

# **Work-Related Burns Michigan 2014-2016**

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A Joint Report of

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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 the years 2014 through 2016. 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 5,069 work-related burns including two deaths among Michigan residents. There were 19 individuals who had two or more separate burn incidents.
- The Bureau of Labor Statistics Survey of Occupational Injuries and Illnesses (BLS SOII) estimated only 2,070 work-related burns occurred from 2014 through 2016. This estimate was 59.1 percent lower than the Michigan-based surveillance system.
- Almost two out of three burns (64.1 percent) were among male workers and the rate of work-related burns among males was 60 percent higher compared to females.
- The most common areas of the body affected were wrists and hands (36.4 percent of cases in 2014 and 34.7 percent of all burn injuries in 2015-2016)
- Roughly half of cases (51.0 percent) were diagnosed with a second-degree burn, with 22.4 percent experiencing a first-degree burn, 4.4 percent experiencing a third-degree burn, and 22.3 percent of cases with no specified degree of burn.
- Most (65.8 percent) burns were caused by a thermal exposure. Slightly more than one in five burns (21.0 percent) were caused by a chemical exposure. The remaining 13.1 percent of burns were caused by electrical, radiation, other, or multiple exposures.
- The accommodation and food services industry accounted for the highest percentage (27.6 percent) of burns, however the mining, quarrying, and oil and gas extraction industry had the highest rate of work-related burns (251.9 burns per 100,000 workers)
- Workers' Compensation was the expected payer for medical care among 2,674 cases (56.6 percent of cases identified from medical records). The payer was unknown for 18.4 percent of cases identified by medical records.
- The Michigan Occupational Safety and Health Administration (MIOSHA) program completed inspections at 61 worksites identified by the surveillance system. MIOSHA issued 121 violations and assessed \$219,880 in fines related to occupational burns from 2014 through 2016.

## **BACKGROUND**

This is the fifth report of occupational burns in Michigan that occurred to Michigan residents from 2014 through 2016. Occupational burns are a preventable cause of 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.<sup>1</sup> This administrative rule supports the surveillance of occupational injuries, including burns, giving MDHHS the authority to mandate reporting of work-related injuries. MDHHS uses these reports 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 2,070 work-related burns occurred in Michigan from 2014 to 2016 (incidence rate of 21.6 burns per 100,000 workers).<sup>2</sup> 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
2. Workers' Compensation Agency (WCA)
3. Poison Control Center (PCC)
4. Michigan Fatality Assessment and Control Evaluation (MIFACE)<sup>3</sup>

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 (ED) or at a hospital-based outpatient clinic. Injuries identified through medical records were eligible for inclusion if the individual was a Michigan resident, 14 years or older at the time of the injury, the medical record included a burn-related International Classification of Diseases, Clinical Modification (ICD-CM) diagnosis code as the primary or secondary diagnosis (see Table 1 for list of included ICD-CM codes based on treatment date), 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, the MSU staff attempted to contact the individual by phone to collect this information.

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

	<b>ICD-9-CM (January 1, 2014 – September 30, 2015)</b>	<b>ICD-10-CM (October 1, 2015 – December 31, 2016)</b>
Burn injury (by part of body burned)	940.0-.9, 941.0-.5, 942.0-.5, 943.0-.5, 944.0-.5, 945.0-.5, 946.0-.5, 947.0-.9, 949.0-.5	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)	948.0-.9	T30.0, T30.4, T31.0-T31.9, T32.0-T32.9

The WCA provided data on claims for wage replacement. Individuals are eligible for wage replacement if they missed seven or more consecutive days of work, including weekends, due to a work-related injury. Work-related burns identified through WCA claims were eligible for inclusion if the claim was paid or expected to be paid, the injury occurred between 2014 and 2016 and the claim was filed for a Michigan resident. Work-related burns were identified through the PCC when a call was made regarding a consultation for a work-related burn injury from 2014 to 2016. Cases identified through the MIFACE program included Michigan residents who died from a work-related burn from 2014 to 2016.

Information on the reporting source(s), type of medical visit as indicated by the medical record (inpatient hospitalization, emergency department, hospital outpatient\*), 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, severity of burn, and percentage of total body surface area burned were abstracted from medical records, PCC reports, and MIFACE reports. Cases were linked to the WCA 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. WCA 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 WCA 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 severity of each work-related burn was classified as a first-, second-, third- or fourth-degree based on the thickness of tissue damage documented in the medical record. The severity of the burn was classified by the highest degree of burn present. For example, if a worker was diagnosed with both first- and second-degree burns, this case would be classified as a second-degree burn. 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 is

\* Hospital outpatient visits include patients placed on an observation status.

more serious and 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.

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 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.

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 WCA 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. 17) 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.<sup>4</sup>

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.<sup>2</sup>

## **RESULTS**

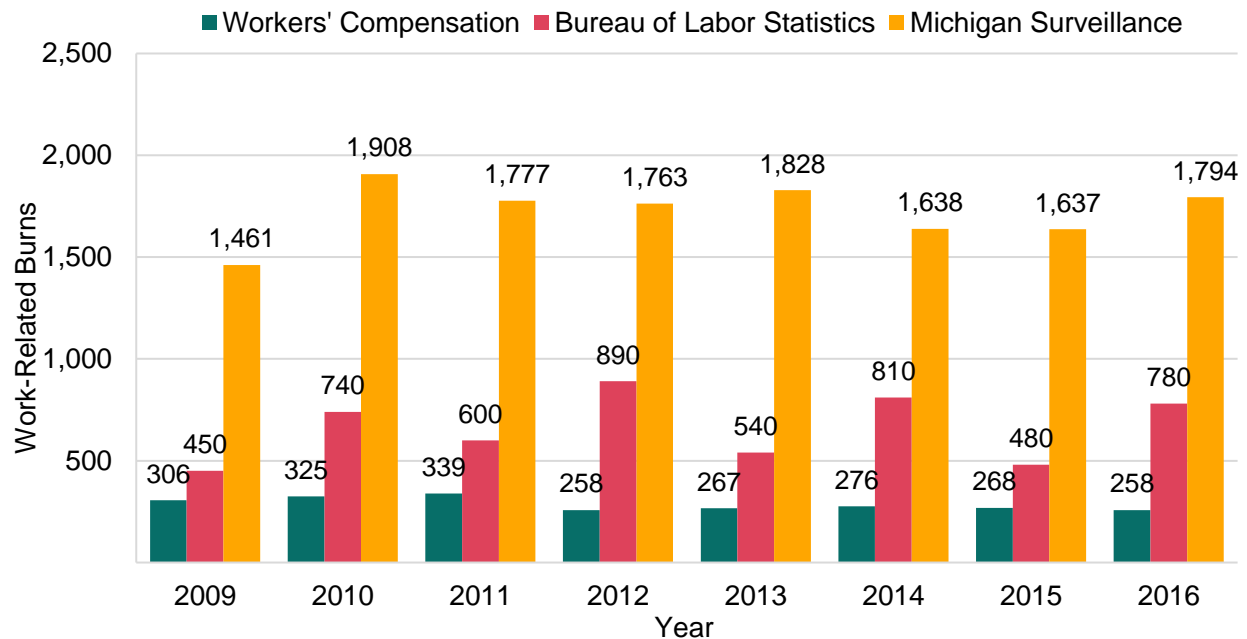
### **REPORTS BY STATE OF RESIDENCE**

A total of 5,236 work-related burn incidents were reported to MSU OEM. Of these, 5,069 occurred to Michigan residents, 64 occurred to non-Michigan residents, and 103 occurred to individuals with an unknown state of residence. Overall, 96.8 percent of work-related burn reports received were associated with Michigan residents. Only work-related burn incidents that occurred to Michigan residents were included for the remaining analysis.

