Hospitalized Work-Related Burns in Washington State, 2000-2013

A summary of SHARP's hospitalized work-related burns surveillance data from 2000-2013.

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www.Lni.wa.gov/Safety/Research/

Hospitalized work-related burns are a reportable condition in Washington State. Physicians can download reporting forms at:
http://www.lni.wa.gov/SAFETY/RESEARCH/OCCHEALTH/BURNS/DEFAULT.ASP#Resources

Find previous reports and other hospitalized work-related burns surveillance materials by searching by project "Burns" at: http://www.lni.wa.gov/Safety/research/pubs/ByProject.asp?J=11

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SHARP
Safety & Health Assessment & Research for Prevention

Washington State Department of Labor & Industries

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Introduction

Work-related burns are a leading cause of acute occupational injury in the United States [Smith et al. 2005; American Burn Association 2015]. A substantial amount of burn injuries result from workplace exposures, with some estimates as high as 42.1% [Smith et al. 2005]. The 2015 National Burn Repository Report cites "Accident, Work Related" as the second most common source for cases from reporting hospitals, making up 13.7% of all burns captured by their system from 2005-2014, with "Workers Compensation" as the primary insurance payor for 9.1% of all cases [American Burn Association 2015]. While only a small percentage of work-related burns require hospitalization, those that do are often severe, costly, and can have lasting consequences including pain, disablement, and economic impacts such as delayed return to work (RTW). One study found that less than half of workers hospitalized with work-related burns were able to return to employment within 2 years at the same job without accommodation [Brych et al. 2001]. From 1994-1998, a total of 290 workers filed claims to the Washington state-fund workers' compensation system for burn injuries that required inpatient hospitalization. These injuries incurred direct costs of almost $2.8 million per year and resulted in approximately 7,600 lost workdays per year (an average of 132 lost workdays per claim) [Curwick 2006]. This report aims to describe the current burden of hospitalized work-related burns in Washington State.

Work-related burns are preventable. Potential strategies that can be used to prevent these serious injuries include engineering controls, personal protective equipment, and employer/employee education. Data from the Washington State hospitalized work-related burns surveillance system can be used as a resource for prevention information that can be shared with workers, health care providers, public health professionals, safety professionals, and other stakeholders.

Methods

Surveillance System

The purpose of Washington State's hospitalized work-related burns surveillance system is to identify and characterize these injuries and associated patterns and trends, in order to reduce and ultimately prevent work-related burns that result in hospitalization or death. This system aims to describe the incidence, prevalence, and mortality of work-related hospitalized burns, identify high risk occupations and industries, generate hypotheses about causative agents and factors, and to prioritize prevention activities.

On July 12, 2000, the Washington State Board of Health adopted revisions to the Washington Administrative Code Chapter 246 Section 101 [WAC 246-101-730] making hospitalized burns a reportable condition. The Washington State Department of Labor & Industries was given authority to maintain a surveillance system which provides for direct reporting from health care providers, and health care clinics and hospitals; the development of routine dissemination mechanisms; and provide consultation and technical assistance to health departments, business and labor organizations. The surveillance system is located within the Safety and Health Assessment and Research for Prevention (SHARP) Program (http://www.Lni.wa.gov/Safety/Research/) of the Washington State Department of Labor & Industries (http://www.Lni.wa.gov) (L&I). Data collection using this system began in September 2000. The Washington State Institutional Review Board (WSIRB) approved all protocols and materials associated with the hospitalized work-related burns surveillance system.

Washington Workers' Compensation System

In WA, non-federal employers are required to obtain workers' compensation (WC) coverage through L&I, unless they meet specific requirements to self-insure (SI) or are covered by an alternative system (e.g., federal workers). The WA WC State Fund (SF) is an industrial insurance program that covers approximately two-thirds of the state's 3.5 million workers, and is administered by L&I. The SF does not cover self-employed workers, though elective coverage is available. Workers covered by self-insurance rather than SF insurance typically work for one of approximately 450 large entities (companies or groups of companies).

The surveillance system's primary data source is L&I's industrial insurance workers' compensation system, hereafter referred to as workers' compensation (WC) data. In Washington, the worker and physician initiate a WC claim by completing a Report of Industrial Injury or Occupational Disease (RIIOD) form. In addition to worker demographic, employment and wage information, the RIIOD includes narrative text from both the worker and the health care provider that describe the injury or illness. The physician provides a medical diagnosis (with ICD-9) code, subjective and objective information regarding the medical diagnosis, evaluation and treatment plan.

All Washington WC SF claims are coded for nature of injury, part of body affected, burn source and secondary source, and event or exposure of injury or illness according to the Occupational Injury and Illness Classification System (OIICS) system from the information on the RIIOD form. OIICS codes are assigned at the beginning of a claim, and as such represent an initial description of the injury or illness.

Data from both SF and SI programs are collected and entered into centralized databases at L&I. These systems include: administrative information necessary to adjudicate a claim; identification of the employer and injured worker; codes characterizing the injury or illness; other necessary medical information; costs associated with disability payments, wage replacement, and pensions; billing information for health care providers, procedures, and treatment; and physician diagnoses codes.

As with any large administrative database, not all claims provide all necessary information. While the majority of claims are filed through the SF and are complete, the medical records for claims covered through an employer's self-insurance (SI) may not be complete. SI claims information is often incomplete regarding cost and time loss days, and therefore SI claims were not included in the analyses for this report.

A claim qualifies as a 'compensable' claim if after a 3 calendar day waiting period, the worker qualifies for wage replacement (time-loss (TL)) and/or disability benefits. Time loss days are actual days paid after the 3-day waiting period, without estimation of future days lost. A claim may change status (i.e., change from non-compensable (medical-only) to compensable) over time. Analyses of rates, cost and time-loss days were restricted to WC SF compensable claims.

Each employer account has a North American Industrial Classification System (NAICS) code assigned which identifies the industry associated with the business's economic activity. The NAICS groups 'economic activity' into 20 sectors (two digit code), 100 subsectors (three digit code) and 317 NAICS industry groups (four digit code) [NAICS 2007]. For this analysis, NAICS industry sectors were grouped according to the National Occupational Research Agenda

(NORA) system, which aggregates the 20 NAICS sectors into 10 Sector groups [National Occupational Research Agenda, NIOSH, 2013].

WA SF WC claimants are also assigned Standard Occupational Classification (SOC) codes [U.S. Bureau of Labor Statistics, 2010] which are used to classify the worker's occupation. The 2010 SOC has 840 detailed occupations, which can be grouped into 461 broad occupations, 97 minor groups, and 23 major groups [U.S. Bureau of Labor Statistics, 2010]. For this analysis, major groups are used.

