

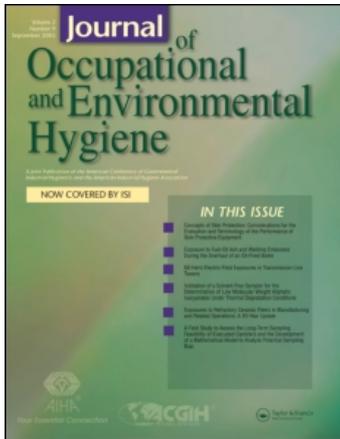
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Characterizing the Health and Safety Needs of the Collision Repair Industry

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Production workers in the collision repair industry are potentially exposed to many harmful chemicals, including isocyanates. Of particular concern is the burden of work-related asthma in this industry that likely reflects exposures to the isocyanates in two-part paints. The main objectives of this study were to gather information about: (i) the collision repair industry business model, (ii) the number of collision repair production workers potentially exposed to isocyanates, (iii) additional chemical and physical exposures of concern, (iv) current health and safety practices in the industry, (v) the health and safety perceptions and needs of business owners and managers, and (vi) strategies to reduce exposure and increase employer and worker awareness. Data were gathered using a combination of key informant interviews, field investigations, and a statewide needs assessment survey. Although a response bias cannot be excluded, the 69% response rate suggests that the survey results are likely representative of Washington State's collision repair industry. Collision repair was determined to be a male-dominated industry chiefly comprising small, nonunionized, family-run businesses. Many shops face numerous safety and health challenges resulting from a combination of misinformation within the industry, insufficient funds to address workplace health and safety concerns, and social barriers to enforcing best practices within the shops. Most notably, inappropriate selection and use of respirators and gloves likely contribute significantly to isocyanate exposures. Collision repair workers are potentially exposed to a variety of additional chemical and physical hazards that deserve attention. This industry requires health and safety intervention of both an educational campaign and technical assistance. Any such intervention must account for the financial, demographic, and social characteristics of this industry.

Keywords gloves, hexamethylene diisocyanate, isocyanates, respiratory protection, survey, work-related asthma

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INTRODUCTION

Production workers in the collision repair industry may be exposed to a wide range of chemical hazards, including metals; organic solvents; and asthmagens, including styrene, acrylates, and isocyanates. Isocyanates are a particular concern because of their widespread use in this industry,⁽¹⁾ and these reactive chemicals are a leading cause of work-related asthma (WRA).⁽²⁾ Isocyanates are used as catalyst hardeners in a variety of two-part polyurethane coatings systems.

However, the final “clear coat” generally is recognized as the principal concern. Spray application of these products can create a significant inhalation hazard for aerosolized isocyanates,^(3–5) and dermal exposures also may occur during handling of pre-mixed or mixed paint products and during spraying and cleanup.^(4,6–10) Isocyanates are strong irritants and sensitizers.⁽²⁾ Animal studies suggest that skin contact with isocyanates may be a significant route of exposure and may lead to systemic respiratory sensitization, resulting in WRA.^(7,11,12)

The American Thoracic Society estimated that 15% of adult asthma may be attributable to occupational exposure.⁽¹³⁾ Occupational disease surveillance in the United Kingdom identified isocyanates as the most common causative agents for WRA in the period 2005–2007.⁽¹⁴⁾ The UK's Surveillance of Work-Related and Occupational Respiratory Disease (SWORD) suggests that “Vehicle spray painters” had the highest rate of WRA for the period 2005–2007.⁽¹⁵⁾ The WRA rate for vehicle spray painters (100 cases per 100,000 workers per year) was 100-fold greater than the rate determined for “All occupations” (one case per 100,000 workers per year).

The Safety & Health Assessment & Research for Prevention (SHARP) program at Washington State Department of Labor & Industries reviewed Washington State's workers' compensation data from 1995 through 2002.⁽¹⁶⁾ The automotive repair industry had the second highest rate of compensable State Fund asthma claims: 20.3 compensable claims per 100,000 full-time equivalents (FTE) per year. This rate was nine times higher than the overall compensable asthma claim incidence

rate of 2.2 per 100,000 FTE per year. In addition, the rate for all asthma claims (compensable as well as noncompensable) filed in this industry (32.5 claims per 100,000 FTE per year) was 3-fold higher than the overall rate for all asthma claims of 9.8 claims per 100,000 FTE per year.