## REPORTS BY SURVEILLANCE SOURCE

Figure 1 shows the number of reported work-related burns by year and surveillance source: Michigan Workers' Compensation alone, BLS SOII, and the Michigan work-related burns surveillance system. 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 past eight years. The number of work-related burns detected by the Michigan-based surveillance system have ranged from 377 percent to 595 percent higher than the burns identified solely through Workers' Compensation claims and 98 percent to 240 percent higher than the official BLS SOII estimate since 2009.

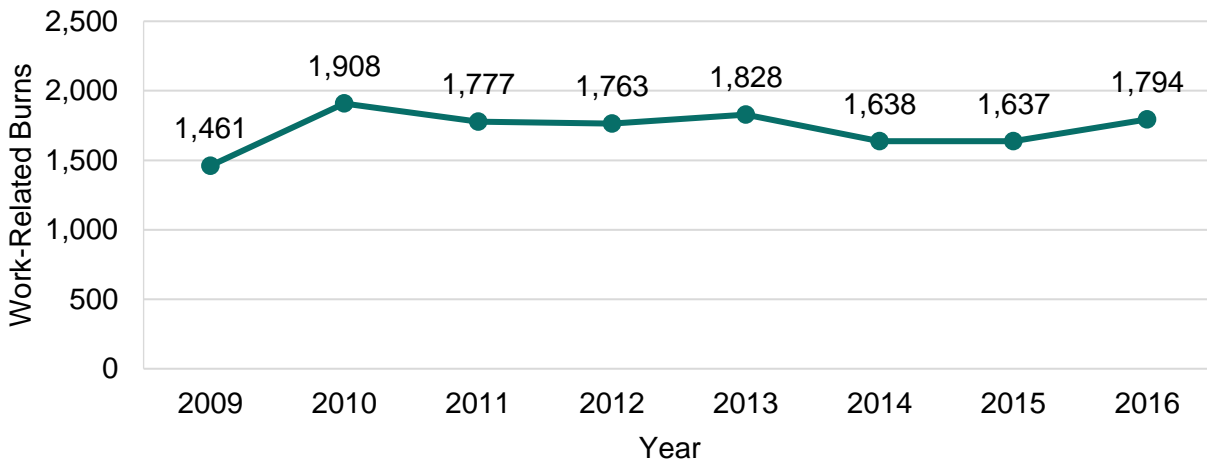
**Figure 1: Number of Work-Related Burns by Surveillance Source, Michigan 2009-2016**



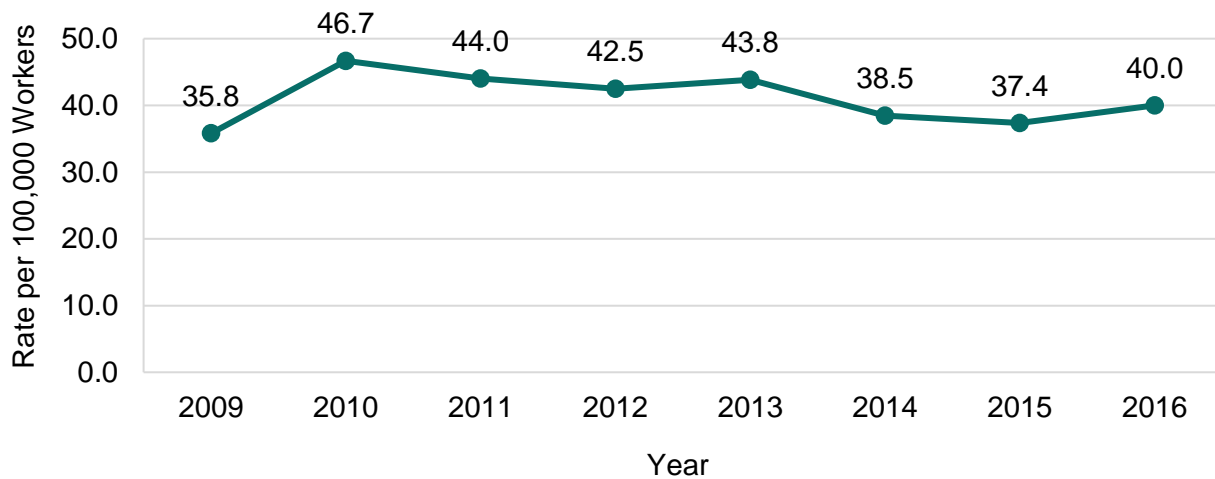
## REPORTS BY YEAR

The 5,069 work-related burn incidents among Michigan residents from 2014 to 2016 represent 5,050 individuals with 19 individuals each experiencing two unique burn injuries during the surveillance period. The number and rate of work-related burns among employed individuals has remained relatively consistent during for 2009-2016.

**Figure 2: Number of Work-Related Burns, Michigan 2009-2016**



**Figure 3: Rate (per 100,000) of Work-Related Burns, Michigan 2009-2016**

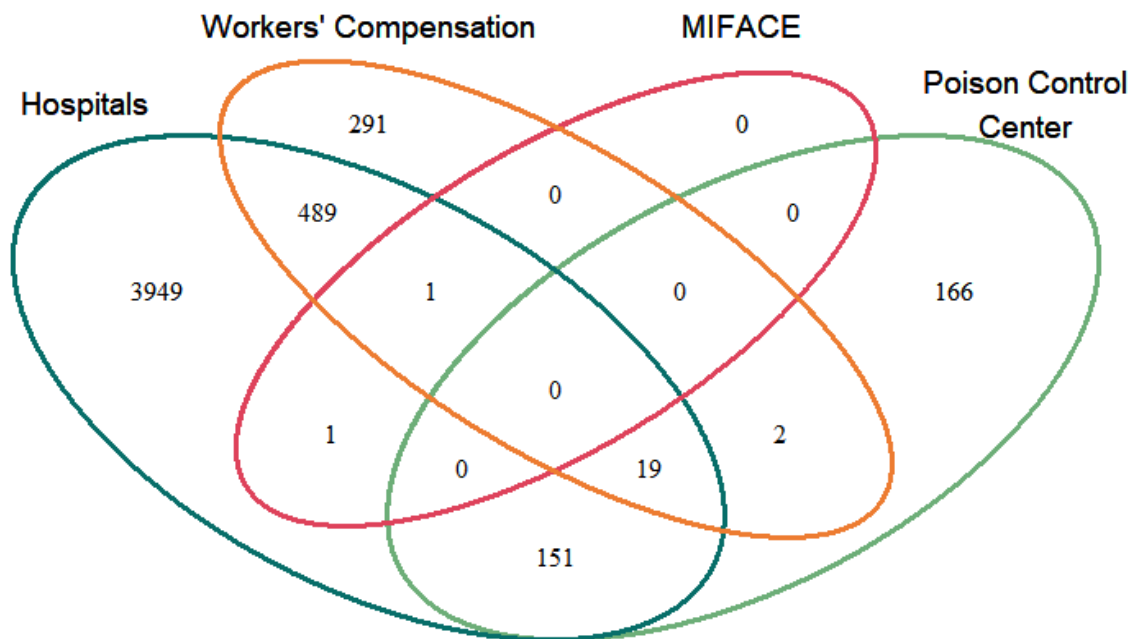




## REPORTING SOURCES

The number of work-related burns among Michigan residents by the reporting source is shown in Figure 4.

