

Work-Related Burns

Michigan 2019-2021

June 2023



**Work-Related Burns in Michigan:
Twelfth Report
(January 2019 – December 2021)**

Michigan State University

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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. All Michigan hospitals are required to report work-related burns and serve as the primary case-finding source. Surveillance data were used to describe trends and identify companies and industries with work-related burns. This report describes these injuries for the years of 2019-2021.

Key results include:

- Work-related burns were identified through medical records submitted by hospitals and occupational health clinics, poison control center reports, Workers' Compensation claims, and The Michigan Fatality Assessment and Control Evaluation (MIFACE) program.
- There were 4,365 work-related burns among workers in Michigan between 2019-2021
- There were 1,796 work-related burns in Michigan in 2019 (37.6 per 100,000 employed persons), 1,186 in 2020 (27.1 per 100,000 employed persons), and 1,383 in 2021 (30.7 per 100,000 employed persons). The reduced number and rate of burns in 2020 and 2021 are presumed to be secondary to decreased work activity related to the COVID pandemic.
- Almost two out of three burns (64.2 percent) were among male workers and the rate of work-related burns among males were 88.8% percent higher than the rate among females.
- The most common part of the body affected were wrists and hands (32.5 percent).
- Thermal burns made up most burns' cases (71.0%). Chemical burns made up roughly one fourth of total burns (23.6%). The remaining 5.4% consist of burns caused by electrical, radiation, other, or multiple exposures.
- The accommodation and food services industry accounted for the highest number (34.3%) and the highest rate of work-related burns (109.7 burns per 100,000 workers).
- For work-related burns identified through medical records, Workers' Compensation was the expected payer for medical care in only 49.9%.
- The Michigan Occupational Safety and Health Administration (MIOSHA) program completed inspections at 38 worksites identified by the surveillance system. MIOSHA issued 73 violations and assessed \$189,300 in fines related to hazardous conditions at these 38 worksites.

This system, which combines data from multiple sources provides a more accurate estimate of the number of work-related burns in Michigan than the official estimate provided by BLS. The Michigan surveillance system identified more than twice as many (2,982 vs. 1,160) work-related burns as the BLS employer Survey of Occupational Injuries and Illnesses (SOII) for the time between 2019 and 2020. The BLS data for burns in Michigan for 2021 are not yet available.

BACKGROUND

This is the eighth report of occupational burns in Michigan, covering injuries that occurred to Michigan workers in 2019-2021. Occupational burns are preventable work-related injuries and are among the most serious injuries that can occur in a workplace. Burns can cause life-long scarring and when hospitalization is required are some of the most devastating, painful, and expensive injuries to treat. Michigan 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 department¹. 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 national source of work-related injury and illness statistics, reported that 600 work-related burns occurred in Michigan in 2019 (incidence rate of 17.0 burns per 100,000 workers), and 540 work related burns occurred in 2020 (rate of 17.0 burns per 100,000 workers²). 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 sources:

1. Hospital Emergency Departments (ED)
2. Occupational Health Clinics
3. Workers' Disability Compensation Agency (WDCA)
4. Poison Control Center (PCC)
5. 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 occupational health 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 the ICD-10-CM codes included), and the incident was documented as having occurred at work.

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 seven or more consecutive days of work, including weekends, or experience “specific losses” 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 2019, 2020, or 2021. Work-related burns were identified through the PCC when a call was made regarding a consultation for a work-related burn injury in 2019, 2020, or 2021. The MIFACE program data was queried for any records of Michigan workers who died from a work-related burn during 2019, 2020, or 2021.

Information on the reporting source(s), type of medical visit as indicated by the medical record (inpatient hospitalization, emergency department, hospital outpatient, or occupational health clinic), 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. Record linkage between cases and the WDCA database was performed using SAS 9.4. Record linkages were first performed for each individual year, linking each year’s cases with the subsequent WDCA records of that year. The three data sets were individually initially linked using the whole SSN and date of injury. Remainder non-matches were then matched using the last four digits of their SSN and the case’s DOB. Definitive cases were removed from the remainder, and the remainder of non-matches were matched using only DOB. After removing true matches burn cases with the same DOBs, the two data files were matched on the full name. The remaining non-matched burns were linked using last name and birth year and again any matches were removed. The final linkage was then performed, matching on sex and last name and any true matches were removed from the remainder unmatched record. After each iteration of matching, matches were visually inspected to verify that they were true matches. The matched data sets were then concatenated with the unmatched medical records and unmatched workers’ compensation paid claims that had cause limited to burn(heat) and burn(chem). All three datasets were then concatenated to create one data set for analysis. One more check was performed to identify cases that sustained a burn in one year but did not have a workers’ compensation claim date until the following year. 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, or 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 WDCA database does not classify injuries by ICD-10-CM codes, it does specify the affected area of the body. This information was used to assign an appropriate ICD-10-CM burn injury code for cases found only in the WDCA database. For cases identified only from PCC reports, the affected body area specified by the caller was translated into an appropriate ICD-10-CM code.

If available, county of residence was abstracted from medical records. 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. Cases with a residence zip code that spanned multiple counties were assigned to the “Unknown County” category. 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 obtained.

