Work-Related Asthma in Washington State, 2009-2013.

A summary of SHARP's work-related asthma surveillance data from 2009-2013.

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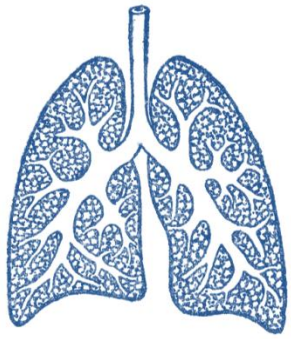

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Work related asthma is a reportable condition in Washington State. Physicians can download reporting forms here: http://www.lni.wa.gov/Safety/Research/OccHealth/Asthma/ReportAsthma/

Find previous reports and other work-related asthma surveillance materials at: http://www.lni.wa.gov/Safety/Research/OccHealth/Asthma/default.asp

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Introduction

Asthma is a serious, common, and costly lung disease in the United States [1-3]. Workplace exposures likely cause or exacerbate asthma in a significant portion of adults with asthma - estimates range from 5-44% [3-6]. In Washington State, for the years 2006-2009, the prevalence of current asthma in workers was 8.1% [7]. Hospitalized occupational asthma costs were estimated for US workers at $2.29 billion dollars in 2007 [8]. Workers with work-related asthma (WRA) may also have higher asthma severity, higher health care utilization, and poorer asthma control than individuals with non-occupational asthma [6, 9].

Methods

WRA surveillance program

The Safety & Health Assessment & Research for Prevention (SHARP) program, within the Washington State Department of Labor & Industries (L&I), operates a work-related asthma surveillance system to identify patterns and trends to inform work-related asthma prevention activities. The objectives of this surveillance system are to describe the incidence of work-related asthma, identify high risk industries and occupations, identify useful prevention strategies and generate hypotheses about causative agents and factors. The Washington State Institutional Review Board (WSIRB) approved all protocols and materials associated with the work-related surveillance system

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 and employer information, the RIIOD includes narrative text from both the worker and the health care provider that describe the injury or illness. All claims received with the word 'asthma' on the RIIOD are extracted monthly from the WC database and imported into the Asthma Surveillance Database (Microsoft Access). An additional reporting source is physicians, who

began reporting cases directly to SHARP in 2000 when work related asthma was established as a reportable condition (WAC 246-101). Physicians use a confidential form that includes the same information as would be found on the RIIOD; the information is entered manually into the Asthma Surveillance Database.

For more information on the SHARP Work-Related Asthma Surveillance Project, please visit: http://www.lni.wa.gov/Safety/Research/OccHealth/Asthma/default.asp.

Physician reporting forms can be found here: http://www.lni.wa.gov/Safety/Research/OccHealth/Asthma/ReportAsthma/.

As with any large administrative database, not all claims have all information. While the majority of claims are filed through the State Fund and are complete, the medical records for claims covered through an employer's self-insurance may not be complete. Additionally, for administrative and legal reasons, there are certain claims that we are not authorized to access (e.g. state government workers employed with the Washington Department of Labor and Industries).

There were 620 unique cases in the asthma database received from either WC and physician reporting during the period of 2009-2013. However, there were 40 cases that were flagged as 'Not Asthma' during the follow-up process and removed from subsequent analysis and are not included in this report. Cases can be flagged as 'Not Asthma' at any of three points - 1) initial claim review; 2) during the worker follow-up interview; or 3) at the 1-year medical record review conducted for non-interviewed workers. 'Not asthma' claims enter the system because the word "asthma" is used by the worker or physician on the initial RIIOD, but upon review of medical records or discussion with the injured worker, is determined to be tangential and not the reason for the claim. Generally, this is the result of a worker (possibly with existing asthma) being injured in some other way; or, asthma is mentioned on the RIIOD, but subsequent medical records do not show any mention of, or treatment for, asthma, only for the other injury or injuries.

Multiple Claim Sources

It is possible for the same case to be reported twice, both from a physician and through the WC data extract. For this report period (2009-2013), there were 577 cases reported from WC and 4 cases reported by medical professionals. One of the four cases reported by medical professionals was received as a duplicate WC claim, and is only counted once in our results. We therefore have a total of 580 unique cases.

Some claimants may have multiple claims during the period; each occurrence is counted as unique if there are different injury dates and descriptions along with new claim ID number. Multiple claims are counted as one occurrence if the injury date and description are the same, as additional claim numbers may be issued for administrative reasons (e.g. discovering an employer is SI not SF); during this report period there were 6 duplicate claims. The greatest number of unique claims any individual claimant had was three (repeated exposures to common agents, e.g. perfume, plant material).

Follow-Up Interview Selection Process

All cases received in the asthma surveillance database (from all sources) are reviewed and follow-up materials are mailed to each worker. The materials include information about the surveillance program, explain how we knew of their claim, provide educational materials on work-related asthma and inform workers that they may be selected for a follow-up telephone interview.

Follow-up interview selection is based on an initial claim review of the RIIOD (or Self Insurer Accident Report) form if a causative agent can be identified by the description given by the worker or health care provider. Follow-up is conducted for workers exposed to high priority agents, such as those involving chronic or acute exposure to any industrial agent, or exposure to an agent arising directly from workplace processes. Exposure agents include chemicals, dusts, gasses, and biological agents such as proteins. An example list of "high priority" exposures are included as Appendix A1. These cases, as well as cases

where no determination of agent can be made from an initial review, are put into the follow-up interview queue to be called. All SHARP surveillance protocol materials (follow-up questionnaire, worker and physician letters, questions & answers about asthma document, and Your Lungs, Your Work, Your Life brochure) are available at: http://www.lni.wa.gov/Safety/Research/OccHealth/Asthma/SurvTools.asp. Cases that have been in the interview queue but are not successfully contacted are put into the medical record review process.