**Figure 4: Cases by Reporting Source\***



*\*Figure for illustrative purposes only. The size of each oval does not correspond to the number of cases identified by that source.*

From 2014 to 2016, hospitals identified 4,610 cases, the WCA database identified 802 cases, PCC identified 338 cases, and MIFACE identified two cases. The majority (86.9 percent) of cases were identified by a single data source. The remaining 13.1 percent of cases were identified by two or more sources. The BLS SOII estimate of 2,070 work-related burns in Michigan during this period may include a portion of the same cases, however no attempt was made to match the Michigan surveillance data set with the BLS SOII dataset due to confidentiality restrictions.

Of the 802 WCA cases, 730 were classified as caused by a thermal burn or a chemical burn. The other 72 cases had a non-burn injury description in the WCA database but were included because they were matched to one or more burn reports from other data sources. WCA cases are displayed in Table 2 by injury cause description.

**Table 2: Injury Causes of Work-Related Burn Cases Identified in Workers' Compensation Claims\***

<b>Injury Cause</b>	<b>Number</b>	<b>Percent</b>
Burn (Chemical)	637	79.4%
Burn (Thermal)	93	11.6%
Crush/Contusion	-	-
Cut/Laceration	-	-
Dermatitis	-	-
Electric shock	8	1.0%
Fracture	-	-
Freezing	-	-
Respiratory Illness	-	-
Multiple Injuries	12	1.5%
Strains/Sprains	13	1.6%
Unclassified	24	3.0%

*\*Numbers and corresponding percentages are suppressed when the number of cases is between one and five to protect the confidentiality of individuals.*

### **VISIT TYPE**

Table 3 displays the number of cases identified through medical records by visit type. Emergency department visits were the most common type of medical encounter from 2014 through 2016 for work-related burns, with 4,175 cases (90.6 percent).

**Table 3: Work-Related Burns by the Type of Medical Encounter, Michigan 2014-2016**

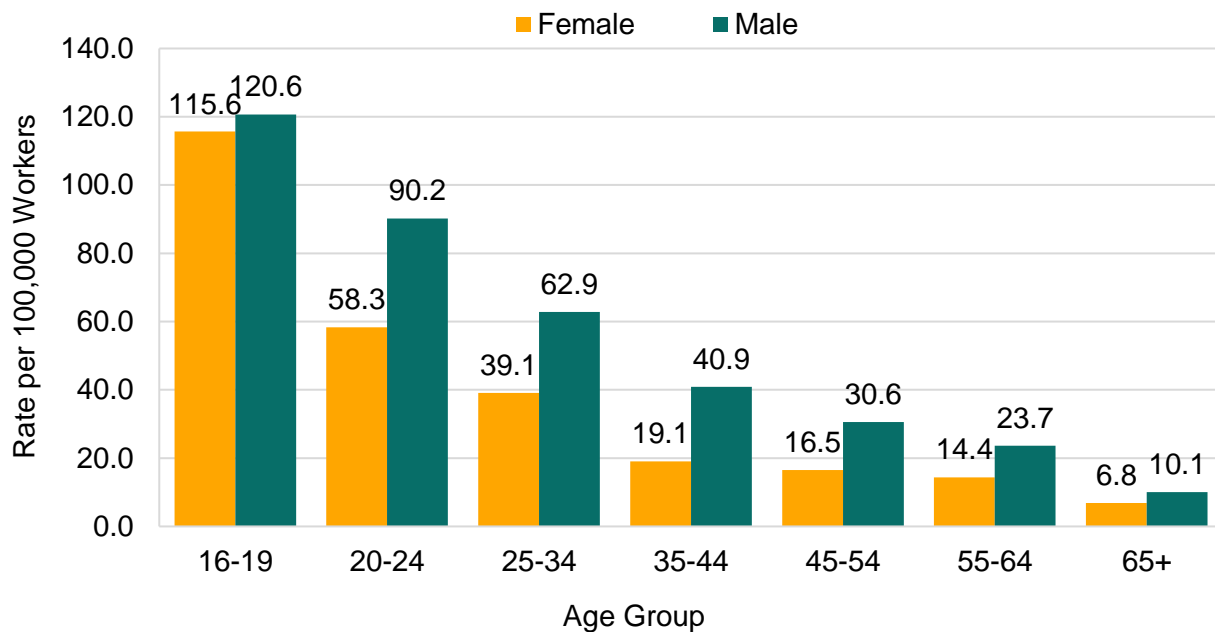
	<b>Number</b>	<b>Percent</b>
Emergency Department	4,175	90.6%
Hospitalization overnight	162	3.5%
Hospital outpatient	63	1.4%
Other*	193	4.2%
Unknown	17	0.4%
<b>Total</b>	<b>4,610</b>	<b>100.0%</b>

*\*Other includes PCC consultations, wound clinic visits, outpatient surgery records, occupational health clinic visits, and other unspecified medical care visits.*

## AGE AND GENDER

Age was reported for 5,014 (98.9 percent) of 5,069 work-related burn injuries from 2014 through 2016. The age of injured workers ranged from 14 to 87 years. The average age was 33.9 years and the median age was 31 years. Almost one-third of work-related burns (31.9 percent) occurred among workers aged 14-24 years. Men accounted for 64.1 percent of work-related burns (3,213) and women accounted for 35.7 percent (1,788). Figure 5 displays the rate of work-related burn rates by age group and sex. Among males, rates were highest for workers aged 16-19 years (120.6/100,000). For females, the highest rate was also in the 16-19 age group (115.6/100,000).

