Emergency Department Visits for Work-Related Injuries and Illnesses in Massachusetts, 2001-2002

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Executive Summary

Beginning in October 2001, Massachusetts acute care hospital emergency departments (EDs) have been required to send summary electronic claims data about emergency department visits to the state Division of Health Care Finance and Policy. This study tests the use of these data for occupational health surveillance purposes. Data for a one-year period from October 1, 2001 through September 30, 2002 were analyzed to describe the extent and nature of ED visits made for treatment of work-related injuries and illnesses. Expected payment by workers' compensation insurance was used as an indicator of the work-relatedness of the patient's condition.

Some of the major findings of the study include:

- **There were 93,082 ED visits for treatment of work-related conditions in Massachusetts from October 1, 2001 through September 30, 2002.** These work-related ED visits accounted for 4.3 percent of all ED visits (2,202,357) during the study period, and 6.1 percent of ED visits (1,529,931) by persons of working age (16-64 years of age).

- **There were about 3 work-related ED visits annually per 100 workers in the state.** Based on comparison with estimates from other occupational health data sources, about 35% of work-related conditions were initially treated in EDs during the study period .

- **Almost three-fourths (71%) of visits for work-related conditions were made by male patients.** The rate of work-related ED visits for males (3.9 ED visits per 100 workers) was over twice the rate for females (1.7 ED visits per 100 workers.)

- **Rates of work-related ED visits were highest for workers under age 25 and declined with age**. This trend was especially evident among males, with male workers age 20-24 having the highest work-related ED visit rate (6.5 ED visits per 100 workers), about five times the rate for male workers over age 64. The mean age of all patients treated in EDs for work-related conditions was 36.4 years.

- **About 15% of patients making work-related ED visits were Black or Hispanic, exceeding the proportion of those minority groups in the state's work force (9%).** Patients making ED visits for work-related conditions were most likely to be White, male, and between 25-44 years old.

- **The vast majority (78.1%) of the work-related conditions treated in EDs were injuries and poisonings, followed by diseases of the musculoskeletal system (7.7%)**. The three most common types of work-related injuries were strains and

sprains (22.5%), open wounds of the extremities (19.8%), and superficial contusions (17.2%).

- **Hospital ED charges for treatment of work-related conditions exceeded $45 million, with an average charge of $481 per visit.** About four-fifths of the charges (81.4%) were for work-related injuries and poisonings,

- **Leading causes of work-related injuries and poisonings treated in EDs included being cut with a sharp object (21.0%), overexertion (19.1%), being struck by an object (16.6%), and falls (15.2%).**

- **Almost 15% of all ED visits for injuries and poisonings for patients aged 16 to 64 years of age old involved work-related conditions**.

- **Over half (54%) of all machinery-related injuries and 43% of all crushing injuries treated in EDs were related to work.**

- **There were 2,286 ED visits made for treatment of work-related burns.** Although most work-related burn victims were male, the majority of work-related burn injuries among workers under 20 years old involved females.

- **There were nearly 1,300 ED visits for work-related injuries and poisonings by teenagers 14-17 years of age.** Close to half of these ED visits by teens (47.3%) were for open wounds. Burns accounted for 11.2% of work-related ED visits for injuries and poisonings by teens whereas they accounted for only 3.1% of work-related ED visits for injuries and poisonings by workers of all ages

- **The types of work-related injuries and poisonings treated in ED's varied by race and ethnicity.** Black workers had a proportionately greater number of ED visits for work-related strains and sprains compared to other racial and ethnic groups, and a smaller proportion of open wounds and burns. Asian workers had a proportionately greater number of ED visits for burns and open wounds compared to other racial and ethnic groups.

- **Approximately 14.2% of all work-related ED visits were repeat visits by the same patient.** Repeat visits are those made by the same patient for subsequent repeat treatment of a particular work-related condition. Of the 91,158 work-related ED visits included in this repeat visit analysis, 76,666 distinct patients were estimated to have made ED visits for 78,239 newly incident injuries and illnesses during the one-year study period.

A number of data limitations should be considered in interpreting these study findings. The use of payment by Workers' Compensation as an indicator of work-relatedness likely underestimates the true extent of ED visits for work-related conditions. Some individuals injured or made ill at work, including the self-employed who comprise approximately 6% of the Massachusetts workforce, may not be not eligible for workers'

compensation. Others who are eligible may not file workers' compensation claims. Also, while external cause of injury codes (E-codes) are generally accurate for broad cause of injury categories, they may be less accurate for the detailed causes of injury presented in this report for burn injuries.

This exploratory study has demonstrated the potential usefulness of ED data as a supplement to other sources of information for occupational health surveillance in Massachusetts, particularly traumatic occupational injury surveillance. The ED data are readily available and contain information that has permitted us to characterize the occurrence, nature, and causes of work-related conditions in a way that complements what can be discerned from workers' compensation claims or estimates produced by the Bureau of Labor Statistics based on occupational illness and injury records maintained by employers. An important advantage of ED data for occupational health surveillance, compared to other available data sources, is that it captures information about all injuries, work-related and non-work-related. It therefore allows an assessment of the contribution of work-related injuries to the overall injury burden, fostering integrated approaches to prevention that cross public health disciplines (e.g. injury control and occupational health). While it is likely that not all ED visits for work-related conditions are identified using payment by workers' compensation as an indicator of work-relatedness, the outcomes of this study are sufficient to warrant periodic use of ED data as a supplement to other occupational health surveillance activities.

Possible strategies for further enhancing the usefulness of ED data for occupational health surveillance include: universal recording and collection of information about the work-relatedness of patient's condition in the electronic database; entering information about the patient's activity at the time of injury; possible inclusion of a dedicated E-code field to capture location where injury took place; ensuring accurate "E-code" information about the external cause of injuries; expanding the collection and reporting of information about the patient's employer; and linking the ED data with workers' compensation claims data from the Massachusetts Department of Industrial Accidents

Introduction

According to the National Center for Health Statistics (NCHS), an estimated 110.2 million visits were made to hospital emergency departments (ED) nationally in 2002.[1] Over a third of those visits (35.6%) were for treatment of injuries, and most of the injuries (62.3%) involved working-aged patients, 18-64 years old. The NCHS estimated that 3.03 million of the ED visits made nationally in 2002 were for treatment of work-related injuries, accounting for 7.7% of all injury ED visits, and 12.0% of the ED visits for injuries among working-aged adults.

The NCHS findings correspond relatively closely to estimates made by the National Institute for Occupational Safety and Health (NIOSH) using data from the National Electronic Injury Surveillance System (NEISS). A NIOSH study estimated that 3.6 million occupational disorders (about 90-95% of which were injuries) were treated nationally in EDs in 1998, approximately 3.6% of all ED visits and 9.0% of injury-related visits (among all age groups).[2] According to NIOSH, the overall annual rate of ED visits among workers (more than 15 years old) was 2.9 per 100 full-time workers, with males having a much higher rate than females (3.4 compared to. 2.1 ED visits per 100 workers). ED treatment rates were highest for younger workers (aged 15-24) and rates decreased steadily with increasing age. Using data from the 1988 Occupational Health Supplement of the National Health Interview Survey, NIOSH has estimated that about 34% of occupational injuries are treated in an ED.[3]

ED data have rarely been used on a state-specific basis for occupational health surveillance purposes. A 1997 study from West Virginia estimated that 12.5% of injuries treated in hospital EDs in that state were work-related.[4] In a 1993 study, researchers from the Massachusetts Department of Public Health (MDPH) used ED records to estimate that work-related injury accounted for 7-13% of all injury-related ED visits involving youths aged 14-17 years old.[5]

Since 2001, all acute care non-federal EDs have been required to submit data on ED visits annually to the Massachusetts Division of Health Care Finance and Policy (DHCFP), as mandated by State Regulation 114.1 CMR 17:00, “Requirement for Submission of Hospital Case Mix and Charge Data.” DHCFP compiles the data into the ED visit data base. This data base has a number of potential advantages for occupational health surveillance including: a) extensive information on patient characteristics, diagnoses, patient co-morbidities, medical services provided, and hospital charges are reliably collected, b) E-codes that provide information about the external cause of injuries are available in the electronic records, c) systems for collection of hospital emergency department data by state agencies are already in place, d) large numbers of records are available from which to derive statistically significant findings, and e) incremental cost of conducting surveillance studies using the available ED data is low.

The aim of this study is to conduct an exploratory examination of emergency department data to assess the usefulness of ED data in describing the distribution and nature of ED visits for work-related injuries and illnesses. The study provides an initial set of descriptive statistics summarizing ED visits for work-related injuries and illnesses Demographic characteristics of patient seeking ED care for work-related conditions are described and patterns of diagnoses, causes of injury, and hospital charges are identified. When appropriate, patterns of ED visits for work-related conditions are compared to visits for non-occupational conditions. The study looks more specifically at ED visits for work-related injuries and poisoning, including a focus on burns, and at work-related ED visits by teenage youths ages 14-17. Suggestions are made for expanding and enhancing the use of ED data for occupational health surveillance in Massachusetts

In addition, this report contains a summary of cases involving multiple ED visits by an individual for treatment of a condition. Understanding such "repeat visits" is important for distinguishing new incident cases from visits for follow-up treatment of an existing condition. Distinguishing repeat from initial visits can provide a better estimate of the incidence of particular conditions within the working population. This is important if ED records are to be used for surveillance purposes. Also, repeated usage of the ED for treatment of work-related conditions can provide a better understanding of the utilization of medical services by injured workers and potential problems in accessing conventional care under workers' compensation.

Methods

Data Source

In Massachusetts, records from emergency departments are collected by the Massachusetts Division of Health Care Finance and Policy (DHCFP) as mandated by State Regulation 114.1 CMR 17:00, "Requirement for Submission of Hospital Case Mix and Charge Data." [6] All acute care, non-federal, emergency departments are mandated under this regulation to submit data annually, thus these data can provide a comprehensive population-based picture of ED visits within the state. For the purposes of state ED data reporting, an "emergency department" is considered to be a department of a licensed hospital that provides emergency services, or a health care facility off the premises of a hospital that is listed on the license of the hospital and qualifies as a Satellite Emergency Facility that provides emergency services. An ED visit is defined as any visit by a patient to an emergency department for which the patient registered at the ED, but which did not result in either an outpatient observation stay nor an inpatient admission to the hospital. ED data have been collected by DHCFP since October 1, 2001.

This report employed data on ED visits as reported by all 77 of Massachusetts's EDs for the period October 1, 2001 through September 30, 2002. This represents the first full year of statewide ED data collection by the DHCFP. The ED database contained 2,327,536 records covering all ED visits during the study period. This study was restricted to ED visits involving Massachusetts' residents, which accounted for 2,202,357 of the visits (94.6%).

Electronic ED data records collected by the DHCFP contain patient information *including encrypted social security number, gender, date of birth, age, race/ethnicity, zip* code of residence, and medical chart number; administrative information including hospital charges, expected source of payment, registration date at the ED, and time of registration; and clinical information including primary and up to five secondary diagnoses coded according to the *International Classification of Disease 9th edition, Clinical Modification* (ICD-9-CM)[7], primary and up to three secondary procedures coded with ICD-9-CM or *Current Procedural Terminology* (CPT) codes, and primary external injury cause coded according to the E-code system in ICD-9-CM. Primary diagnoses in the electronic data were classified according to the *Clinical Classifications Software* (CCS) coding system. The CCS classification system, developed by the U.S. Agency for Healthcare Research and Quality, groups ICD-9-CM codes into 259 mutually exclusive diagnostic categories and 231 mutually exclusive procedure categories.[8] Analyses in this study employed individual ICD-9-CM codes, ICD major diagnostic categories, and the CCS diagnostic coding system.

