

Using workplace safety and health data for injury prevention

The broad array of data available from the Bureau of Labor Statistics on occupational safety and health may make it difficult to hone in on the root causes of workplace injuries and the strategies for preventing those injuries. This article uses descriptive statistics and trend analysis to develop a framework for enabling such investigations. The focus is on five factors—sequence of events, frequency of incidents, severity of injury, interaction of circumstances, and contributing factors—that, if taken into account as part of data analysis, may help data users uncover both root causes and effective preventive strategies.

Much is known about workplace injuries—their frequency, the manner in which they occurred, the resulting physical effects, and more. But how can employers, policymakers, and others best use these data for training and prevention purposes? Is it enough to know that 41 percent of all fatal work injuries in 2011 were the result of transportation incidents? What does the fact that nearly one in three nonfatal workplace injuries requiring days away from work in 2011 was a musculoskeletal disorder reveal about preventing such incidents? Do workplace injuries affect different groups of workers in different ways? These are just a few questions that might need to be considered in an effort to get to the root causes of workplace injuries.

“Root cause” is an abstract concept and one that is not perfectly defined. There is much literature in the business world about identifying the root causes of workplace problems (not just safety issues) and attacking those causes.¹ The present discussion adopts a similar approach by identifying those factors that, if addressed through training and prevention techniques, can help reduce workplace injuries. Data from the Bureau of Labor Statistics (BLS) may hold some answers.

The BLS Occupational Safety and Health Statistics program consists of two sets of data: the Survey of Occupational Injuries and Illnesses (SOII) and the Census of Fatal Occupational Injuries (CFOI). The SOII provides estimates of the number and rate of nonfatal occupational injuries and illnesses by industry and state. It also captures additional detail on the workers involved in an incident and the incident’s circumstances for the most



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severe cases, including those that result in at least 1 day away from work, and, just recently, for a subset of cases resulting in job transfer or restricted work. The CFOI provides a complete count of fatal work injuries, with details about the workers and the incidents. Together, the SOII and the CFOI form a comprehensive U.S. workplace safety and health surveillance system.²

This article goes beyond descriptive statistics to explain some ways of using workplace safety and health data to identify the underlying causes of workplace injuries. The focus is on five approaches that may help illuminate the root cause of an injury:

- Examining the *sequence of events* to understand what really happened
- Considering the *frequency of incidents*
- Assessing the *severity of an injury*
- Looking at the *interaction of circumstances* surrounding an incident
- Identifying *contributing factors*

In 1992, BLS introduced the Occupational Injury and Illness Classification System (OIICS), a classification system used to describe all fatal injuries and the most severe nonfatal injuries and illnesses. Beginning with data for 2011, this system was revised to incorporate new types of diseases, provide consistency with other disease and injury classification systems, and alter certain coding with the express intention of improving information available for injury prevention.³ In describing the various factors underlying workplace injuries, this article identifies changes to the OIICS and the resulting change in data.

Sequence of events

When is a fall not a fall? Perhaps when a person is pushed. Likewise, when is an explosion not an explosion? Perhaps when it is caused by a forklift driven into a gas canister. Employee injuries, when taken at face value, may appear to be the result of one event, but, in reality, the underlying event may be different. Understanding this underlying event is important in allocating prevention resources. For fatal work injuries and the most severe nonfatal work injuries and illnesses, BLS identifies a number of characteristics of the case, including the manner in which the injury occurred (known as the “event or exposure” and typically referred to as “event”). Beginning with data for 2011, event coding has been based on an order of precedence designed to identify the underlying cause of an incident. In the first example above, the underlying cause of the fall (being pushed) is an act inflicted by another person; likewise, the underlying cause of the explosion in the second example is a transportation incident (forklift driven into a gas canister). Directing resources toward greater prevention of fall or explosion incidents, while no doubt important, might not directly lessen the likelihood of these events.

BLS identifies many events or exposures, grouped into seven broad categories in order of precedence (that is, the event that comes first on the list is considered the event of record). The order of precedence is as follows:

1. Violence and other injuries by persons or animals
2. Transportation incidents

3. Fires and explosions
4. Falls, slips, and trips
5. Exposure to harmful substances or environments
6. Contact with objects and equipment
7. Overexertion and bodily reaction

As a result of the now strict adherence to the order of precedence, some events are presently classified in categories that are different from those used in the past. For example, unintentional shootings, which in the past would be included in *contact with objects or equipment*, are now included in *violence and other injuries by persons or animals*. Table 1 identifies several case circumstances for two incidents in which the event could be classified into one of several categories. The order of precedence can be used as one means of identifying the root cause of each incident.