Recognizing the potential for harmful exposures and occupational illness in collision repair workers, SHARP conducted key informant interviews; performed field investigations; and distributed a statewide health and safety needs assessment survey to gather information about: (i) the collision repair industry business model, (ii) the number of collision repair production workers potentially exposed to isocyanates, (iii) additional chemical and physical exposures of concern, (iv) current health and safety practices in the industry, (v) the health and safety perceptions and needs of business owners and managers, and (vi) strategies to reduce exposure and increase employer and worker awareness.

METHODS

A detailed description of the methods used to develop the needs assessment, including a copy of the survey instrument, is provided in SHARP's technical report *Health & Safety in Washington State's Collision Repair Industry: A Needs Assessment*.⁽¹⁷⁾

Survey Development

The needs assessment survey instrument was developed with input from isocyanate subject experts associated with the National Institute for Occupational Safety and Health (NIOSH), the U.S. Environmental Protection Agency's (EPA) Design for the Environment (DfE) program, and Yale University's Survey of Painters and Repairers of Autobody by Yale (SPRAY). SHARP also obtained local perspectives on the collision repair industry from Washington State's Division of Occupational Safety and Health (DOSH) Industrial Hygiene inspectors and staff from the Local Hazardous Waste Management Program (LHWMP) in King County, Washington. Members of the Alliance for the Polyurethanes Industry (API) also reviewed the survey.

LHWMP had established working relationships with several collision repair shop owners during a recent emphasis program on hazardous waste management in this industry. The identities of business owners with shops that qualified for environmental certification ("Envirostars") were provided to SHARP as candidates for key informant interviews and field visits. SHARP then solicited reviews of a preliminary survey instrument from several of these shop owners and representatives of the two principal autobody repair business associations in Washington State (the Autobody Craftsman Association and the Automotive Service Association of Washington). SHARP staff also described the study and solicited feedback on the survey instrument at two local chapter meetings of the Autobody Craftsman Association.

SHARP mailed a second draft of the pilot survey instrument to seven of the collision repair shop owners identified by

LHWMP and followed up with site visits to their shops. The pilot survey was also administered to instructors at a local vocational training school and a paint manufacturer-owned training facility. While conducting the field visits, SHARP interviewed the local shop owners and trainers described above. SHARP also interviewed an independent health and safety consultant, a retired shop owner who had written extensively in trade journals, a representative of a national autobody association, an automobile insurance representative, and the former executive director of the Ohio Board of Motor Vehicle Collision Repair Registration. All this stakeholder input was considered and included in the final needs assessment survey.

Selection of Employers for the Needs Assessment Survey

Four sources of information were used to generate a master list of collision repair shops in Washington State: (i) the membership list of the largest state business association; (ii) Dex online Yellow Pages (business addresses and telephone numbers for all companies listed under *Auto Body Repair & Paint* and businesses that contained the term "collision repair" in their name or Yellow Page advertisement); (iii) a collision repair business database compiled by LHWMP; and (iv) a Google search of Washington State "collision repair" or "auto painting" businesses on the Internet. These data sources were accessed in June 2005. Data from these four sources were combined, and duplicate records were eliminated to generate the master list of collision repair shops.

Survey Strategy

The needs assessment survey was designed to gather information from the owners and managers of collision repair shops and was mailed in June 2005. Included in the package was a cover letter describing the purpose of the survey and letters of support from two local business associations. Also included was a postage-paid return envelope addressed to the firm that conducted the survey.

Recipients were given the option to provide anonymous responses. They also were given a deadline of 2 weeks to complete and return the survey. The survey firm mailed a reminder postcard 3 weeks after the initial mailing (i.e., 1 week after the specified deadline expired). The survey firm then telephoned recipients who had not responded to the reminder postcard to attempt completion over the telephone or to gain commitment to return the survey by mail or fax.

Survey Instrument

The goal of this study was to focus on collision repair shops that actually paint vehicles, rather than those that perform only mechanical repairs and then subcontract vehicle painting. To identify eligible shops, the first question attempted to determine whether any worker (including the business owner) conducted collision repair activities that could potentially

result in exposure to paints: “Does your business actually do collision repair (i.e., do you repair *and* paint cars or other vehicles?” If the answer to this question was “no,” the respondent was instructed to return the survey without answering the remaining questions. However, if the answer to this first question was “yes,” the respondent was instructed to answer the remaining questions.