Work Relatedness of Patients' Conditions

The data collected and reported by EDs do not include a direct indication of whether the patient's condition is work-related. An indirect indicator of work-relatedness is expected primary payment by workers' compensation insurance, which has been found to be a relatively accurate and reliable indicator for work-related conditions in other studies.[9] Hospital administrative staff is responsible for determining the expected primary payer, based on information supplied by the patient and the treating clinicians. In this study, the specification of workers' compensation as expected primary payer was used as an indicator that the patient's condition was likely to be work-related. ED services expected to be paid by other sources—including Medicaid, Medicare, and private insurance—were assumed to be for treatment of non-work related conditions.

Analytical Approach

Descriptive statistics were generated to characterize the extent, distribution, and nature of ED visits for work-related conditions. Selected classification variables include patients' age, sex, race, and ethnicity; diagnoses, and hospital charges. In some instances, comparisons to ED visits for non-work-related conditions were also carried out. Work-related ED visit rates were calculated and expressed as the number of ED visits for work-related conditions per 100 Massachusetts workers. Labor force estimates used to calculate rates were obtained from the Geographic profile of employment and unemployment, Bureau of Labor Statistics, US Department of Labor[10]. These labor force estimates included the self-employed who are typically are not covered by workers' compensation. Self-employed workers comprised approximately 6.4% of the Massachusetts workforce in 2000.

Subgroup analyses are presented for ED visits involving work-related injuries and poisonings (ICD-9-CM codes N800-999) and work-related ED visits by teens 14-17 years old. In addition, a subgroup analysis is provided describing multiple ED visits made by patients for the same condition within a specific period of time (repeat visits) to the same or a different hospital.

Some of the key concepts and terms used in this report are:

Diagnosis

Every ED visit record contains a principal diagnosis and up to 5 associated diagnoses. Only the patient's principal diagnosis was used for the analyses in this report. The primary diagnosis is assumed to be tied to the designated expected payer, which is used to determine the work-relatedness of the ED visit. While the associated diagnoses may frequently be related to the primary diagnosis, there may be cases in which it is not. Identifying these unrelated associated diagnoses as work-related conditions could overestimate the occurrence of work-related illnesses and injuries. Using only the primary diagnosis in this analysis provides a conservative estimate of the extent of work-related illness and injury.

Working age

The report compares several characteristics of ED visits for work-related conditions to ED visits for non-work related conditions. For the purposes of these comparisons, the visits for non-work related conditions were restricted to a comparable population of patients that were of typical working age, 16-64 years old.

Injuries and poisonings

Injuries and poisonings cases involved patients with primary diagnosis in the ICD-9-CM "injury and poisoning" category that encompasses ICD-9-CM codes N800-999. For cases involving injuries and poisonings, the nature of the injury and the body part involved were classified according to the Barell Injury Diagnosis Matrix which is based on the ICD-9-CM coding system. A description of the Barell Injury Diagnosis Matrix is available at: http://www.cdc.gov/nchs/about/otheract/ice/barellsas.htm.

External cause of injury

Massachusetts hospitals are required to submit a cause of injury code (E-code) for every ED visit record where the principal diagnosis code is an injury or poisoning (ICD-9-CM codes N800-999). E-codes provide information on the cause and intent of the injuries diagnosed during the visit. E-codes were provided by hospitals for nearly all the injury and poisoning cases in this data set (99.7%). These E-codes were grouped into broader cause of injury categories according to the International Collaborative Efforts on injury statistics (ICE) . Information on ICE and E-codes is available at:

http://www.cdc.gov/nchs/about/otheract/ice/matrix.htm.

Possible Work-Related Conditions

To identify ED visits for conditions possibly related to work but not designated as paid for by workers' compensation, we also examined all ED visits irrespective of payer, with select primary diagnoses. These included select respiratory conditions, carpal tunnel syndrome, needle stick injuries and exposures to hazardous body fluids, and "observations following a work accident" (V-71.3). In addition, conditions arising out of contact with substances know to be commonly found in working environments. These diagnoses included ICD9-CM codes 980-989 (toxic effects resulting from chemical exposures – excluding intentional poisonings.)

Repeat visits

The ED data contained an encrypted social security number (ESSN) that serves as a unique patient identifier. Encryption of the social security number occurs at the state level, thereby enabling identification of individuals across all EDs. The ESSN and the date of birth were used simultaneously as a way of identifying distinct individuals for

analysis of repeat ED visits by an individual for treatment of a particular condition. Children may occasionally be recorded in the database with a parent's ESSN. Using date of birth with the ESSN helps to distinguish these cases. ESSN was missing for 3,375 cases (3.6% of all work-related cases) and were excluded from the analysis of repeat ED visits. This resulted in 91,158 cases being used for analysis of repeat ED visits. If two different ED visit records had the same encrypted social security number and patient's date of birth, then both visits were presumed to have been made by the same individual.

We attempted to determine the reason for subsequent visits by the same individual within the one-year time period covered by the study (10/1/02-9/30/02); and specifically, whether the subsequent visit was for treatment of the same condition as the first visit or was for a different condition.

The CCS diagnostic coding system was used to determine whether the first and subsequent visits had the same diagnosis. CCS codes were used because they were broad enough to encompass closely related ICD9 codes, while being specific enough to distinguish between clearly unrelated diagnostic conditions. A visit was considered to be a repeat visit for treatment of the same injury if the first visit had the same CCS diagnostic code as the second visit and involved the same patient.

Limitations

Several limitations need to be considered when interpreting the information provided in this report. Indication of expected primary payment by workers compensation is not an exact representation of work-relatedness of cases for a variety of reasons: a) evidence suggests that a sizable proportion (most estimates range from 20 to 40%)[11] of work-related injuries and illnesses are not reported to workers' compensation insurers, b) hospital administrative staff may not have sufficient information upon which to make an accurate determination of expected payment by workers' compensation, c) determinations about payment by workers' compensation may change after discharge from the hospital because of insurance or legal exigencies, and d) self-employed workers (6.5% of all employed persons in Massachusetts in 2002)[12] usually do not have workers' compensation insurance. While studies suggest that both the sensitivity and specificity of workers' compensation payment as a marker for work-relatedness is reasonably strong, readers should realize that there will not be a perfect correspondence and that the ED record's indication of payment by workers' compensation likely underestimates the true extent of ED visits for occupational injuries and illnesses.

The accuracy of E-codes must be considered in interpreting cause of injury results. The accuracy of E-codes for hospitalized injuries may vary by hospital, type of injury, and primary and contributing injury causes. In a number of studies, E-codes have been found to be 50-85% accurate at the four-digit level[13]. A recent study completed by MDPH found E-codes assigned in emergency departments to be approximately 60% accurate at the detailed level, but much better (85% correct) when considered within the

broader external cause of injury categories used in this report. Thus, E-codes are a valid source of information on broadly defined causes of injury.

One of the advantages of ED data is that it contains information about the race and ethnicity of injured workers that is not readily available in other occupational health information sources. However the race and ethnicity data in the ED data base remains to be validated.

One of the notable shortcomings of ED data for occupational surveillance purposes is that ED records do not include information about the patient's employment circumstances such as current employment status, type of occupation or industry, or information about past hazard exposure. The absence of these data limits our ability to learn about the relationships between the patient's condition and employment characteristics that could be important from a prevention standpoint.

In this report, comparisons between ED visits for work-related conditions paid for by workers' compensation and non-work-related conditions paid for by sources other than workers' compensation were made on the basis of raw data, restricted by patients' age range as mentioned above. Comparisons did not control for the influence of other factors—such as gender, co-morbidities, and severity—which potentially could affect the comparisons between work-related cases and non-work-related cases. More extensive multivariate analysis would be needed to examine these issues in depth.

Results

Extent of Emergency Department Visits for Work-related Conditions

A total of 2,202,357 ED visits were made to Massachusetts EDs by Massachusetts residents from October 1, 2001 through September 30, 2002. Among them, 94,533 visits were paid for by workers' compensation, representing 4.3% of all ED visits. This proportion is about 10 times higher than the corresponding proportion of work-related inpatient hospitalizations among all inpatient stays during the same period (0.44%).[14] A total of 1,529,931 ED visits (69.5% of the total) involved patients of working age (16-64 years old), and 6.1% of those visits were for treatment of work-related conditions (Table 1).

Massachusetts employment data from the U.S. Bureau of Labor Statistics (BLS) for 2002 was used to compute an ED visit rate per 100 employed workers (Table 2)[15]. The annual work-related ED visit rate was 2.9 visits per 100 workers. BLS also provides estimates of total number of Occupational Safety and Health Administration (OSHA) reportable occupational injuries and illnesses in Massachusetts based on information provided by employers. The number of ED visits for work-related conditions (94,533) was 86.8% of the 108,900 total reportable occupational injuries and illnesses in Massachusetts in 2002 estimated by BLS[16] (87.4% of BLS estimated reportable occupational injuries and illnesses when adjusted for working age). This suggests that the BLS figure underestimates the true extent of work-related injuries and illnesses in the state. This inference is further supported by workers' compensation claims reporting to the Massachusetts Department of Industrial Accidents (DIA). There were approximately 56,000 5 day lost-time workers' compensation claims reported to the DIA in 2002, and lost-time claims are estimated to represent about 25% of all workers' compensation claims. This would indicate that the true annual incidence of work-related injuries and illnesses in Massachusetts is about 224,000. If so, then the ED visits would represent about 42.2% of all work-related injuries, which is more consistent with the estimate of 34% previously made by NIOSH in their study based on analysis of the 1988 Occupational Health Supplement of the NHIS.

Moreover, as will be covered later in this report, some of the 94,533 visits were likely not for treatment of newly incident injuries and illnesses, but rather were for follow-up visits of existing injuries or illnesses. Based on our analysis of repeat ED visits, we estimate that 78,239 of the work-related ED visits (82.8%) were for treatment of newly incident injuries and illnesses. Thus, assuming 224,000 total work-related injuries in the state, this would imply that 34.9% of new work-related injuries and illnesses receive initial treatment in an ED, closely corresponding to the previous NIOSH estimate from 1988 of 34%.

Table 3 summarizes the geographical distribution of the residences of patients seeking ED care for work-related conditions. Barnstable, Berkshire, Bristol, Duke,

Hampden, and Nantucket counties had relatively higher work-related ED visit rates than the state average ED visit rate, while Hampshire, Middlesex, Norfolk, and Suffolk counties had work-related ED visit rates which were relatively lower than the average.