**Figure 5: Rate (per 100,000) of Work-Related Burns by Age Group and Sex, Michigan 2014-2016\***

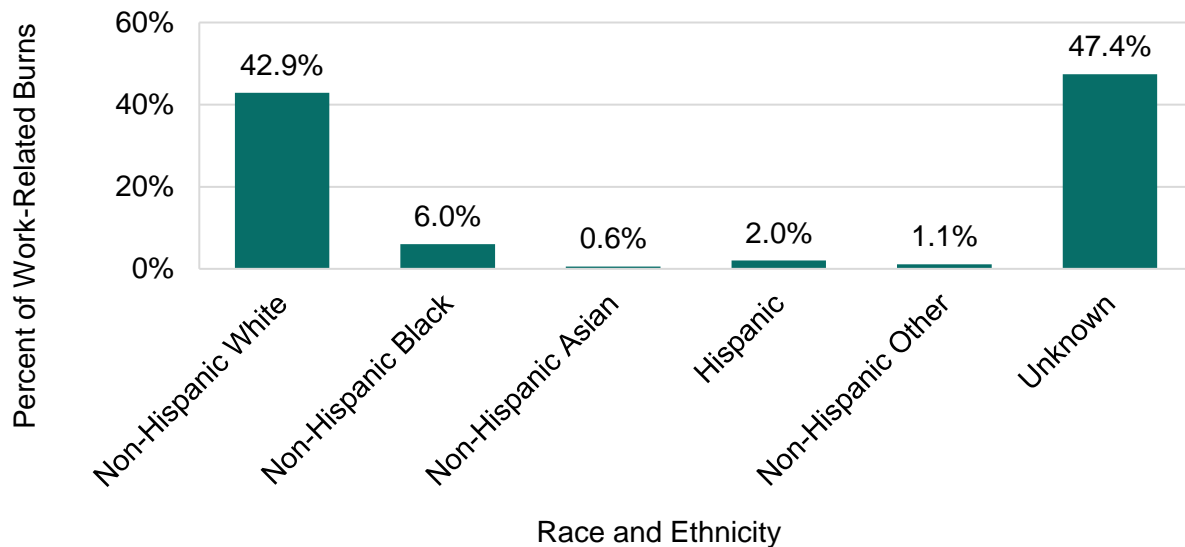


\*Rates are calculated as the number of work-related burn incidents per 100,000 workers. The number of workers employed by gender and age group was provided by Bureau of Labor Statistics' Current Population Survey. Rates are not calculated for workers aged 14 to 15 years due to the unavailability of a denominator for this age group.

## RACE AND ETHNICITY

Race and ethnicity are not recorded on Workers' Compensation claims, therefore race and ethnicity cannot be determined for cases identified only through Workers' Compensation. Among cases identified through medical records, PCC, or MIFACE, 44.2 percent were missing information on race and ethnicity. Overall, only 2,665 of 5,069 cases had race and ethnicity information documented. Non-Hispanic whites accounted for the largest proportion of cases with a known race and ethnicity (see Figure 6).

**Figure 6: Percent of Work-Related Burns by Race and Ethnicity, Michigan, 2014-2016**



## PART OF BODY INJURED

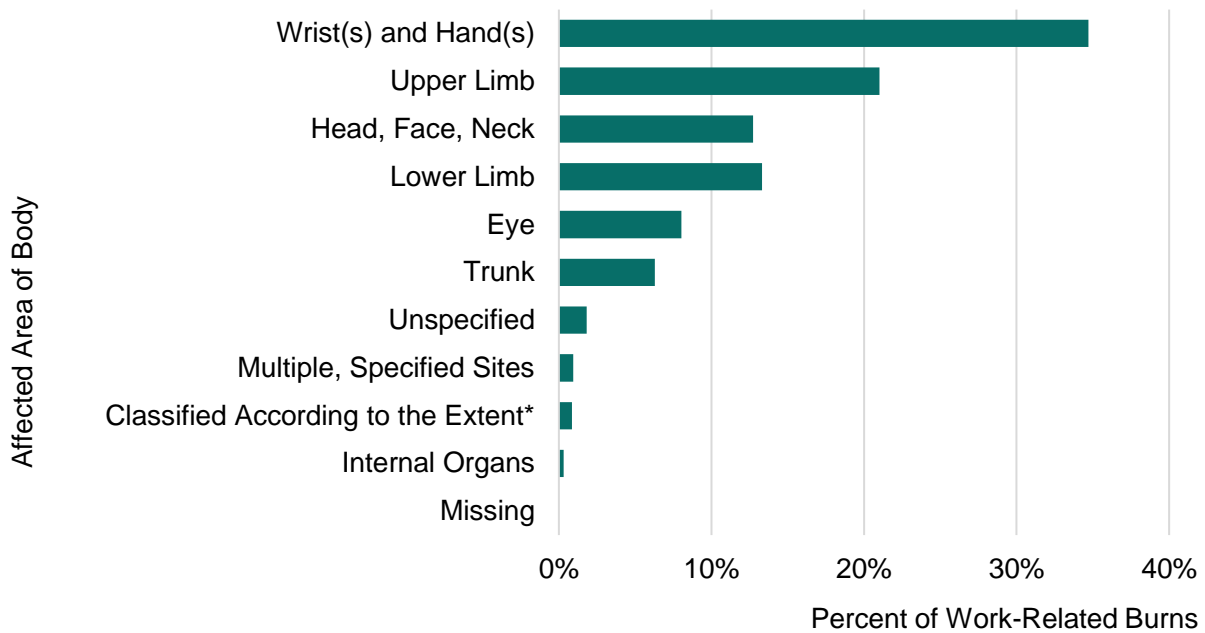
Most medical records included an ICD-9-CM or ICD-10-CM code for burn injuries as listed in Table 1. For cases with only a fire-related external cause code, an appropriate burn injury ICD-CM code was assigned based on the description of the injury in the medical record. The WCA database does not classify injuries by ICD-CM codes but 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 WCA database. For cases identified only from PCC reports, the affected body area specified by the caller was translated into ICD-CM burn injury codes. Prior to 2015, only the primary burn injury diagnosis was recorded. Beginning in 2015, all burn injury codes were recorded for each case. Therefore, only the 2015 and 2016 data representing the number of injuries related to each body part are displayed in Table 4. Figure 7 illustrates the distribution of affected body parts. Burns to the wrists and hands occurred most often (34.7 percent of all injuries from 2015 through 2016) followed by upper limb burns (21.0 percent of all injuries from 2015 through 2016).

**Table 4: Work-Related Burns by Area of Body Injured, Michigan 2015-2016**

	2015-2016 Injuries	2015-2016 Percent
Eye	332	8.0%
Head, Face, Neck	527	12.7%
Trunk	260	6.3%
Upper Limb	870	21.0%
Wrist(s) and Hand(s)	1437	34.7%
Lower Limb	551	13.3%
Multiple, Specified Sites	39	0.9%
Internal Organs	13	0.3%
Classified According to Extent*	35	0.8%
Unspecified	75	1.8%
Missing	0	0.0%

*\*This category is used when ICD-9-CM code 948 or ICD-10-CM codes T31 or T32 is selected or when site of the burn is unspecified, and the percent of body surface burned is recorded in the medical record.*

