Work-Related Burns Michigan 2017

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Michigan Department of
Labor and Economic Opportunity

Work-Related Burns in Michigan, 2017

A Joint Report of the

Michigan Department of Health and Human Services
Bureau of Epidemiology and Population Health
Division of Environmental Health
333 South Grand Avenue
PO Box 30195
Lansing, Michigan 48909

and

Michigan State University
College of Human Medicine
Division of Occupational and Environmental Medicine
909 Wilson Road, room 117 West Fee Hall
East Lansing, Michigan 48824

and the

Michigan Department of Labor and Economic Opportunity
Michigan Occupational Safety and Health Administration
530 West Allegan Street
PO Box 30643
Lansing, MI 48909

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EXECUTIVE SUMMARY

The Division of Occupational and Environmental Medicine at Michigan State University (MSU) and the Michigan Department of Health and Human Services (MDHHS) operate a surveillance system for monitoring work-related burns in Michigan. This report describes these injuries for 2017. Key results include:

- Work-related burns were identified through medical records submitted by hospitals, poison control center reports, Workers' Compensation claims, and the Michigan Fatality Assessment and Control Evaluation (MIFACE) program.
- There were 1,831 work-related burns, including one death, among workers in Michigan, representing a 2.1 percent increase from the previous year.
- The Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses (BLS SOII) estimated that only 630 work-related burns occurred in 2017. The BLS estimate was 65.6 percent lower than the Michigan-based surveillance system.
- Almost two out of three burns (64.6 percent) were among male workers and the rate of work-related burns among males was 59.2 percent higher than the rate among females.
- The most common areas of the body affected were wrists and hands (33.9 percent of all burn injuries in 2017).
- Most (71.4 percent) burns were caused by a thermal exposure. Slightly more than one in five burns (23.5 percent) was caused by a chemical exposure. The remaining 5.1 percent of burns were caused by electrical, radiation, other, or multiple exposures.
- The accommodation and food services industry accounted for the highest percentage (31.2 percent) of work-related burns and the highest rate of work-related burns (117.3 burns per 100,000 workers).
- For work-related burns identified through medical records, Workers' Compensation was the expected payer for medical care in 938 cases. There were an additional 28 work-related burns that received Workers' Compensation wage replacement for lost worktime, but which had another type of health care coverage listed as the expected payer.
- The Michigan Occupational Safety and Health Administration (MIOSHA) program completed inspections at 11 worksites identified by the surveillance system. MIOSHA issued 24 violations and assessed $25,100 in fines related to occupational burns in 2017.

BACKGROUND

This is the sixth report of occupational burns in Michigan, covering injuries that occurred to Michigan workers in 2017. Occupational burns are a preventable work-related injury and are among the most traumatic injuries that can occur in a workplace. Health professionals and health facilities are required to report all traumatic injuries, defined as bodily damage resulting from exposure to physical agents such as mechanical energy, thermal energy, ionizing radiation, or resulting from the deprivation of basic environmental requirements such as oxygen or heat when requested by the Michigan Department of Health and Human Services (MDHHS) or a local health department.[1] This administrative rule supports the surveillance of occupational injuries, including burns, giving MDHHS the authority to mandate reporting of work-related injuries. These reports are used to identify causes of work-related burns, target interventions to reduce the risk of burns, and evaluate the effectiveness of interventions.

The Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses (BLS SOII), which serves as the official source of work-related injury and illness statistics, reported that 630 work-related burns occurred in Michigan in 2017 (incidence rate of 19.0 burns per 100,000 workers).[2] The BLS SOII estimates are based on employer reporting and include private industry and state and local government workers but not the self-employed, independent contractors or workers employed by farms with fewer than 11 employees.

Michigan State University's Occupational and Environmental Medicine Division operates the burn surveillance system as the bona fide agent for MDHHS. Once a work-related burn diagnosis is confirmed and a case meets specific criteria, the Michigan Occupational Safety and Health Administration (MIOSHA) may decide to conduct a workplace investigation.

DATA SOURCES AND METHODS

Work-related burn reports for the Michigan work-related burns surveillance system were received from the following four sources:

1. Hospitals/Emergency Departments (ED)
2. Workers' Disability Compensation Agency (WDCA)
3. Poison Control Center (PCC)
4. Michigan Fatality Assessment and Control Evaluation (MIFACE)[3]

All acute care hospitals in Michigan, including Veterans Administration hospitals, are required to report work-related burns. Medical records were used to identify work-related burns treated at hospital/emergency departments or at a hospital-based outpatient clinic. Injuries identified through medical records were eligible for inclusion if the injury occurred in Michigan, the individual was 14 years or older at the time of the injury, the medical record included a burn-related International Classification of Diseases, Tenth Clinical Modification (ICD-10-CM) diagnosis code as the primary or secondary diagnosis (see Table 1 for list of included ICD-10-CM codes), and the incident was documented as having occurred at work. When the medical record did not contain enough detail to determine if a burn was work-related or not, MSU staff attempted to contact the individual by phone to collect this information.

Table 1: ICD-10-CM Codes Used to Identify Burn Injuries

Injury Classification	ICD-10-CM Codes
Burn injury (by part of body burned)	T20.00-T20.79, T21.00-T21.79, T22.00-T22.79, T23.00-T23.70, T24.00-T24.79, T25.00-T25.79, T26.00-T26.92, T27.0-T27.7, T28.0-T28.9,
Burn injury (by extent of body surface involved)	T30.0, T30.4, T31.0-T31.9, T32.0-T32.9

The WDCA provided data on claims for wage replacement. Individuals are eligible for wage replacement if they miss more than seven consecutive days of work, including weekends, due to a work-related injury. Work-related burns identified through WDCA claims were eligible for inclusion if the claim was paid or expected to be paid and the injury occurred in 2017. Work-related burns were identified through the PCC when a call was made regarding a consultation for a work-related burn injury in 2017. Cases identified through the MIFACE program included Michigan workers who died from a work-related burn during 2017.

Information on the reporting source(s), type of medical visit as indicated by the medical record (inpatient hospitalization, emergency department, hospital outpatient[i], hospital name, date of admission and discharge, patient demographics, city and county of residence, payment source, employer information (name, address, North American Industry Classification System (NAICS) code), injury date and month, mechanism of the injury (type of burn), part(s) of body affected, and percentage of total body surface area burned were abstracted from medical records, PCC reports, and MIFACE reports. Cases were linked to the WCDA database based on a probabilistic match of first and last names, date, month, and year of birth, injury type, social security number, and date, month, and year of injury. The RecordLinkage Package in RStudio, Version 1.1.330 (copyright 2009-2017, RStudio, Inc) was used to perform matching. The distribution of match probability weights was inspected to determine an appropriate threshold for potential links and all potential matches were visually inspected for confirmation. WCDA cases meeting the work-related burn case definition that could not be linked to any case identified from other data sources (i.e., where the WCDA was the only source of the case report) were included as unique cases. Cases identified by more than one reporting source were deduplicated after abstracting information from all data sources.

The cause of injury was classified as either a thermal, chemical, electrical, radiation, or multiple-cause burn based on available descriptive information in the medical record or PCC report. Thermal burns are caused by contact with hot surfaces, flames, hot liquids. Chemical burns are caused by strong acids, alkalis, detergents, or solvents contacting the skin or eyes. Electrical burns are caused by contact with electric current. Radiation burns are caused by prolonged exposure to ultraviolet light or other sources of radiation such as X-rays.