Low priority exposures are those that are commonly encountered, general, and pose less or no opportunity for prevention - e.g. 'perfume' (see Appendix A2). These may not be selected for follow-up interviews, unless time and resources permit. These cases enter the medical record review process. During the report period, 170 of the 580 cases were not selected for follow-up interviews (29%).

We do not conduct interview follow-up for workers under 18 years of age and may not conduct follow-up with workers involved in claim compensation litigation. However, information on occupational asthma and the surveillance program may be sent.

Asthma Follow-Up Questionnaire

The follow-up interview is conducted by phone and is used to gather additional data on the worker's workplace exposures and medical history, as well demographic information. This allows for the potential identification of asthma causing exposures for prevention, as well as providing a basis for determining what type of asthma the worker is experiencing. This determination is primarily based on questions about whether or not workers had asthma in the past, increase of asthma and/or asthma medication in the previous two years, and questions on symptom onset and whether or not the symptoms started after a large exposure to something out of the ordinary.

During the report period, of the 410 cases that entered the follow-up interview process, there were 80 completed follow-up interviews (20%) and 13 refusals (3%).

One-year Medical Record Review Process

Claim and medical information evolve slowly over time, therefore medical record review claims are dispositioned approximately 12 months from the date they were brought into the surveillance system. This allows suitable time for the claim and medical information to develop, increasing the likelihood that the agent and an asthma classification can be made. One year later, claim medical records are reviewed to see if a determination about asthma causing agent or process can be made, and whether or not the claimant has a history of asthma. While these classifications may not be as precise as the SENSOR asthma classifications [10], information from the medical record can generally determine whether an injured worker has a history of asthma (making this WAA) or not (possible NOA).

Asthma Classification

WRA consists of two groups: occupational asthma and work- aggravated asthma (WAA). 'Occupational asthma' generally refers to new onset asthma and is broken down into occupational asthma with latency (new-onset asthma, NOA) and occupational asthma without latency. Latency describes the period between the exposure and the development of symptoms. Occupational asthma without latency is also called Reactive Airways Dysfunction Syndrome (RADS) [11]. WAA refers to pre-existing asthma which is made worse by workplace exposures. Following a completed interview, the claim information and questionnaire responses are reviewed (by an epidemiologist, an industrial hygienist, and an occupational medicine physician) and classified according to the SENSOR asthma case classification scheme for occupational asthma [10].

Workers who deny pre-existing asthma in the previous two years are generally classified as NOA, while workers who have had asthma in the previous two years with worsening workplace symptoms are typically classified as having WAA. If the worker reports large exposure to something out of the ordinary and symptom onset within 24 hours of a high dose workplace irritant exposure with no prior asthma

history and symptoms persisting for more than three months, they would be classified as RADS. Other information from the interview or medical records are also taken into account, such as the worker's description of the incident and exposure.

AOEC Coding

Asthma source agents are coded using the Association of Occupational and Environmental Clinics (AOEC) [12] exposure code list. The AOEC exposure code system lists substances which may cause asthma and gives them a hierarchical numerical (code) designation. The system includes the name of the substance, synonyms, Registry of Toxic Effects of Chemical Substances (RTECS) numbers and Chemical Abstracts Service (CAS) numbers. Substances may be given additional designations such as asthmagen, solvent, pesticide, sensitizer, and irritant associated with RADS. The system is periodically updated and is available on line and for download at: http://www.aoec.org/tools.htm.

Cases can have up to 6 sources entered (most have 1, very few have 3 or more), as workers can be exposed to many hazards simultaneously. The Industrial Hygienist and Epidemiologist review claim coding at time of interview completion or at 1 year post claim medical record review (for workers who are not interviewed) to establish final coding.

Results

There were 580 unique cases of work-related asthma received (from all sources) during the report period of 2009-2013.

Table 1. Age & Sex (all sources) of WRA asthma cases in Washington State, 2009-2013.

	F		M		Total	
	#	%	#	%	#	%
Total	333	57.4	247	42.6	580	100
Age Group						
Under 18	2	0.6	2	0.8	4	0.7
18-24	21	6.3	21	8.5	42	7.2
25-64	306	91.9	213	86.2	519	89.5
Over 65	3	0.9	9	3.6	12	2.1
Missing	1	0.3	2	0.8	3	0.5

Percentages may not equal 100 due to rounding.

Table 2. Claim Status (all sources) of WA WC WRA claims, 2009-2013.

Claim Status	#	%
Not yet allowed	3	0.5
Medical only	203	35.0
Compensable	79	13.6
Rejected	279	48.1
Total Permanent Disability	6	1.0
Kept on Salary	4	0.7
Provisional	1	0.2
Loss of Earning Power	1	0.2
Other*	4	0.7
Total	580	100
Total Compensable*	*90*	*15.5*

*Other includes cases that may not have filed claims (physician reported), or may be missing this information (e.g. some self-insured claims).

** "Total Compensable" claims include those that are compensable, total permanent disability, kept on salary, and loss of earning power.
Percentages may not equal 100 due to rounding.

For the 80 completed interviews, additional demographic information is available. For example, race/ethnicity is not collected by workers' compensation, but questions on these are included in the follow-up interview.

During the report period, 7 interviews were conducted in Spanish using bilingual-certified staff, and 1 interview was conducted in Vietnamese via contracted interpretation services.

Asthma Classification

The majority of work related asthma is classified as work aggravated (66%) followed by new onset (20%). We had insufficient data to classify 14% of the cases. Our prioritization of calling workers exposed to high priority agents results in a higher percentage of NOA classifications in interviewed workers primarily because the high priority agents are predominantly industrial agents more likely to cause NOA (as compared to common WAA sources that are not interviewed, such as perfume). An additional factor that may contribute to increased NOA in interviews is the worker's ability to explain their medical/asthma history and timeline.

