Work-related injuries in a state trauma registry: Relationship between industry and drug screening

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BACKGROUND: Work-related injuries exert a great financial and economic burden on the US population. The study objectives were to identify the industries and occupations associated with worker injuries and to determine the predictors for injured worker drug screening in trauma centers.

METHODS: Work-related injury cases were selected using three criteria (expected payer source of workers' compensation, industry-related e-codes, and work-related indicator) from the Kentucky Trauma Registry data set for years 2008 to 2012. Descriptive analyses and multiple logistic regression were performed on the work-related injury cases.

RESULTS: The "other services" and construction industry sectors accounted for the highest number of work-related cases. Drugs were detected in 55% of all drug-screened work-related trauma cases. Higher percentages of injured workers tested positive for drugs in the natural resources and mining, transportation and public utilities, and construction industries. In comparison, higher percentages of injured workers in the other services as well as transportation and public utilities industries were drug screened. Treatment at Level I trauma centers and Glasgow Coma Scale (GCS) scores indicating a coma or severe brain injury were both significant independent predictors for being screened for drugs; industry was not a significant predictor for being drug screened. The injured worker was more likely to be drug screened if the worker had a greater than mild injury, regardless of whether the worker was an interfacility transfer.

CONCLUSION: These findings indicate that there may be elevated drug use or abuse in natural resources and mining, transportation and public utilities, as well as construction industry workers; improved identification of the specific drug types in positive drug screen results of injured workers is needed to better target prevention efforts. (*J Trauma Acute Care Surg*. 2014;77: 280–285. Copyright © 2014 by Lippincott Williams & Wilkins)

LEVEL OF EVIDENCE: Epidemiologic study, level III.

KEY WORDS: Work-related injury; drugs; industry.

Work-related injuries exert a great financial and economic burden on the US population. In 2010, the total costs of work injuries were estimated to be $176.9 billion, including wage and productivity losses, medical costs, and administrative costs.[1] According to the National Academy of Social Insurance, workers' compensation programs alone paid $57.5 billion in benefits and $28.1 billion in medical benefits associated with work-related injuries in the United States in the year 2010.[2]

State trauma registry data have the potential to identify worker injuries by industry and occupation since it contains an indicator to ascertain work relatedness and have information on the industry and occupation categories of the injured worker.[3] The combination of the work-related indicator, workers' compensation as the expected payer, and work-related e-codes is associated with high specificity in the surveillance of work-related injuries.[4] Data from state trauma registries are also useful for the identification of the presence of drugs and/or alcohol associated with injuries. Approximately 9.3% of adolescent blunt trauma patients admitted to two local Level I trauma centers had positive toxicology results for drugs and alcohol.[5] In another study, trauma patients in an academic Level I trauma center with positive drug and/or alcohol screen results and penetrating trauma were more likely to have arrived dead to the hospital compared with those with negative drug and alcohol screen results.[6]

The prevalence of illicit drug use in the workforce has been estimated to be 14.1%, while the estimated prevalence of illicit drug use in the workplace has been estimated at 3.1%.[7] The objectives of the present study were to identify the industries and occupations associated with worker injuries treated in trauma centers and to determine the predictors for injured worker drug screening in trauma centers.

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PATIENTS AND METHODS

Trauma Registry Data

Data for the present study were obtained from the Kentucky Trauma Registry database for years 2008 to 2012 and represent the most severe traumatic injuries treated at Kentucky trauma centers and reported to the Kentucky Trauma Registry. Trauma registry data were collected according to recommended elements in National Trauma Data Standards (NTDS).[8] Data element names, definitions, types, schemes analyzed in this study and category names within the data result tables were derived from the NTDS admissions data dictionary.[8]

Because of the lack of personal identifiers, interfacility transfers may have generated more than one record, so trauma registry cases reflect the number of trauma hospital discharges rather than numbers of individuals who were hospitalized because of severe trauma. When a patient received emergency department (ED) treatment at a trauma hospital and was subsequently admitted to the same facility, that patient was treated as an inpatient. Data for trauma sustained in Kentucky but treated in out-of-state health care facilities were not included in the study. This study was part of the Kentucky Occupational Safety and Health Surveillance program and was approved by the University of Kentucky Institutional Review Board.