The area of the body affected by the work-related burn was classified based on the ICD-10-CM code assigned in the medical record. For cases without a specific ICD-10-CM code present in the medical record, an appropriate burn injury ICD-10-CM code was assigned based on the description of the injury. Although the WCDA database does not classify injuries by ICD-CM codes, it does specify the affected area of the body. This information was used to assign an appropriate ICD-CM burn injury code for cases found only in the WCDA database. For cases

[i] Hospital outpatient visits include patients placed on an observation status.

identified only from PCC reports, the affected body area specified by the caller was translated into an appropriate ICD-CM code.

County of residence was abstracted from medical records, if available. For cases with missing information on their county of residence, but which had a record in the WDCA database, county was derived from the zip code of residence listed in the claim. Zip codes were converted to counties using the U.S. Census Bureau 2010 ZIP Code Tabulation Area Relationship Files if the zip code was fully contained within a single county. Cases with a residence zip code that spanned multiple counties were assigned to the “Unknown County” category.

For cases that met criteria for a MIOSHA inspection (see pg. 18) but had no employer or workplace information recorded, the injured individuals were contacted by telephone to obtain the missing information. For cases that were reviewed by MIOSHA, the results of the review, including if an inspection was performed, the inspection date, number of violations found, and total fines assessed were also obtained.

Database management was conducted using Microsoft Access. Data analysis was performed using RStudio© software. Incidence rates of work-related burns by age, sex, and industry were calculated using the U.S. Census, Department of Labor’s Current Population Survey for denominators.[4] Incidence rates of work-related burns by county of residence were calculated using the U.S. Census, Department of Labor’s Local Area Unemployment Statistics for denominators.[5]

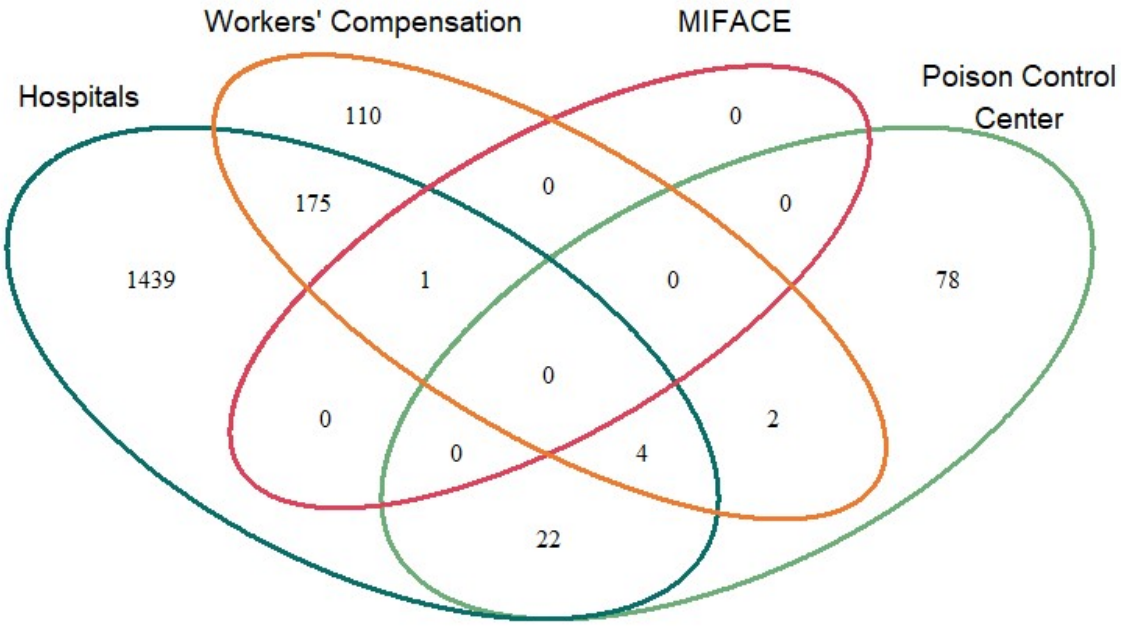
The Michigan work-related burns data were compared to the data from the BLS SOII, which is the nationwide work-related injury/illness surveillance system based on a sample of employers reporting work-related injuries and illnesses in their establishments. The BLS Occupational Injuries and Illnesses and Fatal Injuries Profiles online tool was used to generate numbers and incidence rates of nonfatal occupational burns and corrosions involving days away from work.[2]

RESULTS

REPORTING SOURCES

A total of 1,831 work-related burn incidents were identified through the Michigan work-related burns surveillance system in 2017. Of these, 1,818 (99.3 percent) occurred to Michigan residents and 13 occurred to non-Michigan residents. A total of 1,641 cases were identified by hospital-submitted medical charts, 292 cases were identified in the WDCA database, 106 cases were identified from PCC reports, and one case was identified in MIFACE records (Figure 1). The majority (88.9 percent) of cases were identified by a single data source. The remaining 11.1 percent of cases were identified by two or more sources.

Figure 1: Work-Related Burns by Reporting Source, Michigan 2017



Data Source: Michigan work-related burns surveillance system
Note: Figure for illustrative purposes only. The size of each oval does not correspond to the number of cases identified by that source.

Of the 292 cases identified from WDCA, 263 had their injury classified as either a thermal or chemical burn on the claim (Table 2). The remaining 29 cases had a non-burn injury description or had an unclassified injury in the WDCA database but were included because they were matched to one or more burn reports from other data sources. WDCA cases are displayed in Table 2 by injury cause description.

Table 2: Injury Causes of Work-Related Burn Cases Identified in Workers' Compensation Claims, Michigan 2017

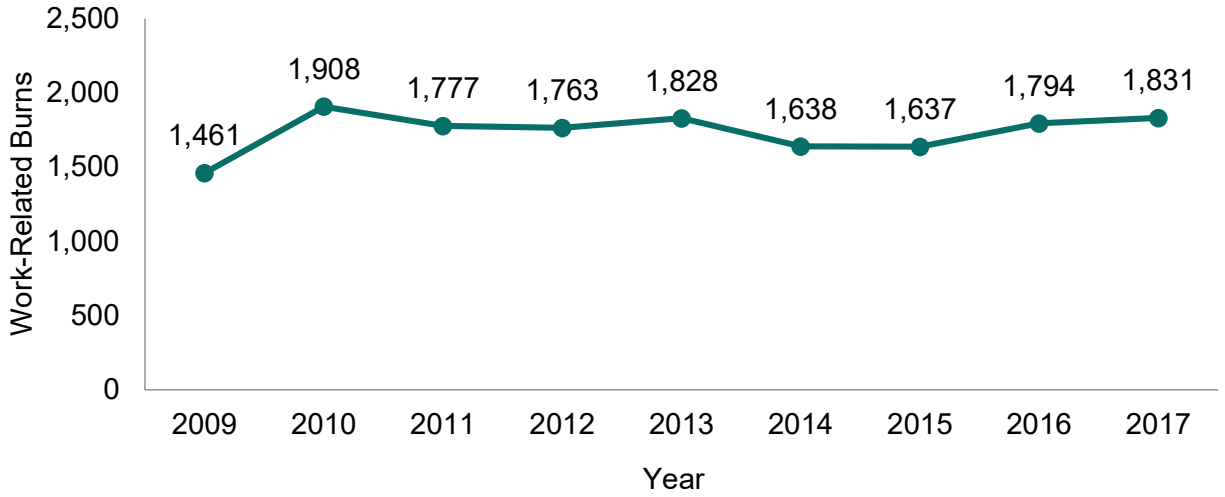
Injury Cause	Number	Percent
Amputation	-	-
Burn (Chemical)	237	81.2%
Burn (Thermal)	26	8.9%
Cut/Laceration	-	-
Electric Shock	6	2.1%
Fracture	-	-
Joint Inflammation	-	-
Abrasion	-	-
Multiple Injuries	-	-
Strains/Sprains	6	2.1%
Unclassified	6	2.1%

Data Source: Michigan Department of Labor and Economic Opportunity Workers' Compensation Agency Database
Note: Numbers and corresponding percentages are suppressed when the number of cases is between one and five to protect the confidentiality of individuals.