Other questions covered the following subject areas: (i) business and employment information, (ii) general health and safety, (iii) shop procedures and equipment, and (iv) other health and safety procedures and perceptions. The qualitative responses to open-ended questions were assigned to an appropriate category.

Data Management and Analysis

The firm conducting the survey entered the data into a proprietary database and provided both a Microsoft Excel spreadsheet and an SPSS file to SHARP. The survey firm did not reveal the identities of survey respondents who requested anonymity or recipients who chose not to respond to the survey. All data derived from the interviews, field visits, and survey responses were kept confidential. Descriptive statistical analyses were performed in Microsoft Excel and SAS (v. 9.1.2).

RESULTS AND DISCUSSION

Detailed results, including tables of responses to all 46 questions, are provided in SHARP’s technical report.⁽¹⁷⁾

Employer Data Sources

A master list of 1258 collision repair shops was generated using the four data sources. The business association database contained 808 entries, which was supplemented by 371 shops retrieved from online Yellow Pages, 71 shops identified in the LHWMP database, and eight listings retrieved from a collision repair franchise’s website.

Survey Response Rate

The sample disposition summary is presented in Table I. Of the 1258 businesses that were mailed surveys, responses were received (via mail and telephone follow-up) from 707 shops. The response rate was 69% and was calculated as follows:

$$\begin{aligned} \text{Response Rate (\%)} &= \left[\frac{\text{Survey Responses}}{\text{Survey Responses} + \text{Refused} + \text{Unreachable} + \text{No Response}} \right] \times 100 \\ &= \left[\frac{707}{707 + 61 + 125 + 139} \right] \times 100 = 69\% \end{aligned}$$

Survey Responses

Of the 707 businesses that responded to the survey, 494 (70%) stated that they repair *and* paint cars or other vehicles.

TABLE I. Collision Repair Survey Sample Disposition

Disposition	No. Shops
Survey responses returned (by mail and telephone)	707
Refused survey	61
Unreachable (no answer, blocked phone no.)	125
Made contact, determined qualified, but no response	139
Unable to determine if qualified (duplicates, no longer in business, no phone/no listing, wrong phone number, disconnected, fax/modem, barriers: language/hearing/other problem)	226
Total	1258

The remaining discussion will focus on the responses from these 494 eligible collision repair shops.

Most survey respondents described themselves as either the shop owner (62%) or the manager (29%). The participating shops were concentrated in Washington State’s most populous counties—King (28%), Pierce (10%), Spokane (8%), and Snohomish (7%). Selected survey responses are summarized in Tables II through V. Note that the sum of the percent values associated with some questions occasionally exceeded 100% when a shop provided multiple answers to that question. Responses to additional questions are presented in SHARP’s technical report.⁽¹⁷⁾

Study Findings

The first goal of this study was to gain an understanding of the collision repair business. The results of the survey (presented in Table II) indicate that this is a male-dominated industry comprising mainly small, nonunionized, family-run businesses. The principal factor influencing a shop’s profitability is the reimbursement rates paid by insurance companies, which are the major source of income for 62% of shops. Several key informants suggested that the reimbursement rates set by insurance companies are not sufficient to allow investment in the training, education, personal protective equipment, and engineering controls that would provide optimal worker protection.

However, others suggested that the relatively slim profit margins characteristic of this industry may also reflect the lack of formal business management training among the owners and managers of smaller shops. Regardless of the cause, this lack of profitability is an important factor to consider when formulating health and safety interventions. Key informants suggested that providing grants, workers’ compensation premium discounts, or tax incentives would increase the likelihood that shop owners would invest more resources in worker health and safety.

The second goal of this study was to describe the number of workers potentially exposed to isocyanates (Table II).