In response to a legislative initiative, Kentucky expanded the number of trauma registry reporting facilities from 5 in 2008 to 18 in 2012. Currently, there are four Level I, three Level III, and four Level IV trauma centers that are verified by the American College of Surgeons (Levels I–III) or the State Department for Public Health (Level IV).

Work-Related Selection Criteria

Work-related trauma cases were selected using three criteria as follows: (1) trauma registry work-related indicator marked "yes"; (2) workers' compensation as the primary expected payer; and (3) a DRG International Classification of Diseases—9th Rev.—Clinical Modification (ICD-9-CM) external cause of injury code algorithm based on a published study by Alamgir et al., (2006) that is currently used by other traumatic work-related injury surveillance researchers.[4,9] With the use of the work-related selection criteria mentioned earlier, 1,827 Kentucky work-related trauma cases were identified and used for the final analysis.

Trauma Registry Field Variables

The patient's industry and occupation were coded according to NTDS. Specific industries were as follows: (1) finance, insurance, and real estate; (2) manufacturing; (3) retail trade; (4) transportation and public utilities; (5) agriculture, forestry, and fishing; (6) professional and business services; (7) education and health services; (8) construction; (9) government; (10) natural resources and mining; (11) information services; (12) wholesale trade; (13) leisure and hospitality; and (14) other services. See NTDS for coded occupations.

Recommended Kentucky Trauma Registry drug screens test for the following drug categories: (1) amphetamines; (2) barbiturates; (3) benzodiazepines; (4) cocaine; (5) Lysergic acid diethylamide; (6) marijuana/Tetrahydrocannabinol/cannabinoids; (7) methamphetamines; (8) opiates; (9) PCP/phencyclidine; (10) tricyclic antidepressants; (11) inhalants; (12) methadone; and (13) oxycodone. The presence of drugs was recorded in the trauma registry data set using (1) no (not tested); (2) no (confirmed by test); (3) yes (confirmed by test [prescription drug]); and (4) yes (confirmed by test [illegal use drug]). "Illegal use drug" includes illegal use of prescription drugs. According to NTDS, the drug presence indicator "refers to drug use by the patient and does not include medical treatment." If the presence of alcohol and/or drugs was suspected but not tested for, the "not known/ not recorded" value was completed. Data sources used to determine alcohol and/or drug presence were laboratory results and ED physician notes as recommended by the NTDS. The following comorbid conditions were enumerated: (1) current smoker; (2) alcoholism; (3) diabetes mellitus; (4) respiratory disease; (5) obesity; and (6) drug abuse or dependence.

Diagnosis and outcome variables included in the study were nature of injury, injured body part, cause and intent of injury, Injury Severity Score (ISS), Glasgow Coma Scale (GCS) score, and hospital discharge disposition. The nature of injury and the body region variables were defined based on the Barell Injury Diagnosis Matrix, using the first listed ICD-9-CM diagnosis.[10] The injury cause and intent were defined based on the recommended framework of ICD-9-CM external cause of injury grouping for presenting injury morbidity data.[11] The ISS ranges from 1 to 75 and was categorized as mild (1–9), moderate (10–15), severe (16–24), and very severe (25–75). The following GCS scale ranges were used: severe (3–8), moderate (9–12), and mild (13–15). The NTDS-defined variable "interfacility transfer" was coded "yes" when the patient was transferred *to* the reporting facility from another acute care facility. The ED and the hospital discharge dispositions were reported in NTDS categories.

