Work-Related Burns in Michigan: Third Annual Report (January 2011 – December 2012)

MICHIGAN STATE
U N I V E R S I T Y

Department of Medicine
909 Fee Rd, Room 117
West Fee Hall
East Lansing, MI 48824

and

LARA
LICENSING AND REGULATORY AFFAIRS

Michigan Department of Licensing and Regulatory Affairs
Michigan Occupational Safety and Health Administration
P.O. Box 30643, Lansing, MI 48909

and

Michigan Department of Community Health
MDCH

Division of Environmental Health
Michigan Department of Community Health
P.O. Box 30195, Lansing, MI 48909

December 19, 2014

Work-Related Burns in Michigan:

Third Annual Report

(January 2011 – December 2012)

A Joint Report of

Michigan State University

and

Michigan Department of Licensing and Regulatory Affairs

and

Michigan Department of Community Health

Prepared by:

Joanna Kica, MPA
Martha Stanbury, MSPH
Martha Yoder, Director MIOSHA
Kenneth Rosenman, MD

Author affiliations: Joanna Kica and Kenneth Rosenman are with Michigan State University, Department of Medicine, West Fee Hall, 909 Fee Rd, Room 118, East Lansing, MI 48824.

Martha Stanbury is with the Michigan Department of Community Health, Division of Environmental Health, P.O. Box 30195, Lansing MI 48909.

Martha Yoder is with the Michigan Department of Licensing and Regulatory Affairs, Michigan Occupational Safety and Health Administration, P.O Box 30643, Lansing MI 48909.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Michigan State University's Occupational and Environmental Medicine Division compiles data on work-related burns in the state of Michigan. This report is the third annual report on occupational burns in Michigan; it covers the years 2011 and 2012. These are the key findings: Work-related burns were identified through multiple reporting sources:

  - There were 1,777 work-related burns including three deaths in 2011. Because six individuals each had two separate burn incidents, 1,771 individuals were burned at work in 2011.
  - There were 1,763 work-related burns including three deaths in 2012. Because seven individuals each had two unique burn incidents, 1,756 individuals were burned at work in 2012.
  - The employer based survey system administered by the Bureau of Labor Statistics (BLS) estimated 600 work-related burns in 2011 and 890 in 2012.

- The BLS employer based system estimate of work-related burns was 42.1% (1,490 of 3,540) of the total number of work-related burns identified in 2011 and 2012 in Michigan's multi-source surveillance system.
- The most common type of medical encounter was an emergency department visit (84.3% in 2011 and 79.9% in 2012).
- Sixty-five percent of all burns were among male workers in both years of surveillance.
- In 2011 83.0% of all work-related burns were among Caucasians; in 2012 79.8% were among Caucasians.
- The most common part of the body burned were wrists and hands (34.6% in 2011 and 37.9% in 2012) and upper limbs except wrists and hands (18.4% in 2011 and 17.8% in 2012).
- Second degree (67.5% in 2011 and 62.6% in 2012) and thermal (69.9% in 2011 and 74.3% in 2012) burns were the most common types of work-related burns.
- Three industries – Accommodation and Food Services, Primary Metal Manufacturing and Healthcare and Social Assistance accounted for more than half of all work-related burn injuries in both years of surveillance, 51.9% and 56.1%, respectively.
- Workers' Compensation was the expected payer in 65.8% of the 1,542 cases in 2011 and in 61.2% of the 1,570 cases in 2012 for which there was a medical record. Payer source could not be determined for 13.6% of 2011 and 14.2% of 2012 medical records reviewed.
- The Michigan OSHA program completed inspections at 133 worksites identified by the surveillance system where individuals were burned in 2011 and 2012. MIOSHA issued 343 violations and assessed $784,440 in fines.

BACKGROUND

This is the third report on occupational burns in Michigan. It covers the years 2011 and 2012. Occupational burns are a preventable cause of work-related injury and are among the most traumatic injuries that can occur in a workplace. A traumatic injury is "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".[1] Health professionals and health facilities are required to report individuals with all injuries, including burns, regardless of cause when requested by MDCH or a local health department. This work-related burn surveillance system, based on mandatory reporting, allows the state to identify causes of work-related burns, target interventions to reduce future burns and evaluate the effectiveness of these interventions.

Nationally, BLS, the official source of work-related injury statistics, reported 600 work-related burns in 2011 (incidence rate of 21 workers per 100,000 full-time workers), and 890 work-related burns in 2012 (incidence rate of 30 workers per 100,000 full-time workers).[2,3] The BLS estimates are based on employer reporting. The BLS estimate includes private industry and state and local government workers but not the self-employed.

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

DATA SOURCES AND METHODS

There were four reporting sources of work-related burns:

- Hospitals/Emergency Departments
- Workers' Compensation Agency (WCA)
- Poison Control Center (PCC)
- Michigan Fatality Assessment and Control Evaluation (MIFACE)[4]

All 134 acute care hospitals, including Veterans' Administration Hospitals in Michigan, were required to report work-related burns. Medical records were used to identify a work-related burn treated at a hospital/emergency department (ED) or as an outpatient visit at a hospital-based clinic. A case identified using hospital medical records was defined as an individual aged 14 years or older receiving medical treatment at a Michigan hospital/ED for whom: (a) a burn-related diagnosis code was assigned (International Classification of Diseases, Ninth Revision (ICD-9)[5] codes for burns: 940.0-.9, 941.0-.5, 942.0-.5, 943.0-.5, 944.0-.5, 945.0-.5, 946.0-.5, 947.0-.9, 948.0-.9, 949.0-.5; ICD-9 codes for accidents caused by fire: E890.0-.9, E891.0-.9, E892, E893.0-.9, E894, E895, E896, E897, E898.0-.1, E899), and (b) the incident was documented as having occurred at work.

The WCA provided access to the database of paid claims for wage replacement. Individuals are eligible for wage replacement when they have had at least seven consecutive days away from work including weekends. A case identified using Michigan's Workers' Compensation system was defined as an individual who was in the lost work time wage replacement database with an accepted claim for a work-related burn that occurred in 2011 and 2012.

A case identified through Michigan's PCC was defined as an individual for whom a call was made by a burned employee, family member, coworker, or healthcare provider, regarding a consultation for a work-related burn injury in 2011 and 2012.

A case identified through the MIFACE program was identified as an individual who died from a work-related burn in 2011 and 2012.

Information from the hospital/ED medical reports, PCC reports and MIFACE reports on each case was abstracted onto a form, including: reporting source(s), type of medical care (hospital, ED, outpatient), hospital name, type of visit, date of admission and discharge, patient demographics, city and county of residence, source of payment, employer information (name, address, NAICS code), injury date, mechanism of the injury (type of burn), part(s) of body burned, severity of burn, and percentage of burn (% Total Body Surface Area, TBSA). Once these burn data were entered into a Microsoft Access database, records were manually linked to records in the Workers' Compensation database. Matches were identified using individual's first and last name, date of birth and date of injury. Finally, WCA cases meeting the work-related burn case definition that did not match with any of the other of the data sources (i.e. where WCA was the sole source of the case report) were identified. Information from Workers' Compensation on matched cases and new cases was added to the database. Duplicates identified by more than one reporting source were eliminated, after abstracting all information available from the duplicate data source.

Individuals whose workplaces could not be identified in the records and whose case met the criteria for a possible MIOSHA inspection (See pg.24) were contacted by telephone to obtain employer information.

For cases whose employers were referred to MIOSHA, additional information was obtained about the results of the referral, including: date of referral, whether an inspection was performed, inspection date, number of violations, and total fines assessed.

Data analysis was performed using queries conducted in Microsoft Access. Burn rates by age, gender, and industry were calculated using the U.S. Census, Department of Labor's Current Population Survey for denominators.[6,7,8,9]

The BLS' Occupational Injuries and Illnesses and Fatal Injuries Profiles online tool was used to generate the 2011 and 2012 BLS estimates and incidence rates of the number of nonfatal occupational injuries and illnesses involving days away from work by selected worker and case characteristics and nature of condition for both private and public ownerships.[2,3] For 2011, code 15XXXX (Burns and corrosions) and code 184XXX

(Burns and other injuries, except fractures) was used. For 2012, code 15XXXX (Burns and corrosions) was used.

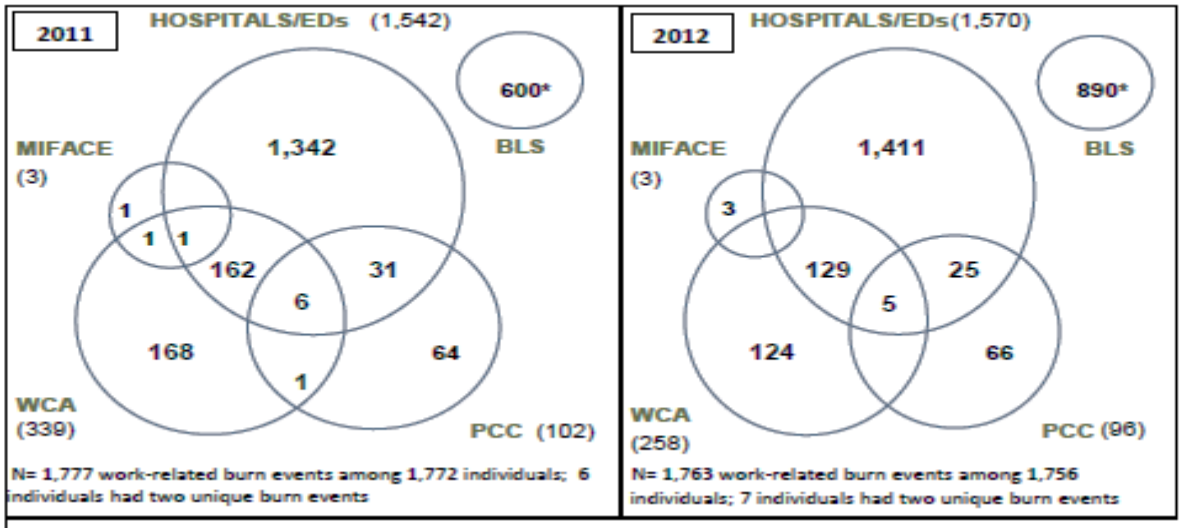
RESULTS

There were 1,777 work-related burn incidents in 2011 and 1,763 work-related burn incidents in 2012 reported from hospital/ED, PCC, WCA, and the MIFACE surveillance programs. The 1,777 events represent 1,771 people because 6 individuals each had two unique burn injuries in 2011; the 1,763 events represent 1,756 people because 7 individuals each had two unique burn injuries in 2012.