**Figure 7: Work-Related Burns by Area of Body Injured, Michigan 2015-2016**

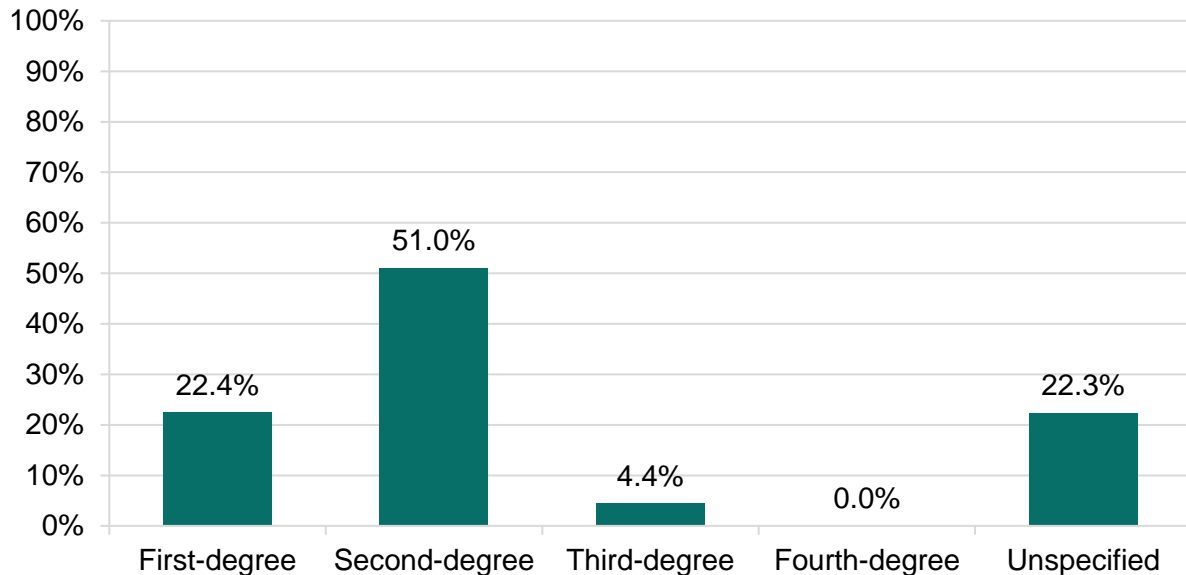


*\*This category is used when ICD-9-CM code 948 or ICD-10-CM codes T31 or T32 is selected or when site of the burn is unspecified, and the percent of body surface burned is recorded in the medical record.*

## SEVERITY

The burn degree was specified for 3,940 (77.7 percent) cases. The distribution of burns by severity is illustrated in Figure 8. A second-degree burn was reported in 2,584 cases, followed by a first degree burn in 1,135 cases, and a third degree burn in 221 cases. No cases were diagnosed with a fourth-degree burn.

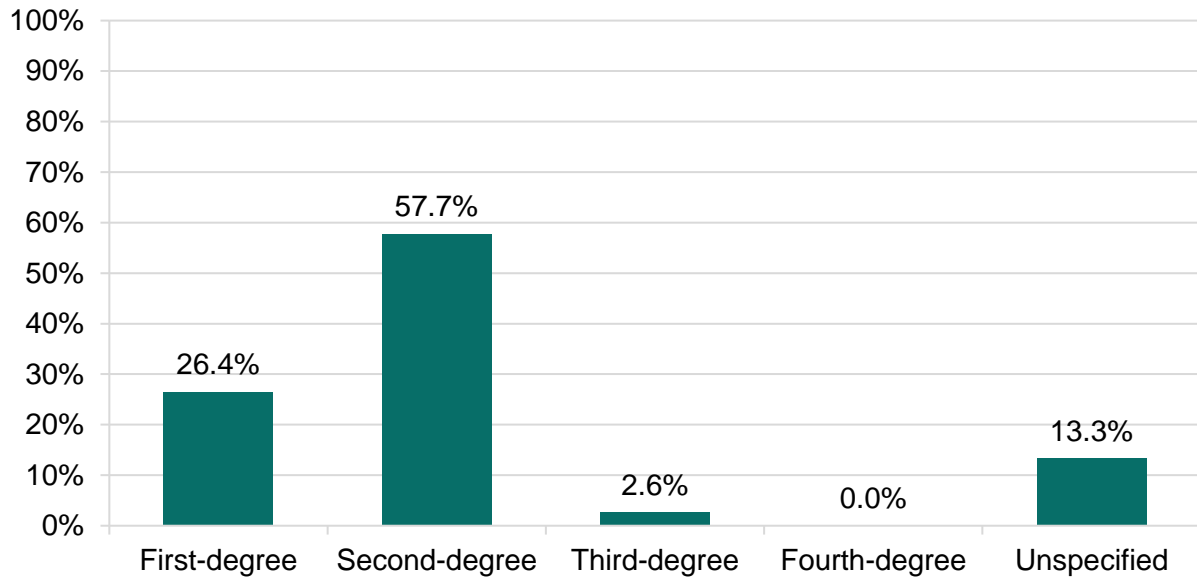
**Figure 8: Work-Related Burns by Maximum Severity\*, Michigan 2014-2016 (N=5,069)**



*\*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 is more serious and 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.*

Young workers are of concern because of the many hazards present in the places they typically work (e.g. fast food restaurants), and because they may have limited or no prior work experience and a lack of safety training.<sup>5</sup> Figure 9 shows the severity of burns among workers aged 14 to 24 years. The degree of burn was specified for 1,338 (86.7 percent) of these cases. Among workers aged 14 through 24 years, 890 workers had a second-degree burn, followed by 408 workers with a first-degree burn and 40 workers with a third-degree burn.

**Figure 9: Work-Related Burns by Severity\* among Workers Aged 14 through 24 Years, Michigan 2014-2016 (N=1,543)**



*\*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 is more serious and 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.*





**Table 5: Work-Related Burn Cases by County of Residence, Michigan 2014-2016\***

<b>County</b>	<b>Number (Percent)</b>	<b>County</b>	<b>Number (Percent)</b>
Alcona	-	Lake	8 (0.2%)
Alger	-	Lapeer	52 (1.0%)
Allegan	59 (1.2%)	Leelanau	-
Alpena	27 (0.5%)	Lenawee	60 (1.2%)
Antrim	8 (0.2%)	Livingston	91 (1.8%)
Arenac	14 (0.3%)	Luce	-
Baraga	-	Mackinac	18 (0.4%)
Barry	46 (0.9%)	Macomb	248 (4.9%)
Bay	73 (1.4%)	Manistee	18 (0.4%)
Benzie	6 (0.1%)	Marquette	74 (1.5%)
Berrien	64 (1.3%)	Mason	24 (0.5%)
Branch	34 (0.7%)	Mecosta	16 (0.3%)
Calhoun	112 (2.2%)	Menominee	-
Cass	11 (0.2%)	Midland	29 (0.6%)
Charlevoix	14 (0.3%)	Missaukee	-
Cheboygan	21 (0.4%)	Monroe	78 (1.5%)
Chippewa	14 (0.3%)	Montcalm	47 (0.9%)
Clare	18 (0.4%)	Montmorency	-
Clinton	27 (0.5%)	Muskegon	118 (2.3%)
Crawford	11 (0.2%)	Newaygo	16 (0.3%)
Delta	34 (0.7%)	Oakland	358 (7.1%)
Dickinson	23 (0.5%)	Oceana	36 (0.7%)
Eaton	55 (1.1%)	Ogemaw	15 (0.3%)
Emmet	24 (0.5%)	Ontonagon	-
Genesee	178 (3.5%)	Osceola	16 (0.3%)
Gladwin	10 (0.2%)	Oscoda	-
Gogebic	8 (0.2%)	Otsego	10 (0.2%)
Grand Traverse	48 (0.9%)	Ottawa	85 (1.7%)
Gratiot	20 (0.4%)	Presque Isle	7 (0.1%)
Hillsdale	15 (0.3%)	Roscommon	10 (0.2%)
Houghton	14 (0.3%)	Saginaw	74 (1.5%)
Huron	62 (1.2%)	Saint Clair	88 (1.7%)
Ingham	112 (2.2%)	Saint Joseph	34 (0.7%)
Ionia	41 (0.8%)	Sanilac	36 (0.7%)
Iosco	23 (0.5%)	Schoolcraft	-
Iron	14 (0.3%)	Shiawassee	32 (0.6%)
Isabella	40 (0.8%)	Tuscola	41 (0.8%)
Jackson	141 (2.8%)	Van Buren	59 (1.2%)
Kalamazoo	159 (3.1%)	Washtenaw	130 (2.6%)
Kalkaska	-	Wayne	671 (13.2%)
Kent	233 (4.6%)	Wexford	29 (0.6%)
Keweenaw	-	Unspecified	584 (11.5%)

\*Numbers and corresponding percentages are suppressed when the number of cases is between one and five to protect the confidentiality of individuals.

