haul Trucking Industries. International Journal of Injury Control and Safety Promotion 24(1):120–130.
30. Higgins D, Cassini V, Bost P, Johnson W, Rautiainen R: [2001] The Fatality Assessment and Control Evaluation Program's Role in the Prevention of Occupational Fatalities. Injury Prevention 7(Suppl 1):i27–33.
31. Haddon WJ, Jr, Baker SP: [1981] Injury Control. In: Preventive and Community Medicine (eds. D Clark and B MacMahon), Little Brown and Company, pp 109–140.
32. Bunn TL, Slavova S, Bathke, A: [2007] Data Linkage of Inpatient Hospitalization and Workers' Claims Data Sets To Characterize Occupational Falls. Journal of the Kentucky Medical Association 105:313–320.
33. McCann M, Cheng MT: [2012] Dump Truck-Related Deaths in Construction, 1992–2007. American Journal of Industrial Medicine 55(5):450–7. doi: 10.1002/ajim.21028. Epub 2011 Nov 23.
34. Boggess BM, Morr DR, Peterman EK, Wiechel JF: [2010] Experimental Evaluation of Underride Analysis Techniques and Empirical Validation of a New Analytical Technique. Accident Analysis and Prevention 42(1):140–52.
35. Du CL, Liang HW, Chen HC, Chen CY, Chu PC, Wang JD: [2006] Cervical HIVD Probably Related to Long-Term Repetitive Shock and Neck Flexion among Dump-Truck Drivers. Journal of Occupational Health 48(4):273–5. doi: 10.1539/joh.48.273.
36. Ruff T: [2006] Evaluation of a Radar-Based Proximity Warning System for Off-Highway Dump Trucks. Accident Analysis & Prevention 38(1):92–8.
37. Milosević S: [1997] Drivers' Fatigue Studies. Ergonomics 40(3):381–9. doi: 10.1080/001401397188215.
38. Welch L, Kirshner H, Heath A, Gilliland R, Broyles S: [1991] Chronic Neuropsychological and Neurological Impairment Following Acute Exposure to a Solvent Mixture of Toluene and Methyl Ethyl Ketone (MEK). Journal of Toxicology: Clinical Toxicology 29(4):435–45. doi: 10.3109/15563659109025739.
39. Occupational Safety and Health Administration: [2014] Summary Reports of Fatalities and Catastrophic Events. Washington, DC: US Department of Labor. URL at: https://www.osha.gov/pls/imis/AccidentSearch.search?p_logger=1&acc_description=&acc_Abstract=&acc_keyword=dump+truck&sic=&naics=&Office=All&officetype=All&endmonth=01&endday=13&endyear=1995&startmonth=10&startday=13&startyear=2021&InspNr=
40. Meyers AR, Al-Tarawneh IS, Wurzelbacher SJ, Bushnell PT, Lampl MP, Bell JL, Bertke SJ, Robins DC, Tseng C, Wei C, Raudabaugh JA, Schnorr TM: [2018] Applying Machine Learning to Workers' Compensation Data to Identify Industry-Specific Ergonomic and Safety Prevention Priorities: Ohio, 2001 to 2011. Journal of Occupational and Environmental Medicine 60(1):55–73. doi: 10.1097/JOM.0000000000001162.