REPORTS BY YEAR

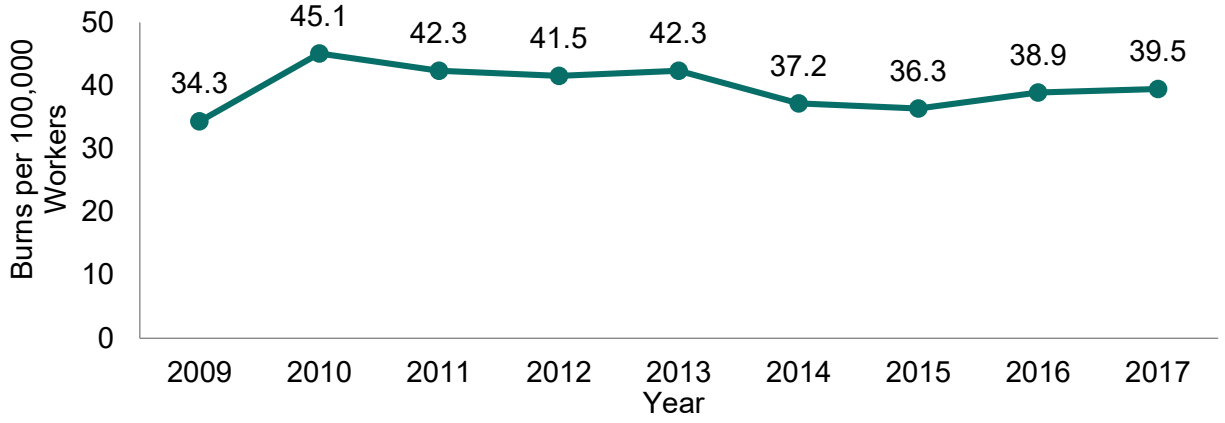
The annual number of work-related burns reached a seven-year high in 2017 (Figure 2). The 1,831 work-related burn incidents among Michigan workers in 2017 represent 1,820 individuals. There were 11 individuals who experienced two unique burn injuries during the surveillance period. The average number of work-related burns among Michigan workers from 2009 to 2017 was 1,737.4 burns (95 percent confidence interval (CI): 1,653.7 – 1,821.2). The rate of work-related burns increased slightly in 2017 compared to the previous year (Figure 3). The average rate of work-related burns per 100,000 employed individuals was 39.7 (95 percent CI: 37.6 – 41.8).

Figure 2: Number of Work-Related Burns, Michigan 2009-2017



Data Source: Michigan work-related burns surveillance system

Figure 3: Rate (per 100,000) of Work-Related Burns, Michigan 2009-2017



Data Sources: Michigan work-related burns surveillance system; Current Population Survey, Bureau of Labor Statistics.
Note: Rates for prior years may fluctuate over time due to revisions in the estimate of employed individuals.

VISIT TYPE

Type of medical care was determined by review of medical records or PCC consultation records, if available. Among the 1,721 work-related burns with a medical record or PCC consultation, 88.4 percent received care in an emergency department setting (Table 3). Among the 77 cases that were admitted for inpatient care, 64 (83.1 percent) were hospitalized overnight and 13 (16.9 percent) were discharged within the same day. The remaining 7.1 percent of work-related burns received another type of medical care such as a PCC consultation, clinic visit or outpatient surgery.

Table 3: Work-Related Burns by the Type of Medical Encounter, Michigan 2017

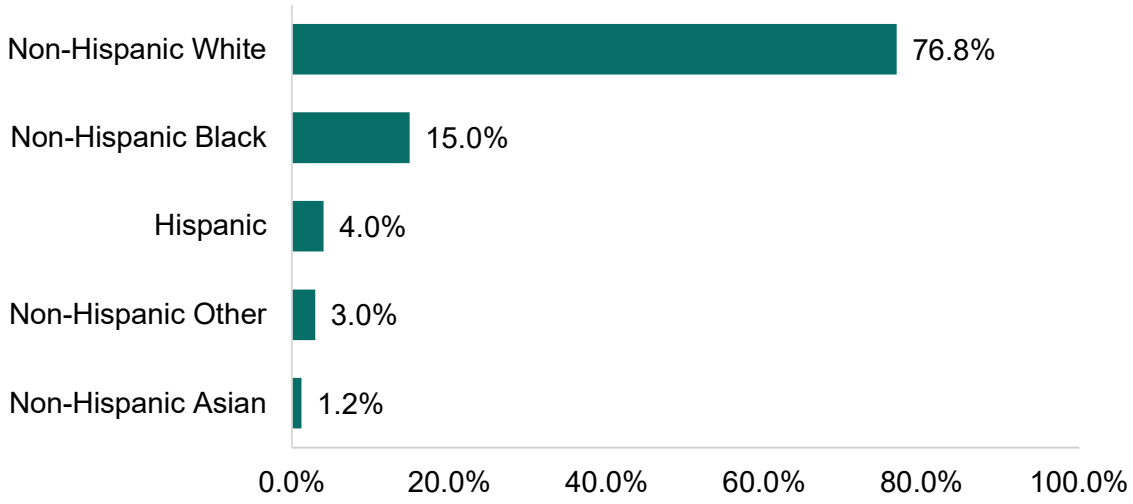
	Number	Percent
Emergency Department	1,522	88.4%
Inpatient Hospitalization	77	4.5%
Other*	122	7.1%
Total	**1,721**	**100.0%**

Data Source: Michigan work-related burns surveillance system
**Other includes PCC consultations, wound clinic visits, outpatient surgery records, occupational health clinic visits, and other unspecified medical care visits.*

RACE AND ETHNICITY

Race and ethnicity are not recorded on Workers' Compensation claims, therefore race and ethnicity cannot be determined for the 110 cases identified only through Workers' Compensation. Among the 1,721 cases identified through medical records, PCC, or MIFACE, 46.8 percent were missing information on race and ethnicity. Only 915 (50.0 percent) of all cases had race and ethnicity information documented. Non-Hispanic whites accounted for the largest proportion of cases with a known race and ethnicity (Figure 4).

Figure 4: Percent of Work-Related Burns by Race and Ethnicity, Michigan, 2017



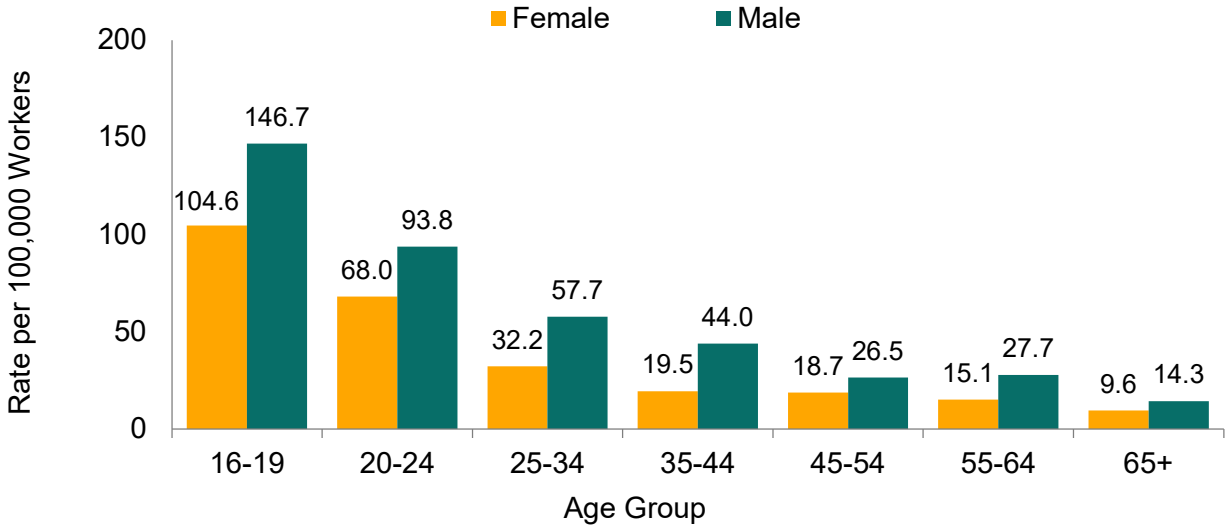
Data Source: Michigan work-related burns surveillance system
Note: This chart excludes 806 cases with an unknown race.