Table 1. ED visits by workers' compensation payment, all patients and working-age patients (16-64 years), Massachusetts, 10/1/01-9/30/02

	All patients		Working-age patients 16-64 years	
	Number	Percent	Number	Percent
Workers' Compensation	94,533	4.3	93,082	6.1
Other than Workers' Compensation	2,107,824	95.7	1,436,849	93.9
Total	2,202,357	100.0	1,529,931	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Table 2. Work-related ED visit rates, Massachusetts, 10/1/01- 9/30/02

	Massachusetts civilian labor force* N	Work-related ED visits per 100 workers
All ages	3,301,000	2.86
Working-age (16-64 years)	3,184,000	2.92

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* Data from Geographic profile of employment and unemployment, 2002, BLS (Available at: http://www.bls.gov/opub/gp/laugp.htm)

Table 3. Work-related ED visits by patient's county of residence, Massachusetts, 10/1/01-9/30/02

	Number of Work-related ED Visits	Percent of Work-related ED Visits	Percent of Mass. Labor force*	Work-Related ED visit rate**
Barnstable	4,306	4.6	3.4	3.78
Berkshire	3,123	3.3	2.0	4.68
Bristol	11,488	12.2	8.0	4.33
Dukes	348	0.4	0.3	3.61
Essex	11,738	12.4	11.1	3.14
Franklin	1,201	1.3	1.2	3.10
Hampden	8,711	9.2	6.4	4.08
Hampshire	927	1.0	2.5	1.08
Middlesex	17,035	18.0	25.1	2.02
Nantucket	288	0.3	0.2	4.23
Norfolk	7,123	7.5	11.0	1.93
Plymouth	7,900	8.4	7.5	3.13
Suffolk	8,104	8.6	10.2	2.36
Worcester	12,241	13.0	11.1	3.30
Total	94,533	100.0	100.0	2.86

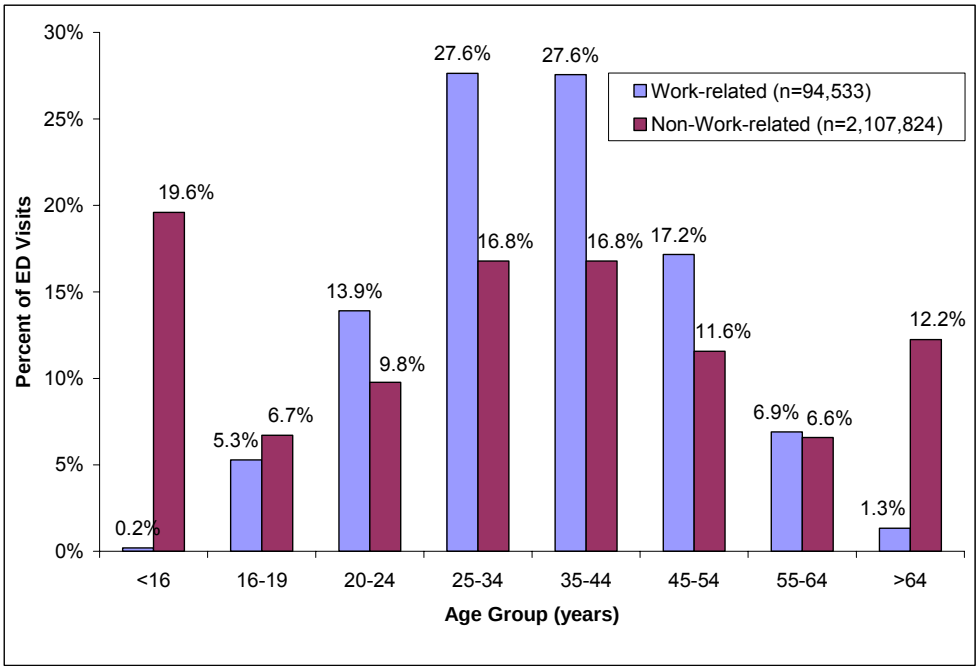
Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* Labor force estimates for counties from Massachusetts Div. of Employment & Training
**Work-related ED visits /100 workers

Characteristics of Patients Making ED Visits for Work-Related Conditions

Age of Patients

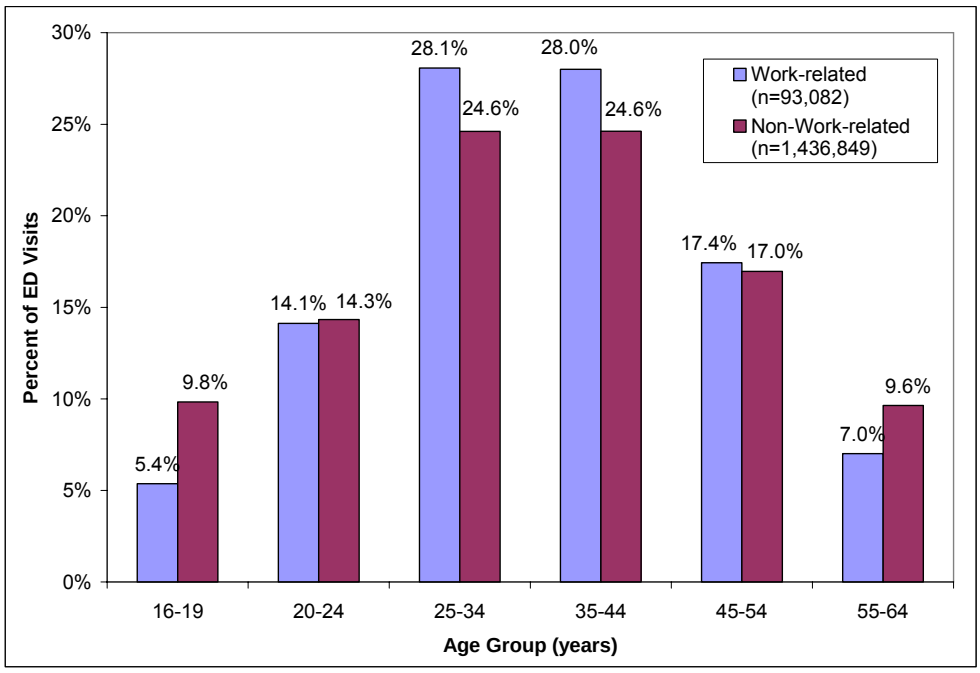
The mean age of patients treated for work-related conditions was 36.4 years old. Almost all (98.6%) work-related cases involved patients aged 16 through 64. ED visits for non-work related conditions had a similar average patient age (35.2 years), but a very different distribution, with comparatively more patients in the younger (<16 years old) and older (>64 years old) age ranges (Figure 1), due to the limited participation of these age groups in the workforce. Most patients (55.2%) making ED visits for work-related conditions were between 25 to 44 years old. An age comparison for ED visits restricted to patients of working age (16-64 years old) is provided in Figure 2.

Figure 1. Percent of ED visits for work-related and non-work-related conditions by patient age, all ages, Massachusetts, 10/1/01-9/30/02.



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Figure 2. Percent of ED visits for work-related and non-work related conditions by patient age, working-age patients (age 16-64 years), Massachusetts, 10/1/01-9/30/02.



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Gender of Patients

Over two-thirds (71.3%) of the ED visits for treatment of work-related conditions were made by male patients (Table 4). As a proportion of the employed population, the work-related ED visit rate for males was over twice as high as that for females, with men having a rate of 3.9 per 100 workers and women a rate of 1.7 per 100 workers. The comparatively higher rate of ED visits for men probably reflects their concentration in more hazardous occupations and their corresponding greater risk for serious traumatic injuries of the type that are typically treated in EDs. Nationally, 65% of all occupational injuries and illnesses reported to the BLS occurred in males in 2002.[17] In Massachusetts, between 1991 and 2004, male workers accounted for 93% of work-related fatalities[18]

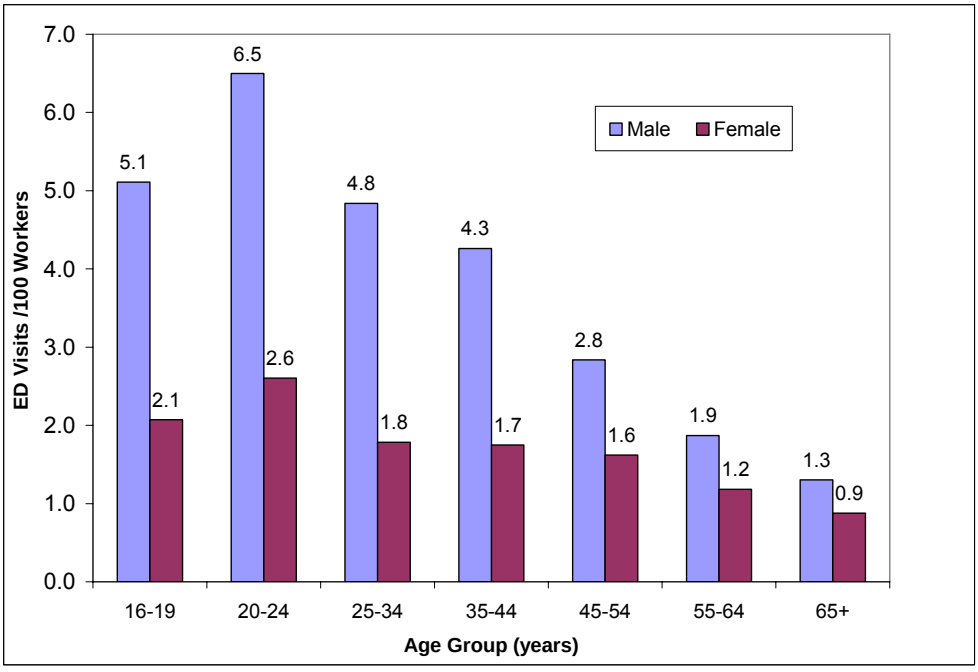
The ED visit rate in younger age groups was higher than in older age groups (Figure 3). This trend was especially evident among males, with male workers aged 20 through 24 having the highest ED visit rate (6.5 per 100 workers), five times the rate for male workers over 64.

Table 4: Work-related ED visits and rates by gender, Massachusetts, 10/1/01-9/30/02.

	Males		Females	
	Number*	Percent	Number*	Percent
Work-related ED visits	67,429	71.3	27,089	28.7
Labor force**	1,731,000	52.4	1,570,000	47.6
Work-related ED visit rate#	3.9		1.7	

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
*15 records were missing gender information
** Geographic profile of employment and unemployment, 2002, BLS
# ED visits/100 workers

Figure 3. Work-related ED visit rates by patient age and gender, working-age patients (16-64 years), Massachusetts, 10/1/01-9/30/02

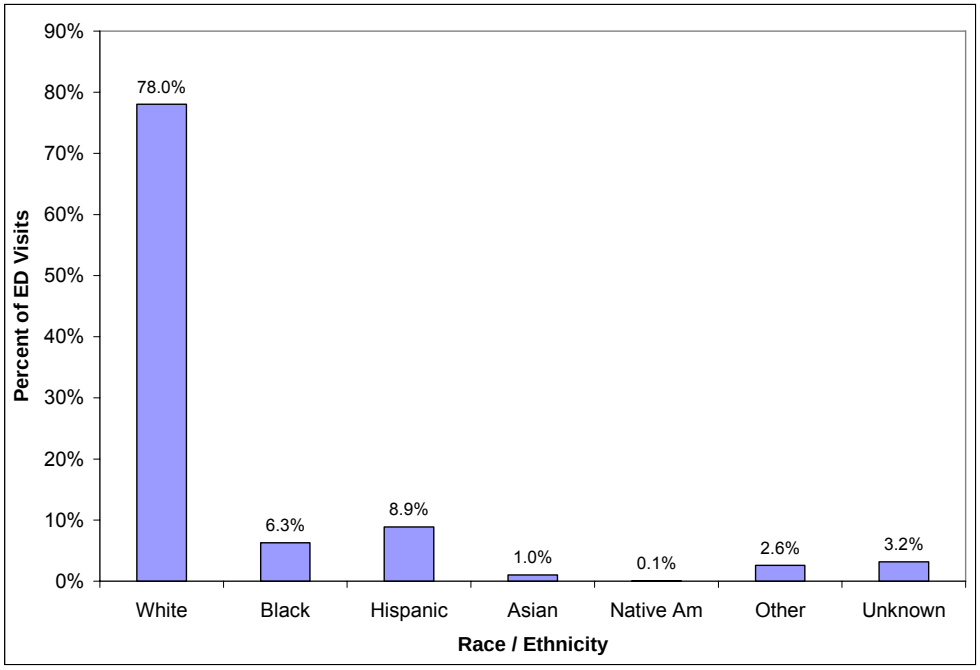


Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Race and Ethnicity of Patients