Because the hospitalized work-related burns surveillance system includes cases that were not coded with NAICS and/or SOC codes, such as those received from a source other than the WA WC SF, the project epidemiologist assigned a NORA sector code and SOC major group code for the analyses involving industry and occupation in this report. These determinations were based primarily on: the available codes (i.e., was it coded by L&I); the reported industry, occupation, and employer; and the narrative text describing the incident (which is entered by the epidemiologist after each case is received and medical records are reviewed).

Case definition & entry process

A case is any worker, who is employed within the borders of the state of Washington, who suffers a burn while performing work-related duties, and the burn results in hospital inpatient treatment or death.

The primary source of hospitalized work-related burns reports is the WA WC SF system. A WC claim is included as a case if it has been assigned a nature of injury code for: heat burns or scald,

chemical burns, non-ionizing radiation burns, or welder's flash; and where the claimant is identified as an inpatient from a hospital bill in the system. Additionally, a claim is included as a case if the claim is accepted, has a nature of injury code for electric shock/electrocution, and the claimant is identified as an inpatient from a hospital bill, and at least one ICD9-CM diagnosis code from a hospital bill is consistent with a burn. Acceptable ICD9-CM codes are 94X burns (where X can range from 0 to 9 and identifies the affected body part), 91X.0 abrasion or friction burn, 91X.1 an infection associated with an abrasion or friction burn, and 692.7 sunburn.

This method relies on hospital billing information, and because SI claimants do not have hospital billing information, surveillance relying on SF WC alone represents an undercount of hospitalized work-related burn cases. For this reason, in addition to using WA WC data, SHARP developed voluntary reporting agreements with hospitals and burn centers in and around Washington to report cases of occupationally related burns in WA workers that were hospitalized at their institution. However, voluntary reporting by burn centers was not consistent through all years of the surveillance system included in this report. Hospital-reported cases were submitted using a mix of paper forms and electronic records (MS Excel over Secure File Transfer systems). Reporting forms were typically cover sheets of hospital admissions and included demographic information, and medical information regarding the nature, size, and cause of the burn. Because the reports came from different hospitals over several years, not all hospital reports have the same information. Some information, such as race/ethnicity, was reported by certain hospitals but is not captured by WC.

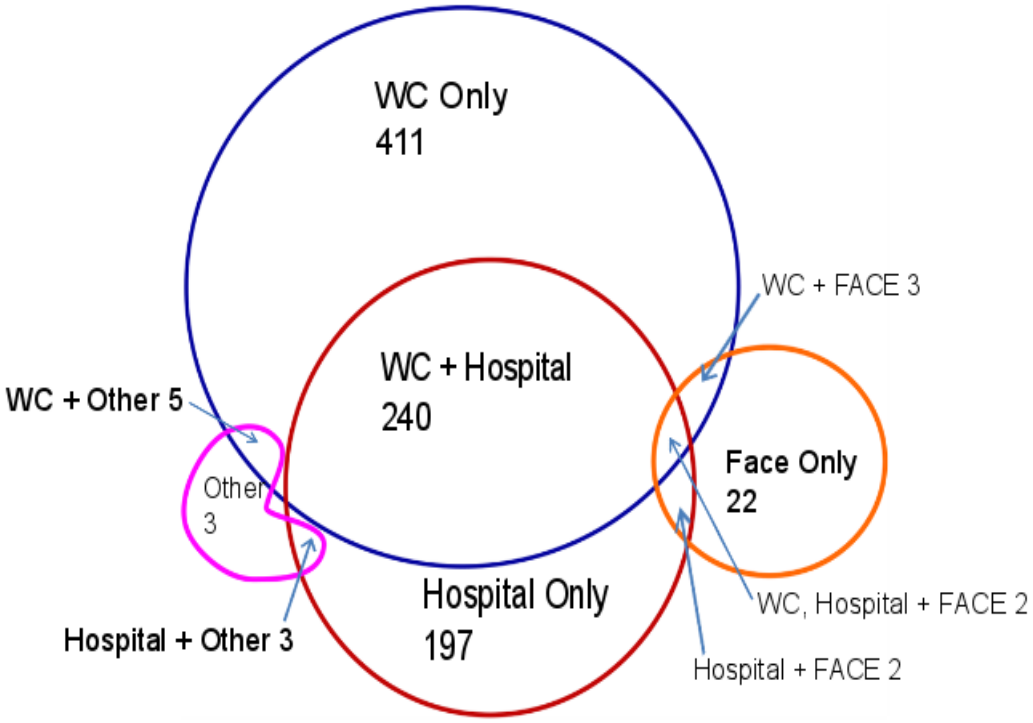
Data from workers compensation claims are extracted from the Department of Labor &

Industries data warehouse on a monthly basis. Deaths resulting from work-related burns are obtained from the occupational mortality reports in the Washington State Fatality Assessment and Control Evaluation (FACE) Program, which tracks, investigates and distributes information for prevention of work-related fatalities in WA. Hospitalized work-related burn cases from September 1, 2000 through December 31, 2013 were included in this report. Figure 1 describes the distribution of cases by reporting source.

Cases are received by the methods described above, and in addition to the coding that is done at the time of claim initiation (for WC claims), research staff also update certain coding fields in the database for all cases after they perform a medical record review (where available). These fields include description of the body parts involved in the burn (check all that apply, 8 region options); the burn classification or degree (partial thickness; deep partial thickness; full thickness; deep necrosis (full thickness); and deep necrosis with loss of body part), percent (%) total body surface area burned (TBSA), date of injury, date of earliest hospital admission, and a series of checks to ensure the case: is a burn; that the injury occurred while performing work duties; that the worker was hospitalized as an inpatient; and whether or not the worker received a fatal injury. A narrative description of the incident from the available medical records and WC forms is entered for each case, which summarizes: notes on the case; the task/event/process/source(s) involved; the depth, TBSA, and extent of the burn (e.g., was the burn circumferential); and treatment and outcome (e.g., excision, grafting, amputation) information.

Burn source coding (OIICS) was generally received from the WC system (for claims), but can be inconsistent, and burns from other sources (e.g., hospital reporting) do not have the same information for burn source. For the sake of clarity and consistency, an additional burn source

Figure 1: Data sources for hospitalized work-related burns cases, Washington State, 2000-2013 (n=888).



WC - case received through Washington Workers' Compensation system.

Hospital - case received by report from University of Washington Burn Center (Seattle, WA), or Oregon Burn Center (Portland, OR).

FACE - Fatality Assessment & Control Evaluation (FACE) Program - the FACE program tracks work-related acute trauma fatalities.

Other - case received by other, miscellaneous sources (e.g. newspaper articles).