AGE AND GENDER

Age was reported for 1,788 (97.7 percent) of work-related burn injuries. The age of workers ranged from 15 to 75 years, with an average of 34.2 years and a median age of 31 years. Almost one-third of work-related burns (31.1 percent) occurred among workers aged 14-24 years. Gender was reported for 1,826 (99.7 percent) of work-related burn injuries. Men accounted for 64.6 percent of work-related burns (n = 1,180) and women accounted for 35.4 percent (n = 646).

Among males, rates of work-related burns were highest for workers aged 16-19 years (146.7 per 100,000). For females, the highest rate was also in the 16-19 age group (104.6 per 100,000). The rate of work-related burns typically declined with increasing age, with the exception of a small increase in the rate of work-related burns for male workers aged 55-64 years (Figure 5).

Figure 5: Rate (per 100,000) of Work-Related Burns by Age Group and Sex, Michigan 2017



Data Sources: Michigan work-related burns surveillance system; Current Population Survey, Bureau of Labor Statistics

Notes: This chart does not include 47 cases with an unknown sex or age. Rates are not calculated for workers aged 14 to 15 years due to the unavailability of a denominator for this age group and because the number of burns in this age category was fewer than six.

PART OF BODY INJURED

Slightly over a third of all work-related burns (33.9 percent) involved burns to the wrists and hands (Table 4). Less than 2 percent of work-related burns were unspecified or missing information on the affected area.

Table 4: Work-Related Burns by Area of Body Injured, Michigan 2017

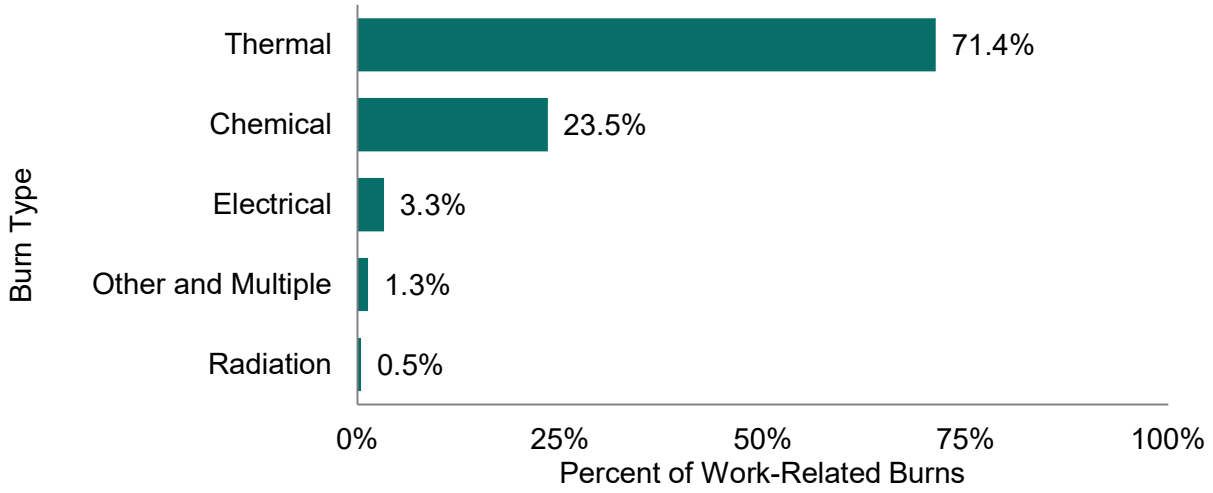
	Number	Percent
Eye	153	8.4%
Head, Face, Neck	119	6.5%
Trunk	57	3.1%
Upper Limb	289	15.8%
Wrist(s) and Hand(s)	620	33.9%
Lower Limb	239	13.1%
Multiple Specified Sites	315	17.2%
Internal Organs	-	-
Classified According to Extent*	-	-
Unspecified	30	1.6%

Data Source: Michigan work-related burns surveillance system
**Includes ICD-10-CM codes T31 and T32 and cases where the site of the burn is unspecified, but the percent of body surface burned is documented in the medical record.*
Note: Data are suppressed when the number of cases is between one and five to protect the confidentiality of individuals.

BURN TYPES

Burn type was documented for 1,637 (89.4 percent) work-related burns. Thermal burns were the most common type with 1,168 (71.4 percent) cases, followed by chemical burns which were reported for 385 (23.5 percent) cases (Figure 6). Commonly reported chemicals involved in chemical burns included sulfuric acid, hydrochloric acid, sodium hydroxide, and phosphoric acid. Electrical burns accounted for 54 (3.3 percent) cases. Radiation burns, which may result from exposure to ultraviolet rays while welding, were recorded in eight (0.5 percent) cases. There were 22 cases (1.3 percent) that had other or multiple burn types recorded.

Figure 6: Work-Related Burns by Type, Michigan 2017

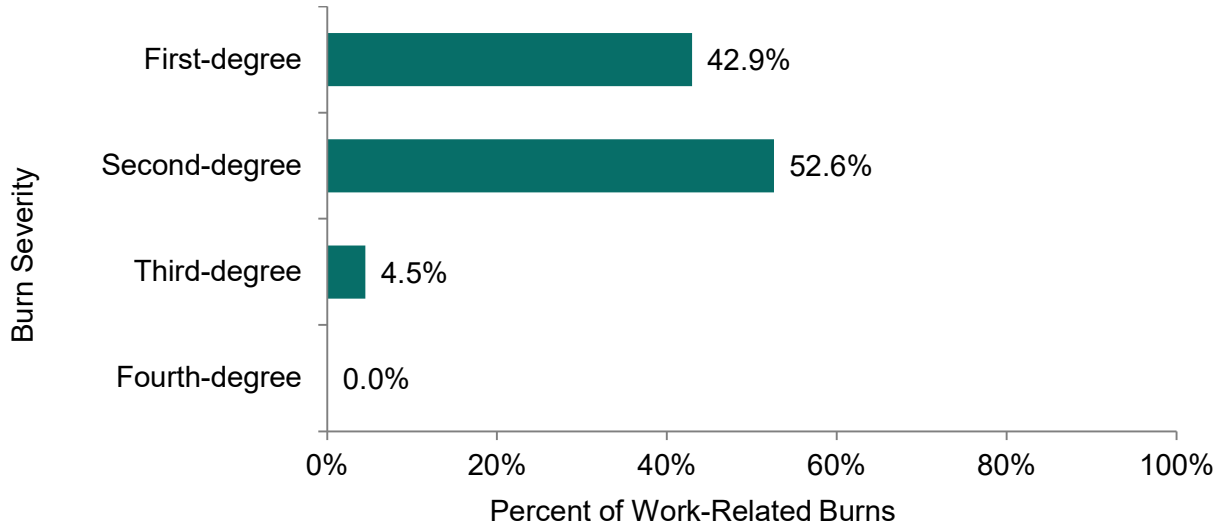


Data Source: Michigan work-related burns surveillance system
Note: This chart excludes 194 cases with an unknown burn type.