Table 3. Asthma Classification of WRA cases in Washington State, 2009-2013.

Determination Source	Asthma Classification										Total *
	New Onset Asthma		*RADS (NOA w/o latency)*		**NOA total (including RADS)**		**Work Aggravated Asthma**		**Unknown (insufficient data)**		
	#	%	#	%	#	%	#	%	#	%	
Interview	36	45.0	*9*	*11.3*	45	56.3	33	41.3	2	2.5	80
Medical Record Review**	33	10.4	*1*	*0.3*	34	10.8	229	72.5	53	16.8	316
Total	69	17.4	*10*	*2.5*	79	19.9	262	66.2	55	13.9	396

*184 cases could not be classified. 183 cases did not have a classification for reasons including insufficient medical record or the claim was received prior to our protocol using the medical record to classify cases having no phone follow up. One physician reported case did not have an asthma classification.

** There were 438 cases that had a medical record review attempt, of which 268 were cases that had been unsuccessful in the interview queue, and 170 not selected for follow-up interview attempt (low priority agent).

Asthma Sources

All counts describing asthma Source and asthma Classification (see Tables 4-6, Figure 1) reflect the first 3 asthma sources entered for each of the 580 cases. Cases can have up to 6 sources entered (most only have 1, very few have 3 or more) based on reported exposure and/or medical record review.

Nine out of the top ten sources of work-related asthma in Washington are the same as those previously reported in 2001-2008 [13], with a few changes in rank (e.g. Plant Material has moved from 3rd to 2nd place). Ergonomic Factors (Exercise) (previous report's #10) has switched places with Acids, Bases, and Oxidizing Agents (previously 11th). Miscellaneous Chemicals, Referenced by Use remains the leading asthma source (unchanged).

Table 4. Overall ranking of WA asthma source agents by asthma classification, 2009-2013.

Source Agent and Asthma Classification - Overall Ranking*						
AOEC Agent Code (Major Grouping) & Description		Classification				**ALL**
		NOA	**RADS**	**WAA**	**Unknown**	
320	Miscellaneous Chemicals & Materials, Referenced by Use	22	5	123	73	223
370	Plant Material	20	1	30	17	68
10	Mineral & Inorganic Dusts	8	2	25	28	63
330	Pyrolysis Products	3	0	37	18	58
390	Microorganisms	2	0	28	24	54
380	Animal Materials	8	1	14	8	31
170	Hydrocarbons, Not Otherwise Specified	7	0	13	2	22
50	Acids, Bases, and Oxidizing Agents	2	2	9	7	20
20	Metals & Metalloids	3	0	10	6	19
60	Aliphatic & Alicyclic Hydrocarbons	3	1	8	5	17
360	Ergonomic Factors (Exercise)	0	0	10	5	15
220	Isocyanates	5	0	1	8	14
270	Polymers	4	0	4	4	12
30	Halogens (Inorganic)	4	1	3	2	10
350	Physical Factors	0	0	8	0	8
40	Miscellaneous Inorganic Compounds	2	0	2	3	7
110	Epoxy Compounds	3	0	1	3	7
70	Alcohols	2	1	2	0	5
130	Ketones	0	0	2	3	5
120	Aldehydes & Acetals	1	0	0	2	3
90	Glycol Ethers	1	0	1	0	2
140	Esters	1	0	0	1	2

150	Carboxylic Acids & Anhydrides	0	1	0	1	2
160	Aromatic Hydrocarbons	0	0	0	2	2
190	Halogenated Aliphatic Hydrocarbons (except Organochlorine Pesticides)	0	0	1	1	2
180	Phenols & Phenolic Compounds	1	0	0	0	1
210	Halogenated Aromatic Hydrocarbons	0	0	1	0	1
230	Aliphatic & Alicyclic Amines	0	0	1	0	1
Total		102	15	334	223	674

* Cases can have up to 6 sources coded.

Table 5. Ranking of WA asthma source agents by asthma classification, completed interviews only, 2009-2013.

Source Agent and Asthma Classification - 80 cases with Completed Interviews*						
AOEC Agent Code (Major Grouping) & Description		Classification				**ALL**
		NOA	**RADS**	**WAA**	**Unknown**	
320	Miscellaneous Chemicals & Materials, Referenced by Use	10	4	15	1	30
370	Plant Material	7	1	7	0	15
050	Acids, Bases, and Oxidizing Agents	2	2	6	1	11
10	Mineral & Inorganic Dusts	5	1	2	1	9
380	Animal Materials	6	1	2	0	9
30	Halogens (Inorganic)	5	1	2	0	8
20	Metals & Metalloids	3	0	4	0	7
170	Hydrocarbons, Not Otherwise Specified	2	0	3	0	5
060	Aliphatic & Alicyclic Hydrocarbons	2	0	2	0	4
070	Alcohols	0	1	2	0	3
220	Isocyanates	3	0	0	0	3
270	Polymers	2	0	1	0	3
330	Pyrolysis Products	2	0	1	0	3
350	Physical Factors	0	0	3	0	3
090	Glycol Ethers	1	0	1	0	2
150	Carboxylic Acids & Anhydrides	0	1	0	1	2
040	Miscellaneous Inorganic Compounds	1	0	0	0	1
110	Epoxy Compounds	1	0	0	0	1
180	Phenols & Phenolic Compounds	1	0	0	0	1
390	Microorganisms	0	0	1	0	1
Total		53	12	52	4	121

* Cases can have up to 6 sources coded. There were 2 interviews that did not yield enough information to identify any source agent.

Table 6. Ranking of WA asthma source agents by asthma classification, medical record review only, 2009-2013.