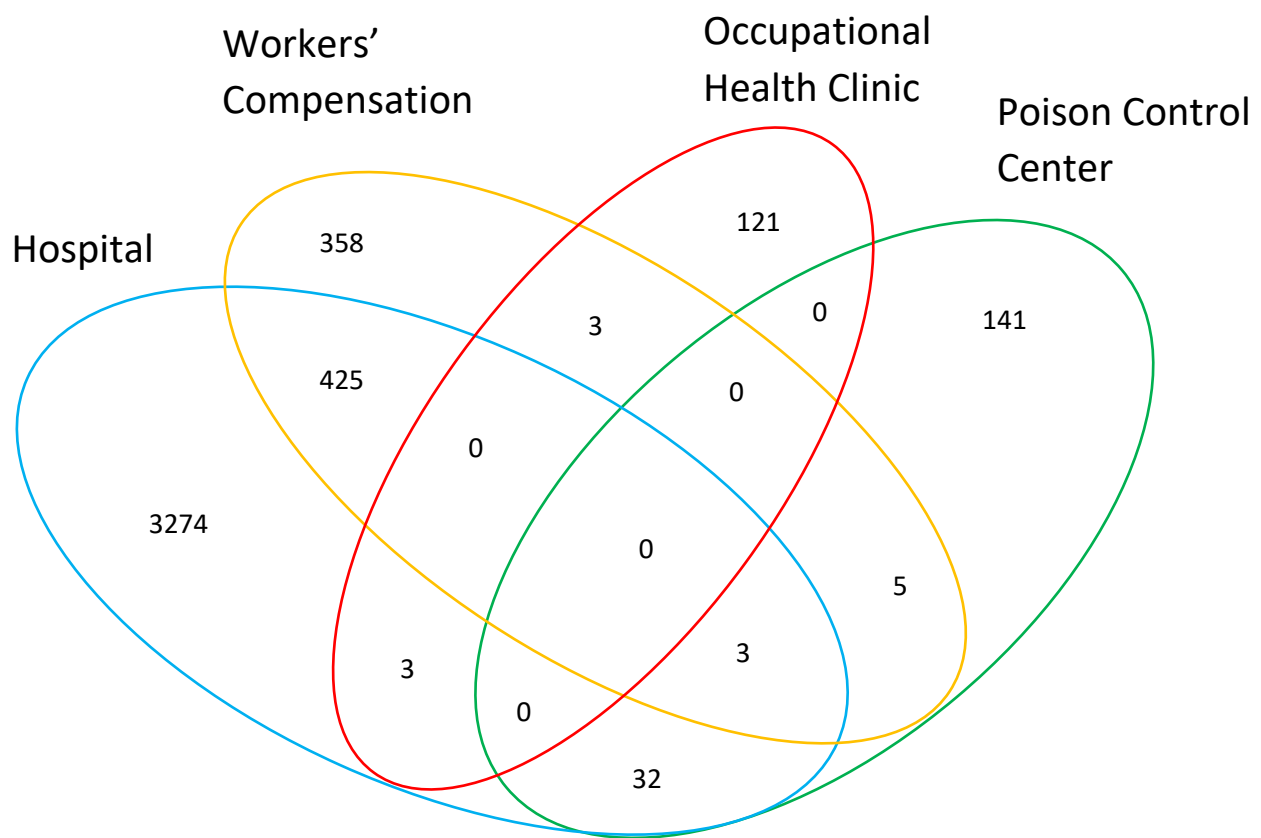
Database management was conducted using Microsoft Access. Data analysis was performed using SAS 9.4. Incidence rates of work-related burns by age, sex, and industry were calculated using the Quarterly Workforce Indicator (QWI)⁴. The QWI utilizes data from the longitudinal employer-household dynamics (LEHD) linked employer-employee microdata. Rates were calculated by taking the average number of persons employed in Michigan from 2019-2021. 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

For 2019-2021, 4,365 work-related burns were identified. Of these, 1,836 burns (98.4 percent) occurred to Michigan residents and 71 occurred to non-Michigan residents. A total of 3,737 burns were identified by hospital-submitted medical charts, 794 were identified in the WDCA database, 141 were identified from PCC reports, 124 were identified by occupational health clinic medical charts (Figure 1). Three work-related burns were identified in MIFACE records, which were also identified in hospitals records. The majority (89.2 percent) of burns were identified by a single data source. The remaining 10.8% of burns were identified by two or more sources.

Figure 1: Work-Related Burns by Reporting Source, Michigan 2019-2021



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.

Case number 1

A man in his 40s, who worked at an automobile factory was using an oxygen tank, which ignited and caused second and third degree burns to both his hands that required skin debridement and grafting. The workplace was cited for two violations. One violation was for \$7,000 for not properly opening the cylinder valve before connecting to a regulator or manifold, and for doing the task near a source of ignition. The other violation was for \$5,000 for not reporting a work-related hospitalization to MIOSHA within 24 hours of the injury occurring.

Of the 794 burns identified from WDCA, 718 were classified as either a thermal or chemical burn (Table 2) and for 22, the cause of the burn was not described. The remaining 54 burns 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 cause.

Table 2: Causes of Work-Related Burns Identified in Workers' Compensation Claims, Michigan 2019-2021

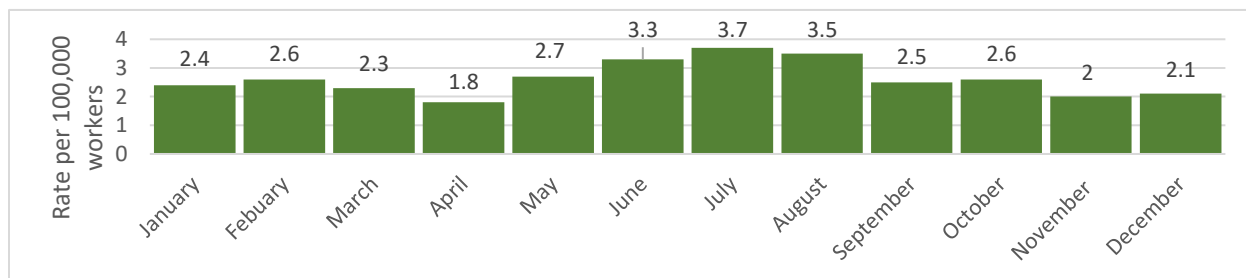
Injury Cause	Number	Percent
Burn (Heat)	615	77.5%
Burn (Chemical)	103	13.0%
Abrasion/Scratch	2	0.3%
Crush/Contusion	11	1.4%
Cut/Laceration	2	0.3%
Electric Shock	6	0.8%
Fracture	4	0.5%
Multiple Injuries	11	1.4%
Other Injury	5	0.6%
Unspecified Respiratory System	1	0.1%
Strains/Sprains	12	1.5%
Unclassified	22	2.8%

Data Source: Michigan Department of Labor and Economic Opportunity Workers' Compensation Agency Database

MONTH OF INJURY

The month of injury was documented for 4,313 cases. The rate of work-related burns was highest during the summer months of June, July, and August, at 3.3, 3.7, and 3.5 work-related burns per 100,000 workers, respectively (Figure 2). The lowest rate occurred in April, with 1.8 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 2: Rate (per 100,000) of Work-Related Burns by Month of Injury, Michigan 2019-2021