Note: Hospital reporting was only active through 2009 (UW Burn Center) and 2013 (Oregon Burn Center).

code was assigned by the project epidemiologist for all cases after reviewing the incident description. These differ somewhat from the OIICS codes typically used by WC and included on some claims. The assigned source code is intended to be more useful for prevention purposes, which in some cases warrants splitting out individual substances ("Acids, misc." vs. "Hydrofluoric Acid"), or in some cases, grouping together broadly - for example: "Gas/Liquid Compound" in this report refers to gasoline, diesel, propane and other hydrocarbon gas, and related explosions which occur in very similar circumstances such as spills or leaks that ignite; "Paint" includes paints, lacquer, and varnish; and "Welding & Welding Equipment" includes burns derived from welding and the use of powered cutting torches. In this report, burn 'source' refers to this researcher-assigned code.

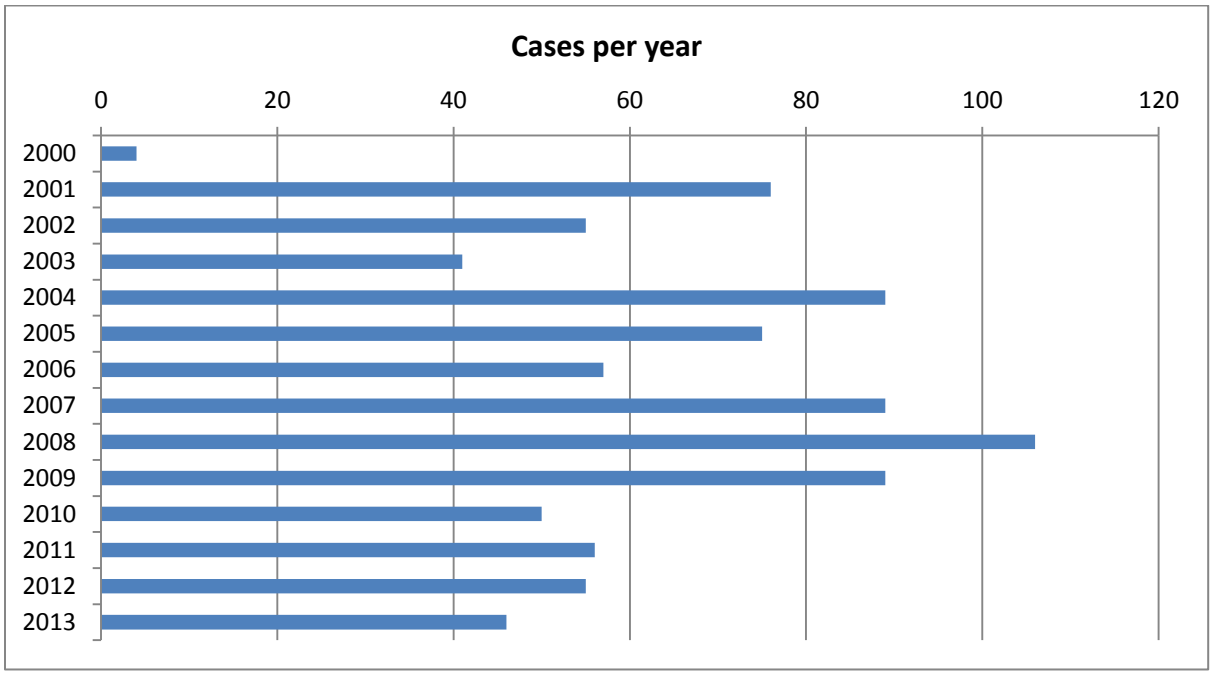
Despite being a notifiable condition in Washington, getting reports of hospitalized work-related burns from sources other than WC was challenging and evolved over time, and this contributed to the variability in the number of reported burns each year (Figure 2), such as the drop in number of burns after one of the hospital burn centers stopped reporting.

Data management

All data collected are used solely for surveillance and prevention purposes. Case reports from sentinel hospitals and FACE mortality reports are entered manually. A monthly query is used to extract case information from the WA WC data warehouse. The surveillance system is maintained as a password-secured Access database, with limited distribution of the password to authorized SHARP personnel. All hard copies of case reports are stored in locked filing cabinets.

Additionally, physical access to the building and the access to individual computers are controlled as part of the Department of Labor & Industries security systems.

Figure 2. Hospitalized work-related burns per year of reporting period, Washington State, 2000-2013 (n=888).



Data analysis

A full time equivalent employee (FTE) was defined as working 2,000 hours per year (40 hours per week for 50 weeks per year). Claim rates are expressed as claims per 1,000,000 FTE unless otherwise noted. For analysis by sector (rates, cost), the Mining sector and the Health Care & Social Assistance sector are not presented individually (they are included in overall) because neither had enough claims during this reporting period (both reported ≤10 compensable claims overall in ≤5 years during the reporting period. The data were analyzed using SAS 9.4 (SAS Institute, Inc., Cary, NC, USA).

Results

General Overview

From September 1, 2000, through December 31, 2013, there were a total of 888 hospitalized work-related burns in Washington State workers, including 29 work-related burn incidents that resulted in fatalities (3.2%). There were 851 cases that appeared to be single individual events, and 37 cases that involved 2 or more workers in 16 separate events (clusters). Of these, 11 events involved 2 workers, 3 events involved 3-4 workers, and 2 involved unknown numbers (including one with the possibility of 5 injured workers).

Demographics

Cases ranged in age from 15 to 74, with a median age of 37 (mean age 37.6) (Figure 3), there was no significant difference in median age between males and females. There were 6 minors (<18 years). The majority of cases (88.7%) were male. Most workers received thermal burns (76.4%) (Figure 4). Two workers had more than 1 (unique) hospitalized burn in the database during this time period.

By body region (Table 1), a third of hospitalized work-related burns cases were for burns that involved multiple body parts. These burns can be more severe or complex to treat, thus warranting inpatient admission.

Figure 3. Age groups by gender, hospitalized work-related burns surveillance cases, Washington State, 2000-2013.