Table 1. Determining the sequence of events

Incident example 1		
Circumstances	Event or exposure categories ⁽¹⁾	Correct code
(1) Worker on 2nd-story roof (2) Worker argues with coworker (3) Coworker pushes worker backwards (4) Worker takes step back and trips on skylight railing (5) Worker falls to ground, fractures skull, and dies	<i>Violence and other injuries by persons or animals</i>	✓
	Transportation incidents	–
	Fires and explosions	–
	<i>Falls, slips, and trips</i>	–
	Exposure to harmful substances or environments	–
	<i>Contact with objects and equipment</i>	–
	Overexertion and bodily reaction	–
Incident example 2		
Circumstances	Event or exposure categories ⁽¹⁾	Correct code
(1) Worker driving forklift in warehouse (2) While turning sharply, one fork strikes a pressurized container filled with flammable gas (3) Container falls to ground and ignites, causing fire (4) Worker suffers third degree burns to lower leg	Violence and other injuries by persons or animals	–
	<i>Transportation incidents</i>	✓
	<i>Fires and explosions</i>	–
	Falls, slips, and trips	–
	Exposure to harmful substances or environments	–
	Contact with objects and equipment	–
	Overexertion and bodily reaction	–
Notes:		
(1) Possible event coding shown in italics.		

In describing the change in coding of events or exposures, BLS indicates that the category *violence and other injuries by persons or animals*

now includes more distinct coding of intentional acts, unintentional acts, and acts of unknown intent The share represented by this division is likely to increase [from previous coding] All injuries resulting from direct human contact are now explicitly included in this division, whether or not the injury could be defined as an assault. For example, an injury to a physical education teacher during a kickball game, to a police officer during a training exercise, to a professional football player during a game, and to a worker injured by a coworker during horseplay will

all be classified into *violence and other injuries by persons or animals*. In addition, the new division includes codes for unintentional shootings.⁴

Looking at data under the new coding system provides some evidence for a shift of nonfatal cases into the “violence” category.⁵ In 2010, under the old system, 18 percent of fatal work injuries and 4 percent of nonfatal work injuries and illnesses resulting in days away from work were classified as *assaults and violent acts*; in 2011, under the new system, 17 percent of fatal work injuries and 6 percent of nonfatal work injuries and illnesses were classified as *violence and other injuries by persons or animals*.

Frequency of incidents

Figure 1. BLS incidence rate calculator and comparison tool

Injuries, Illnesses, and Fatalities

Incidence Rate Calculator and Comparison Tool

STEP 1 - Enter the number of hours actually worked by all employees at your establishment in the given year

[\[where to find this number\]](#)

STEP 2 - Enter a value for at least one of the following data elements

Total number of non-fatal work-related injury and illness cases
 [\[where to find this number\]](#)

Number of cases involving days away from work
 [\[where to find this number\]](#)

Number of cases involving job transfer or restricted work activity only
 [\[where to find this number\]](#)

STEP 3 - Select Year and then Area, Supersector and Industry

Select a Year:

Select an Area:

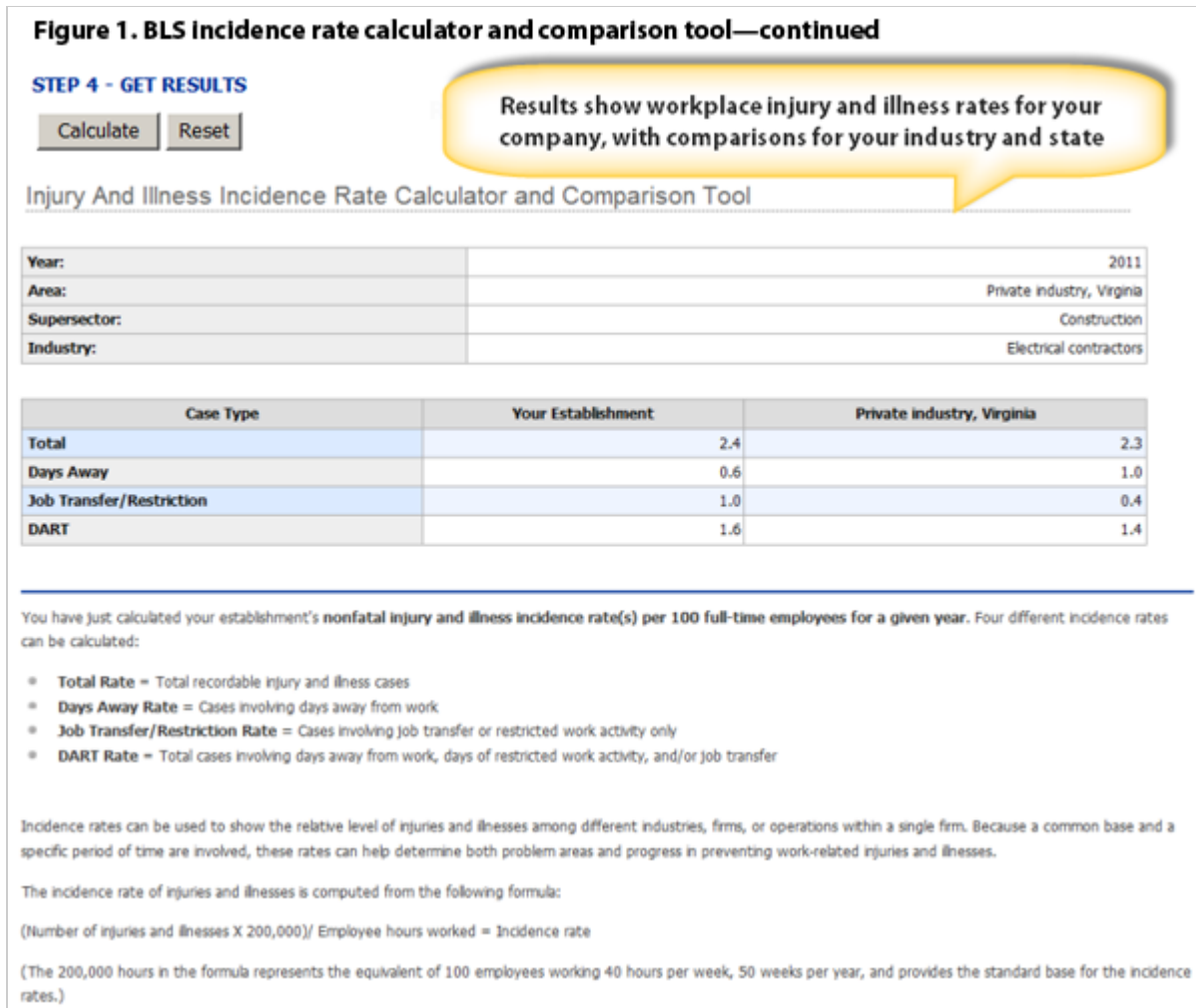
- Private industry, Virginia
- State and local government combined, Virginia
- State government, Virginia
- Local government, Virginia
- All ownerships, Virgin Islands
- Private industry, Virgin Islands
- State and local government combined, Virgin Islands
- State government, Virgin Islands

Select a Supersector:

- Construction
- Manufacturing
- Service providing
- Trade, transportation, and utilities
- Information
- Financial activities
- Professional and business services
- Education and health services

Select an Industry:

- 238140 Masonry contractors
- 238160 Roofing contractors
- 238200 Building equipment contractors
- 238210 Electrical contractors**
- 238220 Plumbing, heating, and air-conditioning contractors
- 238290 Other building equipment contractors
- 238300 Building finishing contractors
- 238310 Drywall and insulation contractors