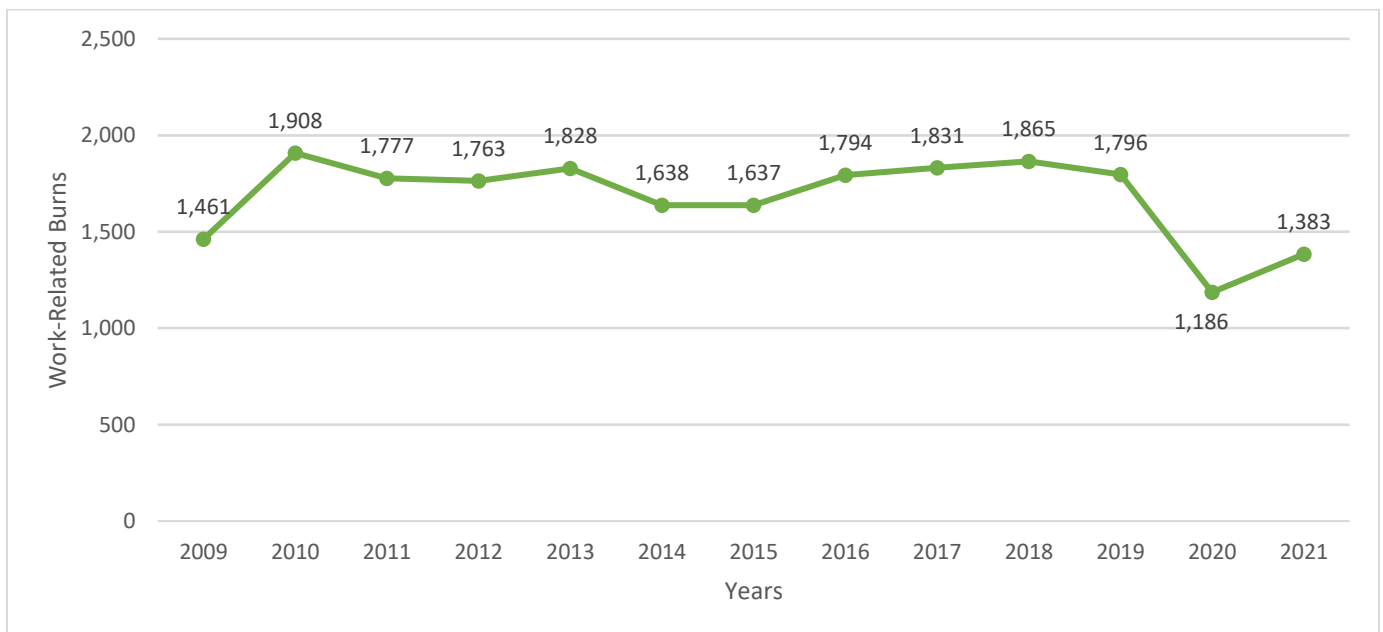


Data Sources: Michigan work-related burns surveillance system; Bureau of Labor Statistics' Local Area Unemployment Statistics seasonally adjusted employment estimates.

REPORTS BY YEAR

The number of work-related burns in 2019-2022 was lower than 2018 (Figure 3). The 34% reduction in the number of burns and the 27.9% reduction in rate of burns in 2020 was most likely due to COVID-19 stay at home orders. The number and rate in 2021 increased but not to pre-covid levels (Figure 4). The 4,365 burns between 2019-2021 involved 4,353 individuals as 12 individuals had two unique burn injuries during the three years. The average number of work-related burns among Michigan workers from 2009 to 2019 was 1,754.4 (95% confidence interval (CI): 1,682.1– 1,826.6). The average rate of work-related burns per 100,000 employed individuals from 2009 to 2019 was 39.5 (95% CI: 37.7 – 41.2). The rate of work-related burns decreased slightly in 2019 compared to the previous year (Figure 4).

Figure 3: Number of Work-Related Burns, Michigan 2009-2021

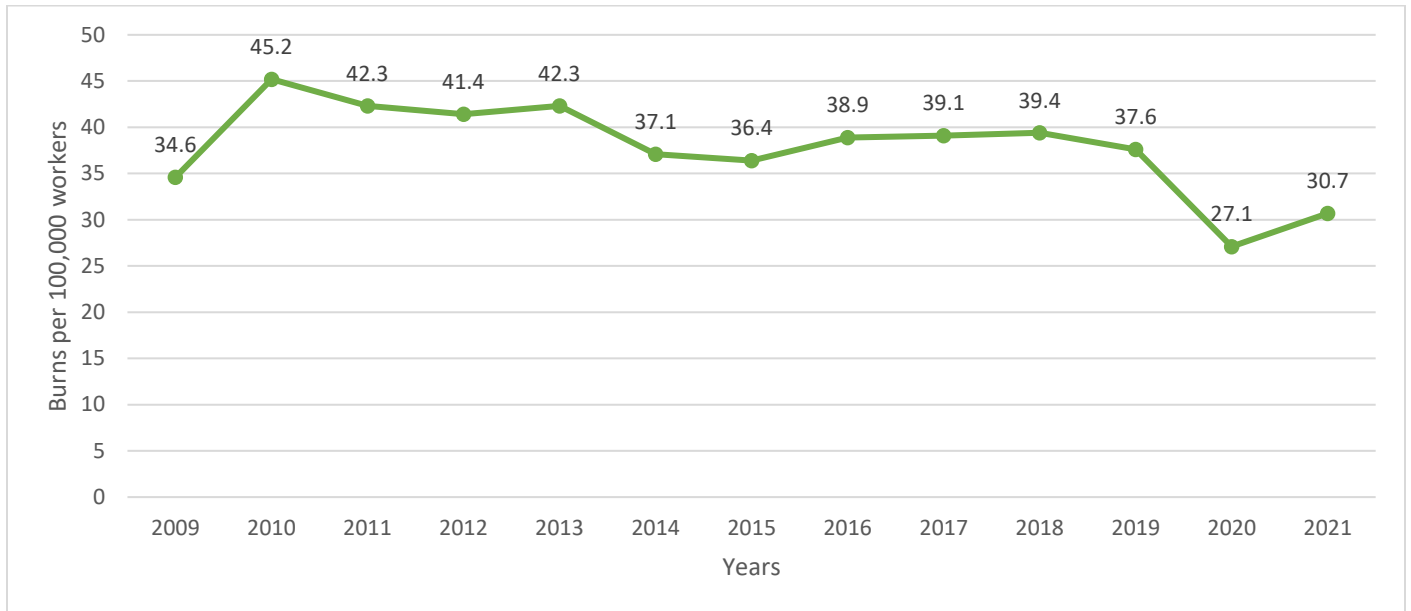


Data Source: Michigan work-related burns surveillance system

Case Number 2

A man in his 40s, who was working with a Hot Saw pneumatic clamping system on an extrusion press, had his left forearm pinched between the operator arms and the 800-degree extruded aluminum parts. This resulted in 2nd and 3rd degree burns to the forearm extending from his thumb to his elbow. The workplace received two citations. One serious repeat citation of \$9,600 for not having an adequate guard for the Hot Saw pneumatic clamping system. The other citation for \$4,200 was also serious for the lack of thermal sleeves.

Figure 4: Rate (per 100,000) of Work-Related Burns, Michigan 2009-2021



Data Source: Michigan work-related burns surveillance system

VISIT TYPE

Medical care type was determined by review of medical records or PCC consultation records. Among the 4,007 work-related burns with a medical record or PCC consultation, 85.6 percent received care in an emergency department setting (Table 3). Among the 302 cases that were admitted for inpatient care, 204 (67.8 percent) were hospitalized overnight and 97 (32.2 percent) were discharged within the same day. The remaining 274 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 2019-2021

Types of Visits	Number	Percent
Emergency Department	3431	85.6
Inpatient Hospitalization	302	7.5
Other*	274	6.8
Total	4007	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.