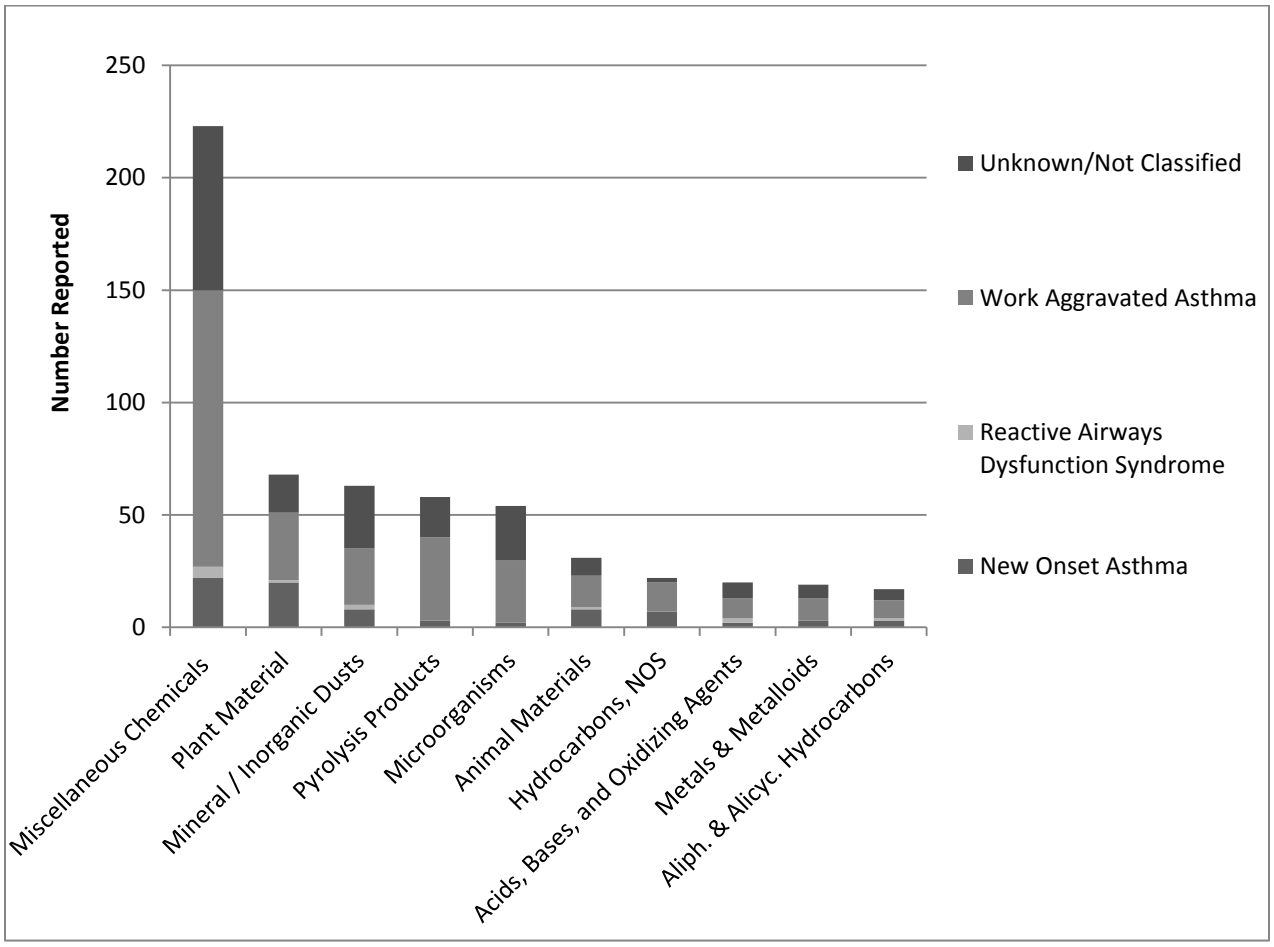
Source Agent and Asthma Class – 438 cases with Medical Record Review Only*						
AOEC Agent Code (Major Grouping) & Description		**Classification**				**ALL**
		NOA	RADS	WAA	Unknown	
320	Miscellaneous Chemicals & Materials, Referenced by Use	12	1	108	71	192
330	Pyrolysis Products	1	0	36	18	55
390	Microorganisms	2	0	27	24	53
10	Mineral & Inorganic Dusts	3	1	23	25	52
370	Plant Material	13	0	22	17	52
380	Animal Materials	2	0	12	8	22
170	Hydrocarbons, Not Otherwise Specified	5	0	10	2	17
360	Ergonomic Factors (Exercise)	0	0	10	5	15
60	Aliphatic & Alicyclic Hydrocarbons	1	1	6	5	13
20	Metals & Metalloids	0	0	6	6	12
220	Isocyanates	2	0	1	7	10
50	Acids, Bases, and Oxidizing Agents	0	0	3	6	9
270	Polymers	2	0	3	4	9
40	Miscellaneous Inorganic Compounds	1	0	2	3	6
110	Epoxy Compounds	2	0	1	3	6
130	Ketones	0	0	3	2	5
350	Physical Factors	0	0	5	0	5
30	Halogens (Inorganic)	0	0	1	2	3
120	Aldehydes & Acetals	1	0	2	0	3
140	Esters	1	0	0	1	2
160	Aromatic Hydrocarbons	0	0	0	2	2
190	Halogenated Aliphatic Hydrocarbons (except Organochlorine Pesticides)	0	0	1	1	2
70	Alcohols	1	0	0	0	1
230	Aliphatic & Alicyclic Amines	0	0	1	0	1
Total		49	3	283	212	547

* Cases can have up to 6 sources coded. There were 79 cases that had medical record review that did not have enough information to identify any source agent (2 NOA, 6 WAA, 10 unknown). There were 438 total medical record review cases - 268 unreached and 170 not selected for interview.