Statistical Analysis

Descriptive analyses of work-related trauma included frequencies and percentages by selected demographic, injury, clinical, and outcome variables, using SAS version 9.3 (SAS Institute, Cary, NC). A χ^2 test for association was used to assess statistically significant differences in the proportions of "screened for the presence of drugs" among the industry categories. A multiple logistic regression model with the dependent variable "screened for the presence of drugs" (yes/no) was used to test for the significant difference in the proportion of cases screened for the presence of drugs among patients with different occupational industries, while controlling for factors such as the ISS, GCS, nature of injury, cause of injury, interfacility transfer, and level of trauma care. Various two-way interactions were also included in the model. A backward selection approach was used in the modeling process. The final model included the following independent variables: (1) industry; (2) ISS categorized as "mild" (ISS, 1–9) or "moderate to very severe" (ISS, 9–75); (3) GCS categorized as "coma/severe" (GCS score, 3–8), "moderate/minor" (GCS score, 9–15), and "not recorded"; (4) interfacility transfer as "yes" or "no"; (5) level of trauma care as "Level I trauma facility" or "other"; and (6) two-way interaction between ISS and interfacility transfer. The strength of the associations was described with adjusted odds ratios (ORs) and their 95% confidence intervals (CIs). The Hosmer-Lemeshow goodness-of-fit test assessed the acceptability of the model fit.

RESULTS

The combination of the work-related indicator, the expected payer source of workers' compensation, and the work-related e-code algorithm identified 1,827 work-related trauma cases (Table 1). The use of the work-related indicator alone captured approximately 91% of the final cases (n = 1,670). The expected payer source of workers' compensation

TABLE 1. Identification of Kentucky Work-Related Trauma Cases, 2008 to 2012

Work-Related Selection Criteria	2008, n (%)	2009, n (%)	2010, n (%)	2011, n (%)	2012, n (%)	Total, n (%)
Work-related indicator marked "yes"*	324 (93%)	285 (94%)	321 (92%)	360 (88%)	380 (94%)	1,670 (91%)
Expected primary payer of workers' compensation**	144 (41%)	154 (51%)	249 (71%)	320 (78%)	269 (65%)	1,136 (62%)
Work-related e-code algorithm†	93 (27%)	60 (20%)	90 (26%)	128 (31%)	91 (22%)	464 (25%)
Total	350	303	350	409	415	1,827

*Work-related indicator = 1,670 total cases for study period.
**Expected payer of workers' compensation added 112 cases not captured by the work-related indicator.
†Work-related e-code Algorithm added 45 cases not captured by the work-related indicator or expected payer of workers' compensation.

alone identified 62% of the total cases (n = 1,136) and identified 112 additional cases (6% of the total cases) that were not identified through the positive work-related indicator. With the use of the work-related e-code algorithm, only 25% of the total work-related trauma cases were identified (n = 464), although the work-related e-code algorithm identified 45 additional cases (2% of the total cases) that were not identified through the positive work-related indicator or the workers' compensation expected payer data fields.

The majority of injured workers were treated in Level I trauma centers (Table 2); one third were interfacility transfers. One third of the injured worker cases were coded with a greater than mild ISS, and only 7% were coded as being in a coma or with a severe brain injury. Most of the injured workers had a GCS score of moderate or minor (83%). Almost one third of the work-related trauma cases were caused by falls (n = 551, 30%). Other causes of work-related injuries were machinery-related injuries (n = 296, 16%), struck by/against injuries (n = 239, 13%), and motor vehicle traffic injuries (n = 224, 12%). Approximately 66% of the work-related trauma cases were between the ages of 25 years and 54 years, 89% were white, 90% were male, and the majority were not Hispanic or Latino (70%) (data not shown).

The "industry" field variable within the trauma registry data set was very complete and useful in identifying the industry where the work-related injuries occurred and was well

TABLE 2. Characteristics of Kentucky Work-Related Trauma Registry Cases, 2008 to 2012

Characteristic	Frequency	Percentage
Trauma center level		
Level I	1,576	86
Levels II–IV	251	14
Interfacility transfer		
Yes	648	35
No	1,179	65
ISS		
>Mild	664	36
Mild	1,108	61
Missing	55	3
GCS score		
Coma/severe brain injury	121	7
Moderate/minor	1,515	83
Not recorded	191	10
Cause of injury		
Falls	551	30
Machinery	296	16
Struck by/against	239	13
Motor vehicle traffic	224	12
Fire/burn	116	6
Cut/pierce	94	5
Other transportation	86	5
Natural/environmental	31	2
Fire arm	26	1
All other	154	8
Missing	10	<1