Reporting Sources

The number of work-related burns in Michigan by the reporting source and a comparison with the number estimated by BLS is shown in Figure1.

Figure 1. Reporting Sources of Work-Related Burn Incidents, Michigan 2011 - 2012



*There is presumably overlap between the 600 (2011) and 890 (2012) estimates of the BLS and the Michigan reporting sources (HDC, MIFACE and WCA) but BLS does not allow access to their data to assess the degree of overlap.

2011 Reporting Sources

In 2011, Hospital/ED reports identified 1,542 cases, WCA 339 cases, PCC 102 cases, and MIFACE 3 fatalities. Hospital/ED reports matched 162 WCA reports and 31 PCC reports, 6 both for WCA and PCC reports, and 1 both for WCA and MIFACE. One

fatality was identified through both the MIFACE program and WCA, and the other one through the MIFACE program only. One burn case was identified by both a WCA and PCC data source but not by the hospital/ED data source. Because of confidentiality restrictions, no attempt was made to match our data set with the BLS data set.

Of the 339 WCA cases, 313 were identified because they had been classified as a burn (a thermal burn (282) or a chemical burn (31)). The other 26 were included because they matched with names from one or more of the other data sources, although they had an injury description in the WCA database as something other than “burn”. All records were identified after matching with a burn report from a hospital/ED record. The descriptions in WCA for these 26 were: 9 “multiple injuries”, 5 “unclassified”, 3 “strains/sprains” 3 “electric shock”, 2 “crush/contusion”, 1 “amputation”, 1 “cut/laceration”, 1 “eye diseases”, 1 “skin conditions”.

2012 Reporting Sources

In 2012, Hospital/ED reports identified 1,570 cases, WCA 258 cases, PCC 96 cases, and MIFACE 3 fatalities. Hospital/ED reports matched 129 WCA reports and 25 PCC reports, and 5 both for WCA and PCC reports. Three fatalities were identified through the MIFACE program only. Because of confidentiality restrictions, no attempt was made to match our data set with the BLS data set.

Of the 258 WCA cases, 234 were identified because they had been classified as a burn (a thermal burn (204) or a chemical burn (30)). The other 24 were included because they matched with names from one or more of the other data sources, although they had an injury description in the WCA database as something other than “burn”. All records were identified after matching with a burn report from a hospital/ED record. The descriptions in WCA for these 24 were: 7 “multiple injuries”, 5 “unclassified”, 3 “electric shock”, 2 “crush/contusion”, 2 “dermatitis unspecified”, 1 “cut/laceration”, “fracture”, 1 “hernia”, 1 “inflammation joints”, 1 “strains/sprains”.

An emergency department visit was the most common type of medical encounter in 2011 and 2012, 1,497 (84.3%) and 1,409 (79.9%) cases, respectively. The type of medical care that workers received was not available for 169 WCA cases, 17 PCC

cases and 1 MIFACE case in 2011 and for 124 WCA cases, 66 PCC cases and one MIFACE case in 2012.

Table 1. Work-Related Burns by the Type of Medical Encounter, Michigan 2011 - 2012

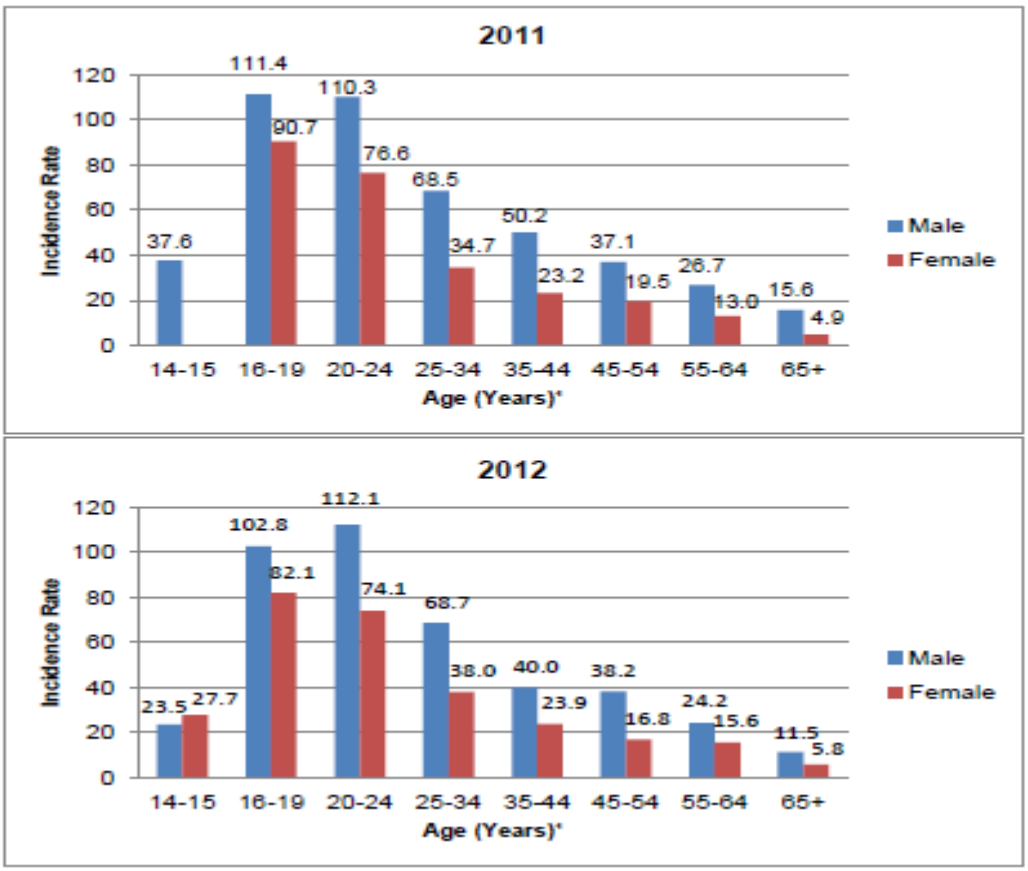
Medical Encounter Type	2011		2012	
	Number	Percent	Number	Percent
Emergency Department	1,497	84.3	1,409	79.9
Hospitalization	29	1.6	49	2.8
Outpatient	64	3.6	114	6.5
Unknown	187	10.5	191	10.8
Total	1,777	100.0	1,763	100.0

Characteristics of Injured Workers

Age and Gender

Age was available for 1,776 (99.9%) workers in 2011 and 1,754 (99.5%) workers in 2012; age was unknown for one male in 2011, and eight males and one female in 2012. The age of injured workers ranged from 15 to 76 years in 2011 and 15 to 84 years in 2012. The average age was 34 in 2011 and 35 in 2012. The median age was 31 in both years of surveillance. One third of burned individuals (550; 31.0% in 2011 and 551; 31.3% in 2012) were identified in the 14-24 age group. One thousand one hundred and sixty-two (65.4%) of all work-related burns in 2011 and one thousand one hundred and forty-nine (65.2%) of all work-related burns in 2012 were among men. Figure 2 displays burn rates by age group and gender for both years of surveillance. Among males, rates were highest for workers aged 16-19 (111.4/100,000) in 2011 and workers aged 20-24 (112.1/100,000) in 2012. For females, the age group with the highest burn rate in both years of surveillance was 16-19 (90.7/100,000 in 2011 and 82.1/100,000 in 2012).

Figure 2. Work-Related Burn Rates by Age Group and Gender, Michigan 2011-2012*

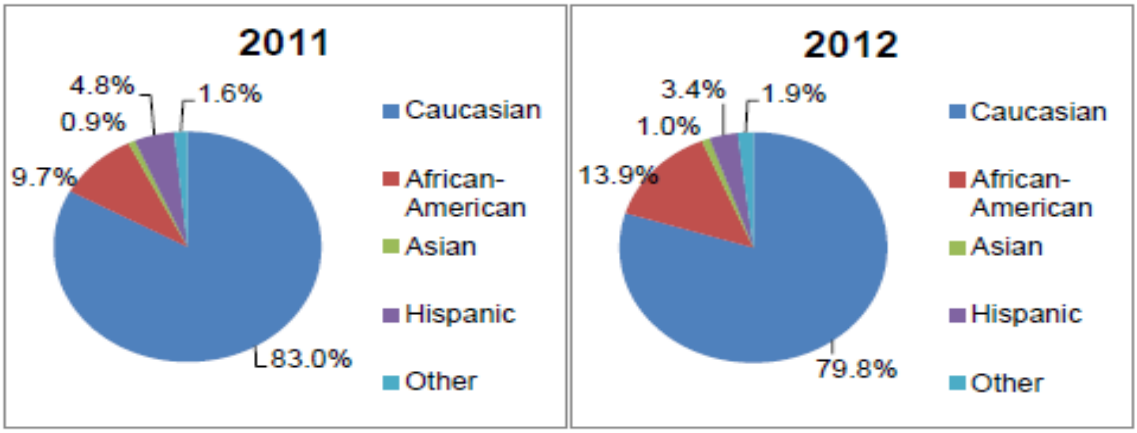


*Rates are the number of workers sustaining a burn per 100,000 workers (number of workers employed by age group used to calculate rates: Bureau of Labor Statistics' Current Population Survey). [6,7]
[1]Information on age was missing for one male worker in 2011 and for eight male and one female workers in 2012.

Race and Ethnicity

Race and ethnicity of injured workers is shown in Figure 3. Of the workers for whom race was available (937 in 2011 and 1,022 in 2012), Caucasians accounted for 778 (83.0%) workers in 2011 and 816 (79.8%) workers in 2012, followed by African-Americans with 91 (9.7%) and 142 (13.9%) cases, Hispanics with 45 (4.8%) and 35 (3.4%) cases, Asians 8 (0.9%) and 10 (1.0%) cases and individuals whose race was classified as Other with 15 (1.6%) and 19 (1.9%), respectively for 2011 and 2012. Race and ethnicity information was unavailable for 840 (47.3%) workers in 2011 and 741 (42.0%) workers in 2012.