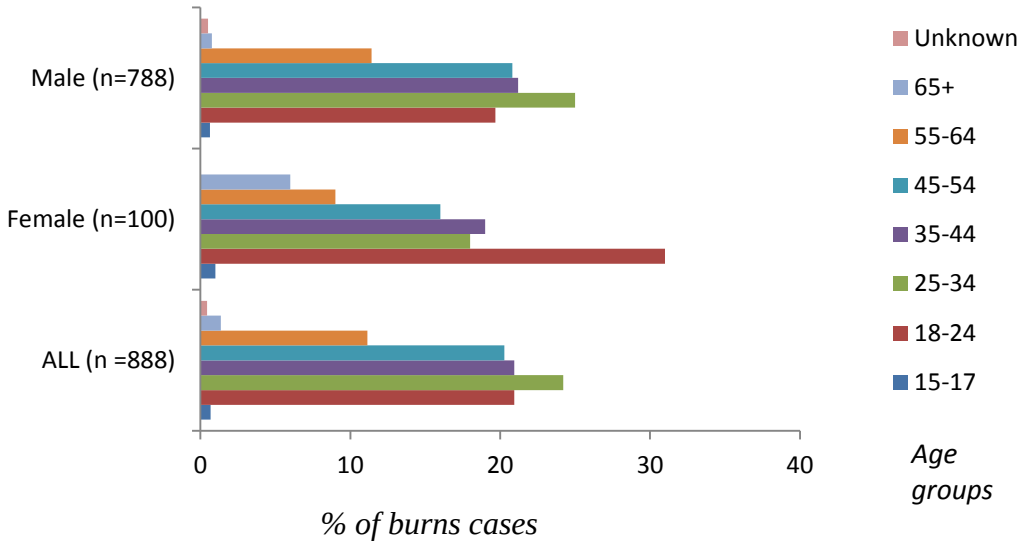


Figure 4. Type of burn, hospitalized work-related burns surveillance cases, Washington State, 2000-2013.

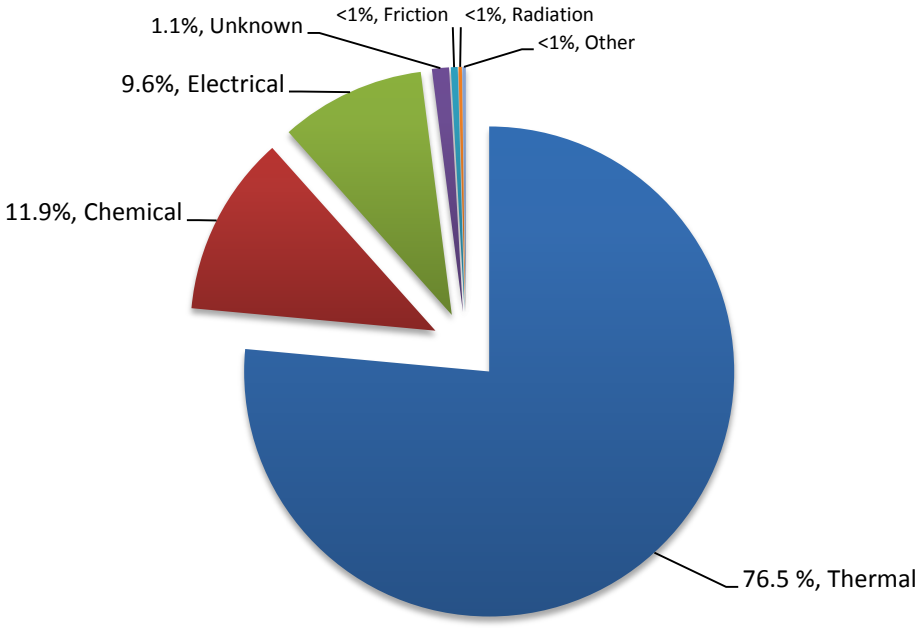


Table 1. Hospitalized work-related burns by body region, Washington State, 2000-2013.

Body Region	#	%
Multiple	387	32.3
Upper Extremity	233	19.4
Lower Extremity	179	14.9
Hand	168	14.0
Head and Face	131	10.9
Trunk	58	4.8
Internal	29	2.4
Eye	15	1.3

*Using coding done by research staff after medical record review. This allows for multiple boxes to be checked (e.g., "multiple" as well as "eye"), therefore numbers reported are greater than the number of individual cases. An additional 6 non-fatal cases and 10 fatalities were not able to be classified as to body part based on available information.

Table 2 lists the sources that were associated with at least 5 cases. The top 5 most common sources of hospitalized work-related burns were "Cooking Oils", "Gas/Liquid Compounds", "Hot Water", "Electrical Apparatus" and "Flame/Fire/Smoke" (Table 2). For burns that were more severe (≥11% TBSA), the top 5 sources were "Gas/Liquid Compounds", "Flame/Fire/Smoke", "Hot Water", "High Voltage", and "Cooking Oils" - which comprised 63% of all burns with ≥11% TBSA. Common sources of burn (assigned) for fatalities were "Flame/Fire/Smoke", "High Voltage", and "Electrical Apparatus" (Table 2).

Table 2. Commonly reported sources of hospitalized work-related burn injuries, Washington State, 2000-2013 (n=888).

Assigned Source	#	%	% of burns from this source > 11%+ TBSA*	% resulting in at least 1 day paid time loss (TL)**	Average & Median days TL**	Fatality (#)	Multiple injury event (# injured)
Cooking Oils	105	11.8	**18.2**	66%	288, 30		
Gas/Liquid Compounds	97	10.9	**37.2**	53%	146,45	2	15
Hot Water	92	10.4	**24.3**	60%	190, 35		
Electrical Apparatus	81	9.1	14.3	42%	182, 48	4	
Flame/Fire/Smoke	73	8.2	**40.8**	48%	184, 33	8	8
High Voltage	65	7.3	**37.5**	60%	**695, 268**	6	8
Asphalt, Tar & Road Oil	48	5.4	10.5	60%	105,35		2
Welding & Welding Equipment	33	3.7	20.7	48%	182, 43	1	
Molten Metal	29	3.3	18.2	62%	80, 39	1	
Chemicals misc.	27	3.0	28.6	44%	639, 48		
Electrical misc.	25	2.8	15.0	28%	14, 6		
Cement & Concrete	17	1.9	8.3	29%	57, 51		
Food Products	14	1.6	0.0	79%	256, 28		
Hydrofluoric Acid	14	1.6	11.1	57%	117, 20		
Vehicles, highway, powered	13	1.5	50.0	54%	**285, 272**	4	2
Alkalis, misc.	12	1.4	0.0	83%	242, 65		
Machines, misc.	12	1.4	0.0	58%	**249, 183**		
Ammonia/um Compound	11	1.2	42.9	55%	64, 46	1	
Steam	11	1.2	55.6	64%	69, 50		
Sulfuric Acid	9	1.0	20.0	22%	**343, 343**		2
Heating Equipment	9	1.0	0.0	56%	**206, 113**		
Acids misc.	9	1.0	50.0	33%	38, 46	1	
Paint	8	0.9	57.1	50%	27, 27		
Radiator Fluid	8	0.9	14.3	63%	13, 9	1	
Pots/Pans	6	0.7	0.0	67%	15, 16		
Blow Torch	6	0.7	0.0	50%	42, 34		
Metal Items, misc.	6	0.7	25.0	83%	515, 63		
Unknown / Unidentified	5	0.6	25.0	20%	5, 5		
Grand Total (including sources with <5 cases)	888	100	24.4	54%	242, 39.5	29	37

* The top 5 sources for burns with >11%TBSA are in bold: "Gas/Liquid Compounds" (19%); “Flame/Fire/Smoke (12%); Hot Water (11%); High Voltage (11%); and Cooking Oils (10%). These 5 sources comprised 63% of all burns greater than 11% TBSA. There were only 681 cases that had a reported %TBSA.

