The Collision Auto Repair Safety Study (CARSS): A Health and Safety Intervention

David L. Parker,[1]* Anca Bejan,[1] Lisa M. Brosseau,[2] Maryellen Skan,[1] and Min Xi[1]

Background *Collision repair employs approximately 205,500 people in 33,400 shops. Workers are exposed to a diverse array of chemical, physical, and ergonomic hazards.*
Methods *CARSS was based on a random and purposeful sample. Baseline and one baseline and one-year evaluations consisted of 92 questions addressing issues, such as Right-to-Know, fire protection, painting-related hazards, ergonomics, electrical safety, and personal protective equipment. Owners received a report and selected at least 30% of items found deficient for remediation. In-person and web-based services were provided.*
Results *Forty-nine shops were evaluated at baseline and 45 at follow-up. At baseline, 54% of items were present. This improved to 71% at follow-up ($P < 0.0001$). Respiratory protection improved 37% ($P < 0.0001$) and Right-to-Know training increased 30% ($P < 0.0001$). Owners completed 61% of items they selected for remediation.*
Conclusions *Small businesses' interventions should address the lack of personnel and administrative infrastructure. Tailored information regarding hazards and easy-to-use training and administrative programs overcome many barriers to improvement.* Am. J. Ind. Med. 58:88–100, 2015.

KEY WORDS: auto-collision repair industry; Collision Auto Repair Safety Study (CARSS); health and safety program implementation; small business safety programs; intervention

INTRODUCTION

In the United States, approximately 205,500 people work in 33,400 auto collision repair businesses (NAICS code 811121), over half (58%) of which have four or fewer employees and 18% of which have 10 or more employees (US Census Bureau, 2013; data from 2011). Although considered a service industry, auto collision repair businesses have a wide range of safety and health hazards including ungrounded electrical wiring, blocked exits, noise, and exposures to hazardous chemicals (e.g., isocyanates and solvents) [Heitbrink et al., 1992, 1993; Cooper et al., 1993; McCammon and Sorensen, 1996; Sparer et al., 2004; Bejan et al., 2011; Reeb-Whitaker et al., 2012; Brosseau et al., 2013].

Injuries and illnesses caused by chemical exposures occur at a higher rate in collision repair than in general industry (5.9 vs. 1.6 injuries and illnesses per 10,000 full-time equivalents [FTE]), as do head, (17.7 vs. 7.1), eye (12.2 vs. 2.6), and knee injuries (14.8 vs. 9.6) [US DOL, 2012]. Workers' compensation data from Washington State indicate that the rate of compensable asthma claims for the automotive repair industry was nine times higher than the overall incidence of such claims for other industries (20.3 versus 2.2 per 100,000 FTE) [Whittaker and Reeb-Whitaker, 2009]. Thus, auto collision repair can be considered a high-hazard industry consisting almost entirely of very small enterprises.

Health and safety program implementation is limited in small enterprises because (1) businesses generally have informal human resource practices, (2) fewer than 5% of small establishments have an employee with expertise to manage health and safety [Furuki et al., 2006], (3) owners are frequently

[1]Park Nicollet Institute, Minneapolis, MN
[2]Division of Environmental and Occupational Health, University of Illinois School of Public Health, Chicago, IL
*Correspondence to: David L. Parker, 3800 Park Nicollet Blvd, Minneapolis, MN 55416. E-mail: parked@parknicollet.com

Accepted 1 July 2014
DOI 10.1002/ajim.22377. Published online 22 September 2014 in Wiley Online Library (wileyonlinelibrary.com).

unaware of safety and health laws and regulations [Hasle et al., 2011], (4) businesses often do not have written health and safety policies [Fonteyn et al., 1997; Bradshaw et al., 2001; Hornsby and Kuratko, 2003; Kotey and Slade, 2005], and (5) most owners do not regard the identification and control of risks as a priority [Gardner et al., 1999; Hasle et al., 2011].

The nature of social relationships in very small enterprises makes it difficult to establish and manage health and safety programs [Hasle et al., 2011]. Owners have daily interactions with employees and may perceive them as friends or family rather than as subordinates. As a result, owners may be reluctant to develop and enforce safety and health policies. In addition, owners and workers tend to seek information from easily accessible channels, such as suppliers who may lack training and whose financial interests often play a role in the type and amount of information provided [Hartman et al., 1994; Parker et al., 2012]. The lack of high quality and independent information means that for both workers and owners, their understanding of work-related health and safety is likely to be shaped by daily experience [Hasle et al., 2011].