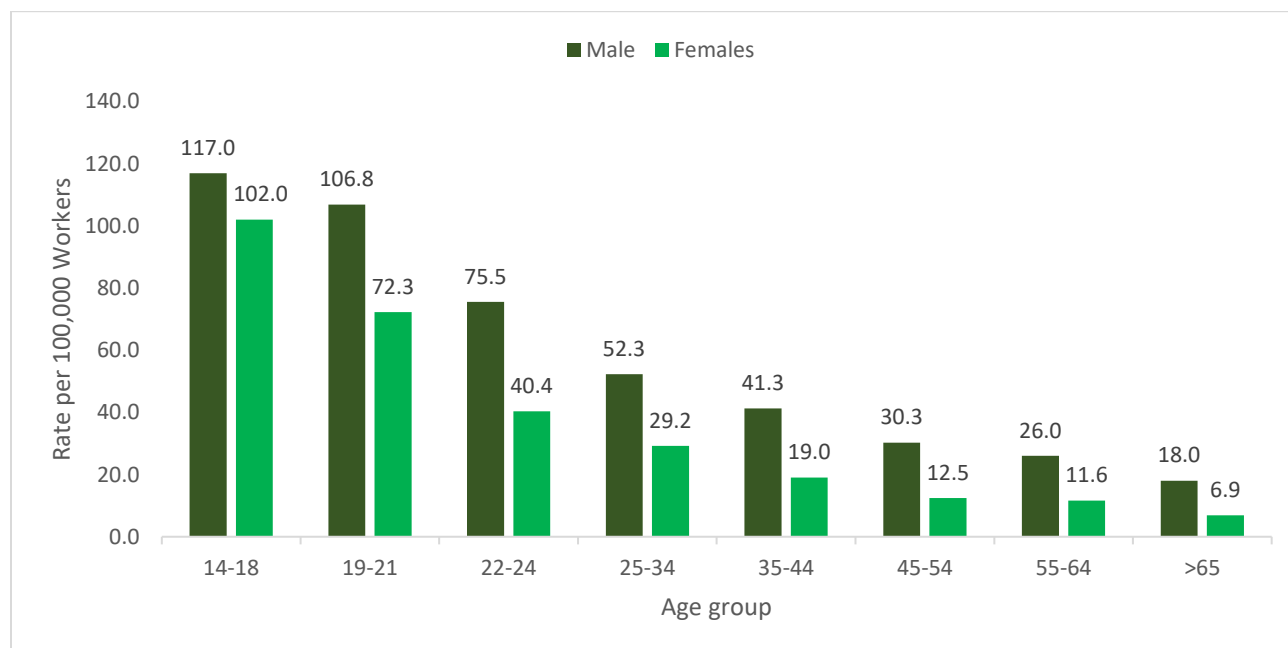
RACE AND HISPANIC ETHNICITY

Race and ethnicity are not recorded on Workers' Compensation claims, therefore race and ethnicity cannot be determined for the 358 cases identified only through Workers' Compensation. Medical records were missing information on race for 2,008 patients (50.1%) and on ethnicity for 2,683 patients (66.9%). Among the 1,999 work-related burns with race data, 1,566 (78.3%) were white, 307 (15.4%) were African American, 24 (1.2%) were Asian, and 102 (5.1%) were "Other". Among the 1,324 burns with data on Hispanic ethnicity 90 individuals (6.8%) were of Hispanic origin. Overall, burns were most common among non-Hispanic whites, 978 (73.8%). Due to the level of missing information, rates for racial/ethnic groups were not calculated.

AGE AND SEX

Age and sex were reported for 4,235 (97.0 percent) of work-related burns. The age of the workers ranged from 14 to 97 years, with an average of 34.7 years and a median age of 31 years. Almost one-third of work-related burns (30.6%) occurred among workers aged 14-24 years. Sex was reported for 4,336 (99.3%) of work-related burn injuries. Men accounted for 64.2% of work-related burns (n = 2803) and women accounted for 35.1% (n = 1,533). There were 44.9 work-related burns per 100,000 male workers and 23.8 work-related burns per 100,000 female workers. The highest rates of work-related burns were among workers aged 14-18 years (117.0 per 100,000 workers for males, 102.0 per 100,000 workers for females). The rate of work-related burns declined with increasing age (Figure 5).

Figure 5: Rate (per 100,000) of Work-Related Burns by Age Group and Sex, Michigan 2019-2021



Data Sources: Michigan work-related burns surveillance system; Number of workers – 2019-2021 Quarterly Workforce Indicators (QWI), U.S. Census Bureau: This chart does not include 130 cases with an unknown age or sex.

PART OF BODY INJURED

Approximately a third of all work-related burns (32.5%) involved burns to the wrists and hands (Table 4). The second most common body part affected by work-related burns not counting multiple specified sites were the upper limb with 14.5%. Fewer 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 2019-2021

Body Part	Number	Percentage
Eye	370	8.5
Head, Face, Neck	244	5.6
Trunk	137	3.1
Upper Limb	631	14.5
Wrist(s) and Hand(s)	1417	32.5
Lower Limb	612	14
Multiple Specified Sites	896	20.5
Internal Organs	10	0.2
Classified According to Extent*	0	0
Unspecified	48	1.1

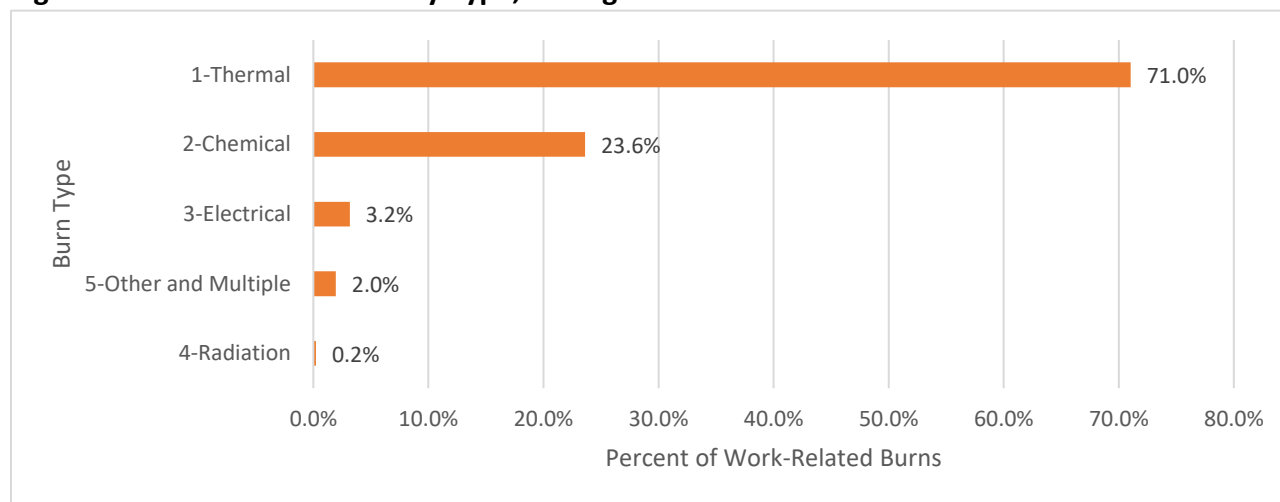
*Data Source: Michigan work-related burns surveillance system

*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.