TABLE 3. Kentucky Work-Related Trauma Registry Cases by Industry and Occupation, 2008 to 2012

	Frequency	Percentage
Industry		
Other services	618	34
Construction	216	12
Manufacturing	108	6
Agriculture, forestry, and fishing	86	5
Transportation and public utilities	72	4
Retail trade	52	3
Natural resources and mining	42	2
Professional and business services	41	2
Government	38	2
Education and health services	22	1
Other	9	<1
Not applicable	354	19
Not known/not recorded	99	5
Missing	70	4
Occupation		
Production	85	5
Construction and extraction	61	3
Transportation and material moving	29	2
Farming, fishing, and forestry	21	1
Installation, maintenance, and repair	15	<1
Food preparation and serving	9	<1
Protective service	8	<1
Sales and related	6	<1
Building and grounds cleaning and maintenance	5	<1
Other	22	1
Not applicable	185	10
Not known/not recorded	994	54
Missing	387	21
Total	1,827	100

populated; there were only 4% missing records, and only 5% were recorded as not known/not recorded (Table 3). The "other services" industry sector was most frequently recorded (34%) as the employment industry of injured workers. Other employment industries of the injured workers were the construction industry (n = 216, 12%), manufacturing industry (n = 108, 6%), and the agriculture, forestry, and fishing industry (n = 86, 5%). In contrast, the "occupation" field variable within the state trauma registry was not useful in identifying the occupations of the injured workers. There was a high percentage of cases in the occupation variable recorded as not known/not recorded or missing (75%) compared with the industry variable (9%). Therefore, the recorded occupations of injured workers treated in Kentucky trauma centers are extreme underestimates and potentially misrepresentative of the occupational category analysis results. The production (n = 85) as well as construction and extraction (n = 61) occupations were recorded most frequently.

Drugs were detected in a relatively high percentage of the total work-related trauma cases (19% total) (Table 4). Prescription drugs were detected in 14% (n = 262) of the total work-related trauma cases; 5% of the total work-related cases detected the illegal use of prescription drugs or illicit drugs (n = 85). Almost one third of work-related trauma patients smoked (n = 523), and 10% had alcoholism diagnosed as a comorbid condition. Obesity was recorded in only 4% of the total cases and diabetes mellitus in only 7% of the total cases. Interestingly, no cases had drug abuse or dependence listed as a comorbid condition. Alcohol was detected in very few of the work-related trauma cases; only 15 cases involved the presence of alcohol beyond the legal limit (0.08% in Kentucky), and only 19 cases detected trace amounts of alcohol (data not shown). Twelve of the work-related trauma patients were pronounced dead in the ED during the study period (1%) (data not shown).

When the work-related trauma cases were cross-tabbed by drug screening and industry, the industries with the highest percentage of positive drug screens were the natural resources and mining (80% tested positive), construction (76% tested positive), and transportation and public utility (76% tested positive) industries (Table 5). The highest frequencies of positive drug screen results were in injured "other services" (n = 90) and construction (n = 60) workers. The highest percentages of workers screened for drugs by industry were in the transportation (46% were tested), "other services" (41% were tested), and construction (37% were tested) industries. Lowest percentages of screened injured workers were observed in the retail trade (only 17% were tested), manufacturing (only 21% were tested), and natural resources and mining (only 24% were tested) industries. The highest percentage of drug-screened injured workers that yielded "negative" results was in the "other services" industry (64% of those tested were negative).

The probability of injured workers being drug screened was *not* associated with the industry of the injured workers (Table 6) ($p = 0.20$), after controlling for ISS and trauma center level status in a multiple logistic regression model. The factors that were independently associated with drug screening of injured workers were being treated in a Level I trauma center ($p < 0.001$) and a GCS score indicating a coma or severe brain injury ($p < 0.001$). If the injured worker was treated in a Level I trauma center, that worker was 11.7 times more likely to be screened for drugs compared with injured workers treated in Level II to IV trauma centers. If the injured worker was in a severe coma or had a severe brain injury, that worker was three times more likely to be drug screened compared with those with a minor or moderate GCS score. There was an interaction between ISS and interfacility transfer. Moderate or severe injuries were more likely to be drug screened, regardless of medical facility transfer status, although the strength of the association was larger for interfacility transfer cases. The adjusted OR for being drug screened was 4.2 (95% CI, 2.9–6.2) for greater than mild injuries compared with mild injuries for interfacility transfer