The AOEC major grouping "Miscellaneous Chemicals and Materials, Referenced by Use" was by far the largest group overall, and was approximately three times greater than Plant Material, Mineral and Inorganic Dust, and Pyrolysis Products (Figure 1). Subcategories within this broad grouping include Pharmaceutical Compounds, Cleaning Materials, Waste, Enzymes, Reactive Dyes, and Unknown Cause

within Defined Process. Cleaning Materials (Table 14) were 70 out of 674 (10.4%) reported/reviewed (1st three/primary) sources from 580 cases.

Figure 1. Top 10 asthma agents and asthma classification in Washington State, 2009-2013.



Industry & Occupation

The top 5 industry sectors reported here for 2009-2013 remain the same as that reported for 2001-2008 [13], although Healthcare has moved from the second highest to the highest percent of claims (switching spots with Manufacturing).

Table 7. Number of claims by 2-digit NAICS Industry Sector, 2009-2013.

2-Digit NAICS*	Industry Description	#	%
62	Health Care and Social Assistance	111	19.1
31-33	Manufacturing	80	13.8
92	Public Administration	65	11.2
61	Educational Services	63	10.9
56	Administrative and Support and Waste Management and Remediation Services	42	7.2
44-45	Retail Trade	34	5.9
23	Construction	32	5.5
11	Agriculture, Forestry, Fishing and Hunting	31	5.3
81	Other Services (except Public Administration)	22	3.8
72	Accommodation and Food Services	18	3.1
42	Wholesale Trade	17	2.9
54	Professional, Scientific, and Technical Services	16	2.8
48-49	Transportation & Warehousing	14	2.4
52	Finance & Insurance	9	1.6
53	Real Estate and Rental & Leasing	8	1.4
51	Information	6	1.0
71	Arts, Entertainment, and Recreation	<5	<1
22	Utilities	<5	<1
21	Mining, Quarrying, and Oil & Gas Extraction	<5	<1

*NAICS = North American Industry Classification System. NAICS codes used here come from the business location of the employer at the time of the claim for WC cases; for cases where this data is not available, a determination may be made by a researcher if there is enough supporting information. There were 6 cases that did not have enough information to make a determination of industry. One industry sector (55- Management of Companies and Enterprises) does not appear in our data. Claim counts less than 5 have been suppressed.

Asthma Follow-Up Questionnaire

The asthma follow-up questionnaire is conducted by telephone interview with the worker. During the report period, there were 80 completed interviews. In addition to a description of the substance(s) or situation that caused the worker's asthma in the workplace, additional information is asked about smoking status (Table 8), employer contact permission (Table 9), current exposure (Table 10), and demographics (Tables 11-13).

(To see the full asthma follow-up interview instrument, please see: http://www.lni.wa.gov/Safety/Research/OccHealth/Asthma/SurvTools.asp).

Table 8. Have you smoked at least 100 cigarettes in your life?*

	#	%
No	56	70.0
Yes	24	30.0
Total	80	100
If yes, are you a current smoker?		
No	20	83.3
Yes	4	16.7
Total	24	100

* Questions 25 & 25a on the Asthma Follow-Up Questionnaire, can be answered as Yes or No. Workers answering Yes to Q25 are asked additional questions about current smoking, age when quit, and age when started smoking on a regular basis. Percentages may not equal 100 due to rounding.

Table 9. Do we have permission to contact your employer?*

	#	%
No	21	26.3
Yes	59	73.8
Total	80	100

* Question 30 on the Asthma Follow-Up Questionnaire, can be answered as Yes or No. Percentages may not equal 100 due to rounding.

Workers who answer yes, that SHARP has permission to contact their employer (we would not reveal their name to their employer), are subsequently asked for employer contact information. Workers who do not give permission are asked for their concerns - the most common concerns cited were about the employer knowing who they were and possible repercussions, not wanting to cause problems for the employer, legal reasons, or that they believe the issue(s) had been corrected.

Table 10. Are you still exposed to the substance(s) or situation that caused your asthma?*

	#	%
No	52	65.0
Yes	23	28.8
Unknown	4	5.0
Not Answered	1	1.3
Total	80	100

* Question 16 on the Asthma Follow-Up Questionnaire and can be answered as Yes, No, or Unknown. Percentages may not equal 100 due to rounding.

For workers who report that they are no longer exposed, the next question (16a) asks why they are no longer exposed. Of the 52 workers who reported they are no longer exposed (Table 10), among the most common reasons given were: no longer employed with the same employer (n=25, 48.1%); short-term or one-time exposure (unlikely to recur) (n=13, 25%); and reported they had been reassigned within their company (n=5, 9.6%).

Table 11. What is the highest grade of school you completed?*

	#	%
Grades 1-8 (Elementary)	6	7.5
Grades 9-11 (Some high school)	3	3.8
Grade 12 or GED (High school graduate)	24	30.0
College 1-3 years (Some college or tech. school)	19	23.8
College 4 years or more (College graduate)	20	25.0
Skipped/Refused	8	10.0
Total	80	100

*Question 26 on the Asthma Follow-Up Questionnaire. Percentages may not equal 100 due to rounding.

Table 12. What is your annual household income from all sources?*

	#	%
$10,000 to less than $15,000	3	3.8
$15,000 to less than $20,000	5	6.3
$20,000 to less than $25,000	2	2.5
$25,000 to less than $35,000	8	10.0
$35,000 to less than $50,000	9	11.3
$50,000 to less than $75,000	14	17.5
$75,000 or more	20	25.0
Don't know/Not sure	7	8.8
Skipped/Refused	12	15.0
Total	80	100

*Question 27 on the Asthma Follow-Up Questionnaire. Percentages may not equal 100 due to rounding.