BURN TYPES

Burn type was documented for 3,825 (87.6%) work-related burns. Thermal burns were the most common type with 2,717 (71.0%) cases, followed by chemical burns, 903 (23.6%) cases (Figure 6). Commonly reported chemicals involved in chemical burns include lye, sodium hypochlorite (bleach), sulfuric acid, hydrochloric acid, sodium hydroxide, and phosphoric acid. Electrical burns accounted for 121 cases (3.2%). Radiation burns, which may result from exposure to ultraviolet rays while welding, were recorded in 9 (0.2%) cases. There were 75 cases (2.0%) that had other or multiple burn types.

Figure 6: Work-Related Burns by Type, Michigan 2019-2021



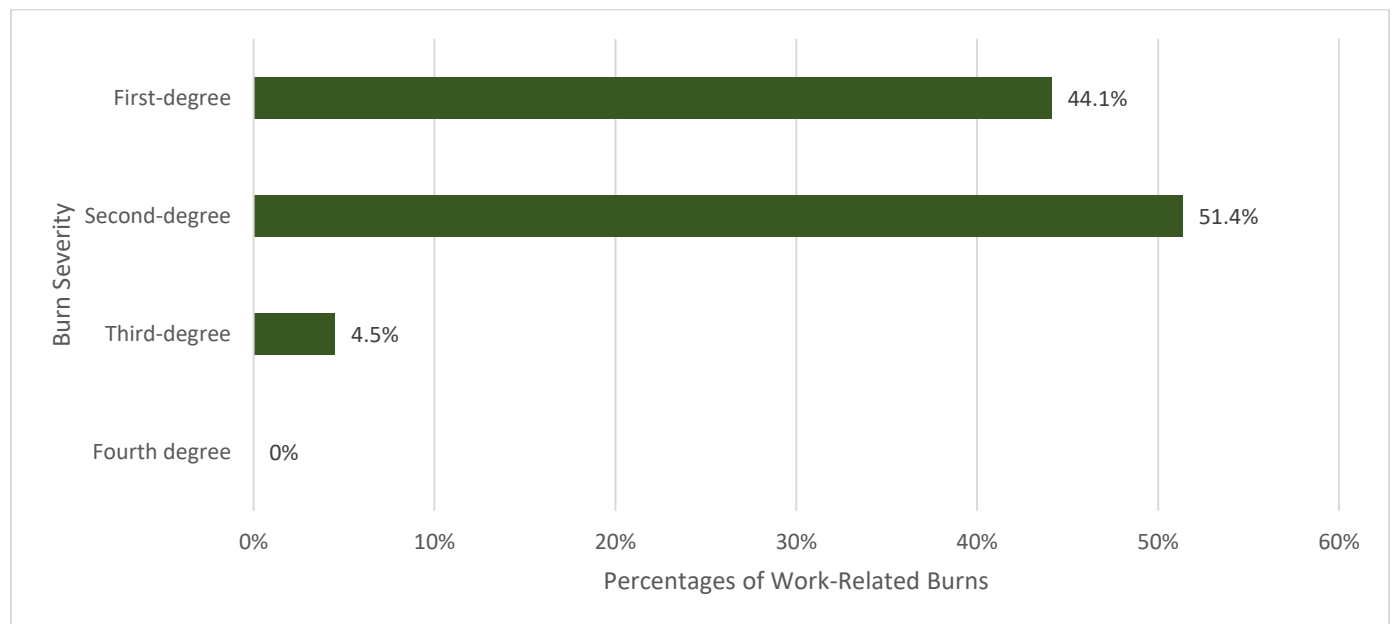
Data Source: Michigan work-related burns surveillance system

Note: This chart excludes 540 cases with an unknown burn type.

SEVERITY

Burn degree was specified for 4,007 (91.7%) cases. Burns were classified as second-degree in more than half of all cases (51.4%). Burns that were classified as first-degree made up 44.1% of total reported work-related burns. 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. Nearly one in-twenty (4.5%) 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 2019-2021



Data Source: Michigan work-related burns surveillance system

Note: This chart excludes 358 cases with an unknown burn severity.

COUNTY OF RESIDENCE

Table 5 presents the number and percent of work-related burns by county of residence among the 4,046 Michigan residents where this information was known. These data do not necessarily reflect the county of the worksite because workers may have been employed outside their county of residence. Two counties (Keweenaw, Schoolcraft) had no residents with work-related burns. Wayne County had the highest number of residents who sustained a work-related burn with 262 cases (15.4%), followed by Oakland County with 107 cases (6.3%). In counties with enough burns to calculate statistically reliable rates Cheboygan had the highest rate (86.9 per 100,000). Among the 20 most populous counties in the state (highlighted below) Calhoun County had the highest rate (17.1 per 100,000).

Table 5: Work-Related Burn Cases and Rate per 100,000 Residents by County of Residence, Michigan 2019-2021