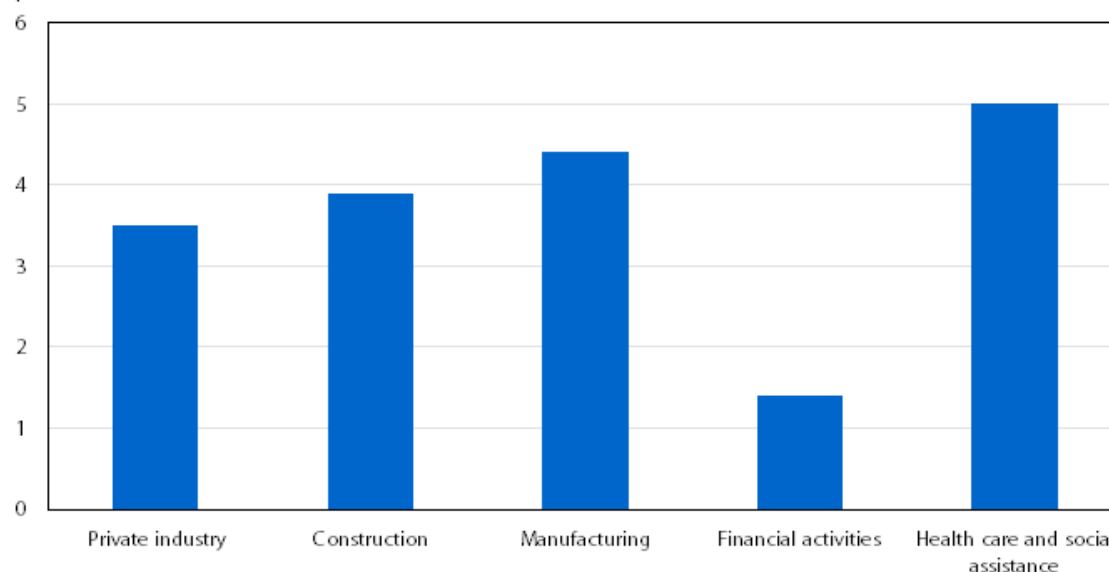
How often do workplace injuries and illnesses occur in your establishment? For many employers, the requirement to post an Occupational Safety and Health Administration (OSHA) injury and illness log each year provides one opportunity to assess worker safety issues. But that log may have little value unless it can be compared against such benchmarks as nationwide or industry totals or against data for a specific state. Such data are available on the BLS website and from many states that partner with BLS to capture and present these data. Further, a simple application on the BLS website allows anyone to compute an injury and illness rate and to view comparisons by industry and state. Figure 1 demonstrates the BLS [incidence rate calculator and comparison tool](#) and provides an example of available results.

Among all private industry employers, the rate of nonfatal workplace injuries and illnesses in 2011 was 3.5 per 100 full-time equivalent workers. Industry data show a wide variation in rates across employers, including a rate of 5.0 among health care and social assistance employers and a rate of 1.4 in establishments engaged in financial activities. (See figure 2.) Likewise, rates vary by state, often as a function of the industry mix within a state.

Although knowing an industry's overall injury and illness rate is important, understanding the frequency of particular events or the particular natures of injury (that is, the principal physical characteristics or symptoms of an injury or illness) may be equally useful in assessing prevention needs. A couple of examples will illustrate the available data and how these data can be used.

Figure 2. Rate of occupational injuries and illnesses for selected industry groups, private industry, 2011

Rate per 100 full-time equivalent workers



Source: U.S. Bureau of Labor Statistics.

An example of an event leading to both fatal and nonfatal work injuries is an incident in the category of falls, slips, and trips (henceforth referred to simply as falls). In 2011, BLS recorded 681 fatal falls and 300,000 nonfatal falls that required at least 1 day away from work. Before 2011, falls were classified on the basis of what the worker fell from and included falls from ladder, falls from roof, and falls from nonmoving vehicles. (Note that falls from moving vehicles are considered transportation incidents, not falls.) A separate coding of the “source” directly responsible for the injury would previously record what the worker hit when falling (most often the floor or ground). The 2011 revisions to the classification system changed this coding substantially. Event coding no longer indicates what the worker fell from; rather, it identifies the level of the fall (e.g., fall to lower level, fall on same level, or fall up stairs) as well as the height of the fall (e.g., less than 6 feet or greater than 30 feet). Further, coding of the source of injury now indicates what the worker fell from (e.g., a ladder or a scaffold) and any contributing factors, such as wind or ice. Table 2 identifies differences in coding of falls between 2010 and 2011.