Figure 3. Race/Ethnicity Distribution of Work-Related Burns, Michigan 2011 - 2012*



*Race/Ethnicity information available for 937 (52.7%) individuals in 2011 and 1,022 (58.0%) individuals in 2012.

Part of Body Injured

Medical records specified the part of body burned and were classified by ICD-9 codes (940.0-.9 – 949.0-.5). Medical records, which included ICD-9 codes regarding Accidents Caused by Fire, were recoded into the ICD-9 codes 940.0-.9 – 949.0-.5, which specify the part of body burned. The Workers' Compensation database did not classify injuries by ICD-9 codes but specified the part of the body burned, which was then recoded into the ICD-9 codes. In the PCC reports, the part of the body injured was specified by the caller and coded by using the ICD-9 codes.

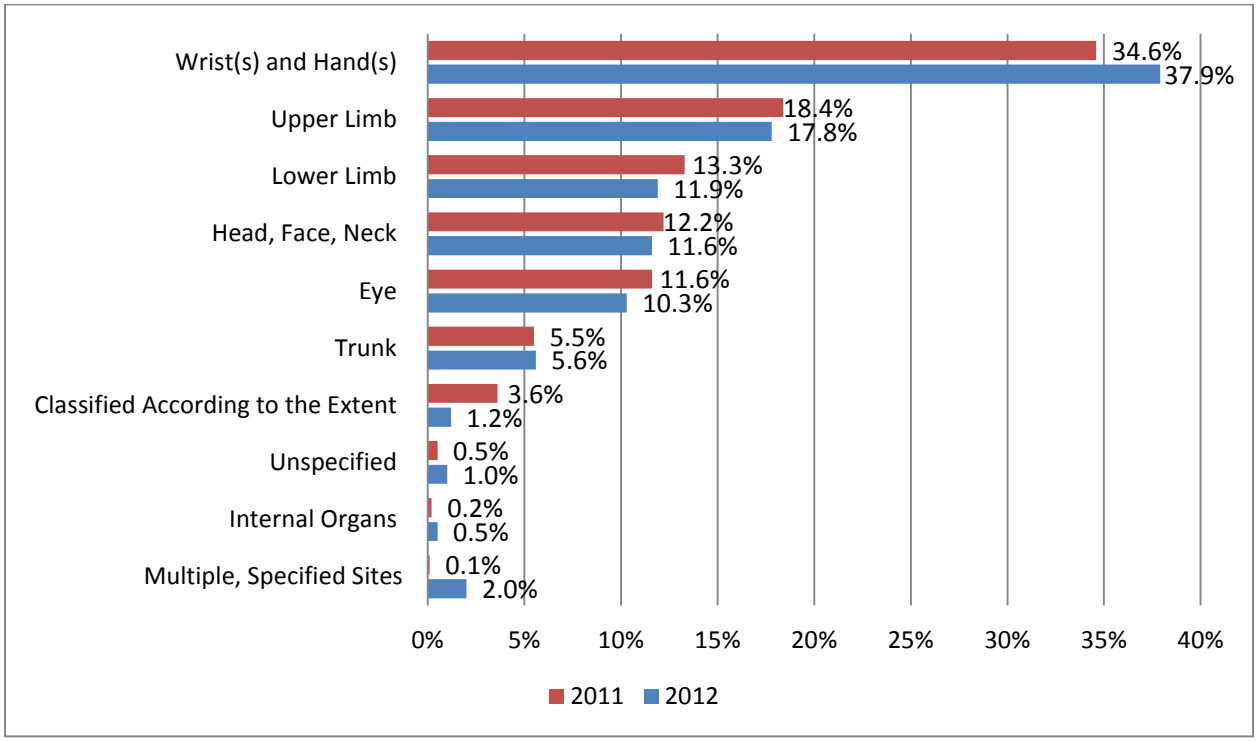
Table 2 and Figure 4 illustrate part of burned body. Burns of wrist(s) and hand(s) occurred most often (34.6% in 2011 and 37.9% in 2012), followed by upper limb burns (18.4% in 2011 and 17.8% in 2012), and then lower limb burns (13.3% in 2011 and 11.9% in 2012).

Table 2. Work-Related Burns by Part of Body Injured, Michigan 2011 - 2012*

Part of Body Burned (ICD-9 Code)	2011		2012	
	Number	Percent	Number	Percent
Eye (940.0-.9)	207	11.6	181	10.3
Head, Face, Neck (941.0-.5)	217	12.2	205	11.6
Trunk (942.0-.5)	98	5.5	99	5.6
Upper Limb (943.0-.5)	327	18.4	314	17.8
Wrist(s) and Hand(s) (944.0-.5)	614	34.6	669	37.9
Lower Limb (945.0-.5)	236	13.3	210	11.9
Multiple, Specified Sites (946.0-.5)	2	0.1	36	2.0
Internal Organs (947.0-.9)	4	0.2	9	0.5
Classified According to the Extent of Body Surface (948.0-.9)[1]	64	3.6	22	1.2
Unspecified (949.0-.5)	8	0.5	18	1.0
Total	1,777	100.0	1,763	100.0

*Numbers and percentages are based on a burn-related primary diagnosis of 1,777 individuals in 2011 and 1,763 individuals in 2012.
[1]This category is used when the site of the burn is unspecified, or with categories 940-949 when the site is specified and the percent of body surface burned is recorded.

Figure 4. Work-Related Burns by Part of Body Injured, Michigan 2011 - 2012*



*Percentages based on a burn-related primary diagnosis of 1,777 individuals in 2011 and 1,763 individuals in 2012.

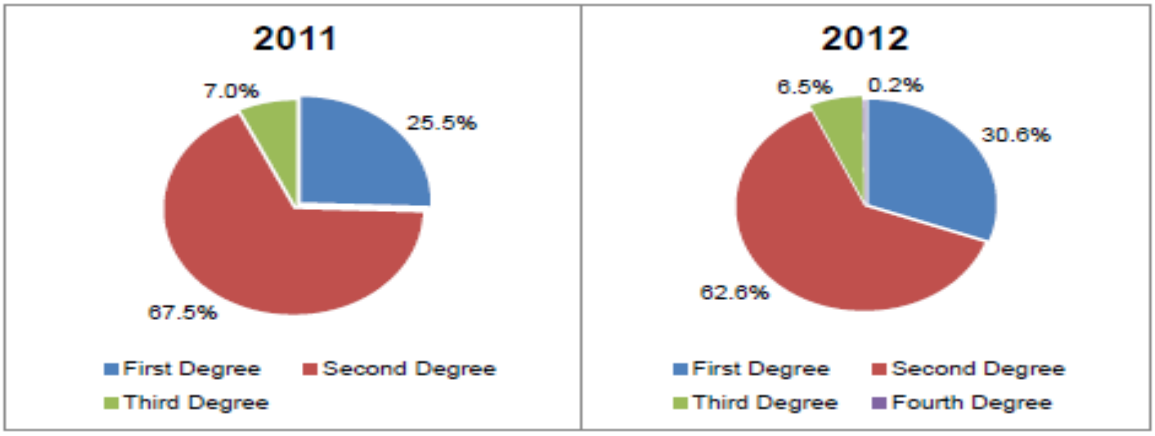
Severity

Burns can be described as first, second, third or fourth degree, or as to their thickness, e.g. superficial, partial and full.

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

Degree of burn was specified for 1,254 (70.6%) individuals in 2011 and 1,283 (72.8%) individuals in 2012, and its distribution is illustrated in Figure 5. Eight hundred and forty-six individuals in 2011 and 803 individuals in 2012 had a second degree burn, which was the most common type of burn, followed by a first degree burn in 320 and 393 workers, a third degree burn in 88 and 84 workers, and a fourth degree burn in 3 workers in 2012. Percentage of body injured was largely unreported. It was specified for only 315 (17.7%) workers in 2011 and 148 (8.4%) workers in 2012, of whom 22 (7.0%) individuals in 2011 and 25 (16.9%) individuals in 2012 sustained burns to more than 10 percent of their total body surface area.

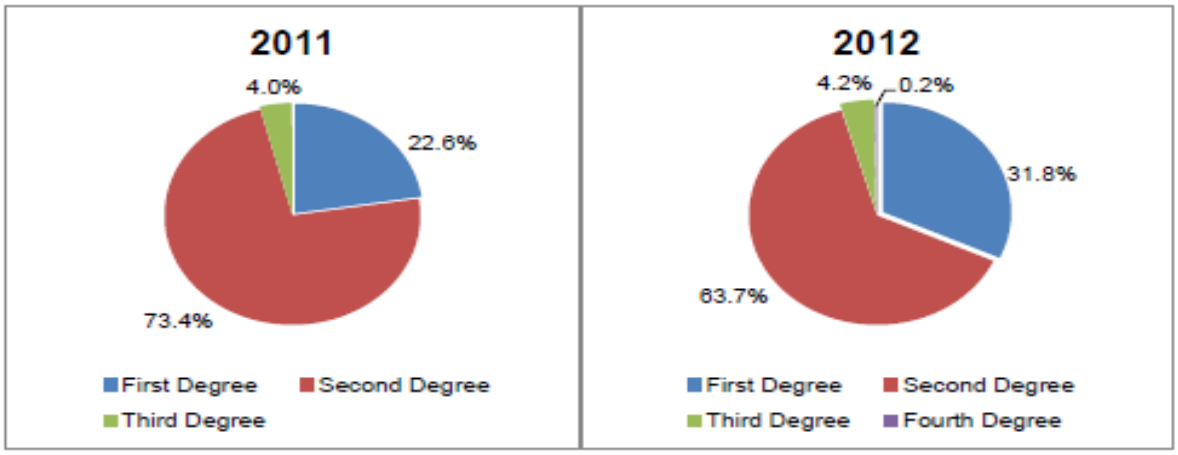
Figure 5. Work-Related Burns by Severity, Michigan 2011 - 2012*



*Degree of burn was specified for 1,254 individuals in 2011 and 1,283 individuals in 2012.