TABLE II. Industry Characteristics and Business Model

Question	Response
Number of years in business	Average: 23 years (median: 20 years) Range: <1 year (three shops) to 90 years (one shop)
Family-owned and operated shops	88%
Number of female production employees	3% employed one female technician One employed two female technicians
Number of cars painted per month	3% employed one female painter Average: 42 (median: 25) Range: 1 (16 shops) to 400 (one shop)
Number of <i>complete</i> cars painted per month (i.e., restore, refinish, and/or paint entire vehicles)	Average: 2.8 (median: 0) Did not paint complete vehicles: 56% One shop painted 115 per month
Size of shop's production area	Less than 1000 ft ² : 6% 1000 to 5000. ft ² : 50% 5000 to 10,000 ft ² : 31% >10,000 ft ² : 11% Don't know: 1%
Shops that are part of a multi-store business, consolidator, franchise, cooperative group, chain, or similar collection of businesses	12%
Expected change in profitability of shops over the next 2 years	Decrease: 27% Unchanged: 32% Increase: 37%
Most important factor influencing the shop's profitability	Insurance company concerns: 28% Business volume: 10%
Total number of employees at busiest time (including office workers, repair technicians, painters, etc.)	63% had between one and nine employees Average: 7.2 (median: 5) Range: none (46 shops) to 63 (one shop)
Unionization	2%
Number of collision technicians	Average: 2.8 (median: 2) Range: none (three shops) to 14 (one shop)
Number of painters	Average: 1.8 (median: 1) Range: none (three shops) to eight (two shops)

Although painters are most likely to have frequent contact with isocyanates, collision technicians may also contact these reactive chemicals by occasionally mixing paints, cleaning paint guns, cleaning up spills, bystander exposures to fugitive paint mists, and incidental contact with hardeners that contaminate shop tools and work surfaces.⁽¹⁰⁾

The survey identified 2168 production employees in Washington State's collision repair industry (i.e., 828 painters plus 1340 collision technicians). Production worker employment was also estimated from Washington State's workers' compensation database. The number of hours reported per quarter was retrieved for employers in the State Fund within North American Industry Classification System (NAICS) code 81121 (Automotive Body, Paint, and Interior Repair and Maintenance) and employees classified in Washington Industrial Classification (WIC) 3412-00 (Automobile and truck: Body and fender repair shops).

Assuming that one FTE works 500 hours per quarter, the 2005 estimate for production worker employment was 2811 FTE. This estimate compares favorably to the survey results (2168 production employees), which likely represents an underestimate because less than 100% of collision repair shops responded to the survey. Therefore, between 2200 and 2800 production employees are potentially exposed to isocyanates in Washington State's collision repair industry.

The third goal was to identify additional chemical and physical exposures of concern (Table III). Survey respondents expressed concern about eye injuries, lacerations, musculoskeletal injuries, burns, crushing injuries, abrasions, and falls. These responses are largely consistent with this study's field observations and the Washington State workers' compensation data analysis performed by SHARP.⁽¹⁸⁾

The fourth goal of this study was to describe current health and safety practices in the industry (Table IV). The emphasis

TABLE III. Chemical and Physical Exposures and Injuries of Concern

Question	Response	Percent (%)
Most important injury, illness, or exposure in the collision repair industry	Eye injuries	15
	Cuts	13
	Respiratory disease	12
	Other injuries	9
	Chemical exposure	8
	Back injuries	7
	Paints	7
	Isocyanates	5
	Dust/particles/fumes	3
	Frame racks	3
	Cancer	2
	Knee injuries	1
	Carpal tunnel syndrome	<1
	Noise/hearing loss	<1
	Don't know	7
	Other	8

was placed on application of clear coats because Woskie et al.⁽¹⁹⁾ demonstrated that the amount of clear coat used by a shop was a significant determinant of isocyanate exposures in spray booths. In this current study, 85% of shops reported that painters wore gloves while spraying two-part clear coats; 51% reported using latex gloves.

However, Liu et al.⁽²⁰⁾ demonstrated that isocyanates may break through latex gloves even after a single painting session. Nitrile gloves are likely more protective and were reportedly used by 40% of shops. Although there are no regulatory requirements to use nitrile gloves in collision repair shops, their use for handling isocyanates is recommended in the peer reviewed literature,⁽²⁰⁾ by a product manufacturer, and by federal agencies.^(21,22) However, this study's field observations revealed that many production employees prefer latex gloves because they are perceived to be more comfortable and more flexible than nitrile.

Ninety-eight percent of shops reported that painters wore respirators while spraying two-part clear coats. Most shops used half face, air-purifying respirators, which are allowable under current workplace regulations as long as an appropriate cartridge change-out schedule is established. Although Liu et al.⁽²³⁾ reported that these respirators provide adequate protection from airborne isocyanate exposures, they do not provide eye protection. Workers were rarely observed wearing eye protection in combination with half face respirators. Appropriate eye and face protection is required under state and federal workplace regulations because contact with spray paint vapors and aerosols may cause permanent eye damage.