Table 13. Race and Hispanic Origin*of Washington WRA follow-up interview respondents, 2009-2013.

Hispanic Ethnicity	Race							Total	
	American Indian, Alaskan Native	Asian	Black	Other	White	Refused	Skipped	#	%
No	1	1	2	--	54	--	--	58	72.5
Yes	--	--	1	4	7	--	1	13	16.3
Refused	--	--	--	--	--	1	--	1	1.3
Skipped	--	1	--	--	--	1	6	8	10.0
Total #	1	2	3	4	61	2	7	80 (100%)	
%	1.3	2.5	3.8	5.0	76.3	2.5	8.8		

* This table is derived from questions 28 "What race are you?" and 29 "Are you of Hispanic origin?" on the asthma follow-up questionnaire. Percentages may not equal 100 due to rounding.

Asthma Sources of special interest

Cleaning materials (AOEC codes 322*) are of particular interest because of widespread use across many industries and occupations. Cleaning Materials made up approximately 10% of reported sources (enough that taken on its own as an agent it would be second to Miscellaneous Chemicals and Materials, Referenced by Use, slightly ahead of Plant Material.

Table 14. Asthma caused or worsened by Cleaning Materials exposures in Washington, 2009-2013.

AOEC 322 - Cleaning Materials (n=70)*					
Agent Source	NOA	RADS	WAA	Unknown	Total
Interview	6	2	6	1	15
Medical Record Review	1	--	35	19	55
Total	7	2	41	20	70

* Cases can have up to 6 sources entered.

Similar to our previous report for 2001-2008 [13], plant materials remained one of the top overall sources (10%) for work-related asthma in Washington State. Washington's unique industries such as Hop farming and logging/wood processing are reflected in the sources identified. Hop worker outreach is an ongoing priority and SHARP has developed publications for workers and medical professionals to aid in

identifying and preventing asthma from exposure to hops, available at:

http://www.lni.wa.gov/Safety/Research/OccHealth/Asthma/Prevention.asp.

Table 15. Asthma caused or worsened by plant materials in Washington, 2009-2013.

AOEC 370 - Plant Materials (n=68)*						
AOEC Code	Description	NOA	RADS	WAA	Unknown	Total
370.004	Plant Material, Not Otherwise Specified	0	0	10	6	16
370.16	Hops	5	0	5	0	10
373.01	Western Red Cedar	6	0	3	1	10
373.00	Wood Dust, Not Otherwise Specified	4	0	3	2	9
370.10	Pollen	0	0	0	4	4
370.07	Grass Cutting	0	0	3	0	3
370.34	Oils, Vegetable	1	1	1	0	3
371.00	Flour, Not Otherwise Specified	2	0	1	0	3
370.003	Organic Dusts, Not Otherwise Specified	0	0	1	1	2
370.35	Capsicum	0	0	1	1	2
370.50	Wheat Dust	1	0	1	0	2
370.04	Vegetable Dust	0	0	0	1	1
370.08	Hay	0	0	0	1	1
371.04	Wheat Flour	0	0	1	0	1
373.13	African Zebrawood	1	0	0	0	1
	Total	20	1	30	17	68

* Cases can have up to 6 sources entered.

Discussion

Washington State has conducted WRA surveillance (primarily using WC records and the follow-up interview) since 2001 and periodic analyses help identify patterns and trends. The asthma follow-up questionnaire provides additional data that WC and medical records cannot provide - first hand descriptions of the exposure substance or process that contributed to causing or worsening a worker's asthma, and demographic data that WC does not capture. Both the interview and medical record review may contribute medical history and/or product names, which may also be used to target prevention efforts and identify emerging hazards.

Since the last report [13], the distribution of age and sex (Table 1) has remained the same, with 57% female and the highest percentage of cases in adults 25-64 years old. A higher percentage of asthma claims in the surveillance system were rejected by L&I - 48% as compared to 37% in the previous report, and a smaller percentage of total compensable claims (15% vs. 18% previously) [13].

Washington State has a higher proportion of WAA (Table 3) than reporting SENSOR states (CA, MA, MI, NJ) [14]. Classifications determined by medical record review rely exclusively on those medical records; the records may not be sufficient or the exposure timeline needed to follow the SENSOR classification (for NOA) protocol [10] may not be apparent. The proportion of NOA to WAA (Table 3) remains similar to the previous report [13].

The sources reported in WA State (Tables 4-6, Figure 1) also differ from those reported by the 4 states that use the SENSOR definition [9, 15], Washington has more cases reporting exposure to Plant Material (10% WA, 5% SENSOR states), but a similar percentage of Miscellaneous Chemicals (if Cleaning Materials are taken as a unique category), approximately 22% (vs. 19%) [10, 15]. This emphasizes the importance of regional surveillance that reflects the unique environment of individual states and their natural and economic landscape, and uses that information to target prevention, as in the case of special emphases on plant & cleaning materials (Tables 14-15) and WA work with hops.

The leading industries reporting WRA in WA (Table 7) have remained largely the same, although with Healthcare & Social Assistance overtaking Manufacturing as having the highest number of claims by 2-digit NAICS sector [13]. In the Healthcare and Social Assistance Sector, the leading source agent was Miscellaneous Chemicals and Materials, Referenced by Use (52%), of which 30% are Cleaning Materials (15% of total).). The second most common agent reported by workers in the Healthcare and Social Assistance sector was Microorganisms (14%).

The prevalence of both having smoked at least 100 cigarettes in a lifetime and the prevalence of current smoking (Table 8) have decreased since the previous asthma report [13]. This reflects the decreasing trend of tobacco use in Washington State [16].