** Time loss days are only available for WC claims; average & median are for claims that have at least 1 day of paid TL. The 5 sources with the highest median days TL are in bold. Two sources not shown (with <5 cases each) had the highest median days of time loss - “Lightning” (2,087) and “Glass Items, not elsewhere classified.” (1,416).

For non-fatal burns cases (n=859), recorded Total Body Surface Area burned (TBSA) was available for 672 (78%) cases and ranged from <1% to 65% TBSA, and 113 (16.8%) cases had

burns of 1% or less TBSA. The majority of burns (53.1%) were < 5% TBSA (Table 3), the mean % TBSA was 9.6% (Q1: 2%, Q3:10%). There was a significant difference between males and females in mean burn % TBSA ($p<0.01$) and males were significantly more likely than females ($p<0.04$) to have a more severe burn of 11% or greater. The majority of burns were classified as deep partial thickness (Table 4).

Table 3: Total Body Surface Area burned (% TBSA), Washington State, 2000-2013.

TBSA*		#	%
	<1-5 %	355	52.1
	6-10%	160	23.5
More Severe	11-25%	116	17.0
	26-50%	35	5.1
	>50%	15	2.2

* An additional 207 cases did not have a total body surface area burned percentage noted in the medical records, or lacked medical records.

Table 4: Burn degree or thickness description, Washington State, 2000-2013.

Burn degree description*	#	%
Partial thickness	147	19.3
Deep partial thickness	334	43.8
Full thickness	254	33.2
Deep necrosis (full thickness)	17	2.2
Deep necrosis with loss of body part	11	1.4

***** Generally this information is included in the medical record; an additional 125 did not have enough/any information regarding the depth of the burn to classify.

Workers' compensation does not collect information on race/ethnicity. For the cases that were reported by hospital or provider or other sources, there may be race, ethnicity or language preference in the medical record. There were 405 cases where some information was available,

primarily in cases reported by one of the participating burn centers. Of these, the hospitalized burn cases were 71.9% White, 19% Hispanic, 5.9% Asian, 3% Black, and less than 1% American Indian or Pacific Islander. Language preference was noted as Spanish for 50 cases, but other languages indicated included: Russian, Korean, Chinese, Vietnamese, Laotian, Cambodian, Ukrainian, Samoan, Tigrinya, Amharic, and Somali.

Claim Costs and Lost Workdays

The total cost incurred for compensable hospitalized work-related burns claims received between 2000 through 2013 was over $46.1 million dollars. The average cost per claim was $66,481; the median cost per claim was $15,087 (lower quartile $8.035, upper $41,864). The highest cost incurred for one claim was over $2 million dollars. There was no significant difference in incurred costs between males and females. The average and median cost of accepted burns claims (non-hospitalized) during this time period for comparison were $2,975 and $375, respectively. The highest average and median cost per hospitalized WC SF claim were in the Mining sector (data not presented). For individual sectors that met the criteria (of 5 or more claims) to be presented - the highest average costs for WC SF claims were in Construction ($96,871) and Manufacturing ($73,108). The highest median costs per hospitalized WC SF claim were in Agriculture ($21,860) and Wholesale & Retail Trade ($19,953). The Services sector, while largest in FTE and number of compensable claims, had the lowest average and median costs of the individual sectors.

Overall, the hospitalized work-related burns claims during this time-period had a total of 116,307 paid days of time loss (excluding fatalities). There were 477 workers that had at least 1 day of time loss (Table 5).

Table 5. Days of time loss, State Fund compensable hospitalized work-related burn claims, Washington State, 2000-2013.

Time Loss Duration (days)	#	%
1-5 days*	30	6.3
6-10 days	21	4.4
11-20 days	60	12.6
21-30 days	87	18.2
31 or more days	279	58.5

*An additional 382 cases either did not have time loss (e.g., received from sources other than WC) or reported zero days of time loss; the 29 fatalities are excluded.

Industry & Occupation

The majority of cases were employed in the Services sector (32.8%), which was also the largest sector (by FTE) in Washington (Table 6). Table 7 shows the distribution by major occupational groups. There were 7 cases where the injured worker was employed as a temporary worker.

Table 8 shows the leading sources of hospitalized work-related burns by industry sector; this information can be used to target resources for prevention towards sector-specific hazards.

Table 6. Distribution of hospitalized work-related burns by industry sector, Washington State, 2000-2013.

Industry Sector	#	%	Rate per million FTEs	Sector % of total FTE
Services (51, 52, 53, 54, 55, 56, 61, 71, 72, 81, 92)	275	32.8	22.6	49.1
Construction (23)	215	25.7	114.8	8.1
Manufacturing (31-33)	137	16.3	66	8
Trade (Wholesale & Retail) (42, 44-45)	119	14.2	27.3	16.6
Transportation & Utilities (22, 48-49)	40	4.8	44.1	3.1
Agriculture, Forestry, Fishing & Hunting (11)	34	4.1	31.9	4
Health Care & Social Assistance (62)	--	<2%	--	10.8
Mining (21)	--	<2%	--	<1%

*There were 836 total cases that had some NAICS code assigned by WC or where industry could be determined by the descriptions given in the medical record. There were an additional 52 cases where no determination of industry could be made based on the information available. Rates are not presented for Health Care & Social Assistance because they did not meet the inclusion criteria (not enough claims per year during the reporting period).

Table 7. Distribution of hospitalized work-related burns by occupational group, Washington State, 2000-2013.

SOC Major Occupational Group	#	%
47-0000 Construction and Extraction Occupations	219	27.1
(47-2110 and 47-2111 Electricians)	*63*	*7.8%*
35-0000 Food Preparation and Serving Related Occupations	170	21.0
51-0000 Production Occupations	110	13.6
49-0000 Installation, Maintenance, and Repair Occupations	103	12.7
53-0000 Transportation and Material Moving Occupations	92	11.4
45-0000 Farming, Fishing, and Forestry Occupations	32	4.0
37-0000 Building and Grounds Cleaning and Maintenance Occupations	16	2.0
17-0000 Architecture and Engineering Occupations	15	1.9
33-0000 Protective Service Occupations	14	1.7
11-0000 Management Occupations	12	1.5
41-0000 Sales and Related Occupations	7	0.9
All Other*	18	2.2
Total**	808	--

* "All Other" includes all major occupational groups that had ≤5 workers each, including: 19-0000 Life, Physical, and Social Science Occupations; 25-0000 Education, Training, and Library Occupations; 29-0000 Healthcare Practitioners and Technical Occupations; 31-0000 Healthcare Support Occupations; 39-0000 Personal Care and Service Occupations; and 43-0000 Office and Administrative Support Occupations.
** There were an additional 80 cases where an occupation was unable to be determined from the available information, these were excluded.