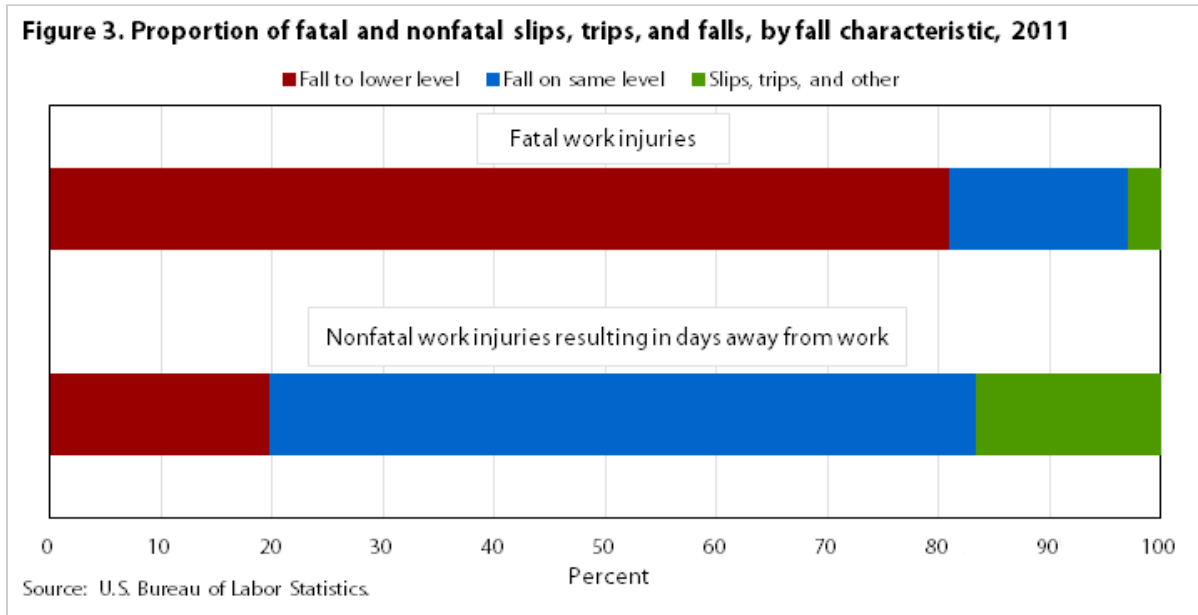
Table 2. Changes to coding of falls

Coding before 2011	Coding in 2011 and beyond
Event or exposure	
Fall on same level	Fall on same level
Fall to lower level	Fall to lower level
Down stairs	Details about height (fell from x feet)
From ladder	Fall from collapsing structure
From roof	Fall through surface
From scaffold	
Source of injury	
What caused the injury (e.g., floor or ground)	What the worker fell from (e.g., ladder, roof, or scaffold)
Secondary source of injury (contributing factor)	
Not coded	Ice, wind, or other factors

See footnotes at end of table.

Source: U.S. Bureau of Labor Statistics

The new coding identified previously unknown characteristics of falls. Consistent with past data, a greater proportion of fatal falls occurred from heights, while a greater proportion of nonfatal falls occurred on the same or a lower level. Further, among fatal falls from heights, 1 in 10 occurred from heights less than 6 feet, while another 2 in 10 occurred from heights greater than 30 feet. Figure 3 shows the proportion of fatal and nonfatal falls by fall level in 2011.



Another area in which frequency data might be useful in focusing prevention activities is the nature of injury. BLS identifies the nature of injury for both fatal and nonfatal cases. For fatal cases, the nature of injury often includes intracranial injuries, injuries to internal organs, or multiple traumatic injuries and disorders; for nonfatal cases, the nature of injury varies widely. Employers might want to compare the frequency of particular natures of nonfatal injuries—such as sprains, strains, and tears (which represent nearly 40 percent of all nonfatal cases) or cuts, lacerations, and punctures (which represent nearly 10 percent of all nonfatal cases)—to determine if their establishment has a disproportionate number of such occurrences. Because sprains, strains, and tears are such a large portion of nonfatal injuries, beginning in 2011, revisions to the coding of the nature of injury provide the following additional detail:

- Major tears of muscles, tendons, or ligaments, including Achilles tendon tears and torn rotator cuffs
- Sprains including minor or medium-grade tears and pulls to ligaments and joints
- Strains including minor or medium-grade tears and pulls to muscles and tendons

Table 3 provides details on these injuries among workers in private industry in 2011.

Table 3. Nonfatal occupational injuries and illnesses resulting in days away from work, by nature of injury, private industry, 2011

Nature of injury	Number	Percent of total	Typical parts of body affected
Total	908,310	100.0	—
Sprains, strains, and tears	340,870	37.5	—
Sprains	84,560	9.3	Ankle, knee
Strains	209,740	23.1	Back, shoulder
Major tears to muscles, tendons, or ligaments	17,150	1.9	Shoulder, knee
Multiple strains, sprains, and tears	7,130	.8	—
Sprains, strains, and tears, unspecified	22,290	2.5	—

Source: U.S. Bureau of Labor Statistics.