## **INDUSTRY**

Table 6 displays the number, percent, and rate of work-related burns by industry. A NAICS industry code was available for 4,827 (95.2 percent) cases. Accommodation and food services had the highest number of work-related burns with 1,333 (27.6 percent) cases, followed by the primary metal manufacturing sector with 492 (10.2 percent) burns, and the health care and social assistance sector which had 445 (9.2 percent) burns. Combined, these three sectors accounted for almost half (47.0 percent) of all work-related burns with an industry classification. The mining, quarrying, and oil and gas extraction industry had the highest rate of work-related burns (251.9 burns per 100,000 workers), followed by accommodation and food service (139.8 burns per 100,000 workers), and the food, beverage and textile manufacturing industry (60.1 burns per 100,000 workers).

**Table 6: Number, Percent, and Rate Work-Related Burns by Worker's Primary Industry, Michigan 2014-2016\***

NAICS	Description	Number	Percent	Rate per 100,000†
11	Agriculture, Forestry, Fishing and Hunting	53	1.1%	29.9
21	Mining, Quarrying, and Oil and Gas Extraction	12	0.2%	251.9
22	Utilities	40	0.8%	38.5
23	Construction	222	4.6%	31.3
<b>31-33</b>	<b>Manufacturing (Total)</b>	<b>818</b>	<b>16.9%</b>	<b>32.1</b>
31	Food, Beverage, Textile Manufacturing	123	2.5%	60.1
32	Wood Products, Paper, Petroleum and Coal Products Manufacturing	203	4.2%	50.0
33	Primary Metal Manufacturing	492	10.2%	25.4
42	Wholesale Trade	117	2.4%	38.2
44-45	Retail Trade	248	5.1%	16.2
48-49	Transportation and Warehousing	56	1.2%	10.4
51	Information	12	0.2%	6.6
52	Finance and Insurance	-	-	-
53	Real Estate and Rental and Leasing	20	0.4%	9.3
54	Professional, Scientific, and Technical Services	38	0.8%	4.8
55	Management of Companies and Enterprises	-	-	-
56	Administrative and Support and Waste Management and Remediation Services	137	2.8%	22.9
61	Educational Services	80	1.7%	7.1
62	Health Care and Social Assistance	445	9.2%	21.3
71	Arts, Entertainment, and Recreation	83	1.7%	30.6
72	Accommodation and Food Services	1,333	27.6%	139.8
81	Other Services (except Public Administration)	148	3.1%	26.3
92	Public Administration	140	2.9%	35.7

†Rates are not calculated when the number of burns was fewer than six, due to statistical unreliability. The number of workers by industry used to calculate rates was provided by the BLS Current Population Survey.

\*Numbers and corresponding percentages are suppressed when the number of cases is between one and five to protect the confidentiality of individuals.

## SEVERITY OF BURNS BY INDUSTRY

Table 7 displays the number and percent of burns by industry and severity for the 3,940 (77.7 percent) cases with a specified burn severity. Most cases (57.8 percent) involved a second-degree burn. Overall, almost two-thirds (65.6 percent) of work-related burns were second-degree. The accommodation and food service industry accounted for the highest number of work-related burns, the majority of which second-degree burns (70.5 percent). The agricultural, forestry, fishing, and hunting industry had the highest proportion of third-degree work-related burns (18.4 percent).

**Table 7: Number of Work-Related Burns by Severity and Industry, Michigan 2014-2016**

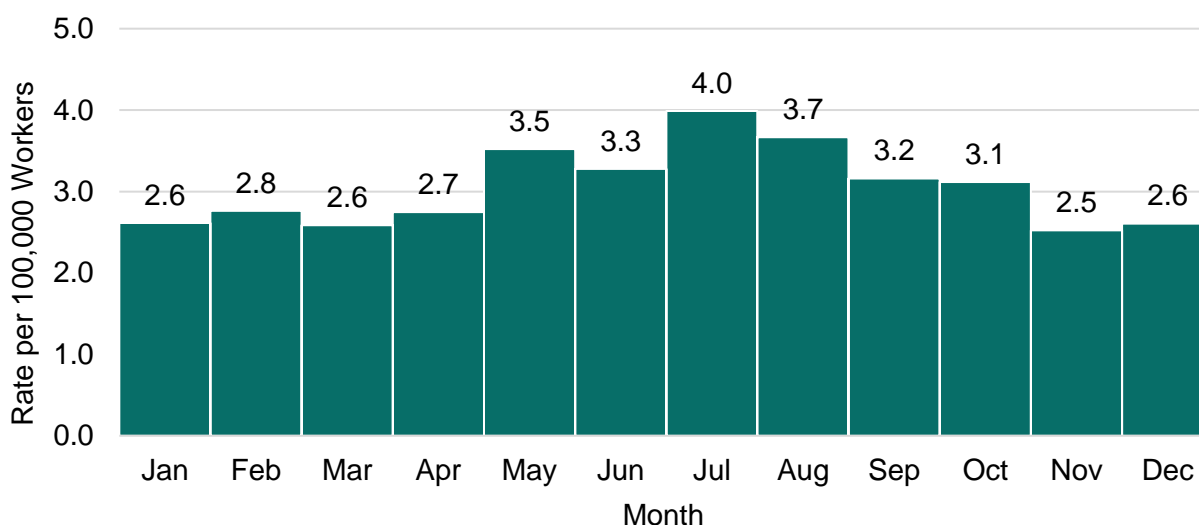
	<b>1st Degree</b>	<b>2nd Degree</b>	<b>3rd Degree</b>	<b>4th Degree</b>
Agriculture, Forestry, Fishing and Hunting	8 (21.1%)	23 (60.5%)	7 (18.4%)	0 (0.0%)
Mining, Quarrying, and Oil and Gas Extraction	-	7 (63.6%)	-	0 (0.0%)
Utilities	-	12 (70.6%)	-	0 (0.0%)
Construction	36 (23.1%)	105 (67.3%)	15 (9.6%)	0 (0.0%)
<b>Manufacturing (Total)</b>	<b>107 (17.7%)</b>	<b>725 (70.1%)</b>	<b>74 (12.2%)</b>	<b>0 (0.0%)</b>
<i>Food, Beverage, Textile Manufacturing</i>	23 (24.7%)	65 (69.9%)	-	0 (0.0%)
<i>Wood, Paper, Petroleum and Coal Products Manufacturing</i>	24 (15.2%)	118 (74.7%)	16 (10.1%)	0 (0.0%)
<i>Primary Metal Manufacturing</i>	60 (16.9%)	242 (68.2%)	53 (14.9%)	0 (0.0%)
Wholesale Trade	21 (22.6%)	61 (65.6%)	11 (11.8%)	0 (0.0%)
Retail Trade	58 (30.1%)	125 (64.8%)	10 (5.2%)	0 (0.0%)
Transportation and Warehousing	8 (19.5%)	29 (70.7%)	-	0 (0.0%)
Information	0 (0.0%)	9 (90.0%)	-	0 (0.0%)
Finance and Insurance	-	-	0 (0.0%)	0 (0.0%)
Real Estate and Rental and Leasing	-	7 (63.6%)	-	0 (0.0%)
Professional, Scientific, and Technical Services	6 (22.2%)	18 (66.7%)	-	0 (0.0%)
Management of Companies and Enterprises	0 (0.0%)	-	0 (0.0%)	0 (0.0%)
Admin, Support, Waste Management and Remediation Services	34 (31.8%)	66 (61.7%)	7 (6.5%)	0 (0.0%)
Educational Services	20 (29.4%)	47 (69.1%)	-	0 (0.0%)
Health Care and Social Assistance	164 (45.2%)	192 (52.9%)	7 (1.9%)	0 (0.0%)
Arts, Entertainment, and Recreation	26 (36.6%)	45 (63.4%)	0 (0.0%)	0 (0.0%)
Accommodation and Food Services	333 (27.7%)	847 (70.5%)	21 (1.7%)	0 (0.0%)
Other Services (except Public Administration)	26 (23.6%)	71 (64.5%)	13 (11.8%)	0 (0.0%)
Public Administration	30 (25.2%)	83 (69.7%)	6 (5.0%)	0 (0.0%)
Unknown Industry	249 (35.9%)	408 (58.9%)	36 (5.2%)	0 (0.0%)
<b>Total</b>	<b>1,135 (28.8%)</b>	<b>2,584 (65.6%)</b>	<b>221 (5.6%)</b>	<b>0 (0.0%)</b>