Table 8. Leading sources of hospitalized work-related burns by industry sector, Washington State, 2000-2013.

Agriculture, Forestry, Fishing & Hunting	# cases	Construction	# cases	Health Care & Social Assistance	# cases
Gas/Liquid Compounds	14	Asphalt, Tar & Road Oil	41	Hot Water	5
Flame/Fire/Smoke	7	Electrical Apparatus	40	Cooking Oils	<5
High Voltage	<5	High Voltage	37	Heating Equipment	<5
Electrical Apparatus	<5	Gas/Liquid Compounds	15	Electrical Apparatus	<5
Hot Water	<5	Electrical misc.	13	Vehicles, Highway, Powered	<5
Welding	<5	Cement & Concrete	12	Flame/Fire/Smoke	<5
Conveyors	<5	Welding & Welding Equipment	6	Glue/Adhesive	<5
Asphalt, Tar & Road Oil	<5	Vehicles, Highway, Powered	5		
Ammonia/um Compound	<5	Hot water	5		
Cement & Concrete	<5	Flame/Fire/Smoke	5		
Total	*34*	*Total*	*215*	*Total*	*11*
Manufacturing	# cases	**Mining**	# cases	**Services**	# cases
Hot Water	23	Gas/Liquid Compounds	<5	Cooking Oils	87
Molten Metal	22	High Voltage	<5	Hot Water	45
Flame/Fire/Smoke	11			Flame/Fire/Smoke	22
Electrical Apparatus	10			Gas/Liquid Compounds	20
Chemicals, misc.	8			Chemicals, misc.	12
Alkalis, all	6			Electrical Apparatus	12
Steam	6			Food Product	10
Welding & Welding Equipment	6			Heating Equipment	8
Gas/Liquid Compounds	6			Hydrofluoric Acid	7
Cooking Oils	5			High Voltage	7
Total	*137*	*Total*	*5*	*Total*	*275*
Wholesale & Retail Trade	# cases	Transportation & Utilities	# cases	No Industry Determination	# cases
Gas/Liquid Compounds	27	High Voltage	9	Gas/Liquid Compounds	6
Flame/Fire/Smoke	13	Flame/Fire/Smoke	7	Flame/Fire/Smoke	6
Hot Water	9	Gas/Liquid Compounds	6	Cooking Oils	5
Ammonia/um Compound	9	Electrical, misc.	5	Electrical Apparatus	5
Electrical Apparatus	8	Vehicles, Highway, Powered	<5	High Voltage	<5
Cooking Oils	7	Electrical Apparatus	<5	Unknown/Unidentified	<5
Welding & Welding Equipment	<5	Welding & Welding Equipment	<5	Hot Water	<5
Chemicals, misc.	<5			Cement & Concrete	<5
Blow Torch	<5			Electrical, misc.	<5
Alkalis, all	<5			Acids, misc.	<5
Total	*119*	*Total*	*40*	*Total*	*52*

Injury Rates

Rates were calculated for 2001-2013 (the year 2000 was excluded because reporting began only in September of 2000 - partial year of data) (Figures 5-6). The Healthcare and Social Assistance sector and the Mining sector are not presented individually, because there were very few (or no) cases from these sectors over most years covered by this report; they are included in the overall rate. The Construction sector had the highest rate of hospitalized burns per million FTE.

Figure 5. Hospitalized work-related burn rates by sector, Washington State, 2001-2013.

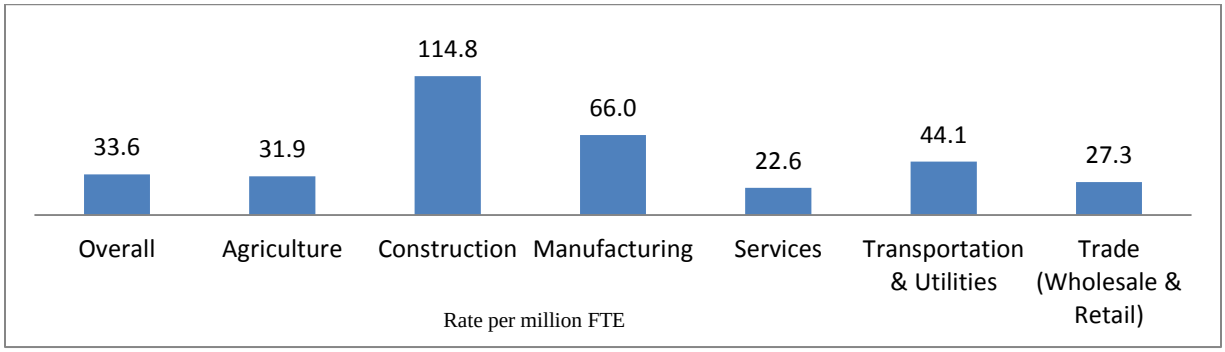
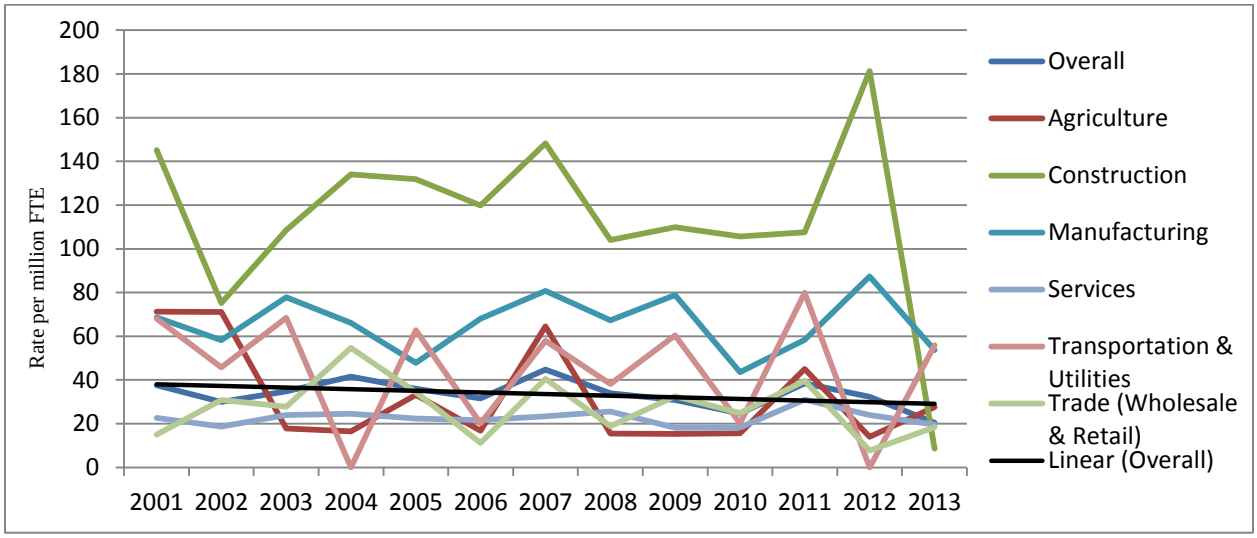


Figure 6. Hospitalized work-related burn rates by industry sector by year, Washington State, 2001-2013.