41. Ward PJ, Rock PJ, Slavova S, Young AM, Bunn TL, Kavuluru R: [2019]. Enhancing Timeliness of Drug Overdose Mortality Surveillance: A Machine Learning Approach. PLoS One 14(10):e0223318. doi: 10.1371/journal.pone.0223318. eCollection 2019.
42. Dong XS, Largay JA, Choi SD, Wang X, Cain CT, Romano N: [2017] Fatal Falls and PFAS Use in the Construction Industry: Findings from the NIOSH FACE Reports. Accident Analysis & Prevention 102:136–143. doi: 10.1016/j.aap.2017.02.028. Epub 2017 Mar 11.
43. Kitching F, Jones CB, Ibrahim JE, Ozanne-Smith J: [2014] Pedestrian Worker Fatalities in Workplace Locations, Australia, 2000–2010. International Journal of Injury Control and Safety Promotion 21(2):163–9. doi: 10.1080/17457300.2013.792286. Epub 2013 May 8.
44. Ruff TM: [2001] Application of Radar To Detect Pedestrian Workers near Mining Equipment. Applied Occupational and Environmental Hygiene 16(8):798–808. doi: 10.1080/10473220118943.
45. Collins JW, Landen DD, Kisner SM, Johnston JJ, Chin SF, Kennedy RD: [1999] Fatal Occupational Injuries Associated with Forklifts, United States, 1980–1994. American Journal of Industrial Medicine 36(5):504–12. doi: 10.1002/(sici)1097-0274(199911)36:5<504::aid-ajim2>3.0.co;2-p.
46. Ore T, Fosbroke DE: [1997] Motor Vehicle Fatalities in the United States Construction Industry. Accident Analysis & Prevention 29(5):613–26.
47. Tiesman HM, Swedler DI, Konda S, Pollack KM: [2013] Fatal Occupational Injuries among US Law Enforcement Officers: A Comparison of National Surveillance Systems. American Journal of Industrial Medicine 56(6):693–700.
48. Smith GS, Veazie MA, Benjamin KL: [2005] The Use of Sentinel Injury Deaths To Evaluate the Quality of Multiple Source Reporting for Occupational Injuries. Annals of Epidemiology 15(3):219–227.
49. Rosenman KD, Kalush A, Reilly MJ: [2006] How Much Work-Related Injury and Illness Is Missed by the Current National Injury Surveillance System? Journal of Occupational and Environmental Medicine 48:357–365.
50. Davidson JE, Proudfoot J, Lee K, Terterian G, Zisook S: [2020] A Longitudinal Analysis of Nurse Suicide in the United States, 2005–2016, with Recommendations for Action. Worldviews on Evidence-Based Nursing 17(1):6–15. doi: 10.1111/wvn.12419.
51. Dutheil F, Aubert C, Pereira B, Dambrun M, Moustafa F, Mermillod M, Baker JS, Trousselard M, Lesage FX, Navel V: [2019] Suicide among Physicians and Health-Care Workers: A Systematic Review and Meta-analysis. PLoS One 12;14(12):e0226361.
52. Yentis SM, Shinde S, Plunkett E, Mortimore A: [2019] Suicide amongst Anaesthetists—An Association of Anaesthetists Survey. Anaesthesia 74(11):1365–1373. doi: 10.1111/anae.14727. Epub 2019 Jul 2.
53. Davidson JE, Stuck AR, Zisook S, Proudfoot J: [2018] Testing a Strategy To Identify Incidence of Nurse Suicide in the United States. The Journal of Nursing Administration 48(5):259–265. doi: 10.1097/NNA.0000000000000610.
54. Applebaum KM, Asfaw A, O'Leary PK, Busey A, Tripodis Y, Boden LI: [2019] Suicide and Drug-Related Mortality Following Occupational Injury. American Journal of Industrial Medicine 62(9):733–741. doi: 10.1002/ajim.23021. Epub 2019 Jul 12.
55. Peterson C, Sussell A, Li J, Schumacher PK, Yeoman K, Stone DM: [2016] Suicide Rates by Industry and Occupation—National Violent Death Reporting System, 32 States, 2016. Morbidity and Mortality Weekly Report 69(3):57–62. doi: 10.15585/mmwr.mm6903a1.
56. Peterson C, Stone DM, Marsh SM, Schumacher PK, Tiesman HM, LiKamWa McIntosh W, Lokey CN, Trudeau AT, Bartholow B, Luo F: [2018] Suicide Rates by Major Occupational Group—17 States, 2012 and 2015. Morbidity and Mortality Weekly Report 67(45):1253–1260. doi: 10.15585/mmwr.mm6745a1.
57. Lavender A, Ramirez-Irizarry V, Bayakly AR, Koplan C, Bryan JM: [2016] Violent Deaths among Georgia Workers: An Examination of Suicides and Homicides by Occupation, 2006–2009. American Journal of Preventive Medicine 51(5S3):S241–S250.
58. Cross W, Matthieu MM, Cerel J, Knox KL: [2007] Proximate Outcomes of Gatekeeper Training for Suicide Prevention in the Workplace. Suicide and Life-Threatening Behavior 37(6).

Inclusion of Gender and Minority Study Subjects

Women

KOSHS fundamental and OHI. Data on women were included in the study if they were at least 16 years of age and the injury/illness was occupationally related. Women comprise approximately 47% of the civilian employed population in Kentucky (n=75,766 in June 2021) (Bureau of Labor Statistics, 2021 data); therefore, it is estimated that women account for approximately the same proportion of worker injuries and illnesses. No data were excluded from the project due to gender.