Figure 6 illustrates severity of burns within young workers aged 14 to 24. Degree of burn was specified for 421 (76.5%) individuals in 2011 and 424 (77.0%) individuals in 2012. Three hundred and nine young workers in 2011 and 207 young workers in 2012 had a second degree burn, followed by a first degree burn in 95 and 135 young workers, a third degree burn in 17 and 18 young workers, and a fourth degree burn in one young worker in 2012.

Figure 6. Work-Related Burns Among Young Workers by Severity, Michigan 2011 - 2012*



*Degree of burn was specified for 421 young workers in 2011 and 424 young workers in 2012.

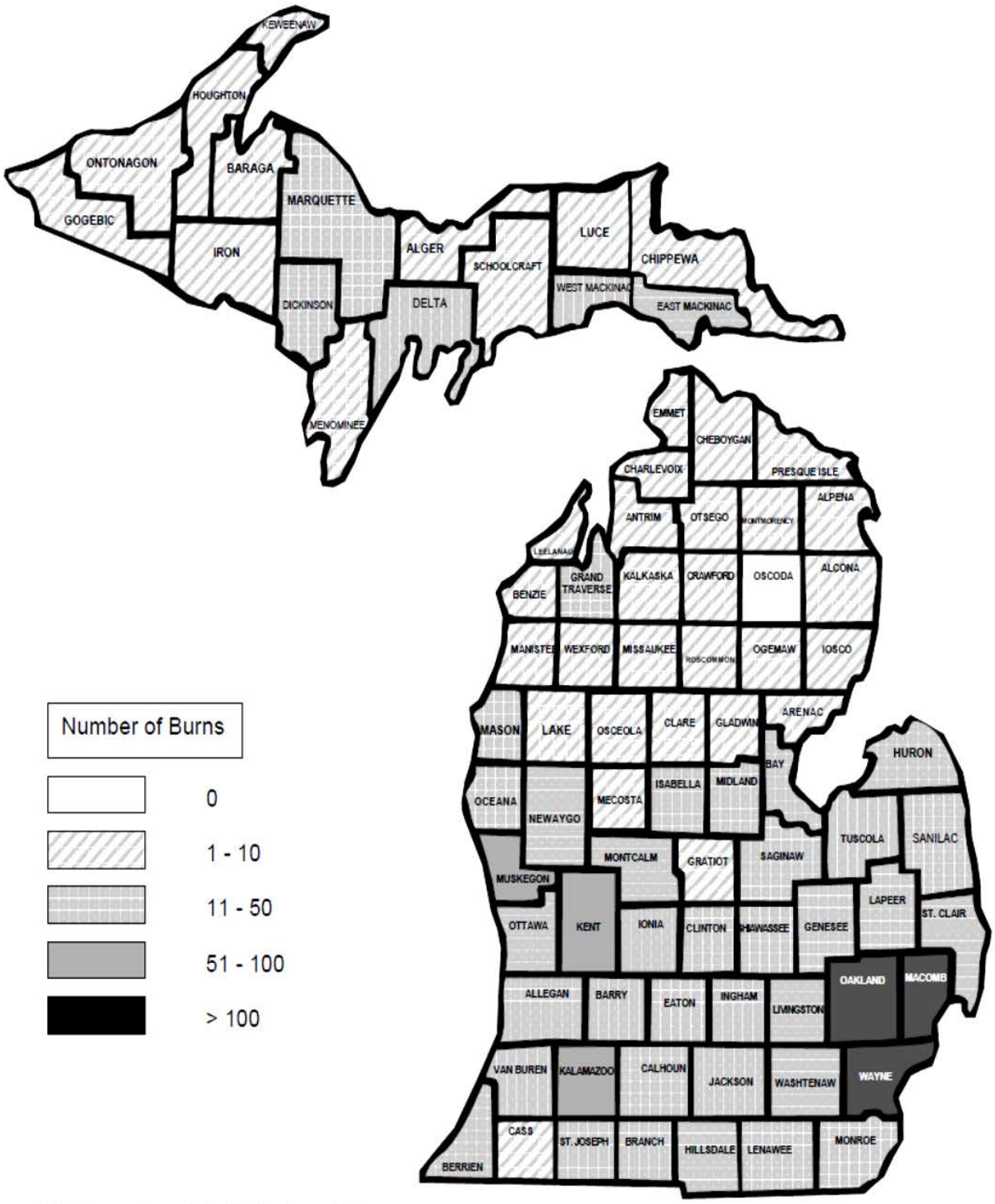
County of Residence

Table 3 and Figures 7 and 8 illustrate the worker's county of residence. There were 1,665 Michigan residents in 2011 (%) and 1,647 (%) Michigan residents in 2012 for whom the county of residence was known. There were 17 out-of-state workers in 2011 and 21 out-of-state workers in 2012. County of residence was unknown for 95 Michigan residents both in 2011 and 2012, 5.3% and 5.4% respectively. It should be noted that the county of residence would not necessarily be the same county where the individuals were injured. Wayne county had the highest number of residents who sustained a work-related burn with 211 (11.9%) cases, followed by 136 (7.7%) cases in Oakland county, and then Macomb county with 102 (5.7%) cases. In 2012, Wayne county had the highest number of residents with a work-related burn with 223 (12.6%) cases, followed by Oakland county with 128 (7.3% cases, and then Macomb with 98 (5.6%) cases.

Table 3. Work-Related Burns by County of Residence, Michigan 2011 - 2012

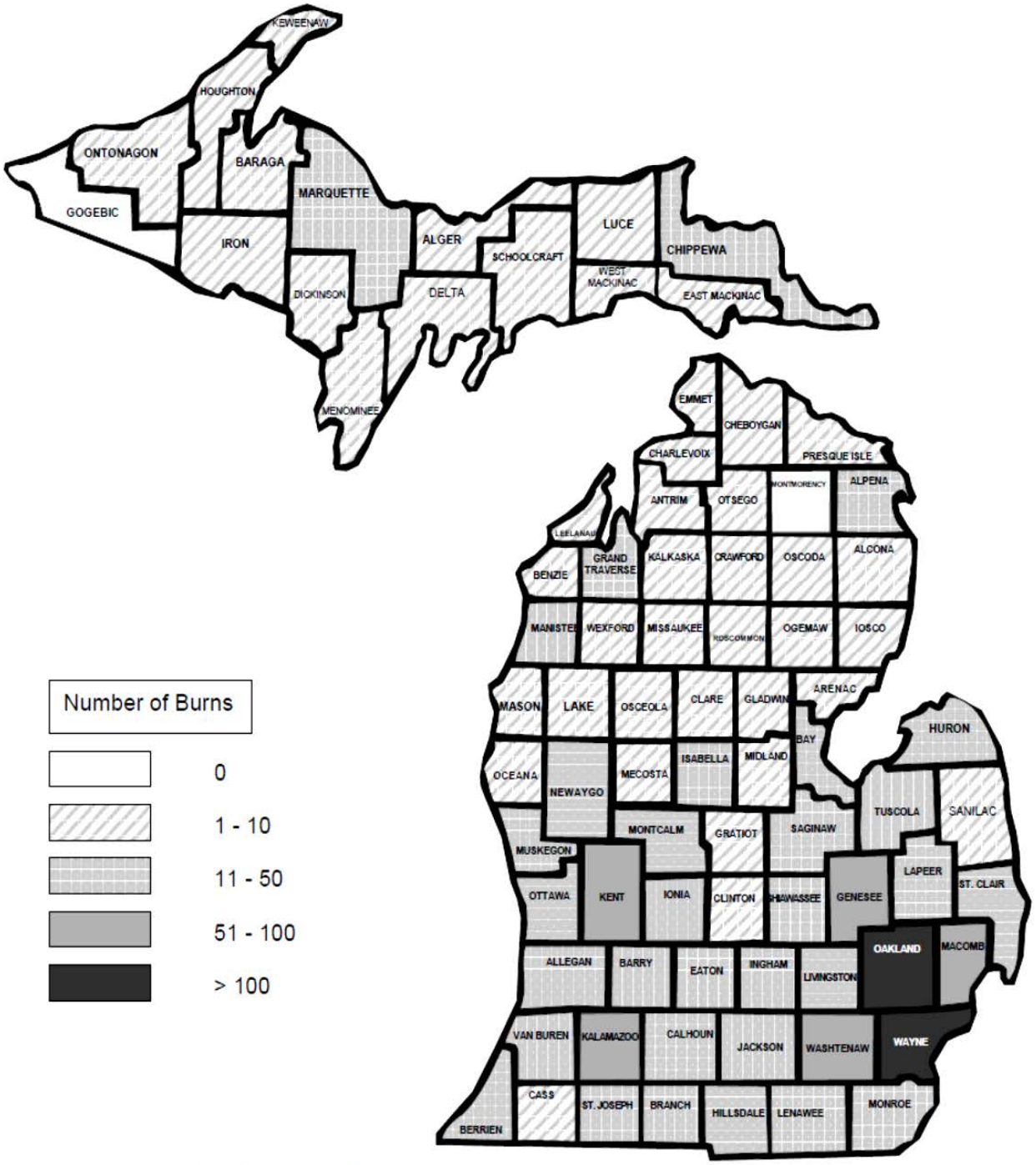
	2011		2012			2011		2012	
County	Number	Percent	Number	Percent	County	Number	Percent	Number	Percent
Alcona	1	0.1	1	0.1	Leelanau	2	0.1	2	0.1
Alger	1	0.1	1	0.1	Lenawee	22	1.2	14	0.8
Allegan	40	2.3	31	1.8	Livingston	41	2.3	39	2.2
Alpena	9	0.5	14	0.8	Luce	2	0.1	2	0.1
Antrim	4	0.2	5	0.3	Mackinac	11	0.6	7	0.4
Arenac	4	0.2	5	0.3	Macomb	102	5.7	98	5.6
Baraga	1	0.1	1	0.1	Manistee	5	0.3	11	0.6
Barry	14	0.8	19	1.1	Marquette	22	1.2	21	1.2
Bay	26	1.5	28	1.6	Mason	14	0.8	4	0.2
Benzie	4	0.2	7	0.4	Mecosta	9	0.5	8	0.5
Berrien	20	1.1	12	0.7	Menominee	2	0.1	2	0.1
Branch	20	1.1	14	0.8	Midland	12	0.7	7	0.4
Calhoun	35	2.0	33	1.9	Missaukee	1	0.1	3	0.2
Cass	4	0.2	6	0.3	Monroe	39	2.2	36	2
Charlevoix	3	0.2	7	0.4	Montcalm	27	1.5	18	1.0
Cheboygan	4	0.2	9	0.5	Montmorency	3	0.2	0	–
Chippewa	9	0.5	16	0.9	Muskegon	52	2.9	35	2.0
Clare	9	0.5	5	0.3	Newaygo	15	0.8	13	0.7
Clinton	11	0.6	10	0.6	Oakland	136	7.7	128	7.3
Crawford	5	0.3	5	0.3	Oceana	15	0.8	5	0.3
Delta	12	0.7	9	0.5	Ogemaw	4	0.2	3	0.2
Dickinson	11	0.6	10	0.6	Ontonagon	1	0.1	3	0.2
Eaton	25	1.4	25	1.4	Osceola	5	0.3	4	0.2
Emmet	8	0.5	6	0.3	Oscoda	0	–	2	0.1
Genesee	50	2.8	51	2.9	Otsego	8	0.5	7	0.4
Gladwin	9	0.5	3	0.2	Ottawa	41	2.3	50	2.8
Gogebic	4	0.2	0	–	Presque Isle	4	0.2	4	0.2
Grand Traverse	16	0.9	19	1.1	Roscommon	5	0.3	1	0.1
Gratiot	7	0.4	9	0.5	Saginaw	19	1.1	30	1.7
Hillsdale	12	0.7	18	1.0	Saint Clair	22	1.2	17	1.0
Houghton	3	0.2	7	0.4	Saint Joseph	14	0.8	11	0.6
Huron	27	1.5	16	0.9	Sanilac	11	0.6	10	0.6
Ingham	35	2.0	50	2.8	Schoolcraft	5	0.3	1	0.1
Ionia	14	0.8	16	0.9	Shiawassee	15	0.8	22	1.2
Iosco	5	0.3	4	0.2	Tuscola	22	1.2	20	1.1
Iron	3	0.2	10	0.6	Van Buren	27	1.5	25	1.4
Isabella	13	0.7	15	0.9	Washtenaw	32	1.8	71	4.0
Jackson	30	1.7	39	2.2	Wayne	211	11.9	223	12.6
Kalamazoo	80	4.5	67	3.8	Wexford	5	0.3	7	0.4
Kalkaska	8	0.5	3	0.2	Out of State	17	1.0	20	1.1
Kent	67	3.8	63	3.6	Out of Country	0	–	1	0.1
Keweenaw	1	0.1	1	0.1	Unknown	95	5.3	95	5.4
Lake	2	0.1	1	0.1					
Lapeer	16	0.9	12	0.7	**Total**	1,777	100.0	1,763	100.0