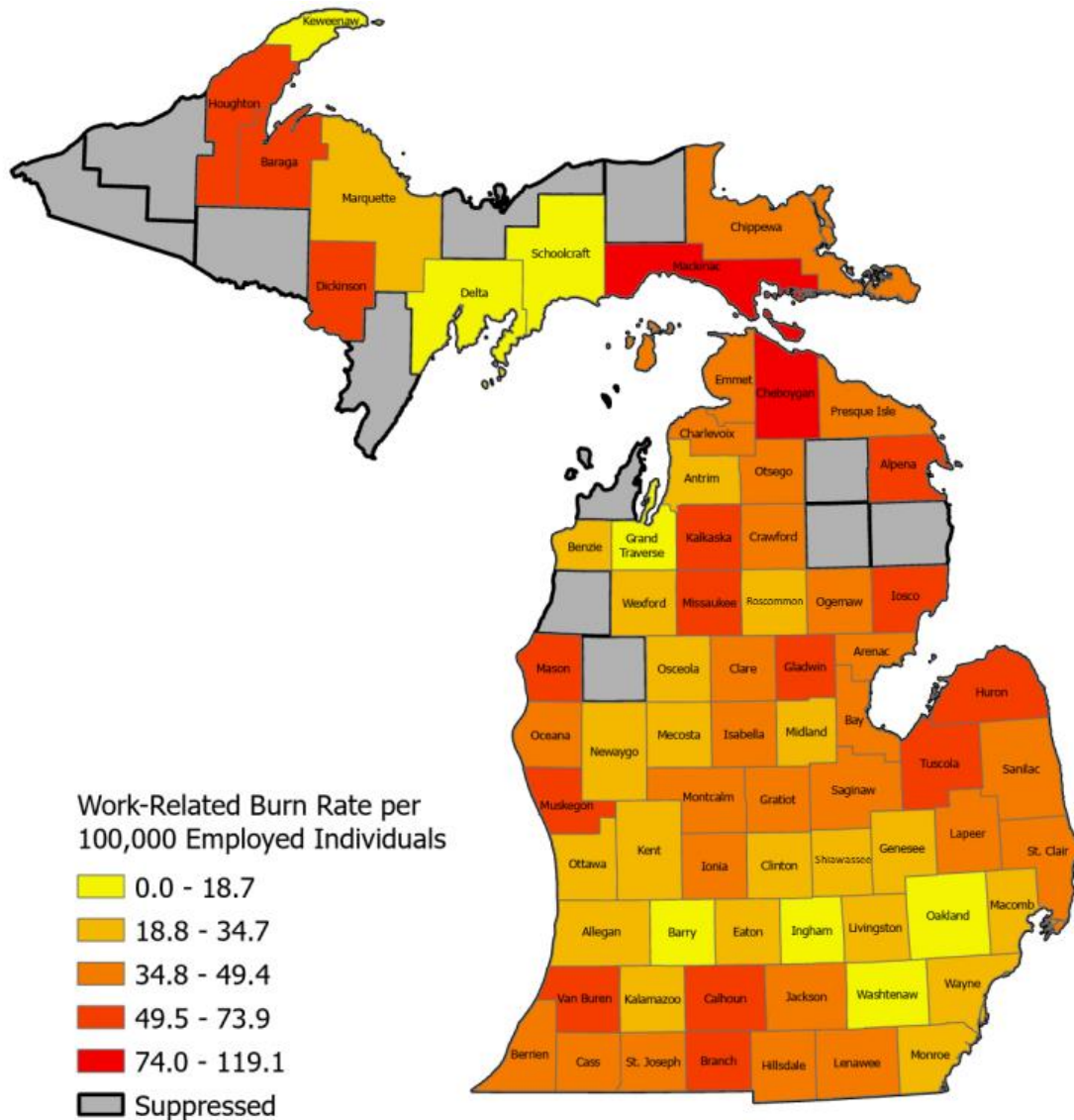
County	Count	Rate	County	Count	Rate
ALCONA	5	*	LAPEER	45	39.8
ALGER	4	*	LEELANAU	1	*
ALLEGAN	47	26.7	LENAWEE	48	37.4
ALPENA	25	67.1	LIVINGSTON	68	23.2
ANTRIM	8	28.4	LUCE	1	*
ARENAC	6	37.1	MACKINAC	16	119.1
BARAGA	6	70.0	MACOMB	278	22.4
BARRY	14	15.6	MANISTEE	5	*
BAY	55	39.9	MARQUETTE	31	34.7
BENZIE	8	33.0	MASON	21	56.4
BERRIEN	75	36.9	MECOSTA	12	23.6
BRANCH	28	50.9	MENOMINEE	5	*
CALHOUN	106	61.9	MIDLAND	38	34.0
CASS	25	36.8	MISSAUKEE	10	51.7
CHARLEVOIX	17	48.3	MONROE	50	24.0
CHEBOYGAN	24	86.9	MONTCALM	32	41.0
CHIPPEWA	20	45.3	MONTMORENCY	3	*
CLARE	14	44.1	MUSKEGON	145	68.2
CLINTON	25	21.7	NEWAYGO	21	32.1
CRAWFORD	7	45.8	OAKLAND	325	17.2
DELTA	8	17.0	OCEANA	14	42.6
DICKINSON	21	60.6	OGEMAW	8	36.3
EATON	54	34.0	ONTONAGON	1	*
EMMET	23	48.2	OSCEOLA	9	28.1
GENESEE	166	33.6	OSCODA	1	*
GLADWIN	16	58.7	OTSEGO	12	37.4
GOGEBIC	1	*	OTTAWA	117	25.6
GRAND TRAVERSE	26	18.7	PRESQUE ISLE	6	44.8
GRATIOT	20	40.2	ROSCOMMON	7	33.7
HILLSDALE	28	49.4	SAGINAW	89	37.9
HOUGHTON	23	50.9	ST CLAIR	93	44.4
HURON	22	51.2	ST JOSEPH	37	46.4
INGHAM	74	17.8	SANILAC	26	48.1
IONIA	38	44.5	SCHOOLCRAFT	0	0.0
IOSCO	16	57.6	SHIAWASSEE	31	33.8
IRON	4	*	TUSCOLA	35	53.7
ISABELLA	39	41.6	VAN BUREN	50	51.4
JACKSON	98	47.2	WASHTENAW	96	17.3
KALAMAZOO	113	30.2	WAYNE	608	27.6
KALKASKA	16	73.9	WEXFORD	11	26.6
KENT	233	23.0	UNKNOWN	326	N/A
KEWEENAW	0	0.0	OUT OF STATE	71	N/A
LAKE	4	*	TOTAL	4365	31.7

Data Source: Michigan work-related burns surveillance system

Rates are suppressed if the count is between 1 and 5 because such rates are not statistically reliable.

The county findings were similar to past findings in that while 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).

Figure 8: Rate of Work-Related Burns (per 100,000) by County of Residence, Michigan 2019-2021



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 and excludes 326 cases with unknown county of residency. Data were suppressed when the number of cases was between one and five due to statistical unreliability. Rates were classified into categories based on natural breaks.

INDUSTRY

The industry of the workplace where the work-related burn occurred was determined for 3,224 (73.9%) cases. Burns were classified into NAICS industry sector categories. The accommodation and food service sector had the highest number of burns (1,085) and rate of work-related burns (120.8 work-related burns per 100,000 employed individuals) (Table 6). Almost all burns (98.3%) 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 2019-2021

NAICS Code	Industry Classification	Total	Percent	Rate per 100,000
11	Agriculture, Forestry, Fishing, and Hunting	61	1.9%	70.5
21	Mining, Quarrying, and Oil and Gas Extraction	6	0.2%	37.3
22	Utilities	25	0.8%	42.1
23	Construction	240	7.4%	46.1
31-33	Manufacturing	616	19.1%	33.6
31	Food, Beverage, Textile Manufacturing Wood Products, Paper, Petroleum, and Coal Products	122	3.8%	78.8
32	Manufacturing	140	4.3%	39.7
33	Primary Metal Manufacturing	354	11.0%	27.3
42	Wholesale Trade	92	2.9%	18.6
44-45	Retail Trade	178	5.5%	13.3
48-49	Transportation and Warehousing	56	1.7%	13.3
51	Information	8	0.2%	4.9
52	Finance and Insurance	2	0.1%	*
53	Real Estate and Rental and Leasing	12	0.4%	7.5
54	Professional, Scientific, and Technical Services	29	0.9%	3.3
55	Management of Companies and Enterprises	1	0.0%	*
56	Administrative and Support and Waste Management and Remediation Services	97	3.0%	12.4
61	Educational Services	69	2.1%	36.6
62	Health Care and Social Assistance	287	8.9%	16.2
71	Arts, Entertainment, and Recreation	72	2.2%	52.5
72	Accommodation and Food Services	1104	34.2%	109.7
722	Restaurants, Food Service and Drinking Places	1085	33.7%	120.8
81	Other Services (except Public Administration)	114	3.5%	29.7
92	Public Administration	155	4.8%	32.5
NA	Total	3224	100.0%	25.9

Data Source: Michigan work-related burns surveillance system

Data were suppressed when the number of cases was between one and five due to statistical unreliability Note this table excludes 1,141 cases with an unknown industry.