Multiple-Worker (Cluster) Events

Cluster events were identified by injury date, employer information, and description of the incident from medical records, and may represent an undercount because not all cases received included detailed information. There were 37 workers in 16 identified cluster events, with workers ranging in age from 18-63, and 94.5% were male. These 16 incidents included: propane or other explosions, electrical contact, and firefighting (see Table 2). Four (4) events (25%) resulted in one or more fatalities (of the 29 fatalities reported during this period, 7 (24%) occurred in multiple-worker events). Only one cluster event involved females. Two clusters referenced other workers burned or fatalities, but there was not enough information to determine if we had additional cases from these events.

Discussion

Work-related burns are preventable, and the data presented in this report can be used to help target resources for prevention. The most common source of burns overall was "Cooking Oils", which reflects the unique hazards faced by certain industries and occupations that should be addressed when considering prevention efforts. This source was primarily found in the Services sector, the largest sector of the WA workforce, along with "Hot Water." These are common sources of burns in food-preparation occupations, as well as in Health Care & Social Assistance (Table 8). These have been previously identified in WA as a hazard to restaurant workers in a variety of technical reports, hazard alerts, and injury narratives (see: http://www.lni.wa.gov/Safety/research/pubs/ByProject.asp?J=11); and previous work found many scald burns were associated with slip/trip/fall events ("Scald Burn Injuries to Restaurant

Workers, 2009"), which is consistent with the medical records reviewed for this report. Workers and employers should use splash guards and practice good housekeeping to keep work areas clear. Further recommendations to reduce scald injuries to restaurant workers are included in this report as Appendix A (additional recommendations can be found in publications #86-5-2008 and #86-4-2008 on SHARP.Lni.wa.gov). "Cooking Oils" was also a leading source of hospitalized burns in the Manufacturing sector, the Wholesale & Retail Trade sector, and those without an industry determination.

Another common cause of burns was "Gas/Liquid Compounds" a generic label that includes various fuels, primarily gasoline & propane. Approximately 5% of burns involved a propane-related incident (n=46), primarily propane tank explosions (n=23), followed by propane heaters (igniting nearby clothing or materials/fumes) and torches. Propane incidents were most common in the Wholesale & Retail Trade and Construction Sectors.

Electrical burns were categorized by whether they were: "High Voltage" - where workers came into contact with high voltage power lines (typically when items they were in or using contacted overhead lines); "Electrical Apparatus" - where workers were working with electrical equipment and appliances; or "Electrical, Miscellaneous" - other electrical contact or that of unknown etiology. SHARP has produced a number of hazard alerts, injury narratives and fatality narratives related to electrical incidents. Recommendations include working de-energized and conducting worksite hazard analysis to identify dangers: http://www.lni.wa.gov/safety/research/healthyworkplaces/files/deenergized.pdf and http://www.lni.wa.gov/safety/research/healthyworkplaces/files/hazardanalysis.pdf.

Additional events of note were scald burns, molten metal burns, and flame burns from workers using welding or cutting torches. Several welding and propane incidents also involved a worker's clothes igniting. These are all avenues for possible prevention efforts.

Hydrofluoric acid (HF) is another agent that shows up as a leading source of hospitalized work-related burns for the Services Sector (Table 8), and also appears in the Wholesale & Retail Trade and Manufacturing sectors, and in cases without an industry classification. HF is used in wash products and in rust & grime removal products and brighteners - typically in car & truck washing and auto detailing, though it also appears in products for home use. It can lead to severe burns, hospitalization, loss of body parts and death. Washington State has recently published an analysis of HF cases in car and truck washing (Reeb-Whitaker et al. 2015) and produced a hazard alert to inform workers and employers about the dangers of HF, available free online in English and Spanish at:
http://www.lni.wa.gov/Safety/Research/Files/83_9_2015_HF_acid_hazard_alert.pdf, and
http://www.lni.wa.gov/safety/research/files/83_9_2015a_hf_acid_hazard_alert_spanish.pdf.

The industry sectors that had the most claims were Services, Construction, and Manufacturing; while the highest claims rates were found in Agriculture (262.4/per million FTE) and Construction (114.8/per million FTE). Services had the most compensable claims (232, 33%), but the lowest rate (22.6/per million FTE) and the lowest average and median costs. This may reflect the large size (FTE) of the sector, as well as different hazard exposures. The Construction & Manufacturing sectors represent smaller sectors in terms of state percentage of FTE, but comprised a large proportion of hospitalized work-related burns cases. Workers in these industry sectors face a variety of hazards from multiple sources (Table 8) and warrant further research and prevention efforts.

The narrative text description of the incident (entered by the epidemiologist after medical record and claim review) reveals some themes regarding the event leading to the hospitalized burn. Common events leading to a hospitalized work-related burns case in Agriculture included burning a substance (e.g., fields, brush, paper, garbage) and either adding accelerant to the fire or the fire otherwise going out of control; explosion of a fuel tank (diesel, propane, or unspecified) or other ignition of fuel; and coming into contact with electricity (e.g., contacting power lines). For the Construction sector, coming into contact with electricity was common, as well as incidents with tar including slips and falls (into tar), and being splashed with tar; Construction sector workers also faced explosion of a fuel tank (diesel, propane, or unspecified) or other ignition of fuel. For the Services Sector, which includes restaurant and other food preparation workers, common narratives included working around deep fryers and slipping/tripping/falling into the hot oil, buckets of hot oil being spilled or stepped in, and being splashed when moving containers of oil or when nearby objects fell into fryers or other containers of hot oil.

The most common major occupational groups were Construction and Extraction Occupations (Standard Occupation Classification 47-0000), which contains Electricians. Electricians accounted for 7.8% of all burns cases and they are at high risk for hospitalized work-related burns. Workers who are exposed to electrical hazards (both electricians and workers who come into contact with electricity in other occupations) may face the additional risk of psychological sequelae from electrical burns, another hazard previously identified in WA (Anderson, Bonauto & Adams 2011; Anderson & Whitaker 2012).