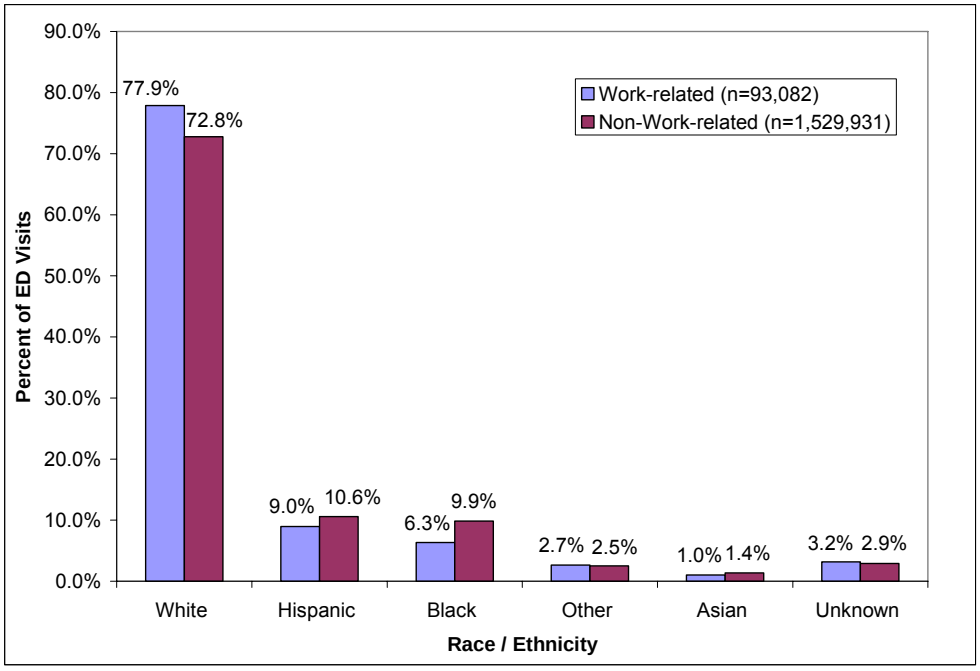
Over three-quarters (78.0%) of ED visits for work-related conditions were made by White patients (Figure 4). Black patients made 6.3% of the visits, Hispanic made 8.9%, and Asians made 1%. By comparison, according to the 2000 U.S. Census, 5.7% of employed persons in Massachusetts were Black, and 6.2% were Hispanic. Thus, the proportion of Black and Hispanic patients receiving ED treatment for work-related conditions exceeds the proportion of Blacks and Hispanic workers in the employed population. This might indicate that Blacks and Hispanics are more likely than whites to work in hazardous occupations that place them at greater risk for suffering serious traumatic injuries. Black and Hispanic workers may also be more likely to seek care for work-related conditions in EDs.

Figure 4. Percent of work-related ED visits by patient race and ethnicity, Massachusetts, 10/1/01-9/30/02



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Figure 5. Percent of ED visits for work-related and non-work-related conditions by patient race and ethnicity, working-age patients (16-64 years), 10/1/01-9/30/02



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Diagnostic Classification for Work-Related ED Visits

Diagnosis by ICD-9-CM Major Categories

Table 5 presents the distribution of ED visits for work-related conditions according to the ICD-9-CM major diagnostic categories. The majority (78.1%) of ED visits were for work-related injuries and poisonings (ICD-9-CM codes 800-999). The next most common category was diseases of the musculoskeletal system and connective tissue (ICD-9-CM codes 710-739). According to the ICD-9-CM classification system, almost all cases of back injuries are classified as injuries and poisonings, as are strains and sprains. The third most frequent category, V-codes, refers to ED visits that may be for follow-up care, such as wound dressing change or suture removal or for circumstances where no current disease exists, but medical consultation or preventative care is desirable (e.g. exposure to blood-borne pathogens or other communicable disease)[19]. Table 6 provides details of the distribution of V-codes for work-related ED visits.

Table 7 summarizes the proportion of all ED visits that were for treatment of work-related conditions among working-aged patients, by major ICD-9-CM diagnostic categories. Overall, visits for work-related conditions comprised 6.1% of all ED visits. This proportion varied by major diagnostic category and was highest (14.2%) for ED

visits involving treatment of injuries and poisonings. By contrast, work-related musculoskeletal conditions comprised only 7.0% of all musculoskeletal conditions treated in EDs.

Table 5. Work-related ED visits by ICD-9-CM major diagnostic categories, Massachusetts, 10/1/01-9/30-02

ICD-9-CM Major Categories	Frequency	Percent
Injury and poisonings (ICD-9-CM 800-999)	73,791	78.1
Musculoskeletal system disorders (ICD-9-CM 710-739)	8,428	8.9
V-codes (ICD-9-CM V01-V82)	5,492	5.8
Skin disorders (ICD-9-CM 680-709)	1,871	2.0
Ill defined symptoms (ICD-9-CM 780-799)	1,867	2.0
Nervous system disorders (ICD-9-CM 320-389)	1,689	1.8
Digestive system disorders (ICD-9-CM 520-579)	350	0.4
Respiratory system disorders (ICD-9-CM 460-519)	263	0.3
Mental disorders (ICD-9-CM 290-299)	216	0.2
Other conditions*	566	0.6
Total	94,533	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

* 37 Cases missing ICD-9-CM code were placed in this category.

Table 6. Work-related ED visits by ICD-9-CM V-code major categories Massachusetts, 10/1/01-9/30/02

V-code Major Categories	Number	Percent
Dressing change or suture removal (V58.3)	2,563	46.7
Exposure to potentially hazardous body fluids (V15.85)	947	17.2
Contact with communicable diseases (V01)	551	10.0
Other specific after care (V67)	497	9.0
Others	934	17.0
Total	5,492	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Table 7. Work-related ED visits as a percentage of all ED visits by ICD-9-CM major diagnostic categories, Massachusetts, 10/1/01-9/30/02.

ICD-9-CM Major Categories	Work-Related		Non-work Related			
	Number	%	Number	%	Total	Work-Related %
Injury and poisonings	73,791	78.1	439,464	30.6	512,125	14.4
Musculoskeletal disorders	8,428	8.9	110,976	7.7	119,321	7.1
V-codes	5,492	5.8	51,316	3.6	56,711	9.7
Skin disorders	1,871	2.0	245,257	17.1	247,084	0.8
Ill defined symptoms	1,867	2.0	64,767	4.5	66,592	2.8
Nervous system disorders	1,689	1.8	67,766	4.7	69,436	2.4
Digestive system disorders	350	0.4	76,458	5.3	76,798	0.5
Respiratory system disorders	263	0.3	137,620	9.6	137,878	0.2
Mental disorders	216	0.2	82,739	5.8	82,949	0.3
Other conditions*	566	0.6	160,486	11.2	161,037	0.4
Total	94,533	100.0	1,436,849	100.0	1,529,931	6.2

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* 37 Cases missing ICD-9-CM code were placed in this category.

Classification by CCS Diagnostic Categories

CCS codes provide more specific information about the type of condition than the ICD-9-CM major diagnostic categories. Using the CCS coding scheme, the most common type of work-related condition treated during ED visits was sprains and strains, accounting for 22.5% of all work-related cases (Table 8). The next most common type was open wounds of the extremities (19.8%), followed by superficial injuries (17.2%). Intervertebral disc disorders (4.9%) was the most common type of work-related condition treated during ED visits that was not in the ICD-9-CM injury or poisoning category

An interesting finding was that the CCS code for aftercare accounted for over 3,000 work-related visits (3.2% of the total). Eighty-seven percent of all aftercare visits paid for by workers' compensation involved dressing changes and suture removals.

Table 8. Frequency of the 20 most common primary CCS diagnosis codes for work-related ED visits, Massachusetts, 10/1/01-9/30/02

CCS code label	Frequency	Percent
Sprains and strains	21,276	22.5
Open wounds of extremities	18,719	19.8
Superficial injury, contusion	16,226	17.2
Other injuries and conditions due to external cause	5,475	5.8
Spondylosis, intervertebral disc disorders, other	4,650	4.9
Aftercare	3,060	3.2
Open wounds of head, neck, and trunk	2,880	3.1
Fracture of upper limb	2,537	2.7
Burns	2,286	2.4
Other connective tissue disease	2,140	2.3
Other non-traumatic joint disorders	1,467	1.6
Skin and subcutaneous tissue infections	1,249	1.3
Residual codes, unclassified	1,244	1.3
Fracture of lower limb	1,232	1.3
Inflammation, infection of eye	890	0.9
Poisoning by nonmedicinal substances	789	0.8
Crushing injury or internal injury	664	0.7
Immunizations and screening for infectious disease	656	0.7
Joint disorders and dislocations, trauma-related	628	0.7
Allergic reactions	573	0.6
All diagnoses	94,473*	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* 60 cases were missing CCS codes

Hospital Charges for Work-Related ED Visits

Hospital charges include ED fees, test and procedure charges, medication charges, and may include physician fees for ED and hospital staff. They may not include other physician fees for private physicians providing care for ED patients. Typically, charges exceed actual costs and payments because insurance providers, who pay for most ED visits, are generally given discounts from the standard charges provided in the ED data. The ED data did not contain Information on the actual payments made for the services.

Hospital charges for all work-related ED visits provided to Massachusetts residents totaled $45.5 million. By comparison the annual charges for inpatient care of work-related conditions were approximately $53.3 million during the same time period. The average ED charge per ED visit was $481 (Table 9). Treatments for work-related

Injuries and poisonings (ICD-9-CM major category) accounted for 81% of the total work-related ED visit charges.

Table 10 summarizes the mean and total hospital charges for the twenty most frequent CCS diagnostic categories for work-related ED visits. The majority (57.8%) of charges were associated with sprains & strains (20.7%), open wounds (20.0%), and superficial injuries (17.1%). The most expensive cases per visit, on average, involved traumatic joint disorders ($792) and upper extremity fractures ($791). Aftercare visits were among the least expensive ($159 per visit).

Table 9. Mean and total hospital charges for work-related ED visits, by ICD-9-CM diagnostic categories, Massachusetts, 10/1/01-9/30/02

	N*	Mean charges per visit (dollars)	Total charges (dollars)	Percent of total charges
Injury and poisonings	73,735	502.1	37,021,743	81.4
Musculoskeletal	8,424	413.6	3,484,502	7.7
V-codes	5,481	246.6	1,351,388	3.0
Skin	1,871	371.7	695,513	1.5
Ill Defined Symptoms	1,865	770.9	1,437,789	3.2
Nervous	1,688	312.3	527,175	1.2
Digestive	350	524.3	183,518	0.4
Respiratory	263	507.5	133,465	0.3
Mental	216	828.2	178,885	0.4
Others	565	777.0	454,376	1.0
All Conditions	94,458	481.4	45,468,354	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* 75 cases were missing hospital charge information

Table 10. Mean and total hospital charges for work-related ED visits for the 20 most common CCS diagnostic categories, Massachusetts, 10/1/01-9/30/02

	Number of visits	Mean charges per visit ($)	Total charges (thousands of $)	Percent of total charges
Sprains and strains	21,264	441.8	9,394.5	20.7
Open wounds of extremities	18,698	486.8	9,101.5	20.0
Superficial injury, contusion	16,214	480.2	7,785.6	17.1
Other injuries & conditions due to external causes	5,470	527.6	2,885.8	6.3
Spondylosis, intervertebral disc disorders, other	4,649	404.4	1,880.0	4.1
Aftercare	3,053	159.4	486.6	1.1
Open wounds of head, neck, and trunk	2,876	603.0	1,734.2	3.8
Fracture of upper limb	2,537	791.4	2,007.8	4.4
Burns	2,285	326.6	746.2	1.6
Other connective tissue disease	2,139	406.2	868.8	1.9
Other non-traumatic joint disorders	1,465	432.2	633.2	1.4
Skin and subcutaneous tissue infections	1,249	431.7	539.2	1.2
Residual codes, unclassified	1,242	412.2	511.9	1.1
Fracture of lower limb	1,231	722.0	888.8	2.0
Inflammation, infection of eye	890	267.1	237.7	0.5
Poisoning by nonmedicinal substances	789	402.9	317.9	0.7
Crushing injury or internal injury	664	629.6	418.1	0.9
Immunizations & screening for infectious disease	656	399.0	261.8	0.6
Joint disorders and dislocations, trauma-related	628	791.5	497.0	1.1
Allergic reactions	573	231.1	132.4	0.3

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Characteristics of Work-Related Injuries and Poisonings (ICD Codes 800-999)

Types of Work-Related Injuries and Poisonings

A total of 73,517 work-related ED visits had a primary diagnosis classified in the ICD-9-CM injury and poisoning category. Table 11 provides a breakdown of the specific types of injuries within this group. Three types of injuries - sprains and strains (29.1%), open wounds (28.9%) and contusion or superficial injuries (22.1%) - accounted for 80% of all ED visits for treatment of work-related injuries and poisonings.