SEVERITY

The burn degree was specified for 1,721 (94.0 percent) cases. Burns were classified as second-degree in more than half of all cases (52.6 percent). Roughly one in-twenty-two (4.5 percent) work related burns was classified as third-degree. No cases were diagnosed with a fourth-degree burn (Figure 7).

Figure 7: Work-Related Burns by Maximum Severity*, Michigan 2017



Data Source: Michigan work-related burns surveillance system
Note: This chart excludes 110 cases with an unknown burn severity.
**A first-degree, or superficial burn is the least serious and involves only the outermost layer of the skin called the epidermis. A second-degree, or partial thickness burn involves the epidermis and a portion of dermis (the second layer of the skin). A third-degree, or full thickness burn involves the epidermis and dermis and permanently destroys tissue. A fourth-degree burn, the most severe burn, extends through the epidermis, dermis, subcutaneous tissue and into muscle and bone. The skin damaged by a fourth-degree burn is not able to heal itself.*

COUNTY OF RESIDENCE

Table 5 presents the number and percent of work-related burns by county of residence among the 1,636 Michigan residents where county of residence was known. One in ten work-related burn cases among Michigan residents (10.0 percent) had an unknown county of residence. Wayne County had the highest number of residents who sustained a work-related burn with 291 cases (17.8 percent), followed by Macomb County with 113 cases (6.9 percent). These data do not necessarily indicate where high-risk worksites were located because workers may be employed outside their county of residence.

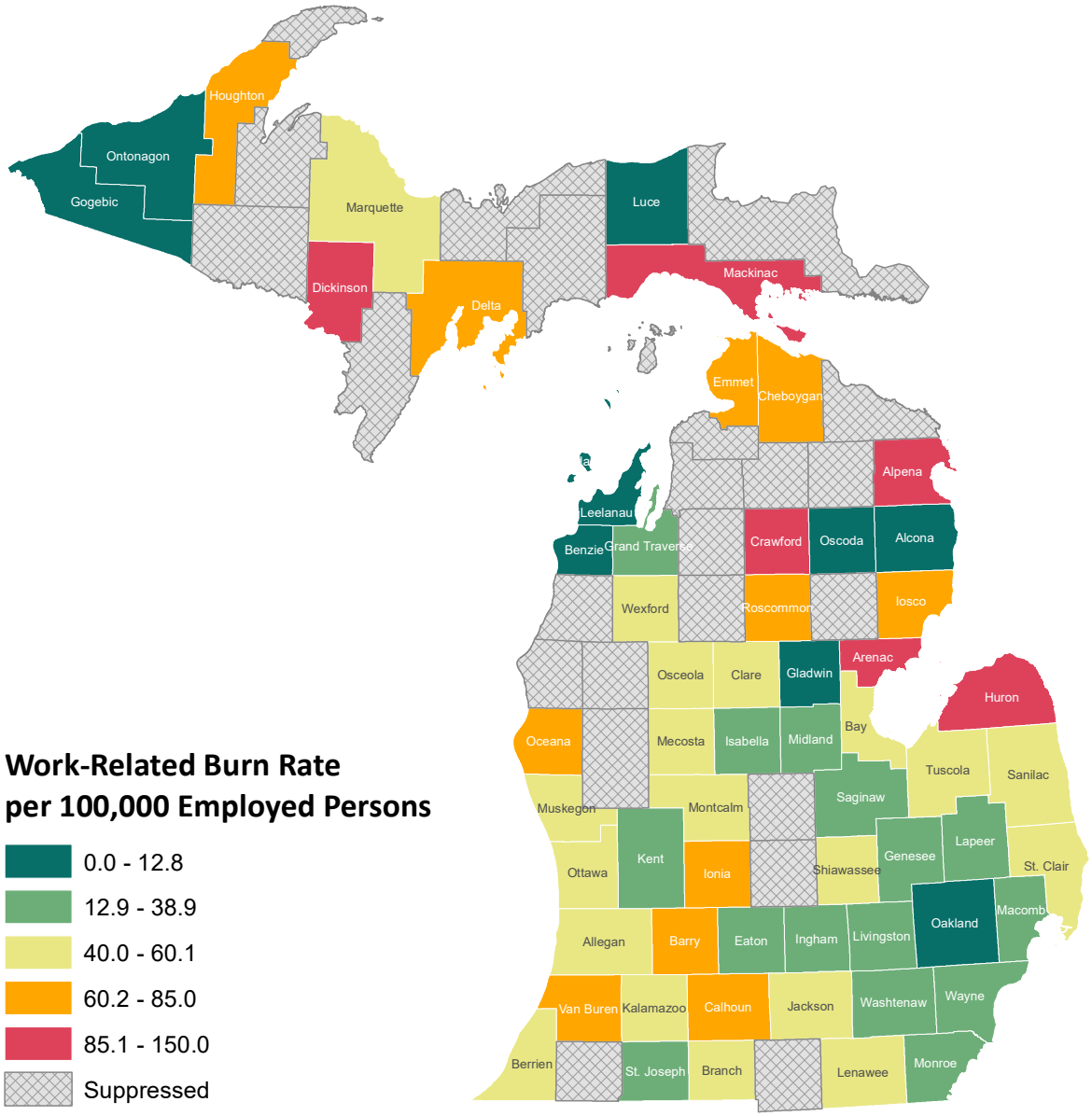
Table 5: Work-Related Burn Cases by County of Residence, Michigan 2017

County	Number (Percent)	County	Number (Percent)
Alcona	0 (0.0%)	Lake	-
Alger	-	Lapeer	11 (0.7%)
Allegan	34 (2.1%)	Leelanau	0 (0.0%)
Alpena	16 (1.0%)	Lenawee	20 (1.2%)
Antrim	-	Livingston	29 (1.8%)
Arenac	6 (0.4%)	Luce	0 (0.0%)
Baraga	-	Mackinac	7 (0.4%)
Barry	20 (1.2%)	Macomb	113 (6.9%)
Bay	20 (1.2%)	Manistee	-
Benzie	0 (0.0%)	Marquette	14 (0.9%)
Berrien	36 (2.2%)	Mason	-
Branch	9 (0.6%)	Mecosta	10 (0.6%)
Calhoun	38 (2.3%)	Menominee	-
Cass	-	Midland	11 (0.7%)
Charlevoix	-	Missaukee	-
Cheboygan	8 (0.5%)	Monroe	23 (1.4%)
Chippewa	-	Montcalm	11 (0.7%)
Clare	6 (0.4%)	Montmorency	-
Clinton	-	Muskegon	39 (2.4%)
Crawford	6 (0.4%)	Newaygo	-
Delta	12 (0.7%)	Oakland	82 (5.0%)
Dickinson	12 (0.7%)	Oceana	8 (0.5%)
Eaton	20 (1.2%)	Ogemaw	-
Emmet	14 (0.9%)	Ontonagon	0 (0.0%)
Genesee	64 (3.9%)	Osceola	6 (0.4%)
Gladwin	0 (0.0%)	Oscoda	0 (0.0%)
Gogebic	0 (0.0%)	Otsego	-
Grand Traverse	17 (1.0%)	Ottawa	66 (4.0%)
Gratiot	-	Presque Isle	-
Hillsdale	-	Roscommon	6 (0.4%)
Houghton	11 (0.7%)	Saginaw	31 (1.9%)
Huron	16 (1.0%)	Saint Clair	39 (2.4%)
Ingham	35 (2.1%)	Saint Joseph	9 (0.6%)
Ionia	19 (1.2%)	Sanilac	9 (0.6%)
Iosco	7 (0.4%)	Schoolcraft	-
Iron	-	Shiawassee	15 (0.9%)
Isabella	10 (0.6%)	Tuscola	12 (0.7%)
Jackson	39 (2.4%)	Van Buren	23 (1.4%)
Kalamazoo	58 (3.5%)	Washtenaw	44 (2.7%)
Kalkaska	-	Wayne	291 (17.8%)
Kent	98 (6.0%)	Wexford	7 (0.4%)
Keweenaw	-		

Data Source: Michigan work-related burns surveillance system
Notes: This table includes only Michigan residents. This table excludes 182 Michigan residents with an unknown county of residence. Data were suppressed when the number of cases was between one and five to protect the confidentiality of individuals.