This paper describes the results of the Minnesota Collision Auto Repair Safety Study (CARSS). The goal of CARSS was to reduce worker exposure to diverse hazards within the collision repair industry. The study focused on helping owners in small auto-collision shops develop and implement health and safety programs.

METHODS

Study Design

All protocols and materials were approved by the Park Nicollet Institute and the University of Minnesota institutional review boards.

This study was a pre-post evaluation of intervention effectiveness. Businesses were evaluated at baseline and one year after the intervention. Intervention mapping was used to define industry needs and develop grant-related activities [Bartholomew et al., 1998]. Social Cognitive Theory was used to understand the underlying shop-specific determinants of health and safety and to help tailor interventions to owners and employees within each shop [Baranowski et al., 2002]. Briefly, the following steps were taken as part of intervention design:

- Potential adverse health outcomes were identified following detailed job hazard analyses, review of published data, and the compilation and review of exposure data [Bejan et al., 2011];
- Nine categories of hazards were identified for intervention [Brosseau et al., 2013];
- Meetings were held with the Alliance of Automotive Service Providers Minnesota; (AASP MN) and its advisory board to discuss owner perceptions related to safety and health, training resources, existing safety and health programs, and format for new programs;
- Focus groups were conducted with owners and workers [Parker et al., 2012];
- A health and safety business evaluation form was developed and tested [Brosseau et al., 2013]; and
- Intervention materials were developed and reviewed with business owners and employees.

Business Eligibility and Recruitment

An auto-collision repair business was eligible if: (1) at least 75% of its revenue was generated by collision repair activities; (2) it had been in business for at least one year before recruitment; (3) it was independently owned and operated or, if a franchise, did not have a corporate-mandated safety program; (4) it had at least one employee and carried workers' compensation insurance; (5) it had a paint booth; and (6) it was not currently using the consulting services of a study partner. A complete description of recruitment procedures is found elsewhere [Parker et al., 2012; Brosseau et al., 2013].

All participating businesses were enrolled during a visit arranged by the principal investigator (DP), at which time the study was explained and informed consent was obtained from the business owner or representative. Initially businesses were randomly selected from a database of 273 collision repair shops located within 50 miles of the Minneapolis and Saint Paul metropolitan area ($N = 26$). This proved to be extremely time consuming, so the remainder of participants were recruited from four sources: AASP MN membership, referral from other owners, focus-group participants, and referral from suppliers. The only incentives provided for participation were the free evaluation, technical, and educational services provided by CARSS.

Business Safety Assessment

Demographic information was collected about each business and the owner. This included the number of employees, years in business, owner education, gender, and years the shop was owned. All businesses were evaluated by a research team member (industrial hygienist) using the same business safety assessment survey at baseline and one year later (final evaluation). The business safety assessment tool and baseline results are described in detail elsewhere [Brosseau et al., 2013]. The business safety assessment tool consisted of 92 questions addressing eight topic areas: (1) shop safety and Right-to-Know training, (2) emergency planning, first aid, and fire prevention, (3) storage and use of compressed gases, (4) paint booth and paint mixing room

hazards, (5) ergonomics, (6) electrical safety and machine safety, and lockout/tagout, (7) personal protective equipment (for eyes, ears, and skin), and (8) respiratory protection.

Each survey question evaluated an item of concern for health and safety in collision shops. The designation "missing/inadequate" was used to describe a variety of situations. For example, elements of a safety program were evaluated only if a written safety program was present; an item was present but incomplete (e.g., the training record indicated that training was completed by fewer than 50% of employees); or the item was present but not used or was out of order (e.g., carbon monoxide monitoring equipment for air-supplied respirators).

Following a review by a safety professional knowledgeable about the collision repair industry, as well as CARSS staff, each of the 92 questions (items) was assigned a level of severity:

- *Critical*: Items that had the potential to cause serious injury to an employee or immediate damage to the facility;
- *Highly Important*: Items that might cause employee injury or long-term health issues or damage to the facility;
- *Important*: Items that might cause non-serious employee injury or illness; or
- *Other*: Items not immediately hazardous that could be fixed relatively easily and would ensure regulatory compliance.