Figure 7 **Work-Related Burns by County of Residence, Michigan 2011**



Total number of Individuals: 1,777
Out of state Individuals: 17
County was unknown for 95 Individuals

Figure 8 **Work-Related Burns by County of Residence, Michigan 2012**



Total number of Individuals: 1,763
Out of state Individuals: 20; Out of country Individuals: 1
County was unknown for 95 Individuals

Industry

Table 4 illustrates the number, percent and rate of work-related burns by industry. For 1,500 (84.4%) individuals in 2011 and 1,491 (84.6%) individuals in 2012, there was sufficient information for industry classification using the North American Industry Classification System (NAICS) industry codes. Twenty-three workers in 2011 and twenty-four workers in 2012 were self-employed. Accommodation and Food Services (two-digit NAICS industry sector 72) had the highest number of work-related burns in 2011 with 408 (27.2%) cases and in 2012 with 499 (33.5%) cases, followed by the Primary Metal Manufacturing sector (NAICS 33), which had 201 (13.4%) burns in 2011 and 177 (11.9%) burns in 2012, and the Health Care and Social Assistance sector (NAICS 62) with 170 (11.3%) burns in 2011 and 160 (10.7%) burns in 2012. These three sectors combined accounted for more than half of all work-related burns for both years of surveillance, representing 51.9% and 56.1% of burns cases, respectively. Most of the burns identified in the Health Care and Social Assistance sector occurred while dealing with food. Firefighters accounted for the majority of burns occurring in the Public Administration industry. Accommodation and Food Services industry had the highest rate in both years of surveillance (127.0 and 170.8 per 100,000 workers, respectively) of burns, followed by Wholesale Trade industry in 2011 (85.1 per 100,000 workers) and Food, Beverage and Textile Manufacturing industry in 2012 (89.2 per 100,000 workers).

Table 5 illustrates the number, percent and rate of work-related burns by industry within young workers aged 14 to 24. Accommodation and Food Services industry accounted for more than half of all work-related burns in both years of surveillance, 50.2% and 56.7%, respectively. Accommodation and Food Services industry had also the highest rate in both years of surveillance (71.0 and 91.0 per 100,000 young workers, respectively).

Table 4. Work-Related Burns by Industry, Michigan 2011 - 2012

Industry Classification (NAICS)	2011			2012		
	Number	Percent	Rate*	Number	Percent	Rate*
Accommodation and Food Services (72)	408	27.2	127.0	499	33.5	170.8
Primary Metal Manufacturing (33)	201	13.4	39.9[1]	177	11.9	35.5[1]
Health Care and Social Assistance (62)	170	11.3	25.9	160	10.7	25.2
Construction (23)	78	5.2	35.1	71	4.8	35.1
Wholesale Trade (42)	73	4.9	85.1	59	3.9	53.4
Administrative and Support and Waste Management and Remediation Services (56)	70	4.7	45.9	62	4.2	43.0
Public Administration (92)	67	4.5	42.5	61	4.1	46.0
Wood Products/ Paper/ Petroleum and Coal Products Manufacturing (32)	63	4.2	50.7[1]	68	4.6	56.5[1]
Other Services (except Public Administration) (81)	62	4.1	31.0	52	3.5	27.0
Retail Trade (44)	61	4.1	20.6[2]	67	4.5	21.1[2]
Food, Beverage, Textile Manufacturing (31)	42	2.8	76.1[1]	46	3.1	89.2[1]
Educational Services (61)	38	2.5	9.4	34	2.3	7.1
Arts, Entertainment, and Recreation (71)	33	2.2	42.6	40	2.7	45.5
Sporting Goods, Hobby, Book, and Music Stores (45)	30	2.0	19.6[2]	14	0.9	10.5[2]
Professional, Scientific, and Technical Services (54)	29	1.9	12.3	22	1.5	9.3
Transportation and Warehousing (48-49)	25	1.7	19.2	17	1.1	11.8
Agriculture, Forestry, Fishing and Hunting (11)	22	1.5	32.2	13	0.9	21.2
Real Estate and Rental and Leasing (53)	14	0.9	22.4	8	0.5	11.3
Mining, Quarrying, and Oil and Gas Extraction (21)	5	0.3	53.7	2	0.1	25.7
Utilities (22)	4	0.3	11.0	9	0.6	19.2
Finance and Insurance (52)	3	0.2	2.2	5	0.3	3.0
Information (51)	2	0.1	2.5	5	0.3	6.9
Total of All Burns	1777**	100.0	42.3	1763**	100.0	41.7

*Rates are the number of workers sustaining a burn per 100,000 workers (number of workers by industry used to calculate rates: Bureau of Labor Statistics" Current Population Survey).[8,9]
**Sufficient information for industry classification was available for 1,500 individuals in 2011 and for 1,491 individuals in 2012.
[1]The denominator for this rate does not include 14,495 individuals in 2011 and 14,209 individuals in 2012 from "Not specified manufacturing industries (Part of 31, 32, and 33)" because the rate of burns was calculated separately for NAICS 31, 32, and 33. This is 2.1% respectively for both years of workforce with NAICS 31, 32 and 33.
[2]The denominator for this rate does not include 6,467 individuals in 2011 and 9,344 individuals in 2012 from "Not specified retail trade (Part of 44, 45)" because the rate of burns was calculated separately for NAICS 44 and 45. This is 1.4% and 2.0%, respectively of workforce with NAICS 44 and 45.

Table 5. Work-Related Burns Among Young Workers by Industry, Michigan 2011 - 2012

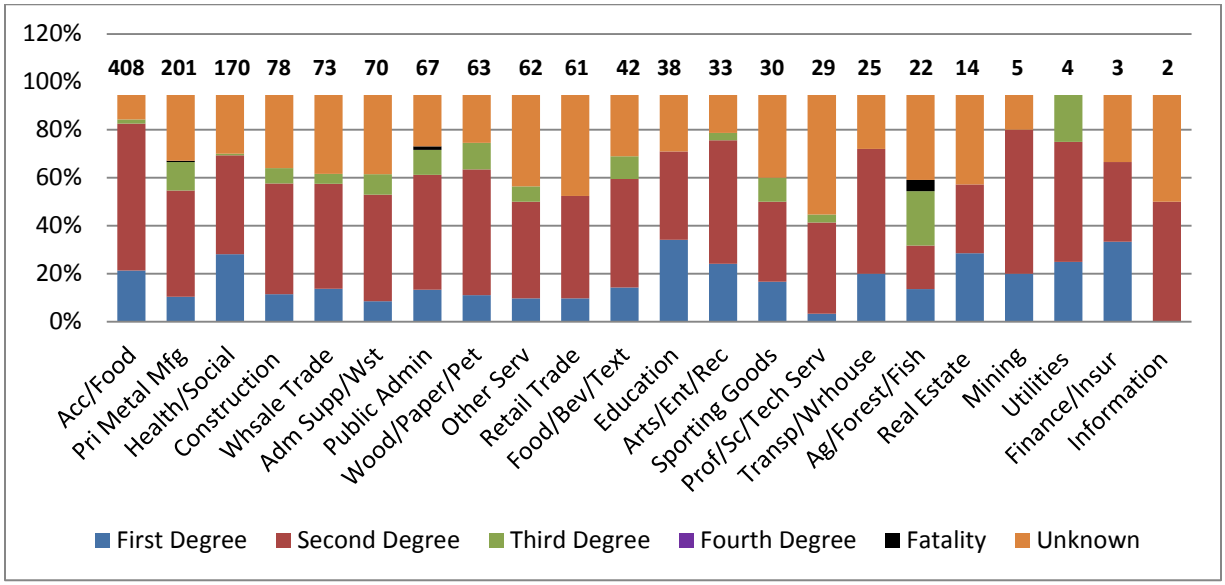
Industry Classification (NAICS)	2011			2012		
	Number	Percent	Rate*	Number	Percent	Rate*
Accommodation and Food Services (72)	228	50.2	71.0	266	56.7	91.0
Health Care and Social Assistance (62)	32	7.0	4.9	28	6.0	4.4
Primary Metal Manufacturing (33)	29	6.4	5.8[1]	40	8.5	8.0[1]
Retail Trade (44)	25	5.5	8.4[2]	21	4.5	6.6[2]
Construction (23)	19	4.2	8.5	16	3.4	7.9
Administrative and Support and Waste Management and Remediation Services (56)	19	4.2	12.4	16	3.4	11.1
Food, Beverage, Textile Manufacturing (31)	14	3.1	25.4[1]	10	2.1	19.4[1]
Other Services (except Public Administration) (81)	14	3.1	7.0	13	2.8	6.8
Sporting Goods, Hobby, Book, and Music Stores (45)	13	2.9	8.5[2]	3	0.6	2.2[2]
Wood Products/ Paper/ Petroleum and Coal Products Manufacturing (32)	12	2.6	9.7[1]	10	2.1	8.3[1]
Arts, Entertainment, and Recreation (71)	9	2.0	11.6	17	3.6	19.4
Public Administration (92)	9	2.0	5.7	3	0.6	2.3
Wholesale Trade (42)	8	1.8	9.3	9	1.9	8.1
Educational Services (61)	8	1.8	2.0	6	1.3	1.3
Professional, Scientific, and Technical Services (54)	5	1.1	2.1	4	0.9	1.7
Agriculture, Forestry, Fishing and Hunting (11)	4	0.9	5.9	5	1.1	8.1
Transportation (48)	3	0.7	3.3	1	0.2	1.0
Real Estate and Rental and Leasing (53)	3	0.7	4.8	1	0.2	1.4
Total of All Burns	550**	100.0	13.1	551**	100.0	13.0