Overall, work-related injuries accounted for 14.5% of all ED visits for injuries and poisonings by working-age patients. This proportion varied by diagnostic category. Work-related crushing injuries accounted for 42.6% of all ED visits for crushing injuries among working age adults. Work-related amputations (38.8%) and burns (27.5%) also accounted for a relatively high proportion of all ED visits for those injury types.

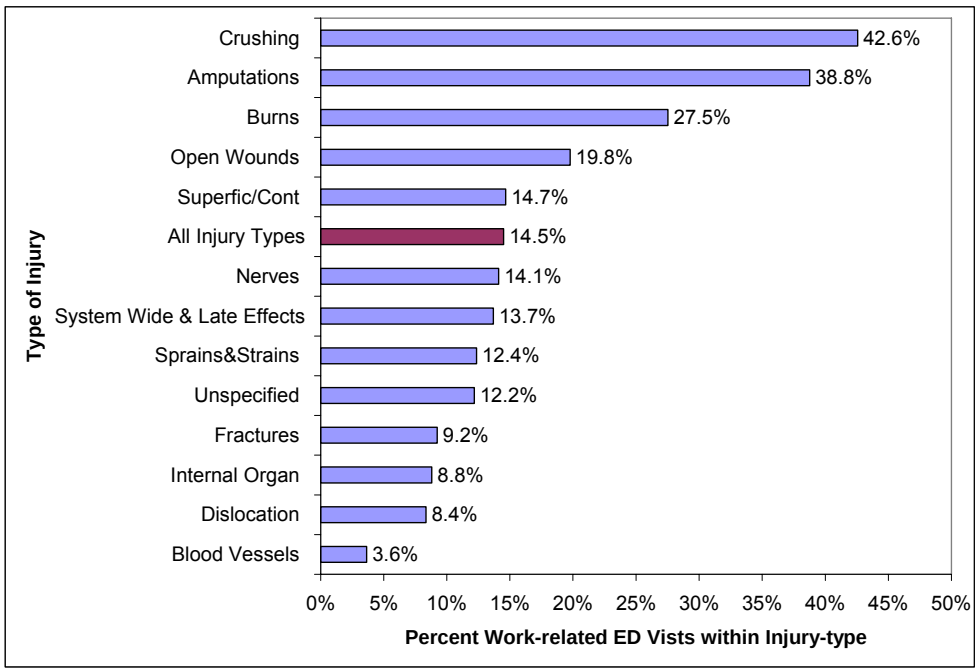
The most common body part injured in work-related ED cases was the upper extremity (45.9% of work-related cases) while lower extremities were injured in 18.9% of the cases (Figure 7). Interestingly, previous MDPH studies of work-related hospital inpatient stays have found that injuries involving the lower extremity were the most frequent type of hospitalized injury, accounting for 39% of all cases requiring hospital admission, while upper-extremity cases accounted for just 33% of the inpatient cases[20]. This tends to suggest that work-related injuries of the lower extremity are, in general, more severe than work-related injuries of the upper extremity.

Table 11. Work-related injuries and poisonings by nature of injury, Massachusetts, 10/1/01-9/30/02 (n=73,791)*

Nature of Injury	Number*	Percent
Open wounds	21,292	29.0
Sprains & strains	21,276	28.9
Superficial injury/contusion	16,226	22.1
Fractures	4,270	5.8
System wide & late effects	3,577	4.9
Unspecified injury	2,601	3.5
Burns	2,286	3.1
Crushing	640	0.9
Dislocation	547	0.7
Internal organ	452	0.6
Amputations	303	0.4
Nerve /blood vessel injury	47	0.1
Total	73,517	100.0

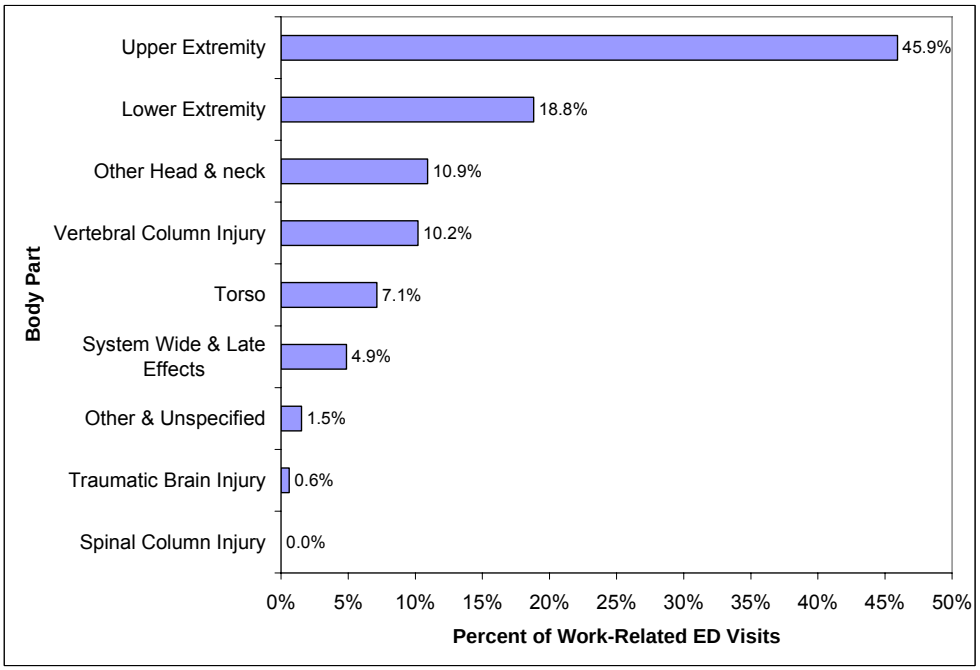
Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* 274 cases were missing type of injury coding

Figure 6. Work-related ED visits as a percentage of all ED visits for injuries and poisonings, by type of injury, working-age patients(16-64 years), Massachusetts 10/1/01-9/30/02, (n=72,391 work-related visits, 499,023 total visits)



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Figure 7. Percent of work-related ED visits for injuries and poisonings by affected body parts, Massachusetts, 10/1/01-9/30/02. (n=72,391)



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Causes of Work- Related Injuries and Poisonings

Almost all (98.9%) ED records contained E-codes that could be used to classify the external cause of work-related injuries and poisonings. Leading causes of work-related injuries included being cut or pierced (21.0%), overexertion (19.1%), struck by or against other objects (16.6%) and falls (15.2 %) (Table 12).

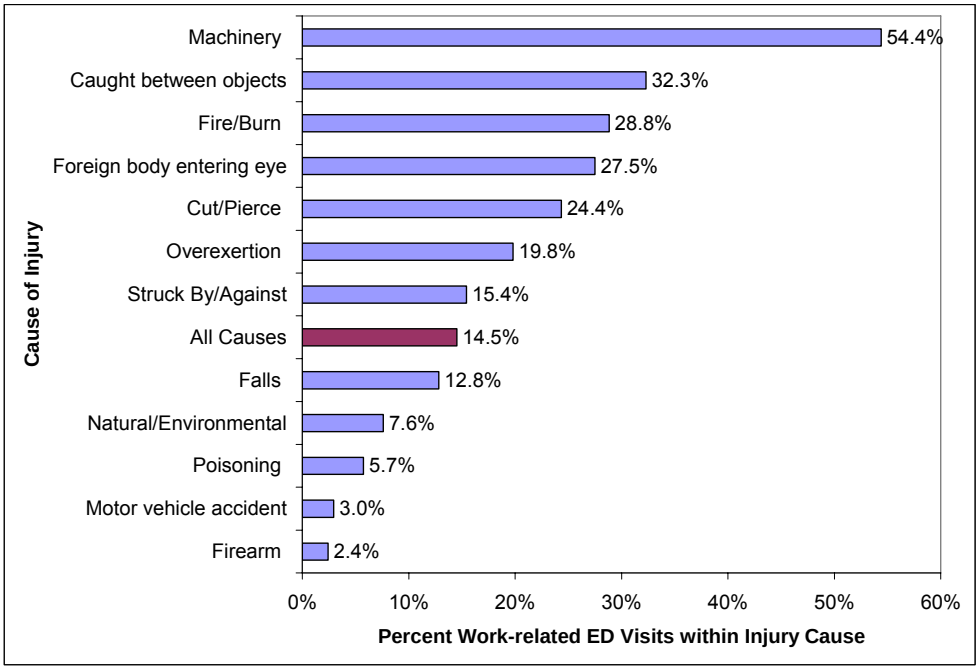
There were 2,278 work-related injuries treated in EDs that were caused by machinery. These machine-related injuries accounted for over half (54.4%) of all the machine-related injuries treated in EDs (Figure 8). Work-related injuries also accounted for a sizable proportion of other types of injury-related ED visits including 32.3% of the injuries involving caught between objects, 28.8% of injuries caused by fire/burns, and 27.5% of the injuries caused by foreign objects entering patients' eyes.

Table 12. Work-related ED visits for injuries and poisonings by external cause of injury, Massachusetts, 10/1/01-9/30/02. n=73,791*

External Cause	Number	Percent
Cut/Pierce	15,324	21.0
Overexertion	13,929	19.1
Struck by/against	12,142	16.6
Falls	11,092	15.2
Caught between objects	3,423	4.7
Foreign body entering eye	3,045	4.2
Transportation accident	2,703	3.7
Fire/Burn	2,364	3.2
Machinery	2,278	3.1
Natural/Environmental	1,216	1.7
Poisoning	570	0.8
Not Specified	2,943	4.0
Other	1,963	2.7
Total	72,992	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* 799 cases were missing cause of injury

Figure 8. Work-related ED visits as a percentage of all ED visits for injuries and poisonings, by external cause of injury, working-age patients (16-64 years), Massachusetts,10/1/01-9/30/02, (n=71,874 work-related, 423,272 total)



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

ED Visits for Work-Related Burns

Burn injuries have been a focus area for surveillance and prevention activities in Massachusetts. Burns were the cause of 3.1% of all work-related ED visits. Overall, most work-related burns occurred among male workers (Table 13). However, the majority of work-related burn victims under the age of 20 were female. This may reflect a concentration of young female workers in food preparation and service jobs. Most work-related burns treated in EDs (69.9%) were caused by contact with boiling or hot water or another hot substance (Table 14). Only 1.8% of burns treated in EDs were electrical burns. By comparison, a previous MDPH study of inpatient hospital care found that 15.4% of hospitalizations for work-related burns were for electrical burns. This indicates that electrical burn incidents are relatively more severe, involving more severe burns or more co-morbidities, often requiring hospital admission.