Table 7: Number and Percent of Work-Related Burns by Severity Within Industry Michigan 2019-2021

Industry Classification	First Degree	Second Degree	Third Degree	Fourth Degree	Unspecified
Agriculture, Forestry, Fishing, and Hunting	31(50.8%)	21(34.4%)	2(3.3%)	0(0.0%)	7(11.5%)
Mining, Quarrying, and Oil and Gas Extraction	3(50.0%)	1(16.7%)	1(16.7%)	0(0.0%)	1(16.7%)
Utilities	10(40.0%)	12(48.0%)	3(12.0%)	0(0.0%)	0
Construction	108(45.0%)	105(43.8%)	15(6.3%)	0(0.0%)	12(5.0%)
Manufacturing	232(37.7%)	266(43.2%)	51(8.3%)	0(0.0%)	67(10.9%)
Food Manufacturing	57(46.7%)	52(42.6%)	6(4.9%)	0(0.0%)	7(5.7%)
Wood Products Manufacturing	58(41.4%)	60(42.9%)	8(5.7%)	0(0.0%)	14(10.0%)
Primary Metal Manufacturing	117(33.1%)	154(43.5%)	37(10.5%)	0(0.0%)	46(13.0%)
Wholesale Trade	33(35.9%)	38(41.3%)	6(6.5%)	0(0.0%)	15(16.3%)
Retail Trade	86(48.3%)	68(38.2%)	7(3.9%)	0(0.0%)	17(9.6%)
Transportation and Warehousing	28(50.0%)	19(33.9%)	5(8.9%)	0(0.0%)	4(7.1%)
Information	5(62.5%)	1(12.5%)	0(0.0%)	0(0.0%)	2(25.0%)
Finance and Insurance	1(50.0%)	1(50.0%)	0(0.0%)	0(0.0%)	
Real Estate and Rental and Leasing	5(41.7%)	4(33.3%)	0(0.0%)	0(0.0%)	3(25.0%)
Professional, Scientific, and Technical Services	9(31.0%)	8(27.6%)	2(6.9%)	0(0.0%)	10(34.5%)
Management of Companies and Enterprises	1(100%)	0	0(0.0%)	0(0.0%)	
Administrative and Support and Waste Management and Remediation Services	39(40.2%)	30(30.9%)	11(11.3%)	0(0.0%)	17(17.5%)
Educational Services	32(46.4%)	28(40.6%)	1(1.4%)	0(0.0%)	8(11.6%)
Health Care and Social Assistance	148(51.6%)	112(39.0%)	1(1.4%)	0(0.0%)	23(8.0%)
Arts, Entertainment, and Recreation	27(37.5%)	36(50.0%)	3(4.2%)	0(0.0%)	6(8.3%)
Accommodation and Food Services	363(32.9%)	623(56.4%)	23(2.1%)	0(0.0%)	95(8.6%)
Other Services (except Public Administration)	55(48.2%)	51(44.7%)	4(3.5%)	0(0.0%)	4(3.5%)
Public Administration	55(35.5%)	85(54.8%)	2(1.3%)	0(0.0%)	13(8.4%)
Total	1271(39.4%)	1509(46.8%)	140(4.3%)	0(0.0%)	304(9.4%)

Data Sources: Michigan work-related burns surveillance system

Notes: This table excludes 1,141 cases with an unknown industry. Data were suppressed when the number of cases was between one and five due to statistical unreliability

SEVERITY OF BURNS BY INDUSTRY

The primary metal manufacturing industry had the highest percentage of burns classified as a third-degree burn (26.4%). Among industries with the number of burns greater than five, the health care and social assistance industry had the highest percentage of work-related burns that were classified as first degree (51.6%) while the accommodation and food services industry had the highest percentage of second-degree burns (56.4%) (Table7).

SOURCE OF PAYMENT

Workers' Compensation was the expected payer for 49.9% of the 4,007 cases with a medical record (Table 8). Among cases with an expected payer of Workers' Compensation, 303 also received wage replacement for seven or more days away from work. There were 80 work-related burns that did not list Workers' Compensation as a payment source for medical records but were matched to a record in the WDCA database. Payment source was not documented for 563 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	303	1696	1999	49.9%
Commercial	23	547	570	14.2%
Self-Pay	9	127	136	3.4%
Other	0	21	21	0.5%
Medicaid or Medicare	48	670	718	17.9%
Unknown	9	554	563	14.1%

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*

Case number 3

A male in his 30s suffered chemical burns to his left eye, when Cipichlor HD (Alkaline solution), a plumbing line cleansing/flushing agent, splashed into his eye. Despite aggressive eye irrigation, surgery was required due to increased intraocular pressure in the left eye. During surgery necrotic conjunctiva with keratinization of the conjunctiva and eyelid margin were found. Ocular surface reconstruction was required with amniotic membrane transplantation of multiple layers. The workplace was cited for three violations. One serious violation for \$3,500 was for not having an eyewash station or other suitable means of eye flushing. A second serious violation for \$3,500 was for not having a face shield or splash proof goggles. The last serious violation was for not having a listing of hazardous chemicals which includes category 1 Cipichlor HD, and that the employee was not trained on the hazards associated with category 1 hazard chemicals.

MIOSHA REVIEW

MIOSHA inspected 38 worksites identified from medical records between 2019-2021. Table 9 shows the distribution of assessed penalties. The maximum penalty was \$16,800 and the median was \$5,600. MIOSHA cited two companies for hydraulic press violations and one company for mechanical press violations. Of the 38 worksites, 34 received citations for a hazard directly related to the burns. The number of citations per company, which received a citation, ranged from one to six. None of these hazards were corrected prior to the inspection even though the inspections occurred three to six months after the burns had occurred.