The percentage of workers who gave consent for SHARP to possibly contact their employer in the future declined from 77.8% to 73.8% (Table 9) [13]. Other measures from the questionnaire did not change much from the previous report - those who are still exposed to the substance or situation that they think caused their asthma (Table 10) remained at 28%, the same as the previous report [13]; the percent reporting asthma symptoms before started working for employer (44% this report, 47% previously). Of those who answered the question (n=74), 93% percent reported their doctor performed breathing tests to diagnose their asthma, which was higher than the percentage reported previously (89%) [13].

The socio-demographic characteristics of WA workers with asthma (from the asthma follow-up questionnaire, n=80) has changed somewhat since the last report [13]. The total proportion reporting 'some college' (1-3 years) to 'college graduate' (4+ years) has declined (Table 11) from the previous report [13], with the number of those reporting 'some college' decreasing from 40% to 23.8% and the largest percentage of cases now in workers with Grade 12 or GED level education (30%). The majority of interviewed WA workers with asthma reported a total annual household income (Table 12) of $75K or above (25%), higher than the previous report (20%) [13]; the percentage of those making $35-50K declined from 20% to 11% (Table 12). The proportion of those reporting White race (Table 13) declined from 79% previously [13] to 76% in the current report, and the proportion of those reporting Hispanic ethnicity increased from 13.7% to 16.3% in the current report.

Limitations

Our practice of prioritizing follow up interviews based on high priority agents does introduce some bias regarding the sources causing work-related asthma. However, we have limited resources and such prioritization directs our efforts toward industrial exposures for which prevention activities will have the

greatest impact. Additionally, only 20% of cases in the follow-up interview queue were completed; in future grant cycles we would aim to have a higher completion rate, of at least 50% if possible.

The data presented in this report is likely to be an under-estimate of the true burden of work-related asthma in Washington State. Asthma claims enter the system primarily via text word search of workers' compensation claims, therefore workers who do not file a claim, claims with incomplete information (blanks) or no mention/misspellings of 'asthma' on the RIIOD are not included. Reporting from self-insured employers is incomplete. Workers who self-select out of employment where their asthma is caused or worsened are unlikely to seek medical attention or file a claim. We know that the prevalence of asthma varies by occupation [7] and that our estimates may be biased toward industry or occupational groups that are more likely to report their symptoms to a health care provider, and previous research in WA has found that WC claim filing also varies widely across industry and occupation groups [17]. Asthma is generally considered to be an illness that is poorly recognized by injured workers or diagnosed by health care providers. Previous research in WA has found that while many workers believe their asthma is caused or worsened by exposures at work, only 10.7% discussed this with a health care provider [7]. The surveillance system would benefit from increased physician reporting.

Conclusion

Work-related asthma continues to be a widespread public health problem in Washington State. Trends for industries having the greatest burden of work related asthma and the predominant agents causing work related asthma can be used to prioritize prevention efforts. Industries with the most workers reporting WRA in the surveillance system were: Health Care & Social Assistance; Manufacturing; Public Administration; Educational Services; and Administrative & Support & Waste Management & Remediation Services. Washington State continues to have more cases of asthma caused by Plant Materials compared to other States conducting occupational asthma surveillance. Additionally, Cleaning Materials as well as the broader category 'Miscellaneous Chemicals & Materials, Referenced by Use', Mineral Dust, and Pyrolysis Products (smoke/exhaust) are all common source agents reported by WA workers.

Surveillance data can also be used by clinicians involved in asthma management to recognize the range of industries and occupations reporting WRA, and to consider the importance of employment history and the impact of possible workplace exposures.

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Appendix A1 – Agents of High Priority

AOEC Code	Description	AOEC Code	Description
10.02	Asbestos	50.1	Hydrochloric Acid
10.03	Cement Dust	50.11	Hydrofluoric Acid
10.05	Clay	50.14	Peroxides
10.08	Graphite	50.17	Potassium Hydroxide (KOH)
10.09	Man-Made Mineral Fibers	50.18	Sodium Hydroxide (NaOH)
10.1	Plaster	50.24	Sulfuric Acid
10.13	Silica, Crystalline	50.28	Disinfectants, NOS
10.14	Vinyl Dust	50.33	Acid & Base Mixture
10.17	Gypsum	50.34	Glacial Acetic Acid
10.22	Nylon Flock	52.01	Ammonia Gas
11	Rock, NOS	60.00	Alicyclic Hydrocarbons, NOS
11.01	Granite	60.00	Aliphatic Hydrocarbons, NOS
20	Metal Fumes, NOS	60.01	Acetylene
20.01	Aluminum	60.06	Methane
20.1	Boron	60.08	Natural Gas
20.14	Chromium, Not Hexavalent	60.11	4-Phenylcyclohexane (4-PC)
20.2	Iron	60.17	Terpene
20.27	Molybdenum	60.18	D-Limonene
20.28	Nickel	60.2	Propane
20.35	Tin, Inorganic	61	Petroleum Fractions
21	Metal Dust, NOS	61.01	Petroleum Spirits
23	Welding, NOS	61.06	Diesel Fuel
23.04	Soldering Flux, NOS	61.07	Asphalt
23.05	Colophony	70.04	N-Butyl Alcohol
23.06	Welding Fume, Galvanized Metal	70.06	Isopropyl Alcohol
23.1	Soldering, NOS	80.01	Ethylene Glycol
30.02	Chlorine	90	Glycol Ethers, NOS
30.06	Chlorine Dioxide	90.01	Propylene Glycol Ethers
40.01	Argon	110.0	Adhesive, Epoxy
40.04	Carbon Monoxide	110.0	Epoxy Resins
40.06	Hydrogen Sulfide	110.0	Paint, Epoxy
40.11	Ozone	120.0	Acetaldehyde
40.18	Sodium Bisulfite	120.0	Formaldehyde
40.2	Sulfur Oxides	120.0	Gluteraldehyde
40.21	Sulfur Gas	120.1	Ortho-phthaladehyde (Cidex OPA)
40.24	Irritant Gases, NOS	130.0	Acetone
41.03	Sodium Chlorite	130	Ketones, NOS
42.02	Sodium Nitrate	130.0	Methyl Ethyl Ketone (MEK)
50	Acids, Bases, Oxidizers, NOS	140.0	Dioctylphthalate
50.05	Calcium Oxide	140.0	Phthalate Ester