*Rates are the number of workers sustaining a burn per 100,000 workers (number of workers by industry used to calculate rates: Bureau of Labor Statistics" Current Population Survey).[8,9]
**Sufficient information for industry classification was available for 454 individuals in 2011 and for 469 individuals in 2012.
[1]The denominator for this rate does not include 14,495 individuals in 2011 and 14,209 individuals in 2012 from "Not specified manufacturing industries (Part of 31, 32, and 33)" because the rate of burns was calculated separately for NAICS 31, 32, and 33. This is 2.1% respectively for both years of workforce with NAICS 31, 32 and 33.
[2]The denominator for this rate does not include 6,467 individuals in 2011 and 9,344 individuals in 2012 from "Not specified retail trade (Part of 44, 45)" because the rate of burns was calculated separately for NAICS 44 and 45. This is 1.4% and 2.0%, respectively of workforce with NAICS 44 and 45.

Severity of Burns within Specific Industries

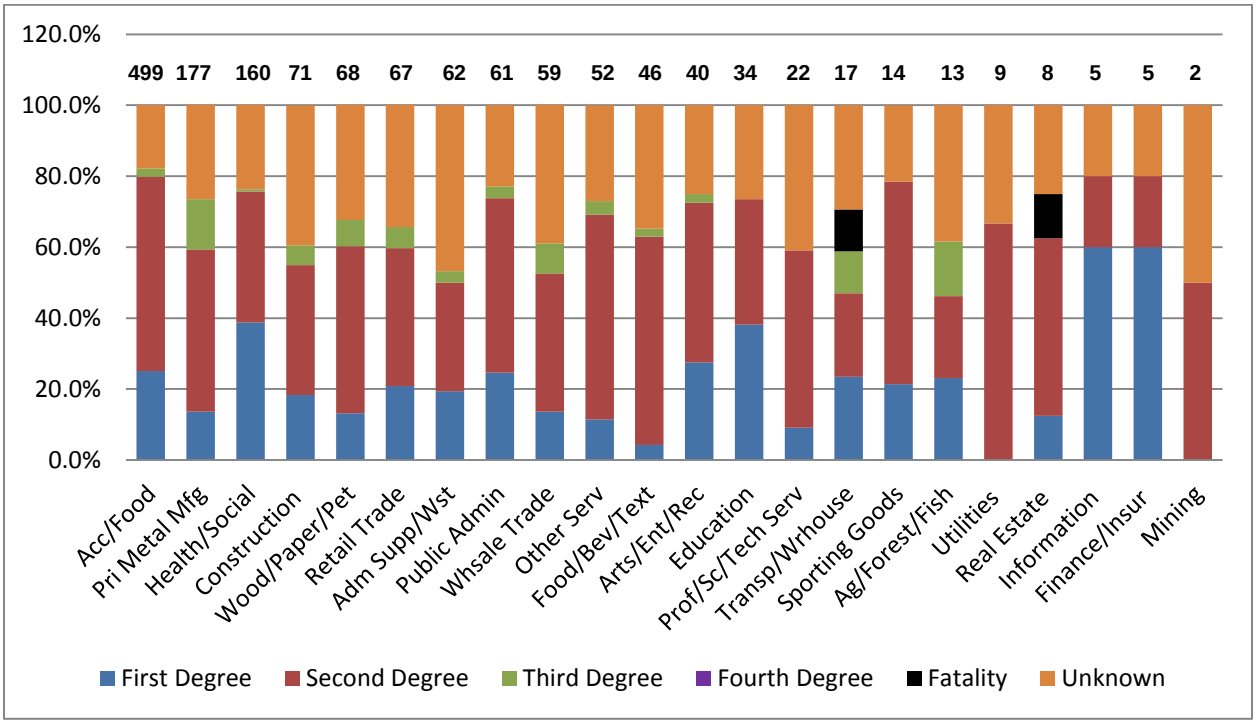
Figure 9 illustrates severity of burns within specific industries for 1,500 individuals in 2011. Figure 10 illustrates severity of burns within specific industries for 1,491 individuals in 2012. The severity of burns was specified for 1,063 (70.9%) individuals in 2011 and 1,098 (73.6%) individuals in 2012. The predominant degree of burn across all industries was second degree in 723 individuals in 2011 and 695 individuals in 2012. Of the three fatalities in 2011, one was reported in the Agriculture, Forestry, Fishing and Hunting sector (NAICS 11), one was reported in Primary Metal Manufacturing sector (33), and the last one in the Public Administration sector (92). In 2012, two fatal burns were reported in the Transportation sector (48), and one fatality was reported in the Real Estate and Rental and Leasing sector (53).

Figure 9. Severity of Burns within Specific Industries, Michigan 2011*



*Numbers above the bars are the total number of fatal and nonfatal burns by industry.

Figure 10. Severity of Burns within Specific Industries, Michigan 2012*



*Numbers above the bars are the total number of fatal and nonfatal burns by industry.

Month of Injury

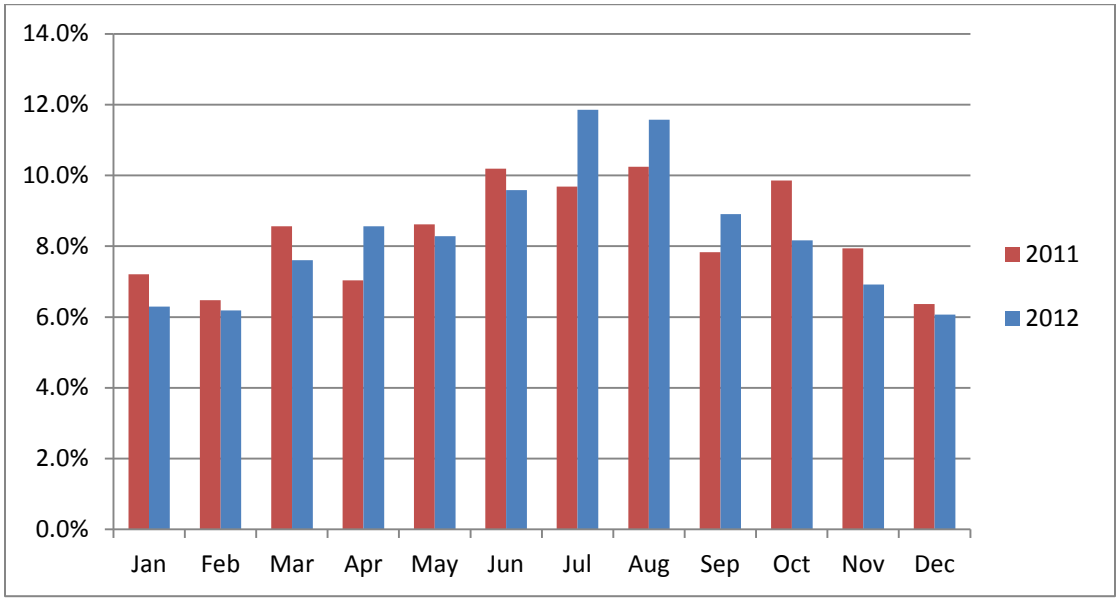
Month of injury was known for all but one individual in 2011 and all individuals in 2012 (Table 6 and Figure 11). The most common months for a burn in 2011 occurred in June and August, with 181 (10.2%) and 182 (10.2%) cases respectively, and in 2012 in July and August, with 209 (11.9%) and 204 (11.6%) cases. The lowest numbers in 2011 and 2012 occurred in December, with 113 (6.4%) and 107 (6.1%) cases respectively.

Table 6. Work-Related Burns by Month of Injury, Michigan 2011 - 2012

	2011		2012	
Month of Injury	**Number**	**Percent**	**Number**	**Percent**
January	128	7.2	111	6.3
February	115	6.5	109	6.2
March	152	8.6	134	7.6
April	125	7.0	151	8.6
May	153	8.6	146	8.3
June	181	10.2	169	9.6
July	172	9.7	209	11.9
August	182	10.2	204	11.6
September	139	7.8	157	8.9
October	175	9.9	144	8.2
November	141	7.9	122	6.9
December	113	6.4	107	6.1
Total	1,776*	100.0	1,763	100.0

*Month of injury was unknown for one individual in 2011.