FACE. Women were included in the project since both genders suffer occupational fatalities. In 2020, women comprised approximately 7% of fatal occupational injuries in Kentucky currently under surveillance by the FACE program (Kentucky FACE program 2020 report); therefore, it is expected that the percentage of women will remain unchanged. All data collection and analysis were performed on both genders to accomplish the specific aims of the study. No women were excluded from the study unless the fatal injury was not work-related or the fatal work injury occurred outside Kentucky's borders, the same exclusion criteria for men. Women and minorities participated in the project in the same way as all other participants. Since only data on deceased subjects were obtained, no subjects were recruited.

Minorities

KOSHS fundamental and OHI. Data on minorities were included in the project. Black minorities comprised ~15% of the civilian employed population in Kentucky in 2020, and Hispanics or Latinos comprised 6% (Bureau of Labor Statistics, 2020 data). Therefore, it is estimated that minorities will account for approximately the same proportion of worker injuries and illnesses. No data were excluded from the project due to race or ethnicity. Data variables examining ethnicity and race were categorized using PHS 398 recommended definitions and standards.

FACE. Data on minorities were included in the project. Black and other race minorities comprise 6% of the fatal occupational injuries in Kentucky currently under surveillance by the FACE program, and Hispanic ethnicity minorities accounted for 4% of the worker fatalities in 2020 (2020 Kentucky FACE report). Therefore, it is expected that the percentage of minorities in this proposed project was unchanged. No data or interviews were excluded from the project due to gender, race, or ethnicity. Women and minorities participated in the project in the same way as all other participants. Data variables examining race and ethnicity were categorized using the PHS 398 recommended definitions and standards.

Inclusion of Children

KOSHS fundamental and OHI. Data on children 16–21 years of age were included in the project. Data were received in the same manner as adult data and were collected by KIPRC as a bona fide agent of the KDPH. Children were included in this project because the occupational safety and health indicators recommended by CSTE and NIOSH for occupational safety and health surveillance include workers 16 years of age and older for numerator and denominator data.

FACE. Children under the age of 21 years were included in the project surveillance data if they were working at their time of death. In 2020, children comprised approximately 2% of the fatal occupational injuries in Kentucky currently under surveillance by the FACE program (Kentucky FACE report). Therefore, it is expected that the percentage of children in this proposed project remained unchanged.

Only female and male witnesses 21 years of age and above were interviewed in worker fatality investigations. Children under 21 years of age were not interviewed because of the emotional distress of talking about a fatal incident. This exclusion is included in our current IRB approval for the FACE project.

Materials Available for Other Investigators

All peer-reviewed publications, Hazard Alerts, training and toolkits are available to researchers on the Kentucky Injury Prevention and Research Center website and by direct request. No individual worker injury and fatality data are available to researchers due to our memorandum of understating restrictions with state agency data owners. Individual-level data need to be requested directly from the state agency data owners.

Data Sets

The Kentucky Injury Prevention and Research Center does not have ownership of any of the authorized data resources that were used to perform epidemiological studies. The authorized data resource providers such as CRASH, Department of Workers' Claims, emergency department, inpatient hospitalization data, and mortality data need to be contacted individually by interested users to obtain their data. All published results such as reports, maps, hazard alerts, peer-reviewed and non-peer reviewed publications are available for

information sharing on our KOSHS website or by direct request from other researchers or by the general public.

Cumulative Inclusion Enrollment Report

This report format should NOT be used for collecting data from study participants.

Study Title: Kentucky Occupational Safety and Health Surveillance Program

Comments:

Racial Categories	Ethnic Categories									Total
	Not Hispanic or Latino			Hispanic or Latino			Unknown/Not Reported Ethnicity			
	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	Female	Male	Unknown/ Not Reported	
American Indian/ Alaska Native	0	0	0	0	0	0	0	0	0	**0**
Asian	0	0	0	0	0	0	0	0	0	**0**
Native Hawaiian or Other Pacific Islander	0	0	0	0	0	0	0	0	0	**0**
Black or African American	0	0	0	0	0	0	0	0	0	**0**
White	0	0	0	0	0	0	0	0	0	**0**
More Than One Race	0	0	0	0	0	0	0	0	0	**0**
Unknown or Not Reported	0	0	0	0	0	0	215,614	174,098	0	**389,712**
Total	**0**	**0**	**0**	**0**	**0**	**0**	**215,614**	**174,098**	**0**	**389,712**