Table 13. Work-related ED visits for burns by patient age and gender, Massachusetts, 10/1/01-9/30/02

Age Range	Male	Female	Total	Percent Female
< 16	5	14	19	73.7
16–19	143	178	321	55.5
20–24	262	168	430	39.1
25–34	409	162	571	28.4
35–44	366	152	518	29.3
45–54	226	81	307	26.4
55–64	59	43	102	42.2
> 64	13	5	18	27.8
Total	1483	803	2,286	35.1

Source: Massachusetts Emergency Department data, 10/1/01 - 9/30/02

Table 14. Work-related ED visits for burns by external cause of injury, Massachusetts, 10/1/01-9/30/02

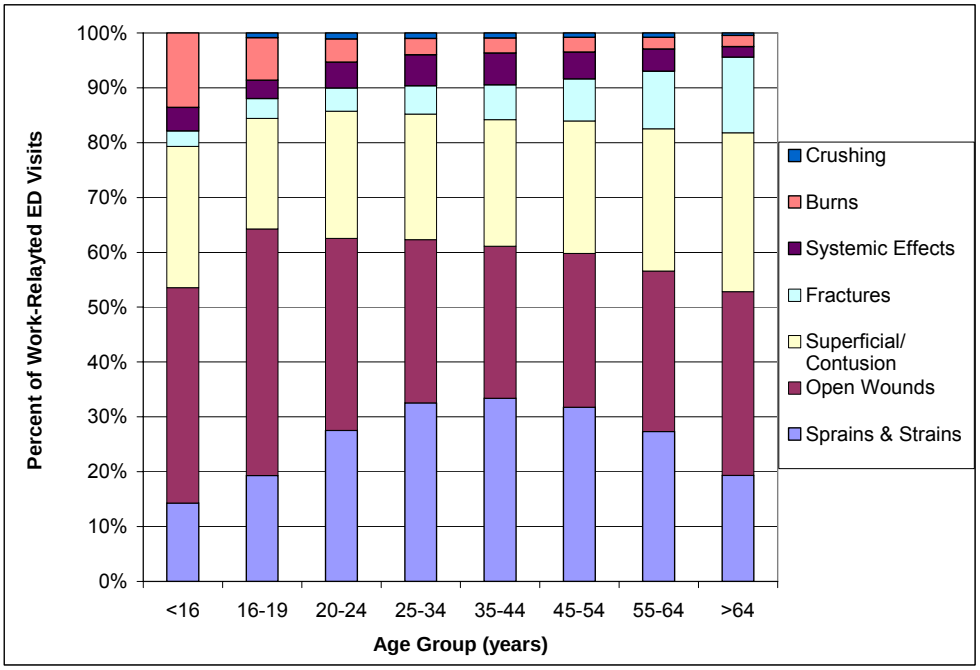
External Cause of Burn	Number	Percent
Boiling water, liquid & steam (E924.0)	847	37.1
Other hot substance (E924.8,.9)	621	27.2
Caustic or corrosive substance (E924.1)	288	12.6
Hot tap water (E924.2)	127	5.6
Wiring and electric machine (E925.0,.2)	15	0.7
Other electric burn (E925.1,.8,.9)	25	1.1
Other cause*	363	15.9
Total	2,286	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02
* Machinery accident (E919), Fire and Flame (E890 – 899), Explosive materials or explosion (E921, E923), and all other external causes.

Types of Work-Related Injuries by Age

The distribution of work-related injury by type varied across age groups. The proportion of sprains and strains was greatest among workers aged 25 through 54. The proportion of open wounds was greatest among the younger age groups under 25. The proportion of burns decreased with patient age, while the proportion of fractures increased with age.

Figure 9. Percent of work-related ED visits by nature of injury within age groups, Massachusetts, 10/1/01-9/30/02



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

ED Visits for Work-Related Injuries Involving Teenage Youths

Another focus area for occupational health surveillance in Massachusetts has been teenage workers 14-17 years of age. A total of 1,396 work-related ED visits were made by teens ages 14 -17 during the study period (Table 15), accounting for 1.5% of all work-related ED visits. The majority (60%) of these teenage patients were 17 years old and 63% were male. Over 85% of teens visiting EDs for work-related conditions were White, with 7.1% being Hispanic and 1.9% Black. The total percentage who were Black or Hispanic (9.0%) was substantially lower than the proportion of Blacks and Hispanics among persons of all ages being treated for work-related conditions in EDs (15.2%). This may reflect a comparatively lower employment rate for minority teens relative to White teens.

Nearly 88.8% of work-related ED visits by teens ages 14 -17 were injuries and poisonings, somewhat greater than for the general working population (78.%). Almost half (47.3%) of the work-related injuries sustained by teens and treated in EDs were open wounds. These were followed by superficial injuries (18.0%) and sprains and strains (12.9%). Burns accounted for 11.2% of all work-related ED visits involving teens, which was much higher than the proportion for all age groups (3.1%).

Cuts were the most frequent cause of work-related injuries among teens accounting for 40.1% of all of the teens' work-related ED visits. This proportion was considerably

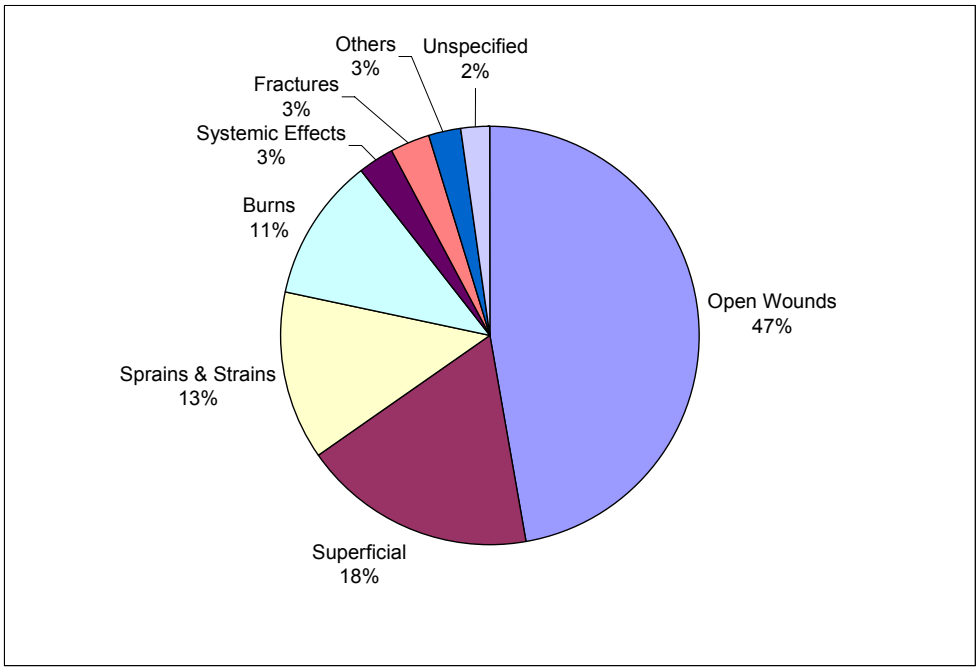
higher compared to work-related ED visits for all ages (21.0%). By contrast, the proportion of overexertion injuries among the teens (7.9%) was lower compared to findings for all age groups (19.3%).

Table 15. Work-related ED visits by teenagers ages 14-17, by gender and race/ ethnicity, Massachusetts, 10/1/01-9/30/02

	Age (years)									
	14		15		16		17		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Gender										
Female	16	50.0	36	37.1	161	37.3	299	35.8	512	36.7
Male	16	50.0	61	62.9	271	62.7	536	64.2	884	63.3
Race/Ethnicity										
White	28	87.5	85	87.6	379	87.7	705	84.4	1,197	85.7
Hispanic	1	3.1	4	4.1	26	6.0	69	8.3	100	7.1
Black	1	3.1	2	2.1	9	2.1	15	1.8	27	1.9
Asian	0	0.0	2	2.1	6	1.4	9	1.1	17	1.2
Other	1	3.1	4	4.1	4	0.9	14	1.7	23	1.6
Unknown	1	3.1	0	0.0	8	1.9	23	2.8	32	2.3
Total	32	100.0	97	100.0	432	100.0	835	100.0	1,396	100.0

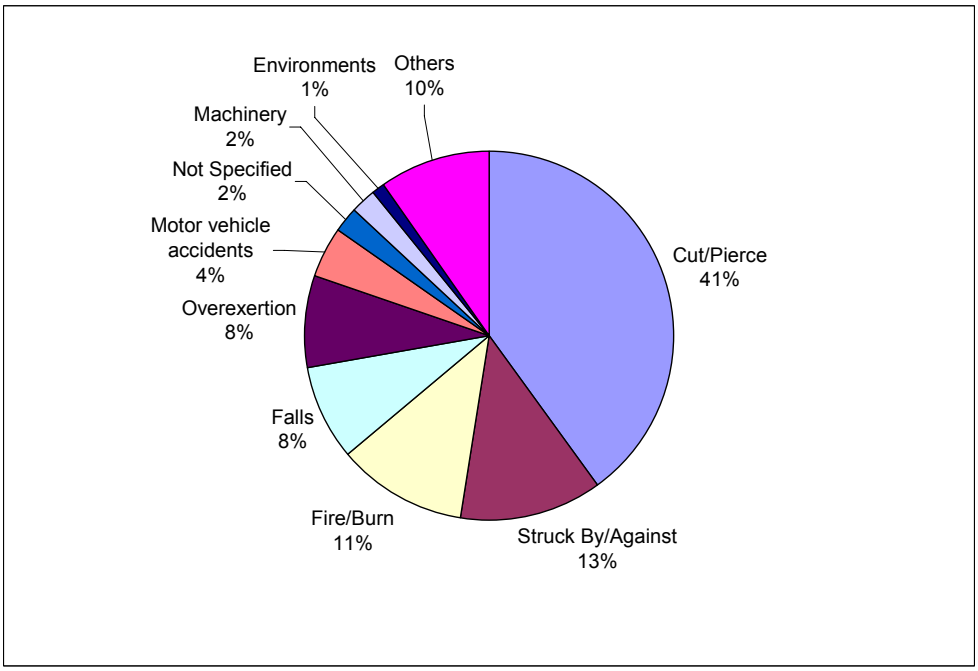
Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Figure 10. Percent of work-related ED visits by teenagers ages 14-17, by nature of injury, Massachusetts, 10/1/01-9/30/02 (n=1,239)



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Figure 11. Percent of work-related ED visits by teenagers ages 14-17, by external cause of injury, Massachusetts, 10/1/01-9/30/02 (n=1,231)

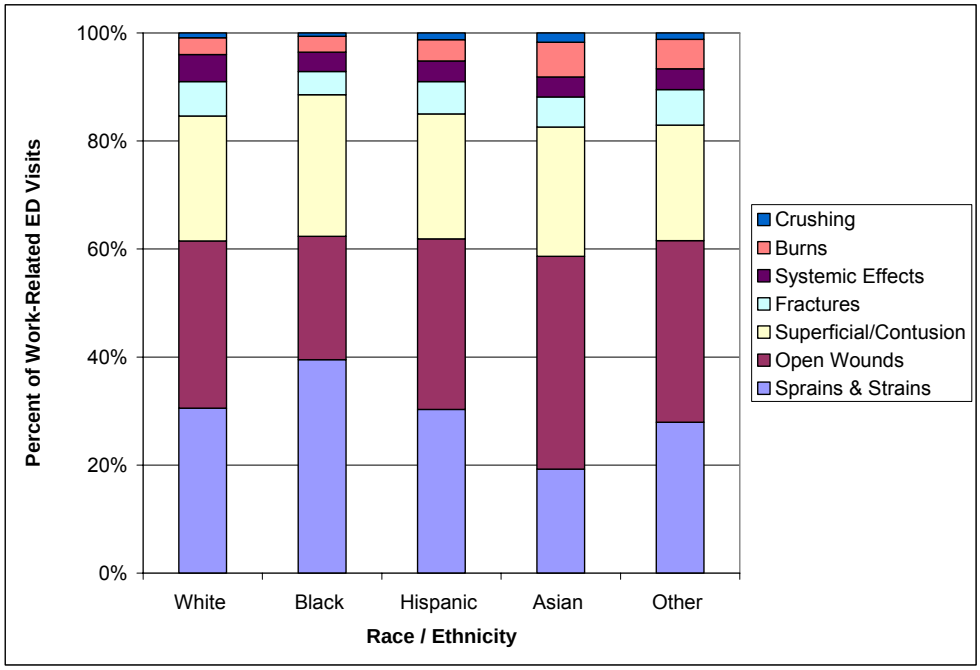


Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Types of Work-Related Injury by Race/Ethnicity

The distribution of injury type varied according to patients' race and ethnicity. The proportion of sprains and strains was highest among Black workers and lowest among Asian workers. By comparison, the proportion of open wounds and burns was highest among Asian workers and lowest among Black workers (Figure 12). These differences may reflect differences in occupations among the various ethnic and racial groups and varying levels of underlying injury risk. The variations could also, in part, reflect differences among groups in the propensity to obtain medical care for work-related conditions in EDs.