Severity of injury

Workplace injuries vary widely in severity; in fact, the least severe ones—those requiring only first aid or no treatment at all—are not recorded by employers on the OSHA logs and therefore not included in BLS statistics. For injuries that are identified by OSHA and tabulated by BLS, the continuum of severity can be described as follows:

- Medical treatment beyond first aid, with no time away from work or restricted activities
- Job transfer or restriction
- Days away from work
- Fatality, which may be further divided into immediate or delayed, often resulting from complications

Differences in BLS data on fatal and nonfatal injuries, along with differences in data collection methods and scopes of employment, make it difficult to combine the data. The sheer magnitude of these incidents (about 4,700 fatal work injuries and about 3.8 million nonfatal work injuries and illnesses in 2011) is such that the fatalities are dwarfed by the nonfatal cases. In fact, the rate of nonfatal work injuries (3.8 per 100 full-time workers) is nearly 1,000 times greater than the rate of fatal work injuries. Despite these differences, using data on fatal and nonfatal injuries together allows a first look at a potential continuum of severity. Table 4 provides estimates of the share of security guard injuries by severity for 2009.⁶ (Note that less than one-half of 1 percent of cases results in a fatality.)

Table 4. Share of security guard injuries, by severity, 2009

Severity	Percent of total cases
Medical treatment beyond first aid	47.5
1 or more days of job transfer or restriction	12.4
1 day away from work	5.0
2 days away from work	5.4
3–5 days away from work	8.0
6–10 days away from work	4.6
11–20 days away from work	4.7

See footnotes at end of table.

Table 4. Share of security guard injuries, by severity, 2009

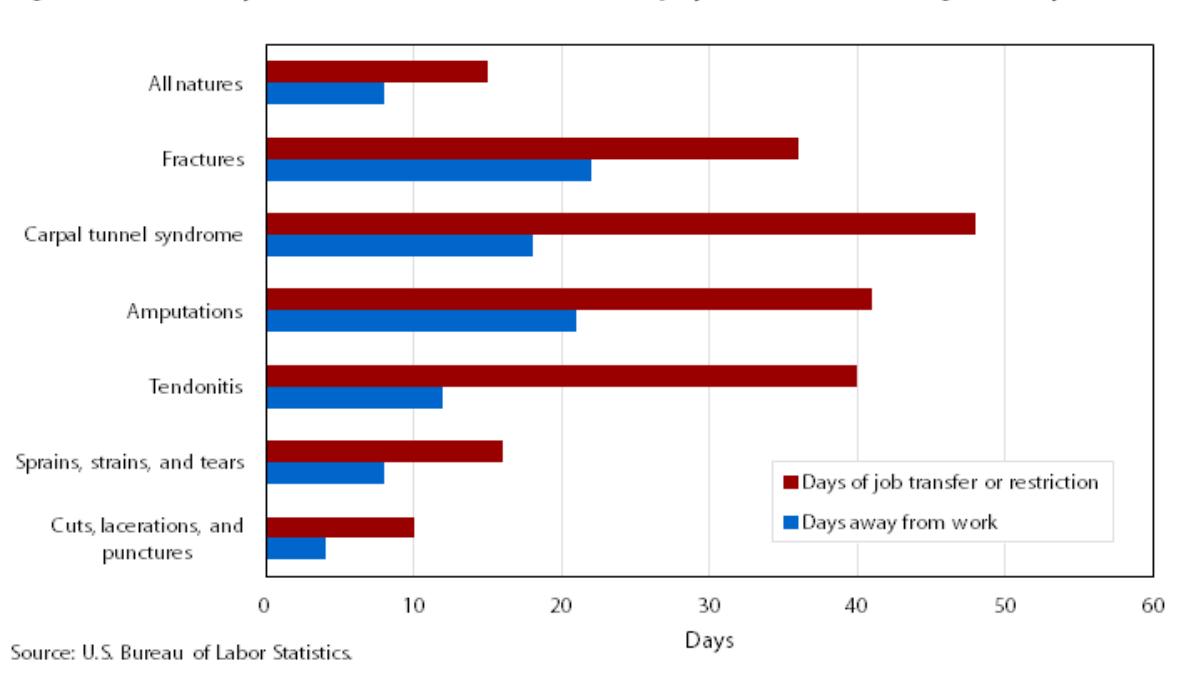
Severity	Percent of total cases
21–30 days away from work	2.5
31 or more days away from work	9.9
Fatality occurring 1 or more days later	.1
Fatality occurring immediately	.2

Note: Data on medical treatment and days of job transfer or restriction represent workers in the guard services industry; other data represent workers in the security guard occupation. Calculations assume that the proportion of cases by severity is the same for workers in the guard services industry and the security guard occupation.

Source: U.S. Bureau of Labor Statistics.