Although the number of work-related burns was highest in large, urban counties in Central and Southeast Michigan, the rate of work-related burns per 100,000 employed residents tended to be higher in rural counties in the northern Lower Peninsula and Upper Peninsula (Figure 8). Mackinac County had the highest rate of work-related burns, with 150.0 burns per 100,000 employed residents. Rate calculations excluded residents of other states.

Figure 8: Rate of Work-Related Burns (per 100,000) by County of Residence, Michigan 2017



Data Sources: Michigan work-related burns surveillance system; Local Area Unemployment Statistics, Bureau of Labor Statistics
Notes: This map only includes cases among Michigan residents. This map excludes 182 Michigan resident cases with an unknown county. Data were suppressed when the number of cases was between one and five due to statistical unreliability and to protect the confidentiality of individuals. Rates were classified into categories based on natural breaks.

INDUSTRY

The industry of the workplace where the work-related burn occurred was determined for 1,464 (80.0 percent) cases. Cases classified into NAICS industry sector categories, as shown in Table 6. The accommodation and food service industry sector had the highest number (457 cases) and rate of work-related burns at 117.3 work-related burns per 100,000 employed individuals (Table 6). The majority (97.8 percent) of burns in the accommodation and food service industry were within the food services and drinking places subsector.

Table 6: Number, Percent, and Rate Work-Related Burns by Industry, Michigan 2017

NAICS	Description	Number	Percent	Rate per 100,000†
11	Agriculture, Forestry, Fishing and Hunting	29	2.0%	99.6
21	Mining, Quarrying, and Oil and Gas Extraction	-	-	-
22	Utilities	-	-	-
23	Construction	88	6.0%	52.5
31-33	**Manufacturing (Total)**	284	19.4%	46.7
31	*Food, Beverage, Textile Manufacturing*	*57*	*3.9%*	*111.9*
32	*Wood Products, Paper, Petroleum and Coal Products Manufacturing*	*62*	*4.2%*	*52.4*
33	*Primary Metal Manufacturing*	*165*	*11.3%*	*37.6*
42	Wholesale Trade	46	3.1%	26.6
44-45	Retail Trade	101	6.9%	21.9
48-49	Transportation and Warehousing	24	1.6%	19.9
51	Information	9	0.6%	15.1
52	Finance and Insurance	-	-	-
53	Real Estate and Rental and Leasing	11	0.8%	20.2
54	Professional, Scientific, and Technical Services	14	1.0%	4.8
55	Management of Companies and Enterprises	-	-	-
56	Administrative and Support and Waste Management and Remediation Services	65	4.4%	22.6
61	Educational Services	41	2.8%	12.5
62	Health Care and Social Assistance	142	9.7%	22.0
71	Arts, Entertainment, and Recreation	46	3.1%	82.0
72	Accommodation and Food Services	457	31.2%	117.3
81	Other Services (except Public Administration)	43	2.9%	31.5
92	Public Administration	52	3.6%	34.8

Data Sources: Michigan work-related burns surveillance system; Current Population Survey, Bureau of Labor Statistics

Notes: This table excludes 367 cases with an unknown industry. Data were suppressed when the number of cases was between one and five due to statistical unreliability and to protect the confidentiality of individuals.

SEVERITY OF BURNS BY INDUSTRY

The primary metal manufacturing industry had the highest percentage of burns classified as a third-degree burn (14.5 percent). The other service industry, excluding public services, had the highest percentage of work-related burns classified as first-degree (62.8 percent), which are the least severe burns. Although the real estate and rental and leasing industry had the highest percentage of second-degree burns (72.7 percent), the accommodation and food services industry had the highest number of second-degree burns (288) (Table 7).

Table 7: Number and Percent of Work-Related Burns by Severity* within Industry Groups, Michigan 2017

	1st Degree	2nd Degree	3rd Degree	4th Degree	Unspecified
Agriculture, Forestry, Fishing and Hunting	17 (58.6%)	8 (27.6%)	-	0 (0.0%)	-
Mining, Quarrying, and Oil and Gas Extraction	-	-	0 (0.0%)	0 (0.0%)	0 (0.0%)
Utilities	-	-	0 (0.0%)	0 (0.0%)	0 (0.0%)
Construction	32 (36.4%)	41 (46.6%)	11 (12.5%)	0 (0.0%)	-
Manufacturing (Total)	**106 (37.3%)**	**127 (44.7%)**	**30 (10.6%)**	**0 (0.0%)**	**21 (7.4%)**
Food, Beverage, Textile Manufacturing	*25 (43.9%)*	*26 (45.6%)*	*-*	*0 (0.0%)*	*-*
Wood, Paper, Petroleum and Coal Products Manufacturing	*20 (32.3%)*	*35 (56.5%)*	*-*	*0 (0.0%)*	*-*
Primary Metal Manufacturing	*61 (37.0%)*	*66 (40.0%)*	*24 (14.5%)*	*0 (0.0%)*	*14 (8.5%)*
Wholesale Trade	17 (37.0%)	24 (52.2%)	-	0 (0.0%)	-
Retail Trade	42 (41.6%)	53 (52.5%)	-	0 (0.0%)	-
Transportation and Warehousing	10 (41.7%)	12 (50.0%)	-	0 (0.0%)	-
Information	-	6 (66.7%)	0 (0.0%)	0 (0.0%)	-
Finance and Insurance	-	-	0 (0.0%)	0 (0.0%)	0 (0.0%)
Real Estate and Rental and Leasing	-	8 (72.7%)	0 (0.0%)	0 (0.0%)	-
Professional, Scientific, and Technical Services	-	-	-	0 (0.0%)	-
Management of Companies and Enterprises	0 (0.0%)	-	0 (0.0%)	0 (0.0%)	0 (0.0%)
Admin, Support, Waste Management and Remediation Services	26 (40.0%)	36 (55.4%)	-	0 (0.0%)	-
Educational Services	18 (43.9%)	23 (56.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Health Care and Social Assistance	79 (55.6%)	58 (40.8%)	-	0 (0.0%)	-
Arts, Entertainment, and Recreation	25 (54.3%)	20 (43.5%)	-	0 (0.0%)	-
Accommodation and Food Services	156 (34.1%)	288 (63.0%)	11 (2.4%)	0 (0.0%)	-
Other Services (except Public Administration)	27 (62.8%)	14 (32.6%)	-	0 (0.0%)	-
Public Administration	19 (36.5%)	33 (63.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Total	**589 (40.2%)**	**764 (52.2%)**	**69 (4.7%)**	**0 (0.0%)**	**42 (2.9%)**