Intervention

Following the baseline evaluation, a report was sent to the owner, who then selected 30% of the report recommendations for remediation over the next 12 months. Of this selection, 80% targeted *critical* or *highly important* items. Owners were encouraged to correct additional problems as time and resources permitted.

Within two weeks of receiving the report, a staff industrial hygienist met with the owner a second time to discuss their selection of improvements, set completion dates, and create user accounts on the CARSS website. A detailed Shop Improvement Plan (SIP) was subsequently sent to the owner. The SIP described the steps needed to implement each recommendation selected by the owner and indicated the target completion dates. Follow-up was conducted quarterly as follows:

- An in-person visit was scheduled at the end of quarter 1. This provided owners an opportunity to ask any questions related to their SIP and ensure they were familiar with the study website.
- Owners were contacted quarterly by telephone or email and asked to report progress towards implementation of the recommendations selected for the SIP.
- In-person visits were scheduled as needed for respirator fit testing or training.
- The final evaluation was conducted one year after the baseline assessment.

During the course of the study, owners and workers had access to the study website. The site provided free training for Right-to-Know, fire safety, and respirator use, safety program templates, medical evaluation for respirator users, hazard-specific checklists, and health and safety information specific to collision repair hazards. Respirator fit testing was provided by study staff upon the owner's request. Four safety newsletters were delivered by mail and posted on the website.

Inter-rater Reliability

Inter-rater reliability was evaluated using joint visits during baseline (seven shops) and follow-up (six shops). During quality-control visits, the two staff industrial hygienists evaluated the shop simultaneously but independently. An external safety professional completed five simultaneous but independent evaluations with each industrial hygienist. For the external safety professional, inter-rater reliability was only assessed for *critical* and *highly important* items.

Data Analysis

Data were entered in Microsoft Excel and analyzed using SAS (SAS version 9.2; SAS Institute Inc., Cary, NC). All results compare baseline measures with those found after one year (final evaluation).

A business safety score was computed for each participating shop. Business safety scores are expressed as the *percent* of applicable survey items present at the time of the baseline and final evaluations.

Not all questions were applicable within all shops. The fewest number of applicable questions was 72 and the greatest was 91. For example, if a business used powered air-purifying respirators, questions concerning fit testing were not applicable. Similarly, if a business was not using air-supplied respirators, questions concerning the air-supply system were not applicable.

A subset of 53 business safety assessment questions was designated for further analysis. Criteria used to select these questions were: (1) the item could be verified by the industrial hygienist; and (2) the item was considered *critical, highly important*, or *important* and/or an area that was frequently cited by MN OSHA. The 53 items were then assigned to one of three topic areas: *facility and equipment safety* (33 questions), *written safety documentation and records* (13 questions) and *personal protective equipment* (seven questions).

Analysis included the computation of means, standard deviations, and Chi-squares. *t*-test, ANOVA, and Pearson

correlation were used to explore the relationship between the business safety score and demographic variables. Inter-rater variability was assessed using the kappa statistic. A two-sample *t*-test was used to examine if shops recruited at random were different from those recruited by other means (e.g., referral, AASP). It was also used to determine if baseline scores differed by when shops were recruited into the study (e.g., early or late).

Data simulations were used to determine the effect of time (i.e., order of recruitment) on study outcomes. Shops were randomized into two groups, and the baseline business safety scores of group 1 were compared with the follow-up business safety scores of group 2. This simulation was repeated 1000 times. The safety score differences between the groups were compared using a two-sample *t*-test if data were normally distributed and Wilcoxon non-parametric test if they were not.

Analysis was conducted (1) to determine if items selected by the owner as part of their SIP were more likely to be completed by the end of the study than items that were not selected, and (2) to calculate differences between items owners reported as complete and those identified as completed by the industrial hygienist during the final evaluation. As seen in Figure 1, at baseline an item could be missing or inadequate (Box 1) or present and adequate (Box 2). For the intervention, owners either did (Box 3) or did not (Box 4) select a missing item as part of their SIP. The last column depicts the different options as to how different items might have changed during the intervention period.

Our primary hypotheses were as follows: (1) the percentage of items found to be present and acceptable was greater at follow-up than at baseline; and (2) a significantly greater percentage of items selected for inclusion in the SIP would be completed when compared with items that were not selected.