Appendix A1 – Agents of High Priority (Continued)

AOEC Code	Description	AOEC Code	Description
142.0	Methyl Methacrylate	320.1	Fire Extinguisher Discharge
151.0	Trimelletic Anhydride	320.1	Glues, NOS
160	Aromatic Hydrocarbons, NOS	320.1	Hair Products
160.0	Ethyl Benzene	320.1	Herbicides, NOS
160.0	Xylene	320.1	Lubricants, NOS
170.0	Cutting Oils	320.1	Pesticides, NOS
170	Hydrocarbons, NOS	320.1	Photo Developing Chemicals, NOS
170.0	Inks, NOS	320.1	Pyrethrins
170.0	Oils, NOS	320.2	Cosmetics, NOS
171.0	Degreaser, NOS	320.2	Mace
171.0	Lacquer	320.2	Printing Chemicals, NOS
171.0	Paint, Latex	320.3	Indoor Air Pollutants from Bldg Reno
171.0	Paint, NOS	320.3	Radiographic Fixative
171.0	Paint, Oil-Based	320.4	Air Bag Discharge Products
171	Solvents, NOS	320.4	Insecticides, NOS
171.0	Stripper	320.4	Methamphetamine Laboratory
171.0	Thinner	321	Pharmaceuticals, NOS
180.0	Hydroquinone	321.2	Pentamidine
190	Chlorinated Hydrocarbons, NOS	321.3	Proventil
190.1	Perchlorethylene	322.0	Ammonia Solution (10%)
192.0	Freon, NOS	322.0	Ammonia Solution, NOS
221	Isocyanates, NOS	322.0	Cleaners, Household, General Purpose
221.0	Methylene Diisocyanate (MDI)	322	Cleaning Materials
221.0	Toluene Diisocyanate (TDI)	322.0	Soap, excluding Laundry Soap/Detergent
250.0	Picric Acid	322.1	Bleach
270.0	Acrylics	322.1	Bleach plus Acid (mixture)
270.0	Latex, Natural Rubber	322.1	Bleach plus Ammonia (mixture)
270	Polymers, NOS	322.1	Cleaners, Carpet
270.0	Polyurethane	322.1	Cleaners, Detergent, NOS
270.0	Polyvinyl Chloride (PVC), Heated	322.1	Cleaners, Disinfectant, NOS
270.1	Resin Systems, NOS	322.2	Cleaners, Drain
270.1	Silicone	322.2	Cleaners, Floor Stripping
270.1	Urea Formaldehyde	322.2	Cleaners, Oven
270.2	Polythylene Terephthalate / Polybutylene	322.2	Cleaners, Tile
271	Rubber, NOS	322.3	Cleaning Mixtures (excluding Bleach plus Acid or Ammonia
310.1	Sulfites, NOS	322.3	Dry Cleaning Fluid, NOS
320.0	Chemicals, NOS (also Multiple Chemicals)	322.3	Floor Wax
320.0	Fertilizers, NOS	322.3	Quaternary Ammonium Compounds, NOS
320.0	Fungicide, NOS	323.0	Sewer Water

Appendix A1 – Agents of High Priority (Continued)

AOEC Code	Description	AOEC Code	Description
323.0	Waste, Hazardous	371.0	Wheat Flour
324	Enzymes, NOS	373.0	Mahogany
330.0	Plastic Smoke	373.0	Western Red Cedar
331.0	Diesel Exhaust	373	Wood Dust, NOS
331.0	Engine Exhaust	373.2	Hardwood, Tropical, NOS
331	Exhaust, NOS	380	Animal Material, NOS
352.0	Radiation, Ultraviolet	380.0	Antigens, Animal
370.0	Grain Dust	380.0	Chicken
370.0	Grass Cuttings	380.0	Dander, Animal
370.0	Hay	380.0	Leather Dust
370.0	Herbal Tea, NOS	380.0	Manure
370.0	Organic Dusts, NOS	380.1	Avian Material, NOS
370.0	Paper Dust	380.1	Mice
370.0	Plant Material, NOS	380.1	Rat Antigens
370.0	Vegetable Dust	380.2	Cat
370.1	Coffee Bean	380.2	Rat Feces
370.1	Hops	381.0	Crab
370.3	Capsicum	381.0	Shellfish
370.5	Corn Dust	381.0	Shrimp Meal
371.0	Corn Starch	381.0	Trout
371	Flour, NOS	382.1	Mites, NOS

Appendix A2 – Agents of Low Priority

AOEC Code	Description
10	Dust, NOS
320.0	Air Pollutants, Indoor
320.0	Air Pollutants, Outdoor
320.1	Odors
320.2	Perfume, NOS
320.3	Carpet Dust
320.4	Air Freshener
330.0	Cigarette Smoke
330.0	Smoke, Lead-Containing
330.0	Smoke/Fumes, NOS
350.0	Cold
350.0	Heat
350.0	Humidity, High
353.0	Struck Against / Struck by Objects
353.1	Assault, Physical
353.1	Violence, Other than Physical Assault
360.0	Exercise
360.0	Stress
370.1	Pollen
380.0	Venom
382.2	Insect Bite, NOS
390.0	Hepatitis B
390.0	Infectious Agents, NOS
390.1	Tuberculosis
391.0	Aspergillus
391.0	Mold, NOS
391.0	Penicillium
391.0	Stachybotrys