Data Sources: Michigan work-related burns surveillance system

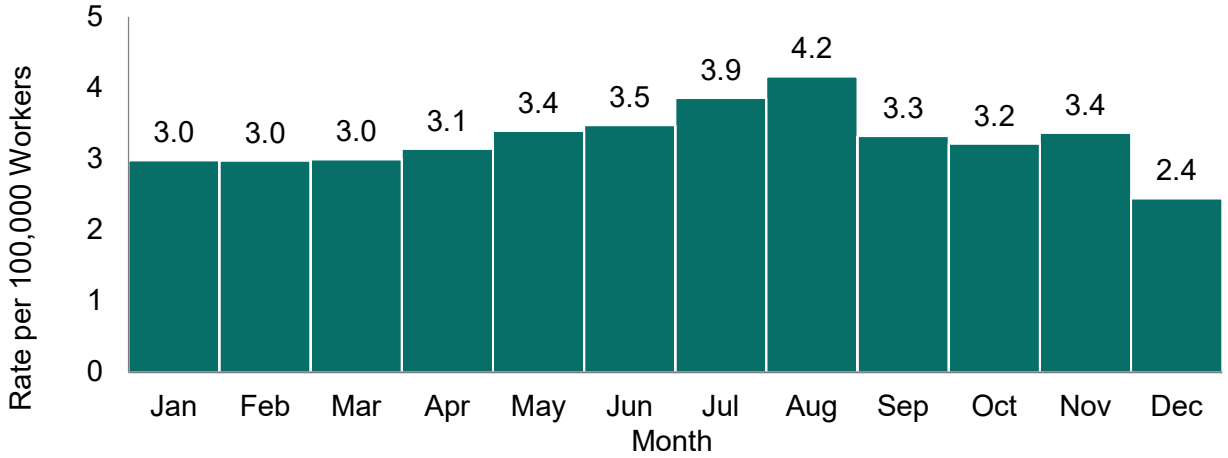
**A first-degree, or superficial burn, is the least serious and involves only the outermost layer of the skin called the epidermis. A second-degree, or partial thickness burn, involves the epidermis and a portion of dermis (the second layer of the skin). A third-degree, or full thickness burn, involves the epidermis and dermis and permanently destroys tissue. A fourth-degree burn, the most severe burn, extends through the epidermis, dermis, subcutaneous tissue and into muscle and bone. The skin damaged by a fourth-degree burn is not able to heal itself.*

Notes: This table excludes 367 cases with an unknown industry. Data were suppressed when the number of cases was between one and five due to statistical unreliability and to protect the confidentiality of individuals.

MONTH OF INJURY

The month of injury was documented for all 1,831 cases. The rate of work-related burns was highest in August and July, at 4.2 and 3.9 work-related burns per 100,000 workers, respectively (Figure 9). The lowest rate occurred in December, with 2.4 burns per 100,000 workers. Seasonally adjusted estimates of employed individuals were used as the denominator for rate calculation to account for fluctuations in the workforce due to seasonal hiring patterns.

Figure 9: Rate (per 100,000) of Work-Related Burns by Month of Injury, Michigan 2017



Data Sources: Michigan work-related burns surveillance system; Bureau of Labor Statistics' Local Area Unemployment Statistics seasonally adjusted employment estimates.

SOURCE OF PAYMENT

Workers' Compensation was the expected payer for medical care in 54.5 percent of the 1,721 cases with a medical record (Table 8). Among cases with an expected payer of Workers' Compensation, 137 also received wage replacement for more than seven days away from work. There were 28 work-related burns that did not list Workers' Compensation as a payment source for medical care but were matched to a record in the WCDA database. Payment source was not documented for 310 work-related burns with a medical record.

Table 8: Work-Related Burns by Expected Source of Payment for Medical Services and Receipt of Workers' Compensation Wage Replacement

Payer	Received Wage Replacement*	No Wage Replacement	Total	Percent of Cases
Workers' Compensation	137	801	938	54.5%
Commercial	6	195	201	11.7%
Self-Pay	10	77	87	5.1%
Medicaid or Medicare	3	168	171	9.9%
Other	1	13	14	0.8%
Unknown	8	302	310	18.0%

Data Source: Michigan work-related burns surveillance system

**Includes claims that are currently being paid and claims that have not been paid yet but are expected to be paid.*

MIOSHA REVIEWS

MIOSHA reviewed work-related burn cases reported to MSU OEM if the individual had been hospitalized or treated in an ED or outpatient facility, sustained at least a second-degree burn, and the injury had occurred within six months of the report. MIOSHA conducted inspections at 11 worksites. All (100.0 percent) of the 11 inspected worksites were cited for one or more MIOSHA safety violations. MIOSHA issued a total of 24 violations and $25,100 in penalties to employers based on work-related burns reported by MSU OEM (Table 9). None of the 11 worksites had abated the hazard that caused the burn at the time of the inspection, which was conducted three to six months after the burn occurred.

Table 9: Number of MIOSHA Workplace Inspections, Issued Violations and Amount of Penalties Assessed by Industry, Michigan 2017

	Inspections	Violations	Penalties
Mining, Quarrying, and Oil and Gas Extraction	1	1	$1,800
Manufacturing (Total)	**6**	**11**	**$9,600**
Food, Beverage, Textile Manufacturing	*1*	*4*	*$1,800*
Wood Products, Paper, Petroleum, Coal Products Manufacturing	*2*	*2*	*$1,800*
Primary Metal Manufacturing	*3*	*5*	*$6,000*
Wholesale Trade	1	5	$4,800
Arts, Entertainment, and Recreation	1	5	$4,900
Accommodation and Food Services	2	2	$4,000
Total	**11**	**24**	**$25,100**

Data Source: Michigan work-related burns surveillance system

TWO EXAMPLES OF MIOSHA ENFORCEMENT INSPECTIONS FOR A WORK-RELATED BURN

Improper Procedures and Failure to Report Serious Injury

An employee of a company that manufactured transformers received electrical burns to his hands while working with a high voltage piece of machinery. The employee was testing live wires on an electrical transformer without appropriate guards in place to prevent contact with live electrical parts. The employee was hospitalized overnight for treatment of his burns. Upon inspection of the worksite, MIOSHA found two violations, including one serious violation. The following citations were issued to the employer; Citation 1: when work is performed near or on equipment or circuits which are or may be energized, safety related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts (R 408.14003(1)); Citation 2: hospitalizations, amputations, and losses of an eye. Within 24 hours after the inpatient hospitalization of one or more employees or an employee's amputation or an employee's loss of an eye, as a result of a work-related incident, you must report the inpatient hospitalization, amputation, or loss of an eye to MIOSHA (R 408.22139(2)).

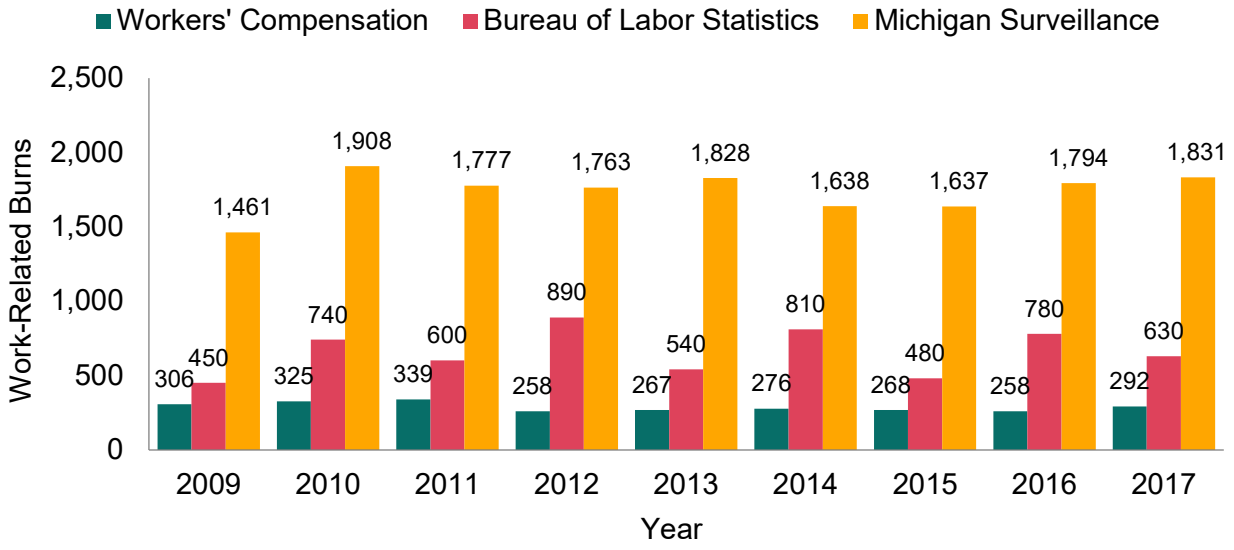
Inadequate Personal Protective Equipment