Table 9: Penalties Assessed in MIOSHA Worksite Inspections, 2019-2021

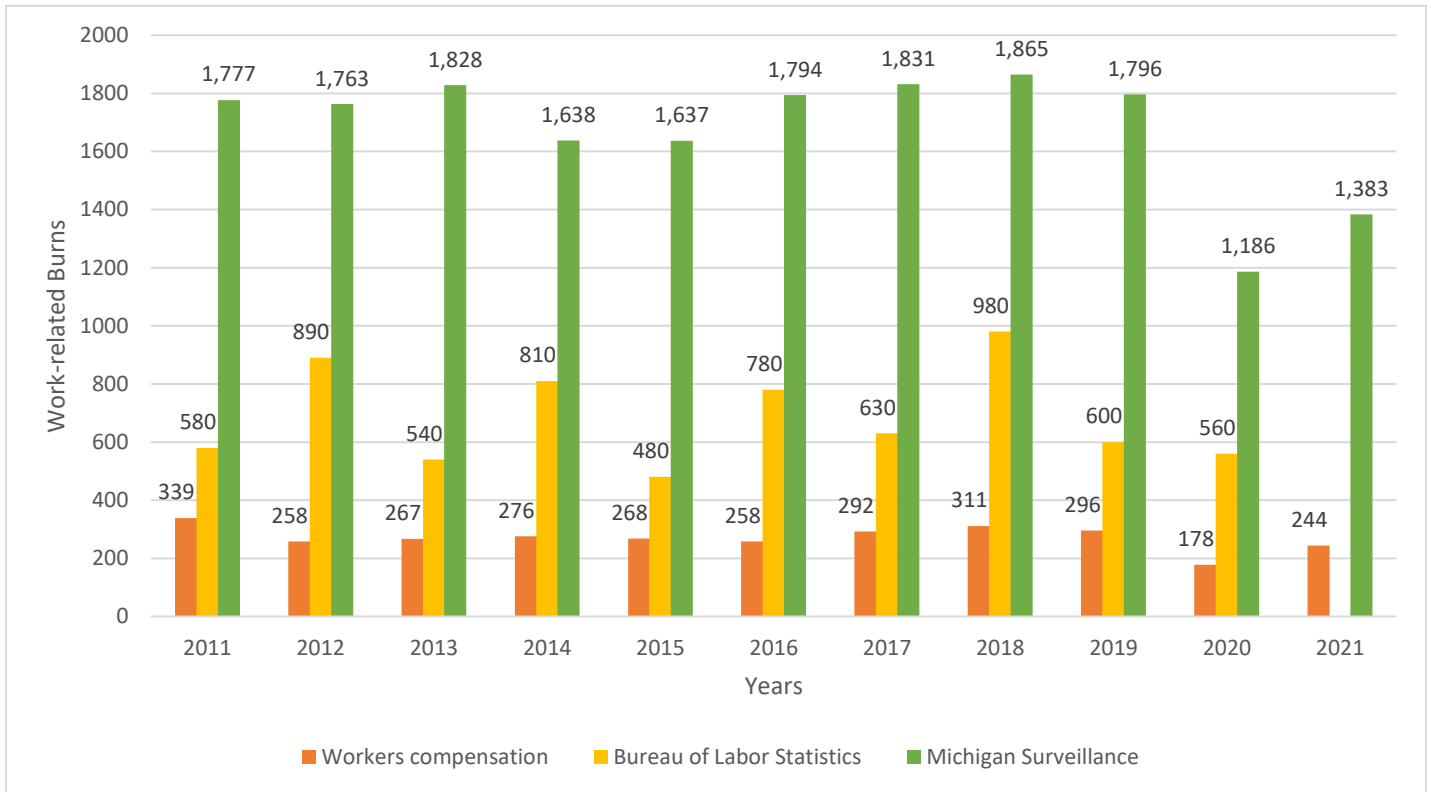
Penalty Assessed	Number of Worksites	Percent
\$0	4	10.5%
\$1-\$999	4	10.5%
\$1,000-\$9,999	24	63.2%
\$10,000-\$20,000	6	15.8%
Total	38	100.0%

**Data Source: Michigan work-related burns surveillance system*

COMPARISON OF SURVEILLANCE SYSTEM

The Michigan-based surveillance system has consistently detected a larger number of work-related burns than either the Workers' Compensation database or the BLS SOII over the past ten years (Figure 10). The annual number of work-related burns detected by the Michigan-based surveillance system has been an average 149.9% higher than the official BLS SOII estimates and 519.2% higher than the estimate identified from Workers' Compensation claims from 2011 through 2021. The Michigan-based surveillance system identified 1,822 more work-related burns than the BLS SOII for the years 2019 and 2020 and 3,647 more work-related burns than Workers Compensation for the years of 2019 through 2021.

Figure 9: Number of Work-Related Burns by Surveillance Source, Michigan 2011-2021



Data Sources: Michigan work-related burns surveillance system, Michigan Department of Labor and Economic Opportunity Workers’ Disability Compensation Agency Database, Bureau of Labor Statistics Survey of Occupational Injuries, and Illnesses. BLS data from 2021 are not yet available.

DISCUSSION

Decreased work activity secondary to the COVID-19 pandemic presumably reduced the number and rate of burns in Michigan in 2020 and 2021. While the rates of burns in the year 2019 remained consistent with the previous nine years, the number and rate of burns in 2020 and 2021 showed a marked decrease. For example, comparing the rate 2019 to 2020 indicates that there was 27.9% decrease in the rates of burn (2019 had 37.6 burns per 100,000 while 2020 had 27.1 burns per 100,000).

Males 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 1,104 cases between 2019 and 2021 with a rate of 109.7 work related burns per 100,000 workers. Most (71.0%) burns were caused by thermal burns, and more than half of all work-related burns were 2nd degree (51.4%). It is possible that the true number of work-related burns were greater than what was reported because first-degree burns were less likely to require medical treatment and less likely to result in missed days of work and henceforth were less likely to be reported.

The Michigan work-related burn surveillance system has consistently detected a greater number of work-related burns than both the BLS SOII and the WDCA database from 2009-2021. There are multiple factors why BLS undercounts work-related burns, one factor is 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 92 self-employed individuals and 23 farm workers between 2019-2021 and therefore these two differences between the Michigan and the BLS system would not 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 used by 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.

There are several possible explanations for the difference with the number of burns identified in Workers' Compensation database. First the WDCA data set only included burns that caused seven or more consecutive days away from work, which are presumably the most severe cases. Second the WDCA excluded the self-employed, but again there were only 92 self-employed workers in the Michigan' multi-source reporting system. Third, there were coding errors in the WDCA data. Matching WDCA claims with hospital records identified 76 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. Fourth, 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 of 2019-2023 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, Michigan lowered the age of cases required to be reported from 16 to 14 years 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.

LIMITATIONS

Despite the advantages of the Michigan work-related burns surveillance system over the BLS SOII, several limitations could impact the ability of the state-based surveillance system to identify all burns. A work-related burn would be missed if a worker burnt in Michigan received medical treatment exclusively at an out-of-state hospital, which are not required to comply with MDHHS reporting regulations. Burns that were treated at non-hospital affiliated facilities and/or did not receive workers' compensation for seven or more consecutive days away from work were not identified in the

surveillance system. This limitation most likely affected workers with less severe first-degree burns, who for example might receive medical care in an urgent care clinic.

Other limitations are that medical records often do not document the specific cause of the burn. Medical records may also lack information on the patient's employer or industry, and most records did not include information on the patient's race and Hispanic ethnicity. Workers' compensation claims do not collect information on the cause of injury or the worker's race and ethnicity. Workers' compensation claims may lack detailed injury descriptions and deducing the degree of the burn may not be completely accurate.

CONCLUSIONS

The Michigan work-related burn surveillance system leverages hospital reporting and workers' compensation claims data, providing a more accurate number of work-related burns than the official estimate based on the employer-based reporting system maintained by the BLS. In addition, the hospital reports in the state-based surveillance system are used to target public health interventions to find and reduce workplace hazards. Progress continues to be made in reducing the risk of work-related burns. We expect the number and rate of work-related burns to increase in 2022 from 2020 and 2021 as Michigan resumed pre-COVID-19 work activity. More work is necessary to prevent work-related burns and we will continue to monitor the occurrence of these burns to provide data to target preventive actions.

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