Figure 12. Percent of work-related ED visits by nature of injury within race/ ethnic groups, Massachusetts, 10/1/01-9/30/02



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Possible Work-Related Conditions Not Paid by Workers' Compensation

In this study, expected payer by workers' compensation insurance was used as a marker for identifying work-related conditions. However, it is possible that some work-related conditions were not designated to be paid by workers' compensation because they were not recognized as work-related by the patient or clinician, because patients were not eligible for workers' compensation, or because of potential obstacles in securing workers compensation coverage. Evidence has shown that occupational diseases, in particular, often are not reported accurately in workers' compensation data bases.[21]

Table 16 lists some conditions among working-age ED patients that are often caused by workplace exposures. "Observation following an accident at work" included in this table is an available V code that would normally be expected to indicate a work-related condition. However an ED observation in the absence of specific treatment or lost work days would not necessarily be covered by workers' compensation insurance.

Table 17 lists ED visits involving unintentional exposure to various toxic substances that are typically found in occupational settings. Except for ethyl alcohol, venom, and detergent, exposure to these substances generally occurs from work activities, and thus the conditions can also be considered as possibly work-related. However, only 16.6% of the cases in Table 17 were listed as expected to be paid by workers' compensation.

Table 16. ED visits for possible work-related conditions, by workers' compensation payment, working-age patients (age 16-64 years), Massachusetts, 10/1/01-9/30/02

	WC	Non-WC
Needle stick injury	1,121	434
Exposure to hazardous body fluid	943	312
Carpal tunnel syndrome	56	604
Observation following an accident at work	26	13
Extrinsic alveolitis		
Farmers' lung	0	1
Suberosis (Cork-handlers' disease or lung)	0	1
Other specified allergic alveolitis and pneumonitis	0	2
Unspecified allergic alveolitis and pneumonitis	0	8
Total	2,146	1,375

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Table 17. ED visits related to toxic effects from unintentional exposure to selected substances, by Workers' Compensation payment, working-age patients (16-64 years), Massachusetts, 10/1/01-9/30/02

ICD-9	Description	WC	Non WC
980.0	Ethyl alcohol	0	116
980.1	methyl alcohol	0	8
980.2	Isopropyl alcohol	0	13
980.3	Fusel oil	0	1
980.8	Other specified alcohols	0	1
980.9	Unspecified alcohol	0	247
981	Toxic effect of petroleum products	7	11
982.0	Benzene and homologues	8	1
982.1	Carbon tetrachloride	0	4
982.3	Other chlorinated hydrocarbon solvents	0	2
982.8	Other nonpetroleum-based solvents, acetone	7	17
983.0	Corrosive aromatics	2	4
983.1	Acids	7	7
983.2	Caustic alkalis	6	7
983.9	Caustic, unspecified	9	51
985.0	Mercury and its compounds, minamata disease	2	3
985.8	Other specified metals	0	6
985.9	Unspecified metal	2	2
986	Toxic effect of carbon monoxide	57	148
987.0	Liquefied petroleum gases, butane, propane	3	9
987.1	Other hydrocarbon gas	10	24
987.2	Nitrogen oxides	0	1
987.3	Sulfur dioxide	0	1
987.4	Freon	7	3
987.5	Lacrimogenic gas	8	4
987.6	Chlorine gas	5	26
987.8	Other specified gases, fumes, or vapors	71	73
987.9	Unspecified gas, fume, or vapor	155	271
989.0	Hydrocyanic acid and cyanides	0	1
989.2	Chlorinated hydrocarbons	0	1
989.3	Organophosphate and carbamate	1	3
989.4	Other pesticides, not elsewhere classified	4	14
989.5	Venom	300	3152
989.6	Soaps and detergents	1	13
989.82	Latex	4	10
989.83	Silicone	1	0
989.84	Tobacco	1	0
989.89	Other	26	68
989.9	Unspecified substance, chiefly nonmedicinal	20	31
	Total	724	4354

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Identifying Repeat ED Visits for Work-Related Conditions

Not all ED visits for work-related conditions can be expected to be for newly incident conditions. Understanding the extent and nature of repeat ED visits is helpful in interpreting ED data for occupational health surveillance purposes and to gauge the actual utilization of hospital ED facilities by patients with work-related injuries and illnesses.

Extent of Repeat ED Visits by the Same Patient

From October 1, 2001 through September 30, 2002, there were 91,158 ED visits made for work-related conditions by 76,666 distinct individuals. Records for an additional 3,375 ED visits for work-related conditions were missing patient's social security number and thus were excluded from this analysis. Most (85.8%) of the individuals only visited the ED once during the study period. However, 10,923 of the individuals were treated at an ED more than once for a work-related condition. These 10,923 individuals made a total of 25,415 ED visits for treatment of a work-related condition, which represented 27.9% of all work-related ED visits. Of these 10,923 individuals, 8,745 made exactly two ED visits, 2,033 made from 3 to 5 visits, and there were 145 persons who made more than five visits to an ED for treatment of a work-related condition. The individual visiting the ED most often made 53 visits during the year for treatment of a work-related condition. These statistics are summarized in Table 18.

Table 18. Repeated work-related ED visits, Massachusetts, 10/1/01-9/30/02

No. of ED visits made by the patient during the study period	Number of individual patients	Percent of individual patients	Total visits made by these patients	Percent of visits made by these patients
1	65,743	85.7	65,743	72.1
2	8,745	11.4	17,490	19.2
3-5	2,033	2.6	6,697	7.3
6-10	123	0.2	839	0.9
11+	22	0.1	389	0.4
Total	76,666	100.00	91,158	100.00

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Of the 10,923 patients who made more than one visit, 26.8% of them had exactly the same ICD-9-CM diagnosis at the second ED visit as at the first. Using CCS codes (which are broader), 36.0% of these patients had exactly the same CCS diagnostic code at the second visit as at the first. These repeat visits (numbering 3,931, 4.3% of

the total) are most likely repeat visits for the same condition. In addition, 2,023 patients making a second visit had "aftercare" noted as the CCS diagnostic code for the second visit. By definition, aftercare involves follow-up treatment for a previous injury or illness. Thus, at least 5,954 visits (3,931 + 2,023) were likely repeat visits to the ED by a person getting follow-up treatment for a previous work-related condition.

Characteristics of Patients Making More than One ED Visit

Table 19 summarizes the demographic characteristics of patients who visited the ED more than once for treatment of a work-related condition. The percent distribution of age and race/ethnicity in this group were similar to the larger population of workers who made only one visit. Male patients made 75.8% of the repeat visits, and were disproportionately more likely to make a repeat visit (71.3% of all ED visits for work-related conditions involved male patients). Black patients constituted 7.2% of patients making repeat visits compared to 6.3% for all visits.

Table 19. Age, gender and race/ethnicity of patients making repeated work-related ED visits, Massachusetts, 10/1/01-9/30/02

Item		Frequency	Percent
Age			
	<20	516	4.7
	20 – 24	1,581	14.5
	25 – 34	3,180	29.1
	35 – 44	3,138	28.7
	45 – 54	1,712	15.7
	55 – 64	662	6.1
	>64	134	1.2
Gender			
	Male	8,278	75.8
	Female	2,645	24.2
Race/Ethnicity			
	White	8,537	78.2
	Black	785	7.2
	Hispanic	929	8.5
	Asian	100	0.9
	Other	249	2.3
	Unknown	323	3.0
Total		10,923	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Types of Work-Related Disorders Requiring Repeat Visits

A total of 3,931 "second visits" were made by the same patient for a CCS diagnostic code that was exactly the same as the first visit. The ten most common diagnostic codes for these "repeat visits" are summarized in Table 20. The most frequent diagnosis for the repeat visits was sprains and strains (29.7% of the repeat visits) followed by open wounds of the extremities (15.6%), superficial injuries (13.8%), and intervertebral disc disorders (8.9%).

Table 20. Second work-related ED visits with the same diagnosis as the first, by CCS diagnostic category, Massachusetts, 10/1/01-9/30/02

CCS diagnostic category	Number of Second ED Visits	Percent
Sprains and strains	1,167	29.7
Open wounds of extremities	614	15.6
Superficial injury, contusion	543	13.8
Spondylosis, intervertebral disc disorders, other back	349	8.9
Other aftercare	242	6.1
Skin and subcutaneous tissue infections	184	4.7
Burns	118	3.0
Other injuries and conditions due to external cause	112	2.8
Other connective tissue disease	85	2.2
Fracture of upper limb	70	1.8
Other	447	11.4
Total	3,931	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

In addition, there were 2,023 second visits that listed "aftercare" as the CCS diagnostic code for the second visit, and thus should be considered repeat visits by the same patient for the same condition. Table 21 summarizes the CCS diagnosis at the first visit for these "aftercare" cases.

Table 21. Second work-related ED visits with "aftercare" diagnosis by CCS diagnostic category of first visit, Massachusetts, 10/1/01-9/30/02

CCS diagnosis category	Number of Second ED Visits	Percent
Open wounds of extremities	1,224	60.5
Open wounds of head, neck, and trunk	330	16.3
Burns	138	6.8
Fracture of upper limb	72	3.6
Superficial injury, contusion	56	2.8
Other	203	10.0
Total	2,023	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Timing of Repeat Visits

Table 22 summarizes the time period separating patients' first and second visits to the ED for treatment of a work-related condition. Over half (51.6%) of these second visits were made within two weeks and 59.0% of them were made within a month.