An employee of a plastic materials manufacturer sustained third-degree burns to his head and upper limbs when attempting to extinguish a fire by dousing burning plastic with water. The water caused the plastic material to combust, resulting in severe burn injuries to the employee's face and upper arms. MIOSHA issued citations for five serious workplace safety violations. The following citations were issued to the employer; Citation 1: an employer shall assess the workplace to determine if hazards are present, or are likely to be present, that necessitate the use of personal protective equipment (R 408.13308(1)); Citation 2: an employer shall ensure that each affected employee uses appropriate eye or face protection, when exposed to eye or face hazards (R 408.13312(1)); Citation 3: an employer shall ensure that each affected employee uses appropriate hand protection, when employees' hands are exposed to hazards (R 408.13392); Citation 4: an employer shall ensure that each employee who is required to work so that his or her clothing becomes wet due to a condition other than the weather or perspiration uses body protections such as aprons, coats, jackets, sleeves, or other garments that will keep the employee dry (R 408.13394(1)); Citation 5: a hand tool shall be used only of the purpose for which it was designed or approved (R 408.13831).

COMPARISON OF SURVEILLANCE SYSTEMS

The Michigan-based surveillance system has consistently detected a greater number of work-related burns than both the Workers' Compensation database and the BLS SOII over the past nine years (Figure 10). The annual number of work-related burns detected by the Michigan-based surveillance system has been on average 175 percent higher than the official BLS SOII estimates and 509 percent higher than the estimate identified from Workers' Compensation claims from 2009 through 2017. In 2017, the Michigan-based surveillance system identified 1,201 more work-related burns than the BLS SOII and 1,539 more work-related burns than Workers Compensation.

Figure 10: Number of Work-Related Burns by Surveillance Source, Michigan 2017



Data Sources: Michigan work-related burns surveillance system, Michigan Department of Labor and Economic Opportunity Workers' Disability Compensation Agency Database, Bureau of Labor Statistics 2017 Survey of Occupational Injuries and Illnesses

DISCUSSION

The overall rate of work-related burns during 2017 was 39.5 burns per 100,000 workers. The rate has remained relatively consistent over the past nine years, ranging from 34.3/100,000 to 45.1/100,000. Workers under 20 years of age experienced the highest rate of work-related burns. Males also experienced a higher rate of work-related burns compared to females. The accommodation and food service industry accounted for the highest number and rate of work-related burns with 457 cases and a rate of 117.3 work-related burns per 100,000 workers. Among these cases, 98.7 percent were in the food services and drinking places subsector, which includes full- and limited-service restaurants, caterers, bars, and other similar establishments. Most (71.4 percent) work-related burns were caused by a thermal exposure and about half were classified as a second-degree burn (52.6 percent). It is possible that the distribution of work-related burn severity is biased to more severe burns because first-degree burns are less likely to require medical treatment and less likely to result in missed days of work and thus less likely to generate a Workers' Compensation claim.

The Michigan work-related burn surveillance system has consistently detected a greater number of work-related burns than both the BLS SOII and the WCDA database from 2009 to 2017. The BLS's undercount of work-related burns is partially explained by the fact that BLS only knows the type of injury for cases with one or more days away from work or with altered work duties, whereas the Michigan multi-source surveillance system counted work-related burns regardless of how many days of work were missed or if the burn resulted in altered work duties. Secondly, the BLS excludes self-employed, household employees and farm workers who work on farms with less than 11 employees. Michigan's burn surveillance identified only 32 self-employed individuals and 23 farm workers in 2017 with a work-related burn so the difference in the type of workers covered in each system would not be an important factor to explain the undercount in the BLS data. Other possible explanations for the BLS undercount may be that employers are not providing complete case reports, the statistical sampling procedure of BLS, or employers are not properly identifying employee injuries as burns. A factor that will cause small differences in the rates between the Michigan multi-source system and BLS is that the denominator used in the Michigan multi-source system is the number of workers and BLS uses full time equivalents.

The Workers' Compensation database identified only 292 (15.9 percent) of the work-related burns. There are a number of possible explanations for the Workers' Compensation difference. 1) The WDCA data set only included burns that caused more than seven consecutive days away from work, presumably the most severe cases. 2) WDCA excluded the self-employed, but again there were only 32 self-employed workers in 2017 in Michigan' multi-source reporting system. 3) There were coding errors in the WDCA data. Matching WDCA claims with hospital records identified 29 work-related burns that were not classified as burns in the WDCA data. Potentially there were other injuries in the WDCA database that were similarly misclassified but were not identified because no medical records were received. 4) Some companies may be handling burns unofficially and not reporting them to Workers' Compensation insurance companies or the WDCA.

MIOSHA declared a strategic goal for fiscal years 2014 to 2018 to reduce the rate of worker injuries and illnesses in high-hazard industries by 15 percent (Goal 1.1) and updated it for the 2019-2023 plan to reduce the annual incidence rate in high hazard industries by 2 percent per year.[6] The Michigan-based surveillance of work-related burns is critical to supporting the achievement of this goal because it provides a reliable mechanism for measuring progress and

identifying important risk factors and helps facilitate MIOSHA reviews and inspections of potentially hazardous workplaces. Improvements to the timeliness of surveillance data, such as requiring hospitals to report cases on a quarterly basis rather than annually, have allowed MIOSHA to perform more inspections within the six-month window. Additionally, the Michigan-based surveillance system can quickly adapt to emerging issues and concerns at the state level; for example, lowering the age of cases required to be reported from 16 to 14 years in order to capture burn injuries among working teens. Data are also used to develop and target educational materials for employers and employees in high-risk industries and professions.

REFERENCES

1. Michigan Administrative Code Rule 325.301-306. Available at https://ars.apps.lara.state.mi.us/AdminCode/DeptBureauAdminCode?Department=Health%20and%20Human%20Services&Bureau=All, Accessed July 28, 2020.
2. United States Department of Labor, Bureau of Labor Statistics' Occupational Injuries and Illnesses and Fatal Injuries Profiles, 2017. Available at https://data.bls.gov/gqt/InitialPage. Accessed July 15, 2020.
3. Work Related Fatalities. Occupational and Environmental College of Human Medicine, Michigan State University. Available at http://www.oem.msu.edu/index.php/work-related-injuries/work-related-fatalities. Accessed January 8, 2019.
4. Current Population Survey Data Tables. United States Census Bureau. Employed individuals by age, gender, and industry estimates, Michigan 2017. Available at https://data.census.gov/mdat/#/. Accessed September 21, 2020.
5. Local Area Unemployment Statistics. U.S. Bureau of Labor Statistics. Available at https://www.bls.gov/lau/. Accessed July 15, 2020.
6. MIOSHA Strategic Plan Goals for FY 2014-2018 and 2019-2023. Michigan Occupational Safety and Health Administration. Michigan Department of Licensing and Regulatory Affairs. Available at https://www.michigan.gov/lara/0,4601,7-154-89334_11407_30928---,00.html. Accessed September 21, 2020.

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