Data are not yet available to present this type of continuum of severity for many characteristics, such as worker age. Currently, such details are only available for fatalities and nonfatal cases that result in days away from work. (Some examples of these details by worker age are discussed below.) However, BLS is in the process of expanding the available data for another large component of nonfatal cases—worker injuries or illnesses that result in job transfer or restriction. These new data, currently available for only a limited number of industries, provide added information on recovery time, although one could debate whether more days of job transfer or restricted work indicate a higher or lower injury severity than do fewer days away from work. (See figure 4 for an example focusing on the food manufacturing industry.) The two sets of data simply add to the amount of detail available for prevention, and BLS hopes to expand upon these data in the future.

Figure 4. Median days to recover, selected natures of injury, food manufacturing industry, 2011



For cases with days away from work, details include a distribution by range of days, which can illustrate which events, natures, or other characteristics are most severe in terms of recovery time. Further, data are available on the median days away from work by worker characteristic, providing a benchmark for comparison. These data can be used in tandem to identify particular characteristics of incidents where the median days may not be alarming,

but where a large proportion of cases have long durations. For example, in 2011, two occupations—sales managers and hand grinding and polishing workers—each had the same median days away from work—8 days; however, only 11 percent of sales managers were away from work for 30 days or more, compared with 30 percent of grinders.

The severity of nonfatal injuries varies with the nature of injury. Among all cases in private industry in 2011, there was a median of 8 days away from work. Fractures had a median of 29 days, while cuts and lacerations had a median of 4 days. For events, falls on the same level had a median of 10 days, while falls to a lower level had a median of 21 days. This type of data may help direct resources toward those cases that lead to greater time away from work. Below are some examples of variations in the severity of falls for workers in private industry in 2011:

- All falls—median of 12 days away from work
- Falls on same level—median of 10 days away from work
- Falls to lower level—median of 21 days away from work
- Falls resulting in sprain or strain—median of 10 days away from work
- Falls resulting in fracture—median of 36 days away from work

Interaction of circumstances

The revised injury and illness classification system provides new insight into the circumstances surrounding a work injury event. As previously noted, information on the event and the source of injury for workplace falls now offers insight into what the worker fell from, the distance of the fall, and any contributing factors, such as weather. An expanded use of “secondary source” codes adds to the information available on the interaction of circumstances leading to an injury. The codes available for both source and secondary source are the same; several hundred possible codes fall into the following categories:

- Chemicals and chemical products
- Containers, furniture, and fixtures
- Machinery
- Parts and materials
- Persons, plants, animals, and minerals
- Structures and surfaces
- Tools, instruments, and equipment
- Vehicles
- Other sources

There are several areas in which the expanded use of secondary source coding provides more detail about the interaction of circumstances. For example, when an injury or fatality is the result of violence, the source is the person or animal responsible for the injury or illness and the secondary source is the injury-producing weapon,

object, or substance. Before this coding change, the source associated with an employee murdered by a coworker would differ based on how the murder occurred. If the decedent were manually strangled, the source would be the coworker. If the decedent were shot, the source would be the bullet and the secondary source would be the coworker. Under the new system, in both instances the source would be the coworker and any weapon would be coded as the secondary source.⁷

Data from 2011 show the results of this coding change. In the 468 work-related homicides identified for that year, robbers were identified as assailants about one-third of the time, relatives or partners 8 percent of the time, and coworkers 10 percent of the time. These data can be further broken out to reveal that the most prevalent assailants in female homicides were relatives or partners, whereas robbers were the most prevalent assailants in male homicides.

In another example of the interaction of case circumstances, combining the nature of injury with the event or exposure leading to the injury yields information on musculoskeletal disorders (MSDs), commonly referred to as ergonomic injuries. MSDs accounted for one-third of all days-away-from-work cases in 2011. In the food manufacturing industry, for example, new details for cases requiring job transfer or restricted work reveal that MSDs accounted for 47 percent of all cases. By knowing the specific events that led to MSDs—events such as overexertion; bodily reaction; repetitive motion involving microtasks; or rubbed, abraded, or jarred by vibration—employers, worker representatives, and safety professionals can enhance their ability to identify changes in work practices that can limit these types of injuries.

Contributing factors

BLS captures a considerable amount of detail about both fatal and nonfatal workplace injuries, sufficient to identify certain patterns in the data. For example, factors such as age, time of day, hours on the shift, or unusual weather conditions (e.g., ice or wind) can be cross tabulated with particular injury events to identify patterns. The example in table 5 shows how the results of a fall, and the time required to recover from a nonfatal fall, can vary considerably with age.