In contrast to the current regulatory requirements for respiratory protection, several nonregulatory state and federal entities^(1,24,25) recommend using supplied-air respirators when spray painting. When asked why workers do not use supplied-air respirators, 29% of respondents stated that the shop does not supply these respirators because the painters do not like them; 23% stated that the shop has supplied-air respirators but the painters do not use them. This finding is consistent with the observation by Sparer et al.⁽⁵⁾ that painters did not always wear supplied-air respirators in shops that made them available. Key informant interviews and field visits revealed that some shop owners are aware that supplied-air respirators offer the best protection against isocyanate exposures, but painters refuse to wear them because of perceptions about interference with visual acuity and mobility while painting.

The survey revealed that application of two-part clear coats was primarily conducted in enclosed spray booths. However, 9% percent of respondents suggested that painting was performed in ventilated prep stations, and 3% said that painting occurred on the shop floor. During the field investigations, several prep stations were comprised of a separate area with an exhaust filter bank mounted in the wall. Occasionally, these stations were separated from the rest of the production area by movable plastic curtains, but some configurations did not have a local source of supply air.

Although some ventilated prep stations may provide sufficient airflow velocities to protect painters from isocyanate overexposures, Washington State's workplace health and safety regulations dictate that routine spray finishing with flammable materials may be conducted only in approved spray booths. Paint spraying outside of approved spray booths may also violate fire protection codes.

Slightly less than half of the survey respondents reported that two-part clear coats were applied in downdraft booths (46%); 26% reported prefabricated crossdraft booths, 20% reported custom crossdraft booths, and 10% reported semidowndraft booths. Under experimental conditions, Heitbrink et al.⁽²⁶⁾ determined that downdraft booths produced lower particulate exposures for workers than crossdraft or semidowndraft booths. Woskie et al.⁽¹⁹⁾ determined that custom-built crossdraft booths yielded the highest isocyanate exposures, prefabricated crossdraft booths yielded intermediate exposures, and the lowest exposures were noted in downdraft or semidowndraft booths.

This current study revealed that 64% of larger shops (production areas >5000 ft²) had a downdraft booth, whereas only 36% of smaller shops (<5000 ft²) had this type ($p < 0.0001$). This observation is consistent with the findings of Woskie et al.,⁽¹⁹⁾ who reported that larger shops had more downdraft booths than did smaller shops. The current study determined that 70% of smaller shops had custom crossdraft booths, compared with 30% of larger shops. This discrepancy likely reflects the fact that smaller shops are more likely to design and build their own custom crossdraft booths than purchase downdraft booths. The finding that smaller shops are less likely to have downdraft booths (most protective) and

TABLE IV. Current Safety and Health Practices

Question	Response	Percent (%)	
Gloves used by workers while mixing or applying two-part clear coats ^A	Latex	51	
	Nitrile	40	
	Neoprene	8	
	Natural rubber	5	
	PVC	1	
	Laminated polyethylene	<1	
	Cloth/leather	<1	
	Other	1	
	None	2	
	Don't know	9	
Personal protective equipment used by workers while spraying two-part clear coats ^A	Respirator	98	
	Gloves	85	
	Shoot suit	83	
	Safety glasses	59	
	Head socks	54	
	Cloth or leather work boots	46	
	Earplugs or muffs	40	
	Goggles	37	
	Disposable coveralls	31	
	Fabric coveralls	29	
	Disposable boot covers	14	
	Rubber boots	9	
	Respirators used by workers while spraying two-part clear coats ^A	Half-face type with replaceable cartridges	46
		Full-face type with an air supply hose	26
		Disposable half-face type with cartridges	23
Hood or head covering with air supply hose		18	
Full-face type with cartridges		16	
Half-face type with an air supply hose		14	
Hood-type powered air-purifying respirator (PAPR)		8	
Dust masks (filtering face pieces)		3	
None		0	
Don't know		<1	
Reasons why workers do not use supplied air respirators ^A	Other	<1	
	The painters don't like them	29	
	Too expensive	25	
	We have them but the painters don't use them	23	
	Too difficult to maintain	3	
	Too difficult to install	3	
	Other	21	
	Don't know	9	
Location where painters spray two-part clear coats ^A	Downdraft booth	46	
	Prefabricated crossdraft booth	26	
	Custom crossdraft booth	20	
	Semi-downdraft booth	10	
	Ventilated prep station	9	
	On the shop floor	3	
	Somewhere else	2	

^ATotal exceeds 100% because some respondents provided multiple responses.