TABLE 4. Kentucky Work-Related Trauma Cases by Drug Screening Results and Comorbid Conditions, 2008 to 2012

	Frequency	Percentage
Drug use		
No (not tested)	811	44
No (confirmed by test)	286	16
Yes (confirmed by test [prescription drug])	262	14
Yes (confirmed by test [illegal use drug])	85	5
Not applicable	133	7
Not documented	250	14
Comorbid conditions		
Current smoker	523	29
Alcoholism	188	10
Diabetes mellitus	132	7
Respiratory disease	75	4
Obesity	64	4
Drug abuse or dependence	0	

TABLE 5. Kentucky Work-Related Trauma Cases by Industry and Drug Screening Characteristics, 2008 to 2012

	Drug Screening Characteristics				
Industry	Yes (% of Those Tested)	No (Confirmed by Test) (% of Those Tested)	Number Tested (% of Total)	Not Tested (% of Total)	Total
Other services	90 (36)	163 (64)	253 (41)	365 (59)	618
Construction	60 (76)	19 (24)	79 (37)	137 (63)	216
Transportation and public utilities	25 (76)	8 (24)	33 (46)	39 (54)	72
Agriculture, forestry, and fishing	21 (70)	9 (30)	30 (35)	56 (65)	86
Manufacturing	17 (74)	6 (26)	23 (21)	85 (79)	108
Natural resources and mining	8 (80)	2 (20)	10 (24)	32 (76)	42
Retail trade	6 (67)	3 (33)	9 (17)	43 (83)	52
All other industries	8 (31)	18 (69)	26 (24)	83 (76)	109
NA	89 (72)	35 (28)	124 (35)	230 (65)	354
Missing	22 (49)	23 (51)	45 (26)	125 (74)	170
Total	346 (55)	286 (45)	632 (35)	1,195 (65)	1,827

TABLE 6. Logistic Regression for the Probability of Drug Screening Among Injured Workers in the Kentucky Trauma Registry, 2008 to 2012

Variable	OR (95% CI)	*p*
Industry		0.20
All other industries	0.83 (0.41–1.70)	
Natural resources and mining	1.22 (0.46–3.27)	
Other services	1.48 (0.84–2.58)	
Retail trade	0.67 (0.26–1.69)	
Transportation and public utilities	1.72 (0.82–3.63)	
Agriculture, forestry, and fishing	1.51 (0.72–3.15)	
Construction	1.50 (0.81–2.76)	
Missing/not applicable	1.30 (0.74–2.30)	
Manufacturing	Reference	
Level I trauma center		<0.001
Yes	11.72 (6.03–22.79)	
No	Reference	
GCS score		<0.001
Coma/severe brain injury	2.78 (1.77–4.36)	
Moderate/minor	Reference	
Not recorded	0.27 (0.16–0.44)	
ISS		<0.001
Interfacility transfer		0.01
ISS × interfacility transfer		<0.05
>Mild ISS vs. mild ISS for cases that were not interfacility transfer	2.12 (1.62–2.78)	
>Mild ISS vs. mild ISS for interfacility transfers	4.23 (2.87–6.23)	

OR (95% CI), *p* value for probability to test for the presence of drugs.

cases; for noninterfacility transfer cases, the adjusted OR was 2.1 (95% CI, 1.6–2.8). The Hosmer-Lemeshow goodness-of-fit test had a *p* value of 0.20, showing acceptable fit.