Figure 11. Work-Related Burns by Month of Injury, Michigan 2011 - 2012



Source of Payment

Workers' Compensation was the expected payer in 1,014 (65.8%) of the 1,542 cases for which there was a medical record in 2011 (Table 7). One hundred and thirty four of these 1,014 (13.2%) received wage replacement for more than seven days away from work. Workers' Compensation was the expected payer in 961 (61.2 %) of the 1,570 for

which there was a medical record in 2012 (Table 7). Ninety-three of the 961 (9.7%) received wage replacement for more than seven days away from work. For 210 cases in 2011 and 223 cases in 2012, payment source could not be identified. Of the 528 cases for which Workers' Compensation was not listed as a payment source in medical records in 2011, 35 were matched to a case in the Workers' Compensation claims database. Of those 35 cases, 31 were classified as a burn and 4 had an injury description in the WCA database as something other than "burn". Of the 609 cases for which Workers' Compensation was not listed as a payment source in medical records in 2011, 41 were matched to a case in the Workers' Compensation claims database. Of those 41 cases, 33 were classified as a burn and 8 had an injury description in the WCA database as something other than "burn".

Table 7. Work-Related Burns by Payment Source, Michigan 2011 - 2012

Expected Source of Payment	2011				2012			
	Total		Non-Self-Employed		Total		Non-Self-Employed	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Workers' Compensation	1,014	65.8	1,014	66.7	961	61.2	961	62.1
Commercial Insurance	169	11	157	10.3	204	13	196	12.7
Self Pay	136	8.8	130	8.6	134	8.5	127	8.2
Other	13	0.8	12	0.8	48	3.1	43	2.8
Not Specified	210	13.6	207	13.6	223	14.2	221	14.3
Total	1,542	100	1,520	100.0	1,570	100.0	1,548	100.0

Data Source: Michigan hospital/ED medical records

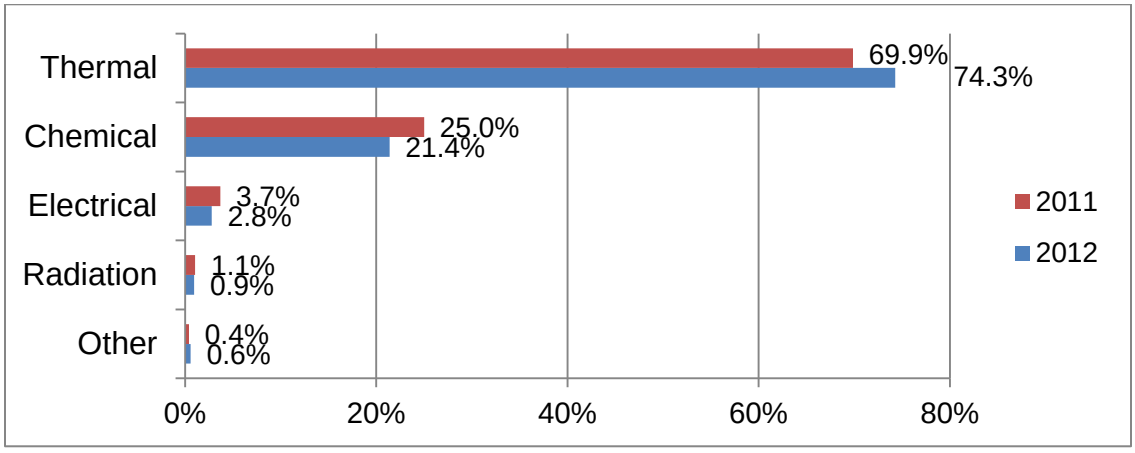
Causes of Burns

Burns can be caused by a variety of substances and external sources, e.g. heat, chemicals, electricity and radiation. There are 4 major types of burns:

- Thermal – Caused by contact with hot surfaces, flames, hot liquids.
- Chemical – Caused by acids and other skin damaging chemicals, molten metal compounds, hydrocarbons such as gasoline or hot tar.
- Electrical – Caused by contact with electric current.
- Radiation – Caused by ultraviolet radiation generated by the electric arch in the welding process.

Burn type was specified for 1,712 (96.3%) workers in 2011 and 1,687 (95.7%) workers in 2012 (Figure 12). The predominant burn type was thermal in 1,196 (69.9%) workers in 2011 and 1,253 (74.3%) workers in 2012, followed by chemical in 428 (25.0%) workers in 2011 and 361 (21.4%) workers in 2012, electrical in 63 (3.7%) workers in 2011 and 47 (2.8%) workers in 2012, and radiation in 18 (1.1%) workers in 2011 and 16 (0.9%) workers in 2012 (all from exposure to ultraviolet rays from welding). "Other" category information not included here. When the industry was specified, Accommodation and Food Services industry had the highest percentage of thermal burns with 361 (88.5%) cases in 2011 and 442 (88.8%) cases in 2012. Thirty-two percent of chemical burns in 2011 and 66.1% chemical burns in 2012 occurred in the Primary Metal Manufacturing industry. Some of the kinds of chemicals involved in chemical burns included sulfuric acid, sodium hydroxide, nitric acid, phosphoric acid and iodine. Among hospitalized individuals, thermal exposure was the cause for 19 (65.6%) cases in 2011 and 35 (71.4%) cases in 2012, chemical for 5 (17.2%) cases in 2011 and 7 (14.3%) cases in 2012 and electrical for 5 (17.2%) cases in 2011 and 7 (14.3%) cases in 2012 of the burns. An electrical burn was more likely to require hospitalization as compared to a thermal or chemical burn, 7.9% and 14.9%, 1.6% and 2.8% and 1.2% and 1.9%, respectively for 2011 and 2012. No radiation burns required hospitalization in either year of surveillance. Thermal burns were the cause of death of three individuals in 2011 and three individuals in 2012.

Figure 12. Work-Related Burn Type, Michigan 2011 - 2012*



*Burn type specified for 1,712 individuals in 2011 and 1,687 individuals in 2012.

Referrals to MIOSHA

The MIOSHA referral criteria for a work-related burn that occurred in 2011 or 2012 was that the individual had to have (1) been hospitalized, treated in an ED or treated as an outpatient, (2) sustained at least a second degree burn, and (3) the burn had to have taken place within six months of the referral. MIOSHA inspected 50 workplaces in 2011 and 83 workplaces in 2012 where burns occurred.

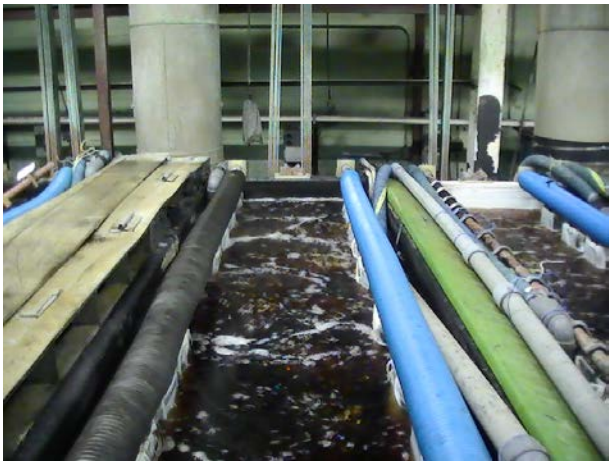
Table 8 illustrates the distribution of violations and penalties assessed by the industry type of the inspected workplaces in 2011 and 2012.

Table 8. Workplaces Inspected by MIOSHA: Violations and Penalties Assessed by Industry, Michigan 2011 - 2012

Industry Classification (NAICS)	2011			2012		
	# of Enf. Insp.	# of Violations	Total Penalties Assessed	# of Enf Insp.	# of Violations	Total Penalties Assessed
Utilities (22)	0	-	-	1	1	$5,000
Construction (23)	4	9	$387,200	6	13	$9,800
Food, Beverage, Textile Manufacturing (31)	3	3	$3,800	5	11	$11,400
Wood Products, Paper, Petroleum and Coal Products Manufacturing (32)	5	5	$11,350	6	9	$13,150
Primary Metal Manufacturing (33)	16	86	$108,670	26	76	$149,770
Wholesale Trade (42)	5	23	$7,350	6	15	$3,600
Retail Trade (44)	0	-	-	3	3	$2,550
Sporting Goods, Hobby, Book and Music Stores (45)	2	1	$1,750	0	-	-
Transportation and Warehousing (48)	1	0	$0	2	2	$600
Professional, Scientific, and Technical Services (54)	1	0	$0	1	5	$7,900
Administrative and Support and Waste Management and Remediation Services (56)	1	1	$1,000	3	1	0
Educational Services (61)	1	1	$0	0	-	-
Health Care and Social Assistance (62)	0	-	-	10	30	$41,000
Accommodation and Food Services (72)	9	9	$3,950	8	13	$8,550
Other Services (ExceptPublic Administration) (81)	2	20	$850	4	3	$700
Public Administration (92)	0	-	-	2	3	$4,500
Total	**50**	**158**	**$525,920**	**83**	**185**	**$258,520**

Examples of Work-Related Burn MIOSHA Enforcement Inspections

- *Electroplating, Plating, Polishing, Anodizing, and Coloring:* A male in his late thirties, who performed maintenance daily on the line, sustained second degree burns while cleaning out a plating tank. The employee's foot slipped into the solution of potassium cyanide, caustic soda beads and caustic potash anhydrous. The chemicals spilled over the top of employee's boot. The temperature of the solution was approximately 150°F. MIOSHA found 20 violations (19 "Serous" and 1 "Other"), including Citation 1 Item 1: "The employer did not furnish to each employee, employment and a place of employment, which was free from recognized hazards that were causing or were likely to cause death or serious physical harm to the employee: Inadequate fall protection in that: (…) b) The harness used during the accident has not been inspected since June 2005 (date of injury: 8/15/2012), c) The harnesses are not rated for chemical exposure and they are stored on the plating catwalk and exposed to a corrosive environment. Place the wire brush on the end of a pole. Clean the "V" Block while standing on the catwalk. Cover tanks during the servicing of hoses or use adequate fall protection; Citation 1 Item 2: An open-sided floor or platform four feet or more above adjacent floor or ground level was not guarded by a standard barrier on all open sides."