TABLE V. Safety and Health Perceptions and Needs

Question	Response	Percent (%)
Sources of health and safety information for two-part paint systems ^A	Material safety data sheets	95
	Other manufacturer or supplier information	77
	Trade journals	46
	Internet	26
	Other source	7
	Department of Labor & Industries	1
	No access to health information	<1
	Don't know	<1
Most effective way to protect the health and safety of collision repair workers	Wearing PPE/safety equipment	25
	Education/training	23
	Enforcement/supervision	10
	Communication	8
	Worker awareness/knowledge/care	7
	Safety programs	6
	Shop cleanliness	4
	Engineering control/shop improvements	3
	Providing equipment/tools	3
	Don't know	3
	Refused	<1
	Other	8
	Greatest challenge to implementing best practices in health and safety	Employee resistance issues
Supervision/enforcement of safety procedures		10
Financial considerations		8
Time constraints		8
Education and training		2
Don't know		8
Refused		<1
Other		14
	None/no challenges	11

^ATotal exceeds 100% because some respondents provided multiple responses.

more likely to have custom crossdraft booths (least protective) has significant implications for worker exposure.

The fifth goal of this study was to learn about the health and safety perceptions and needs of business owners and managers (Table V). Most shop owners received their health and safety information from material safety data sheets, paint and materials manufacturers and suppliers, and trade journals. Key informant interviews revealed that certain poor work practices (such as the use of latex gloves) are perpetuated by misinformation provided by some of these sources.

Only 25% of shops contracted with a private health and safety consultant, and only 1% reported receiving information from the Washington State Department of Labor & Industries (the state agency tasked with administering workplace health and safety regulations and providing consultation services). This finding is particularly disconcerting because specialized expertise is required to develop effective safety and health programs, especially concerning respiratory protection. It is clear that many shop owners are lacking good

quality health and safety information and require technical assistance.

Twenty-five percent of respondents suggested that the most effective way to protect the health and safety of workers was personal protective equipment and safety equipment. This response contrasts with the prevailing opinion among health and safety professionals that engineering controls are much more effective at controlling workplace exposures (only 3% of respondents named engineering controls as the most effective).

When asked about the greatest challenge to implementing health and safety best practices, 39% of respondents cited employee resistance. This resistance was described as lack of "employee participation," "employee cooperation," "employee compliance," "employee awareness," "consistency," "common sense," and "employee commitment." Twenty percent of respondents could not identify a strategy to overcome these challenges to implementing best practices, and an additional 20% suggested that being provided good information, training, and education would be effective.

Intervention Strategies

The final goal of the study was to identify strategies to reduce exposures and increase employer and worker awareness. A successful intervention strategy must recognize the challenges faced by small businesses in general, and the collision repair industry in particular. State and federal workplace regulations require that employers identify and address hazardous exposures in the workplace.

However, preventing occupational illness and injury is often difficult in small businesses because they generally have few safety and health resources, usually cannot hire staff devoted to safety and health activities, and often lack the ability to identify occupational hazards and conduct surveillance.⁽²⁷⁾ Field observations revealed that collision technicians and painters are almost entirely focused on their production tasks while at work; there is very little opportunity in most shops for these workers to devote time to health and safety issues. This situation likely reflects the fact that very few production workers are salaried (only 7% of collision technicians and 10% of painters). Employees' wages, generally, are related to their production output.

Field observations revealed that many collision repair shops had significant deficiencies in their respiratory protection programs, especially with regard to fit testing, selection, and maintenance of air-purifying respirators. Maintenance of supplied-air respirators and the associated compressor systems was also lacking. Another major deficiency was the use of inappropriate gloves for handling isocyanates, lacquer thinners, and other solvents. In addition, spray booths often failed to provide sufficient airflow to protect workers due to inadequate filter change-out schedules, accumulation of debris in exhaust filters, or other mechanical problems.

Collision repair workers may also be exposed to excessive noise and other physical and musculoskeletal hazards while prepping and painting vehicles. Field observations revealed inconsistent use of hearing protection and eye protection. Several tasks performed by collision technicians and painters had numerous risk factors for musculoskeletal injuries, including awkward postures, forceful exertion, and repetitive motion.