DISCUSSION

The industry of the injured worker was not a predictor for being drug screened. The differences in the proportion of cases drug screened by industry group were due to a number of factors: (1) injury severity, (2) medical necessity of the drug screen in relation to follow-up treatment, (3) information available from the medical facility of initial treatment, and (4) variation in medical facility practices on drug screening. These findings agree with trauma treatment improvement protocol recommendations.[12] Most of the injured workers treated in trauma centers were used in the "other services" and construction industries. "Other services" includes such services as (1) repair and maintenance; (2) personal and laundry services; (3) religious, grantmaking, civic, professional, and similar organizations; and (4) private households (gardeners, etc.).[13]

Drugs were detected in 19% of all work-related trauma cases, primarily in the "other services" and construction industries; the high percentage is in agreement with reported illicit drug use by industry. Food preparation and serving as well as construction occupations are more likely to have elevated illicit drug use compared with low-risk occupations.[7] Moreover, the National Drug-Free Workplace Alliance estimates that construction laborers had 25.4% illicit drug use and food preparers had 27.6% illicit drug use in the past year.[14] The high positive drug screen percentage also coincides with a nationwide increase in drug overdose hospitalizations over approximately the same period.[15,16] In addition, there may be heightened awareness of drug abuse by health care providers through increased medical residency and postresidency training on substance abuse resulting in increased drug screening. There could also be an increase in trauma hospital training of practitioners and nurses on the drug use data element within the NTDS.[17] Lastly, patients may have received prescription drugs through emergency medical service administration or ED administration that could have been reflected in positive drug screen results.

Based on the elevated percentage of positive drug screen results, urine drug screens should be performed routinely on trauma activation patients who were injured at work. Routine urine drug screens of abuse are already recommended for trauma activation patients in trauma centers by the American College of Emergency Physicians and the American College of Surgeons but are at the discretion of individual hospitals.[18] Expansion of the Kentucky trauma system is in progress for the standardization of drug testing among trauma activation patients. This standardization will further improve the completeness of trauma data for the presence of drugs in injured individuals and in workers treated in trauma centers. Konstantinidis et al.[19] (2013) found that only 1.7% of patients were screened for drugs when the National Trauma Data Bank was analyzed. In our study, 35% (n = 632) of the total cases were screened for drugs; more than half of those drug screened resulted positive (55%).

Patients with positive drug screen results are referred to in-house counseling and may be referred to outside counseling and/or substance abuse treatment facilities. Screening, Brief Intervention, and Referral to Treatment (SBIRT) programs in Level I trauma units target those individuals who test positive for substance abuse (alcohol and/or illicit drugs [including illicit use of prescription drugs]). There is increasing evidence that SBIRT is also effective for illicit drug use.[20–23] Madras et al. (2009) recorded a 67.7% decrease in illicit drug use in patients with positive drug screen results 6 months after receiving the SBIRT intervention in a health care setting.

Limitations

One limitation of the current study is that a positive drug screen result in an injured worker treated in a trauma center may not necessarily mean that the worker was impaired by those drugs at the time of the injury event. A drug screen only detects the presence or absence of drugs, not actual drug levels. An injured worker could have had a therapeutic level of a drug(s) in his or her system that was detectable in the drug screen, and the worker may not have been impaired, as judged by medical standards. Differences exist in the definition of impairment between the medical and legal communities. Medical literature defines impairment as the loss or limitation of normal functioning.[24] Legal literature defines impairment as a person's diminished ability to "see, hear, walk, talk, and judge distances below the normal level as set by the state" (http://definitions.uslegal.com/i/impairment/). Although the medical community has used a cadre of signs and symptoms to indicate whether an individual is influenced by drugs or alcohol, there has been limited standardized medical evaluation of what constitutes drug and alcohol impairment. Another limitation is that a synthetic cannabinoid (a rapidly growing drug of use) drug screen was not included in the current study.

CONCLUSION

These findings indicate that there may be elevated drug use or abuse in natural resources and mining, transportation and public utilities, as well as construction industry workers. Future research should focus on (1) improved identification of the specific drug types in the positive drug screen results of injured workers to better target substance abuse prevention efforts; (2) surveillance data quality improvement of the "occupation" variable in the trauma database; and (3) a risk analysis based on industry.

AUTHORSHIP

T.L.B. performed the literature search, designed the study, interpreted study results, and wrote the manuscript. S.S. analyzed the data, interpreted study results, and reviewed the manuscript. A.C.B. advises the state trauma system and data collection and critically reviewed the manuscript.

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DISCLOSURE

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