\*Numbers and corresponding percentages are suppressed when the number of cases is between one and five to protect the confidentiality of individuals.

## MONTH OF INJURY

Figure 11 shows the rate of work-related burns per 100,000 workers by month. The month of injury was documented for 4,947 cases. The rate of work-related burns was highest in July and August, at 4.0 and 3.7 work-related burns per 100,000 workers, respectively. The lowest rate occurred in November, with 2.5 burns per 100,000 workers.

**Figure 11: Rate (per 100,000) of Work-Related Burns by Month, Michigan 2014-2016\***



\*Rates are calculated as the number of work-related burn incidents per 100,000 workers. The number of workers employed by month was provided by 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 2,674 (58.8 percent) of the 4,610 cases with a medical record (Table 8). Of these cases, 338 (12.6 percent) received wage replacement for seven or more days away from work. For 753 cases, the payment source could not be identified. Of the 1,936 cases that did not list Workers' Compensation as a payment source for medical care, 111 were matched to a record in the WCA database, however it is possible that Workers' Compensation paid for lost wages, but not medical care for some cases.

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

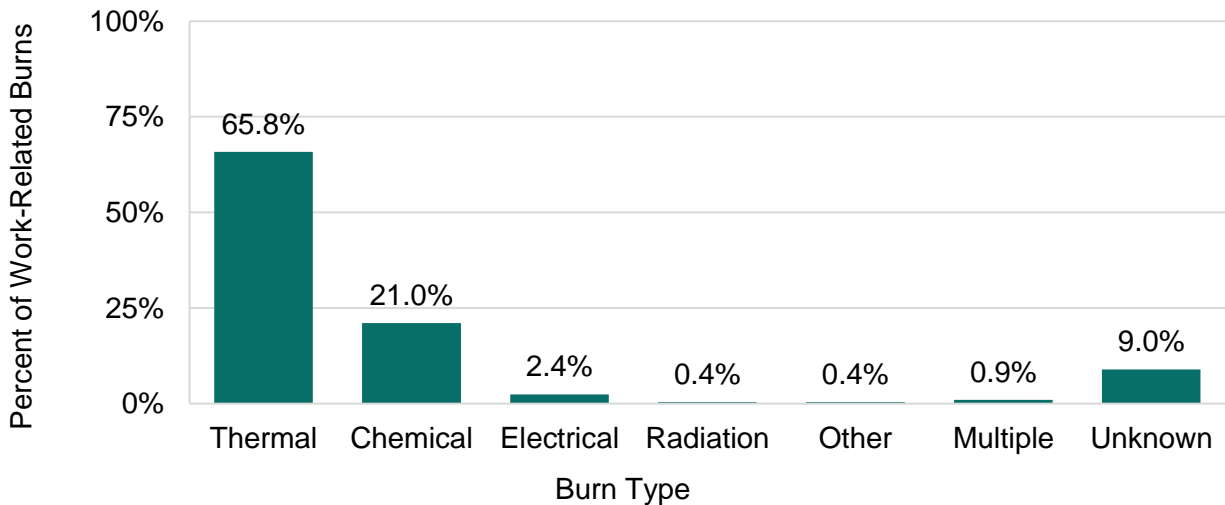
Payer	Received Wage Replacement*	Did Not Receive Wage Replacement	Total	Percent of Cases
Workers' Compensation	338	2,336	2,674	58.0%
Commercial	22	340	362	7.9%
Self-Pay	21	286	307	6.7%
Other	24	490	514	11.1%
Unknown	44	709	753	16.3%

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

## BURN TYPES

Burn type was specified for 4,614 (91.0 percent) events from 2014 through 2016. Thermal burns were the most common type of burn reported, with 3,337 (65.8 percent) cases, followed by chemical burns which were reported for 1,066 (21.0 percent) cases. Electrical, radiation, and other causes were reported for 163 (3.2 percent) of cases, and 48 cases (0.9 percent) had multiple burn causes recorded. The distribution of work-related burns by type is shown in Figure 12. Among workers hospitalized for a work-related burn (n=225), 150 (66.7 percent) resulted from thermal exposure, 26 (11.6 percent) resulted from a chemical exposure, 30 (13.3 percent) resulted from electrical exposure, and 19 (8.4 percent) resulted from another, unknown, or multiple causes. Radiation burns can result from exposure to ultraviolet rays during welding. Commonly reported chemicals involved in chemical burns included sulfuric acid, hydrochloric acid, sodium hydroxide, and phosphoric acid.

**Figure 12: Work-Related Burns by Type, Michigan 2014-2016**



## MIOSHA REVIEWS

MIOSHA reviewed work-related burn cases reported to MSU OEM if the case had been hospitalized or treated in an emergency department or outpatient facility, sustained at least a second-degree burn, and the injury had occurred within six months of the report. Table 9 displays the number of violations and amount of penalties assessed by industry type for the 61 workplaces where MIOSH conducted an inspection.