The results reported here are similar to previous work in WA [Curwick 2006], and identified many of the same persistent hazards for Washington State workers, including flames/fire/smoke, electricity, and chemical exposures. In this report, workers with hospitalized work-related burns

were mostly male, middle-aged, had thermal burns, and burns of 10% TBSA or less. A National Burn Repository report covering the years 2004-2013 (similar to the years included in this report) found that for both "Electrical Injuries" and "Chemical Injuries", the majority of persons burned were male, were burned under work-related circumstances (61.1% work-related and 47.4%, respectively) and had burns of less than 10% TBSA [American Burn Association 2014].

These results are also comparable to other studies of work-related burns [Clouatre et al. 2013; Kica & Rosenman 2012; Walters 2009], though WA work is limited to hospitalized work-related burns (for calculation of rates, costs, TL), which is a possibly more serious subset of cases and limits comparability. Clouatre et al., also looking at hospitalized cases, found that work-related burns comprised 23% of all admissions to the reporting regional burn centers over the 10 year study period; those with work-related burns were typically male, older, had thermal burns, and had burns with an average of 11.9% TBSA. The same study found more electrical than chemical burns [Clouatre et al. 2013], and our distribution of burn injury mechanism was slightly different (Figure 3), with a more pronounced majority of thermal burns, followed by chemical and electrical burns. Similar to this report, a Michigan study also used multiple sources of data and found those with work-related burns (including, but not limited to hospitalized cases) to be primarily male workers, with thermal burns, and with burns of less than 10% TBSA [Kica & Rosenman 2012]. However, they found a higher percentage of chemical burns and only a small percentage of electrical burns [Kica & Rosenman 2012]. A study of occupational burns using Oregon WC data found that the leading cause of burns was 'heat burn and scald', that males were more likely to be hospitalized than females, and that "fats and oils" were the reported source for 12.7% of their accepted burn claims [Walters 2009]. The Oregon WC report is similar to what is reported here, however, the Oregon data included non-hospitalized burns and reflected

more accepted burns in accommodation and food services workers, especially in cooks and food preparation workers [Walters 2009]. While our data showed a larger percentage of construction and extraction workers, food preparation workers had the second highest proportion of hospitalized work-related burns in Washington (Table 7) and should be considered for further prevention efforts.

This report was generated using multiple data sources, and there are inherent limitations - each source reporting different types of information at different times (e.g., hospitals sometimes reporting race/ethnicity), with some sources more complete & consistent than others. Additionally, there is underreporting; despite mandatory reporting laws, reporting of hospitalized work-related burns from sources other than WC were voluntary, inconsistent, and have not continued. The WA burn surveillance system is based on two main reporting sources, WC (SF) data and burn center reports and this multiple-data source approach is one of the system's strengths.

Conclusions

Hospitalized work-related burns are devastating and costly injuries that can be prevented. This study uses surveillance data to identify industries at increased risk, characterizes common sources and events leading to hospitalized work-related burns, and suggests ideas for future research and prevention efforts and the targeting of prevention resources. In Washington State, work should be done to prevent burns from cooking oils, gas and propane ignitions and explosions, and electrical burns, particularly preventing contact with high-voltage lines. Workers in the Construction industry sector, Construction & Extraction occupations and Food Preparation occupations are at high-risk for serious work-related burns that lead to hospitalization, and should be prioritized for prevention efforts.

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APPENDIX A:
Recommendations to prevent scald injuries in restaurant workers

For the full document, please see:
http://www.lni.wa.gov/safety/research/files/restaurantscaldburns.pdf

Scald Burns are Preventable

Following are recommendations you can take to reduce worker exposures and prevent burn injuries from hot liquids/steam:

What EMPLOYERS can do to reduce the risk of a scald burn injury:

- Place microwaves at a safe height within easy reach for all users to avoid spills. The face of the person using the microwave should always be higher than the front of the door.
- Provide splash screens for frying foods.
- Maintain equipment to ensure that lids are tight fitting; handles are securely attached on vessels that contain hot liquids.
- Ensure workers are trained on the hazards of hot liquids and safe work practices. Supervisors should encourage, and when necessary, enforce safety rules and best practices.
- Designate someone each shift to be responsible for immediately cleaning up spills.
- Ensure someone on each shift knows and can use first aid procedures for managing burns.
- Always practice good housekeeping, keep floors clean of liquids and other debris. Slips, trips and falls are responsible for almost a third of all restaurant scald burns.
- Use non-slip matting, no-skid waxes and coat floors with grit, especially in areas where cooking oils and other liquids may spill.

Recommendations specifically for Deep Fryers

- Install a gravity feed chute on deep fryers to an external receptacle so that workers do not have to handle hot waste cooking oil.
- Install automatic food lowering devices for fryers.
- Provide and use splash guards on fryers.
- Keep a clear area around and above deep fryers to keep things from falling into a deep fryer.
- Train and enforce proper cleaning procedures for ventilation components or filters. Do not allow anyone to stand on the hot fryer or a nearby uneven surface, for any reason. Have workers use a ladder or stepstool to reach any equipment, and ONLY when the oil is cool and securely covered.

What EMPLOYEES can do to reduce the risk of a scald burn injury:

The most important things you can do is to make sure you are aware of how to assess burn hazards in your workplace and how you can reduce your risk of being burned or burning one of your co-workers. Good communication between co-workers, understanding and following all of the safety procedures at your workplace can help to reduce your risk of a serious, potentially life altering injury from a scald burn.

- If manually transferring hot liquids ensure the liquid is at a safe level for carrying (1/2 full), use splash guards, or secure lids for all vessels containing hot liquids.
- If transferring hot liquids using a rolling cart, ensure the vessel is secure on the cart so that sudden stops or jarring will not allow the container to tip or fall.
- Carefully handle microwaved liquids, assume they are hot. Microwaved foods and liquids can reach temperatures greater than boiling without the appearance of bubbling.
- Always practice good housekeeping, keep floors clean of liquids and other debris. Slips, trips and falls are responsible for one in three restaurant scald burns.
- Use hot pads, potholders, or appropriate size gloves or mitts when appropriate.
- Wear protective shoes; open toed shoes, sandals or boots, where hot oil can pool, are not appropriate. Also where shoes with slip-resistant soles to avoid slipping or falling.

Recommendations specifically for Deep Fryers

- Use splash guards when cooking with deep fryers.
- Keep a clear area around and above deep fryers to ensure things do not fall into a deep fryer.
- Don't stand on the hot fryer or nearby uneven surface, for any reason. Use a ladder or stepstool to reach filters or ventilation equipment above the fryer, but ONLY when the oil is cool and securely covered.
- If adding solid grease to a deep fryer, place the grease in the basket then lower into the hot oil, do not put directly into fryer.