Many of the safety and health practices necessary to protect collision repair workers have been recognized for decades. For example, these small businesses struggle to implement adequate booth ventilation and respiratory protection. Consequently, this industry is amenable to the "Research to Practice" approach proposed by NIOSH, which is defined as "... the transfer and translation of research findings, technologies, and information into highly effective prevention practices and products which are adopted in the workplace."⁽²⁸⁾ The way that research information is translated to these workplaces must account for the financial and social characteristics of this industry. Any outreach effort must recognize that the social organization of work within small businesses is extremely complex and poses unique challenges to developing effective intervention strategies.

Eakin⁽²⁹⁾ suggests that most owners of small workplaces have very little involvement in activities related to workplace health and safety and strive to sustain good working relationships with valued employees. This study's field observations revealed that some shop owners express considerable concern for the health and well-being of their employees, likely because many of these businesses are family owned and operated. Even when this is not the case, there was frequently a strong sense of community within some shops.

However, some shop owners allow valued production employees to dictate work practices even if they are not protective. In particular, this behavior was observed with the painters' selection and use of gloves and respirators. One possible explanation for this dynamic is the observation that some business owners will not discipline or place excessive pressure on their painters for fear they will seek employment elsewhere.

Another explanation is that some shop owners may perceive intervention with their employees to be inappropriately paternalistic—they do not believe they have the right or obligation to intervene in the health-related aspects of employee behavior.⁽²⁹⁾ These findings are consistent with the obstacles to implementing safe work practices observed by the EPA.⁽³⁰⁾

It is critically important to include prominent owners and managers, business associations, trade groups, and other industry leaders in any intervention to ensure that these efforts are meaningful and relevant to the target population. Collaborating with trade organizations to disseminate information is also critical, especially since 95% of respondents subscribe to at least one trade journal.

Providing on-site technical assistance is an essential component of any outreach strategy, and efforts should be made to promote the services currently available from state and federal OSHA consultation programs and other health and safety professionals. Collective efforts should be developed that provide low-cost health and safety services as collaborative partnerships among local, state, and federal agencies; trade associations; retrospective rating programs; and other stakeholders.

In conclusion, there is a critical need to develop a multifaceted education and training campaign for this industry. Although the solutions to protecting workers have been documented for several decades, this information has not been delivered effectively to the collision repair industry. Using "research to practice" strategies and financial incentives would likely be an effective means to improve workplace health and safety in this underserved business sector.

Study Strengths and Limitations

This study was the first attempt to characterize the collision repair industry in Washington State. Although this study provided considerable insight into the industry, certain limitations in the design may compromise the representativeness of the data gathered in this study.

The principal limitation associated with the seven initial field visits and key informant interviews is that the subjects and their shops may not be representative of Washington State's collision repair industry. The shop owners who participated in interviews and shop visits were the pre-eminent business owners in the Puget Sound region. Consequently, the health and safety conditions observed at their shops are likely better than the majority of shops in the state. Another limitation is the fact that workers were not included in the key informant interviews. SHARP determined that it was not possible to schedule time with workers during the workday because of their busy production schedules. At that time, SHARP was not aware of any other forums in which painters and other workers could be convened. Despite these limitations, the observed health and safety deficiencies were consistent with those described by other investigators.^(5,31)

The principal limitation of the needs assessment survey is that the responses were self-reported by employers. Consequently, the responses may not reflect actual conditions and practices at the surveyed workplaces for fear of retribution by regulatory agencies, concerns about privacy, etc. However, the survey responses were consistent with this study's field observations at seven collision repair shops, information provided by this study's stakeholders, and data published by other investigators.^(5,31)

Strengths of this study include the following: (i) the use of several data sources to identify employers eligible for inclusion in the sampling frame (most collision repair shops in Washington State were likely identified); (ii) the use of site visits to validate the survey instrument prior to distribution; (iii) the support and participation of local shop owners, trainers, and business associations; and (iv) the high (69%) response rate to the survey. Note that unreachable businesses were conservatively assumed to perform collision repair and were included in the denominator of the response rate calculation. Excluding these unreachable shops would have yielded a response rate of 78%. Although a response bias cannot be excluded without further information, we conclude that this relatively high response rate results in a representative profile of Washington State's collision repair industry.

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