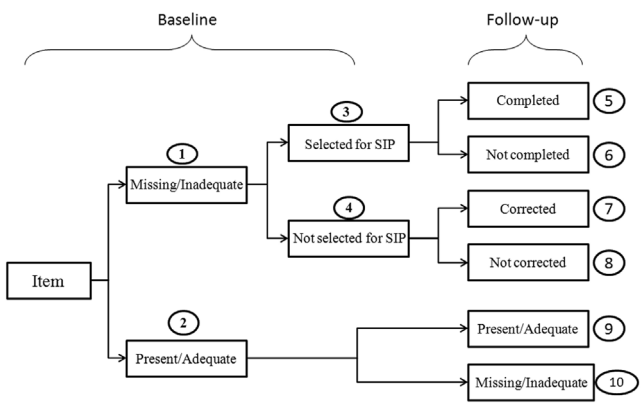

FIGURE 1. Depiction of item selection in the intervention process.

RESULTS

Business Participation and Demographics

Between November 2009 and May 2011, 49 shops were enrolled and received baseline business safety assessments as described by Brosseau et al. (2013). Of these, three businesses declined to participate at follow-up, and one was subsequently determined not to meet eligibility criteria because it was part of a car dealership. A final evaluation was conducted in 45 shops (94% of eligible) between January 2011 and May 2012. Only the 45 businesses with both baseline and final evaluations were included in these data analyses.

At baseline, the 45 shops had an average of 7 employees (SD = 4.8; range = 1–27) and had been in business for an average of 32.3 years (SD = 12.3; range = 5–60). At the final evaluation, the size of the shops was largely unchanged, with an average of 7.2 employees (SD = 4.5). No shop was unionized; 31 businesses were AASP MN members at baseline and 33 at the final evaluation. No differences in demographics were seen between businesses recruited via random selection (n = 18) and those recruited for participation by other means (n = 27).

At baseline, owners (n = 47) or managers (n = 16) were on average 48.5 years old (SD = 8, range = 31–65), had been working in collision repair for an average of 26 years (SD = 13), and had been in the same administrative position for 13.9 years (SD = 11.3; range = 1–39). Twenty-six percent of the owners or managers had attended high school, 32% graduated from high school, and 42% attended at least some college. Twenty-seven percent of the owners had not attended, 40% had attended some, and 32% graduated from vocational school or technical college. All but one owner was white/non-Hispanic, and 89% of owners were male.

Inter-rater Reliability

For the two staff industrial hygienists, the kappa statistic ranged from 0.72 to 0.97 (mean = 0.91). The kappa statistic ranged from 0.76 to 1 between staff industrial hygienists and the external safety professional. A kappa statistic greater than 0.75 indicates good inter-rater reliability [Fleiss, 1981].

Business Evaluation

Table I shows the overall business scores for 45 businesses at baseline and the final evaluation. At baseline, the three sections with the lowest scores were safety in the shop and Right-to-Know training, respiratory protection, and paint booth and mixing room. The highest scores were for compressed gases and electrical and machine safety. After one year, overall business safety scores had improved by 17%

TABLE I. Overall Safety Scores at Baselines and Follow-up for 45 Businesses

	Baseline		Follow-up		Change		
	Mean (%)	SD (%)	Mean (%)	SD (%)	Mean (%)	SD (%)	*P*
Overall	54	10	71	11	17	11	<0.0001
Survey section							
Storage and use of compressed gases	81	27	81	29	0	37	0.99
Electrical and machine safety and lockout/tagout	69	13	75	12	6	12	0.001
Ergonomics	64	16	73	11	9	17	0.0002
Emergency planning, first aid, and fire prevention	60	12	73	11	13	12	<0.0001
Personal protective equipment: ears, eyes, and skin	58	19	77	16	19	21	<0.0001
Paint booth and mixing room	50	23	56	25	6	19	0.06
Respiratory protection	41	18	78	25	37	29	<0.0001
Shop safety and Right-to-Know training	38	17	68	23	30	24	<0.0001

($P < .0001$), as did the scores in six of the eight survey sections ($P < 0.001$–0.0001). The largest improvements occurred in respiratory protection (37%), safety in the shop and Right-to-Know training (30%), and personal protective equipment for the ears, eyes, and skin (19%). The smallest improvements were seen in survey sections related to electrical and machine safety (6%, $P = 0.001$) and the paint booth and mixing room (6%, $P = 0.06$).