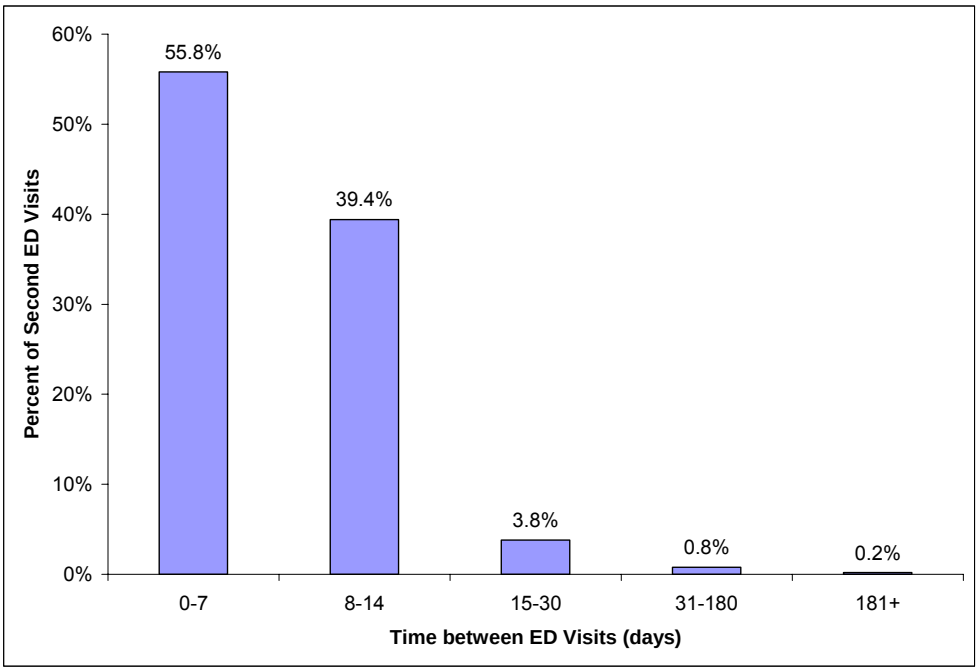
Table 22. Time period between the first and second work-related ED visits, Massachusetts, 10/1/01-9/30/02

Period (days)	Number of Second Visits	Percent
0-7	4,159	38.1
8-14	1,475	13.5
15-30	804	7.4
31-60	912	8.4
61-90	738	6.8
91-180	1,671	15.3
181+	1,164	10.7
Total	10,923	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

For second visits that were specifically coded as "aftercare" visits (n = 2,023), the vast majority (95.2%) were made within two weeks after the initial visit, and 98.7% were made within 30 days after the initial visit, as depicted in Figure 13.

Figure 13. Distribution of time periods between first and second work-related ED visits for cases in which the second diagnosis was aftercare, Massachusetts, 10/1/01-9/30/02 N= 3,931



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

For second visits involving the same patient and having the same CCS code as the first visit (n=3,931), the majority (58.2%) of second visits also occur within two weeks following the initial visit. Table 23 summarizes the time period separating patients' first and second visits to the ED for treatment of a work-related condition. About two-thirds (65.0%) of these visits took place within 30 days after the first visit.

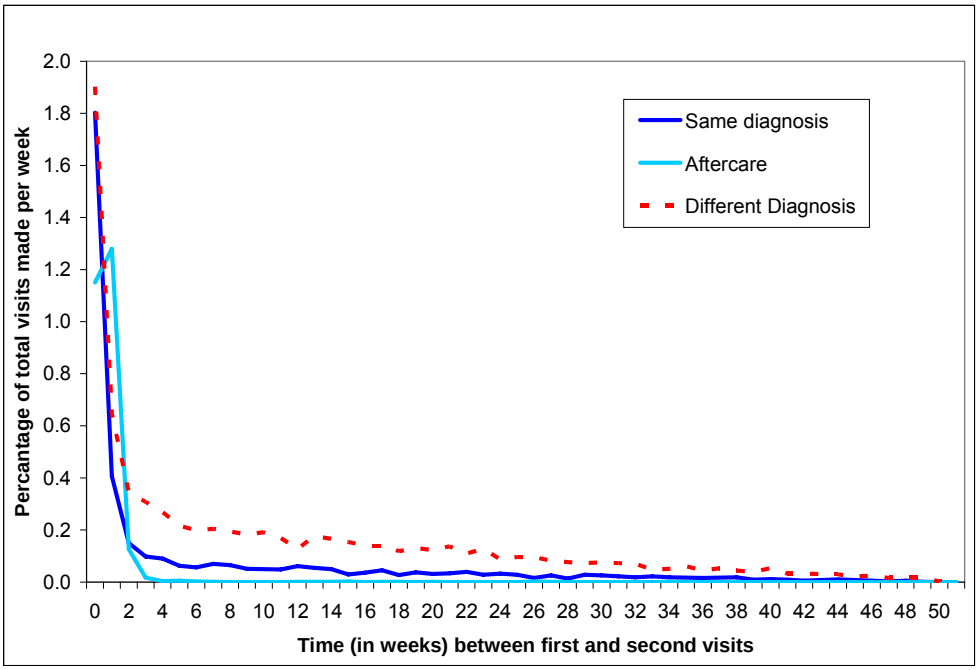
The data in Tables 22 and 23 suggest that most repeat visits for the same condition take place within 2-4 weeks after the initial visit for work-related injuries. One can infer that it is likely that many second visits that occur with 2-4 weeks after the initial ED visit by the same patient are actually repeat visits for treatment of the condition associated with the initial incident, even if the CCS codes do not match exactly between the first and second visits. In this respect it is interesting to note that the proportion of second visits made per week falls off sharply after the first four weeks following the initial visit even if the CCS diagnostic codes are different between the first and second visit, in much the same way that they do for aftercare visits and for visits in which the first and second visit have the same diagnostic code (Figure 14).

Table 23. Time period between the first and second work-related ED visits with the same CCS diagnostic category, Massachusetts, 10/1/01-9/30/02

Periods (days)	Number of Second Visits	Percent
0-7	1,912	48.6
8-14	378	9.6
15-30	269	6.8
31-60	289	7.4
61-90	246	6.3
91-180	469	11.9
181+	368	9.4
Total	3,931	100.0

Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

Figure 14: Time between first and second work-related ED visits by type of diagnosis at the second visit, percentage of all visits by week, Massachusetts, 10/1/01-9/30/02



Source: Massachusetts Emergency Department Data, 10/1/01-9/30/02

From these data, we can estimate that the total number of ED visits for work-related conditions that are repeat visits for the initial condition is probably at least 5,954 (second visits either for aftercare or for a condition with the same CCS coding as the first visit),

plus the proportion (estimated at 65%) of second visits made by patients making repeat visits within 30 days after the initial visit having different CCS coding at the second visit than at the first visit (another 1,814 visits) plus a comparable proportion of the remaining tertiary and subsequent repeat visits (another 5,151 visits). Thus, we estimate that approximately 12,919 visits involve repeat visits for the same condition, which is 14.2% of all the total 91,158 ED visits for work-related conditions made during the study period This leaves approximately 78,239 ED visits that are for newly incident work-related injuries and illnesses, suffered among the 76,666 distinct patients receiving care at Massachusetts' EDs. The resulting "adjusted" work-related injury and illnesses annual incident rate (for injuries and illnesses requiring ED care) is 2.37 per 100 members of the Massachusetts civilian labor force, compared to the ED visit rate of 2.86 per 100 labor force members previously provided in Table 2.

Conclusions

The mandated collection of Massachusetts emergency department data that was initiated in October of 2001 provides opportunities for using those data for state public health and surveillance purposes. This study has tested the usefulness of the new ED data as a supplement to other data sources in understanding the extent and nature of occupational injuries and illnesses in the state. We have found that there are distinct advantages to using these data including the ease of acquisition, low cost, and relative completeness of the available data. The inclusion of information about patient demographic characteristics, diagnostic information, estimates of hospital charges, and special E-coding, which permits classification by cause of injury, all add to our knowledge about the incidence of work-related disorders, and suggest priorities for public health responses for affected population groups.

At the same time, there are several important limitations in the data that restrict their usefulness for occupational health surveillance. Most notably, there is no information about the patients' employment status or the type of work they perform. Also, the data does not contain any clinical or self-reported information about the work-relatedness of the patient's disorder, other than the indirect indication of expected payment by workers' compensation. However, because of the specific nuances of workers' compensation insurance and disincentives to proper workers' compensation reporting, it is likely that using workers' compensation as a surrogate indicator of occupational causation tends to underestimate the extent of the problem.

The types of work-related conditions treated in EDs are similar to, but different in important respects, from other occupational injuries and illnesses. In general, the kinds of conditions seen in EDs are more likely to be traumatic injuries rather than the non-traumatic back-related and musculoskeletal disorders that are so common in the occupational setting. These non-traumatic injuries are more likely treated in a non-emergency ambulatory facility.

Nevertheless, the analyses we performed resulted in several important findings that have potentially significant public health implications:

1. Our finding that about 34% of initial work-related injuries and illnesses are treated in hospital EDs is consistent with previous studies. This, along with the finding that approximately 14.2% of ED visits are for follow-up care of previously treated work-related conditions, will help public health officials better estimate the true incidence of work-related injuries and illnesses in the state.

2. ED data had relatively complete and extensive ICD-9-CM E-Code and V-Code data that allowed additional information to be obtained about the cause and intent of injury that is not generally available from other sources.

3. The extensive patient demographic information available in the ED data provides future opportunities for more detailed analyses within particular subpopulations. For example, it should be possible to learn more about patients with specific conditions such as fractures, amputations, or spinal injuries; or among different ethnic, age, or gender groups.

4. The ED data provides information about the utilization of healthcare facilities by individuals with work-related conditions that is potentially useful for healthcare resource planning purposes and health services research. For example, the finding that a significant proportion of ED visits are for repeat follow-up care of a work-related injury or illness raises questions about why such services are not being provided in a (less costly) ambulatory setting. It may indicate an access to care issue or certain inefficiencies in the administration of workers' compensation benefits. Additional follow-up research is needed in this area.

An important advantage of emergency department data for occupational health surveillance, compared to other available data sources, is that it captures information about both work-related and non-work-related injuries. This makes it possible to assess the contribution of work-related injuries to the overall injury burden, fostering integrated approaches to prevention that cross public health disciplines (e.g. injury control and occupational health).

The outcome of this study is sufficient to warrant continued periodic examination of ED data to supplement other occupational health surveillance activities in the state. MDPH should work with DHCFP to explore possible steps to improve the usefulness of emergency department data in this regard. Potential strategies for improving the utility of emergency department records for occupational health surveillance include:

- Explore the possibility of collecting information on injury at work similar to the information collected on death certificates. This would help capture work-related injury cases for workers not covered by workers' compensation. The possibility of collecting information on the activity at the time of injury for all injuries should also be explored. An activity code is included in ICD-10 and includes work as one of several options. The inclusion of activity codes would provide additional information that could be used to target intervention activities.

- The inclusion in the database of a dedicated, second E-code field should be explored. The second E-code could provide information on the location at time of injury or additional information on the circumstances of injury. Currently some hospitals do submit more than one E code, however, the reporting of place of injury may be improved with a dedicated, second E code field.

- Complete and accurate entry of E-code information should be emphasized.

Employer information (name and address) has been found to be available in computer data systems of hospitals and is important for occupational health surveillance, but the

time and expense of coding this information limits its usefulness in routine surveillance. The option of collecting employer information should be explored. At a minimum, MDPH should have legal access to this information when necessary for specific studies. Currently access to this information is at the discretion of the individual hospitals for all but specific work-related conditions that are required to be reported under public health regulations.

This report has taken a preliminary look at using the ED data for occupational health surveillance and has found the data useful in describing the nature and extent of work-related injury and illness, even when using a limited number of coded data fields. The ED data represents a rich data source for occupational health surveillance. Further exploration of the data may be warranted in a number of areas:

- The sensitivity of using workers' compensation as expected payer as the indicator of work-relatedness needs to be determined to assess the proportion of work-related injuries and illnesses that may be missed by this type of analysis.
- The use of secondary diagnosis codes may provide a fuller characterization of illnesses and injuries.
- The possibility of linking the ED data with workers' compensation data from the Massachusetts Department of Industrial Accidents would provide the opportunity for a much richer assessment of the employment circumstances surrounding serious injuries, patients' success in accessing timely and appropriate medical care, and identifying prevention opportunities.

These analyses may prove useful in assessing data quality for surveillance and extending the range of occupational health issues that can be addressed using these data.

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