Table 5. Variation of fall characteristics by worker age, 2011

Fatal work injuries		
Fall characteristic	All workers	Selected age groups
Fatal falls	681—15 percent of all fatal work injuries	70 percent of all fatal falls occurred among those age 45 and older
Fatal falls on same level	111—2 percent of all fatal work injuries	91 percent of all fatal falls on same level occurred among those age 45 and older
Nonfatal work injuries and illnesses resulting in days away from work		
Fall characteristic	All workers	Selected age groups
Rate of falls	26.1 per 10,000 full-time workers	Among those age 65 and older, 43.0 per 10,000 full-time workers
Nature of injury resulting from fall	Twice as many sprains as fractures	Among those age 65 and older, one-third more fractures than sprains
Median days away from work due to falls	12 days	Among those age 65 and older, 16 days

Source: U.S. Bureau of Labor Statistics.

It is important to remember that, although rich in detail, BLS data can go only so far in identifying training and prevention techniques. It is unknown what other factors—for example, adequacy of training, language barriers, or availability and proper use of protective equipment—might contribute to workplace injuries.

Putting it all together

The available data on occupational safety and health can be overwhelming, and looking at individual aspects of the data independently may not be sufficient to identify root causes and prevention strategies. The factors considered here—sequence of events, frequency of incidents, severity of injury, interaction of circumstances, and contribution factors—are just a starting point toward enabling such investigations.

BLS is going further to provide useful data to meet prevention needs. First, the initial use of the revised injury and illness classification system has provided good insights into coding ambiguities and consistency issues. BLS has refined some definitions to help alleviate those ambiguities and is experimenting with a variety of computer-assisted coding techniques to help improve data consistency. Second, BLS is continuing its test collection of details of nonfatal cases that result in job transfer or restricted work, with a goal of expanding those data to cover all industries. Third, BLS has recently released new data on fatally injured contractors. Here again, knowing not only the industry in which the fatally injured worker was employed (e.g., the temporary help supply industry) but also the worker's contracting employer can provide further insight into the root cause of an incident (in this case, the location where the incident occurred).

BLS also maintains a robust research agenda in an effort to ensure that data on nonfatal injuries and illnesses are complete. Among the areas of exploration are (1) comparisons of SOII data with other sources of worker injury data, (2) interviews with employers to gain a greater understanding of obstacles to complete coding as well as training needs, (3) computer-assisted coding schemes designed to build consistency and identify outliers for further examination, and (4) potential recontact of employers to identify the frequency and nature of changes to work injury records that may be made after initial BLS data collection. This work is designed to improve data quality and consistency of BLS occupational safety and health data and to serve the needs of stakeholders looking to identify root causes of injuries and approaches to prevention.

SUGGESTED CITATION

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NOTES

¹ Root cause analysis attempts to identify and correct the underlying reason for a problem, rather than simply the obvious symptoms. The following link is to one of many available commercial resources that provide more information on root cause analysis: <http://rootcauseanalysisbasics.com/>.

² For complete information on, and data from, the BLS Occupational Safety and Health Statistics program, go to www.bls.gov/iif.

³ The OIICS is available at <https://www.bls.gov/iif/oshoiics.htm>. For information on the recent changes to the OIICS, see Joyce M. Northwood, Eric F. Sygnatur, and Janice A. Windau, "Updated BLS Occupational Injury and Illness Classification System," *Monthly Labor Review*, August 2012, pp. 19–28, <https://www.bls.gov/opub/mlr/2012/08/art3full.pdf>.

⁴ Northwood, Sygnatur, and Windau, "Updated BLS Occupational Injury and Illness Classification System."

[5](#) Data users should be cautious about placing too much emphasis on differences between 2010 and 2011 data. Because the definitions used before and after the transition to the new classification system are different, it is not possible to compute variance data to validate those differences. When data over several years are available, looking at them may help establish trends that result from the new classification system.

[6](#) The information on the outcomes of workplace injuries, illnesses, and fatalities comes from different sources that do not have consistent scope or detail. The data on workers who receive medical treatment and days of job transfer or restriction represent workers in the guard services industry; other data represent workers in the security guard occupation. Calculations assume that the proportion of cases by severity is the same for workers in the guard services industry and the security guard occupation. Additional details about the development of the continuum of severity and its limitations are available in William J. Wiatrowski, “On guard against workplace hazards,” *Monthly Labor Review*, February 2012, pp. 3–11, <https://www.bls.gov/opub/mlr/2012/02/art1full.pdf>.

[7](#) Many of the examples of usage of OIICS codes are taken from Northwood, Sygnatur, and Windau, “Updated BLS Occupational Injury and Illness Classification System.”

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