**Table 9: Number of MIOSHA Workplace Inspections, Issued Violations and Amount of Penalties Assessed by Industry, Michigan 2014-2016**

	Inspections	Violations	Penalties
Agriculture, Forestry, Fishing and Hunting	1	0	\$0
Mining, Quarrying, and Oil and Gas Extraction	1	2	\$3,500
Utilities	0	0	\$0
Construction	2	0	\$0
<b>Manufacturing (Total)</b>	<b>32</b>	<b>58</b>	<b>\$158,450</b>
<i>Food, Beverage, Textile Manufacturing</i>	3	4	\$7,250
<i>Wood Products, Paper, Petroleum, Coal Products Manufacturing</i>	13	20	\$35,950
<i>Primary Metal Manufacturing</i>	16	34	\$115,250
Wholesale Trade	3	4	\$3,550
Retail Trade	3	7	\$4,480
Transportation and Warehousing	0	0	\$0
Information	0	0	\$0
Finance and Insurance	0	0	\$0
Real Estate and Rental and Leasing	1	4	\$500
Professional, Scientific, and Technical Services	0	0	\$0
Management of Companies and Enterprises	0	0	\$0
Administrative, Support, Waste Management and Remediation Services	0	0	\$0
Educational Services	0	0	\$0
Health Care and Social Assistance	1	2	\$2,450
Arts, Entertainment, and Recreation	1	4	\$400
Accommodation and Food Services	14	37	\$41,250
Other Services (except Public Administration)	2	3	\$5,300
Public Administration	0	0	\$0
<b>Total</b>	<b>61</b>	<b>121</b>	<b>\$219,880</b>

## **EXAMPLES OF MIOSHA ENFORCEMENT INSPECTIONS FOR WORK-RELATED BURN**

### **Improper procedures, equipment, and personal protective equipment**

A restaurant worker in his twenties received second-degree burns to his foot and ankle after slipping into a deep fryer while attempting to clean a range hood. The employee stood on the surface of the range while cleaning the hood, near the deep fryer that still contained hot oil. A sheet tray had been placed over the surface of the deep fryer, in place of the lid. While cleaning the range, the employee slipped, and his foot landed in the deep fryer. During the workplace inspection, it was also found that employees used stacked crates to access high spaces within the kitchen area. MIOSHA found seven serious violations including Citation 1 Item 1: employer shall provide training to each newly assigned employee regarding the operating procedures, hazards, and safeguards of the job; Citation 1 Item 2: one of the following shall be used to gain access to another elevation of more than 16 inches: (a) flight of stairs, (b) fixed industrial stairs, (c) ramp, (d) fixed ladder, or (e) a portable ladder, as prescribed in the occupational safety standards commission standard; Citation 1 Item 3a: 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; Citation 1 Item 3b: an employer shall ensure that each affected employee uses appropriate eye or face protection, when exposed to eye or face hazards; Citation 1 Item 3c: an employer shall base the selection of the appropriate hand protection on an evaluation of the performance characteristics of the hand protection; Citation 1 Item 4: employers shall develop, implement, and maintain at each workplace, a written hazard communication program which at least describes how the criteria for labels and other forms of warning, safety data sheets, and employee information and training will be met; and Citation 5: an employer shall ensure that suitable facilities for quick drenching or flushing of the eyes and body are provided within the work area for immediate emergency use when the eyes or body of any person may be exposed to injurious or corrosive materials.

### **A Damaged Press with Inadequate Guarding**

A machine press operator in his twenties suffered second-degree burns to his arm as well as a crush injury and fractures to his hand and wrist while changing the mold on a vertical rubber injection molding press. When the mold did not settle properly, the employee reached into the machine to check for rubber build-up. The injection unit seal was damaged, allowing the cylinder to drift down. No safety pins or blocking device were in use at the time, causing the employee's hand and wrist to be severely crushed between the nozzle and the top of the mold. During the MIOSHA inspection, interviews with employees revealed that safety pins were often missing and not used during mold changes and that lockout inspections had not been routinely performed. MIOSHA found seven violations including Citation 1: there shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment, such as parts that are broken, bent, cut, or deteriorated by corrosion, chemical action, or overheating; Citation 2 Item A: employees shall be trained in, and familiar with, the safety-related work practices required by rules that pertain to their respective job assignments; Citation 2 Item B: each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control; Citation 2 Item C: procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by the General Environmental Controls section of Occupational Safety and Health Standards 1910 Subpart A; Citation 2 Item D: locks, tags, chains, wedges, key blocks, adapter



pins, self-locking fasteners, or other hardware shall be provided by the employer for isolating, securing or blocking of machines or equipment from energy sources; Citation 2 Item E: the employer shall conduct a periodic inspection of the energy control procedure at least annually to ensure that the procedure and the requirements of this standard are being followed; Citation 3: an employer shall not allow a machine to be operated which is not guarded as prescribed or where the machine has a known defect which could affect the safety of an employee.

## **DISCUSSION**

The overall rate of work-related burns during this period was 38.3 burns per 100,000 workers. The rate has remained relatively consistent over the past eight years, ranging from 35.8/100,000 to 46.7/100,000. Workers under 25 years of age experience the highest rate of work-related burns. Males also experience a higher rate of work-related burns compared to females. The accommodation and food service industry account for the highest number of work-related burns with 1,333 cases (27.6 percent of all work-related burns). However, the mining, quarrying, and oil and gas extraction industry experienced the highest rate of work-related burns (251.9 per 100,000).

The Michigan-based work-related burn surveillance system detects more cases than the BLS SOII because the BLS SOII only includes cases with one or more days away from work or with altered work duties, whereas the Michigan-based system counts all work-related burn injuries, regardless of the impact the injury had on work. Additionally, the BLS SOII only reports the most severe injury in cases where a worker has sustained more than one reportable injury and it also excludes self-employed workers, independent contractors and farm workers employed at farms with fewer than 11 employees. Lastly, it is likely that differences in the underlying methodology of the surveillance systems account for the discrepancy in work-related burns. The BLS SOII is derived from a sample of employers who are asked to self-report the number of employees with an eligible work-related burn within the past 12 months. Poor record keeping, impaired recall, or intentional underreporting by employers may result in a lower estimate of the number of work-related burns. The Michigan surveillance system does not rely on employers to report work-related burns but may also be affected by underreporting if hospitals fail to submit records for all work-related burns, if medical records do not record whether the injury was work-related, or if work-related burns do not receive an appropriate burn-injury ICD-CM code.

The Michigan's Workers' Compensation data identified the fewest number of work-related cases compared to the BLS SOII and the Michigan-based surveillance system. Workers' Compensation data likely undercount work-related burns because burns that do not result in at least seven consecutive days away from work are ineligible for wage-replacement. Furthermore, when a worker files a Workers' Compensation claim for an incident involving several injuries, the claim doesn't distinguish each injury type, but rather records the injury within the 'multiple injuries' category. Additionally, self-employed individuals are not eligible for Workers' Compensation and therefore will not be represented the Workers' Compensation data. Additionally, some work-related burns may not be detected if they are coded as another injury type on the wage-replacement claim. Of the 508 Workers' Compensation records that were successfully matched to a medical record, 72 (14.2 percent) had a non-burn injury code listed on the wage-replacement claim.

From 2014 through 2016, the Michigan-based surveillance system detected 4,267 more work-related burns than the Workers' Compensation database and 2,999 more than the BLS SOII,

underscoring the importance of maintaining a comprehensive mandatory-reporting surveillance system.

MIOSHA has 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).<sup>6</sup> 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.

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