- *Rolled Steel Shape Manufacturing:* A male in his early twenties was hospitalized for twenty-three days after sustaining second and third degree burns to the right leg and foot. The employee was standing on top of the tundish lid, and after breaking off the nozzle, knelt down stepping back on a floor opening of a 2800°Fmolten steel container. The employee's foot fell through, though the employee did not think it contacted the molten steel, but just the very hot air. The employee's steel plate boot and pant leg caught fire. MIOSHA found 3 "Repeat Serious" violations, including Citation 1 Item 1: "An open-sided floor or platform four feet or more above adjacent floor or ground level was not guarded by a standard barrier on all open sides; Citation 1 Item 2: A hatchway, floor opening, and/or floor hole into which persons may accidentally walk or through which material may fall was not guarded; Citation 1 Item 3: Live parts of electric equipment operating at 50 volts or more was not guarded against accidental contact by use of approved cabinets or other forms of approved enclosures."

- *Canned Fruits, Vegetables, Preserves, Jams, and Jellies:* A male in his early forties was hospitalized for three days due to thermal second degree burns to his right arm and hand. The employee sustained burns while working on a condensate return line which broke and sprayed the employee. MIOSHA found 2 "Serious" violations, including Citation 1 Item 1a: "Procedures were not developed, documented and utilized for the control of hazardous energy when performing condensate return line repair; Citation 1 Item 1b: Authorized employee(s) did not 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."

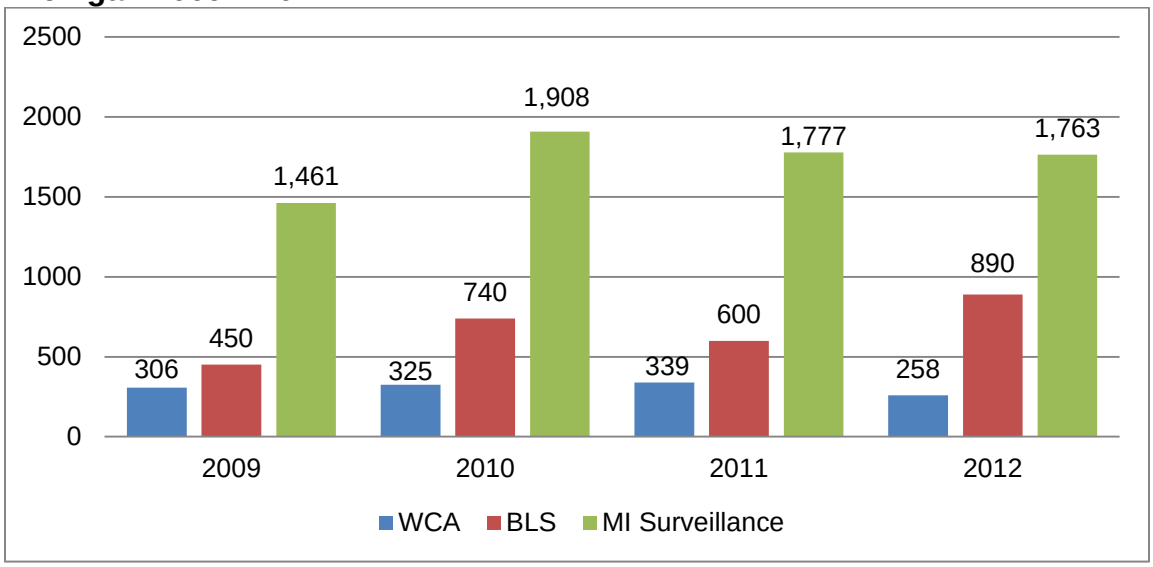
- *Full-Service Restaurants:* A female in her mid-thirties sustained thermal second degree burns to her right leg. The injury occurred when the employee reached over the soup line to retrieve an order from the pantry window. When the employee turned to walk away, part of the employee's clothing caught the soup ladle handle, pulling it from the soup container. The ladle contained approximately 10 ounces of soup at the temperature between 140 – 180°F. The soup spilled down the back of the employee's right leg. MIOSHA found 1

"Serious" violation - Citation 1 Item 1: "Materials, including scrap and debris, were piled, stacked, or placed in a manner that created a hazard to an employee (ten soup containers had half-curved handled ladles sticking out into the walkway up to two inches)."

DISCUSSION

This is the third report on work-related burn data in Michigan. It covers two calendar years, 2011 and 2012. The Michigan comprehensive surveillance system of work-related burns provides a more accurate estimate of the true number of work-related burns than the employer-based reporting system maintained by BLS, which is the official source of work-related statistics.[10] The Michigan system identified 1,777, work-related burns in 2011 in comparison to 600 reported by BLS and 1,763 work-related burns in 2012 in comparison to 890 reported by BLS (Figure 13). The employer-based system estimates account for only 33.8% of all work-related burns in 2011 and 50.5% of all work-related burns in 2012 identified by the Michigan multi-source surveillance system.

Figure 13. Number of Work-Related Burns by Three Surveillance Systems, Michigan 2009 – 2012



The BLS's undercount of work-related burns is partially explained by the fact that BLS includes in its statistics only cases with one or more days away from work or with

altered work duties, whereas the Michigan multi-source surveillance system counted all work-related burn injuries. Based on data from WCA, the Michigan Multi-source surveillance system included at least 339 individuals with more than seven days away from work but we do not have data on how many individuals had one to seven days or required a job transfer or restriction. Secondly, the BLS excluded self-employed, independent contractors and farm workers who work on farms with less than 11 employees. Michigan's burn surveillance identified only 23 self-employed in 2011 and 24 self-employed in 2012 and 22 farmers with burns in 2011 and 13 farmers with burns in 2012 so the difference in the type of workers covered in the BLS survey does not explain the undercount in the BLS data. Other possible explanations for the BLS undercount may be that employers are not providing complete reporting, the statistical sampling procedure of BLS, or employers are not properly identifying employees' injuries as burns.

Michigan's Workers' Compensation data also identified many fewer cases than the other data sources combined. Reasons contributing to the Workers' Compensation undercount include: 1) The WCA data set only included burns that caused 7 or more consecutive days away from work; 2) WCA excluded the self-employed, but again there were only 35 self-employed workers in our more complete reporting system; 3) Coding or miscoding errors in the WCA data. The matching with other data sources showed that 23 work-related burns identified from medical records or PCC were not classified as burns in the WCA data. Presumably there were other injuries in the WCA database that were similarly misclassified; 4) It is possible that some companies are handling burn injuries unofficially and not reporting them to Workers' Compensation insurance companies or the WCA.

Michigan OSHA Strategic Goal #1.1 for Fiscal Year 2009-2013[11] is to reduce by 20% the rate of worker injuries and illnesses in high-hazard industries, which include: Beverage and Tobacco Product Mfg. (312), Wood Products Mfg. (321), Plastics and Rubber Products Mfg. (326), Nonmetallic Mineral Product Mfg. (327), Primary Metal Mfg. (331), Fabricated Metal Product Mfg. (332), Machinery Mfg. (333), Transportation Equipment Mfg. (336), Recyclable Material Merchant Wholesalers (423930), Merchant Wholesalers, Nondurable Goods (424), Landscaping Services (561730), Hospitals (622)

and Nursing and Residential Care Facilities (623). Some of the highest rates for work-related burns were not included in these high-hazard industries (i.e. Accommodation and Food Services and Primary Metal Manufacturing (Table 4)).

Surveillance of work-related burns is crucial to the recognition and prevention of these conditions. In the first two years of Michigan's work-related burns surveillance system, ten worksites were identified (seven in 2009 and three in 2010) by the surveillance data where a subsequent intervention by MIOSHA likely reduced burn risks to other employees. The small number of MIOSHA investigations in 2009 and 2010 was partially limited by the delay in identifying and confirming the burn before referral to MIOSHA, and partly because of more restrictive criteria for referral. One modification in the surveillance system that has since been made is to require hospitals to report every 3 months rather than once a year to increase the timeliness of reports so as to increase efficacy of follow-up investigations. This modification has significantly increased the number of MIOSHA inspections, which totaled 50 in 2011 and 83 in 2012. A second modification that has been introduced to Michigan's burn surveillance system has been lowering the reporting requirement from age 16 to age 14 in order to capture burn injuries among working teens. This group frequently works in food services, the industry with the highest burn rate in Michigan's 2009 - 2012 data.

In addition to strengthening the worksite intervention component of the system, we plan to develop educational materials for distribution to employers and employees where there are patterns in causes for the burns. This will allow implementation of controls at more facilities than where a Michigan OSHA inspection was performed.

REFERENCES

1. Michigan Administrative Code Rule 325.301-306, available at: http://www7.dleg.state.mi.us/orr/AdminCode.aspx?AdminCode=Department&Dpt=CH&Level_1=Public+Health+Administration

2. United States Department of Labor, Bureau of Labor Statistics' Occupational Injuries and Illnesses and Fatal Injuries Profiles, 2011. Data obtained by navigating through screens starting at the following website: http://data.bls.gov/gqt/InitialPage

3. United States Department of Labor, Bureau of Labor Statistics' Occupational Injuries and Illnesses and Fatal Injuries Profiles, 2012. Data obtained by navigating through screens starting at the following website: http://data.bls.gov/gqt/InitialPage

4. Michigan Fatality Assessment and Control Evaluation available at: http://www.oem.msu.edu/MiFACE_Program.aspx

5. Public Health Services and Health Care Financing Administration. International Classification of Diseases, 9th Revision, Clinical Modification. Washington: Public Health Service, 1980.

6. U.S. Census Bureau. 2011 sex and detailed age data obtained through navigating through screen starting at the following website: http://dataferret.census.gov.

7. U.S. Census Bureau. 2012 sex and detailed age data obtained through navigating through screen starting at the following website: http://dataferret.census.gov.

8. U.S. Census Bureau. 2011 industry data obtained through navigating through screen starting at the following website: http://dataferret.census.gov

9. U.S. Census Bureau. 2012 industry data obtained through navigating through screen starting at the following website: http://dataferret.census.gov

10. Azaroff LS, Levenstein C, Wegman DH. Occupational Injury and Illness Surveillance: Conceptual Filters Explain Underreporting. *Am J Pub Health* 2002; 92:1421-1429

11. MIOSHA Strategic Plan FY 2009-2013 available at:
http://www.michigan.gov/lara/0,4601,7-154-11407_30928-37890--,00.html