Overall, facility and equipment safety improved by 6% ($P = 0.0004$) (Table II). There was a high degree of compliance with electrical wiring standards, especially in paint booths where there is a substantial risk of explosion. Statistically significant improvements were accomplished for 5 (15%) of the items in this topic group. The two critical items with the lowest level of compliance at baseline showed the greatest change: the presence of GFCI outlets in wet locations (34%, $P = 0.002$) and emergency exits not locked (13%, $P = 0.06$). The two highly important items that were significantly improved were: smoking not allowed inside the business facility (11%, $P = 0.025$) and grounding of flammable liquid containers (21%, $P = 0.03$). At the final evaluation, a significantly greater number of businesses were not using extension cords in place of permanent wiring (31%, $P = 0.008$); however, there was no improvement in the presence of electrical wires in bad repair. In addition, 51% of all items in facility and equipment safety had improved in less than 5% of the shops and 7 (21%) of items worsened ($P > 0.05$).

As seen in Table III, the overall presence of written safety documentation and records improved by 43% ($P < 0.0001$). This topic group showed the greatest changes when compared with the other topics. In addition, significant improvements were seen for each of the 13 items. The minimal improvement was 13% for critical important items and 11% for important items. At baseline, a written policy that objects heavier than 50 pounds must be lifted with assistance was not found in any shop but present in 11% of shops at the final evaluation. While the number of shops that created a written disciplinary policy almost tripled, the overall percentage of businesses that had a disciplinary policy remained small (20%).

All five questions related to a respiratory protection program showed a substantial improvement. For example, at baseline 24% of shops had a written respiratory protection program compared with 73% at the final evaluation, an improvement of 49%. At baseline, respirator users in 13% of shops ($n = 6$) had completed an OSHA-mandated medical evaluation compared with 68% at the final evaluation.

Table IV shows the percentage of shops in which different aspects of personal protective equipment were present. Overall issues related to personal protective equipment (PPE) improved by 14% ($P < 0.0001$). All items were considered highly important. At baseline and the final evaluation, all facilities provided respirators with organic vapor and particulate pre-filter cartridges and no painters used improper PPE, such as dust masks during painting. The greatest improvements were noted in the required use of safety glasses for operations that generate eye hazards (28%, $P = 0.005$), followed by an increase in the use of adequate gloves (not using medical grade latex) by body technicians (26%, $P = 0.001$). While the number of shops requiring respiratory protection during all spray painting operations (both inside and outside the paint booth) showed a substantial improvement (9%), this was not statistically significant.

After the baseline visit, owners selected an average of 59% (SD = 17.5%, range 30%–100%) of recommendations for implementation (all recommendations were selected by one shop). This surpassed the 30% target. Most recommendations (83%) addressed items that were rated critical or highly important. The following summarizes CARSS services utilized by shops:

- Fit testing was absent in 41 shops at baseline. CARSS staff provided fit testing in 21 shops and five shops received fit testing from a consultant or sales representative.

TABLE II. Facility and Equipment Safety: Percent of Shops in Which an Item was Present at Baseline and Follow-up

	% Shops in Which Item was:				
Item evaluated	**Present at Baseline**	**Selected for SIP***	**Present at Follow-up**	**Change**	***P***
Overall	70	60	76	6	0.0004
Critical items					
Electrical wires are not present in the paint booth	100	n/a	100	0	
Regular electrical outlets are not present in the paint booth	100	n/a	100	0	
There is no unfinished electrical wiring in the shop	98	100	100	2	0.32
The lights present in the paint booth are explosion-proof	93	0	91	-2	0.56
Regular electrical outlets are not present in the paint mixing room	86	33	84	-2	0.65
There are no open junction boxes	87	67	78	-9	0.25
Emergency exits are not blocked or obstructed	82	88	73	-9	0.25
Electrical panels do not have unguarded openings	76	91	76	0	1
There is a fire suppression system in the paint booth	76	27	84	9	0.045
Emergency exits are not locked from inside	71	100	84	13	0.06
GFCI outlets are present in areas where water is used	47	94	81	34	0.002
Highly important items					
Fire extinguishers are fully charged	91	100	98	7	0.18
Compressed gas cylinders are stored with the safety caps screwed on when not in use	91	67	90	-1	0.65
Fire extinguishers have the seal in place	89	100	93	4	0.48
Emergency exits lead to a safe location	89	60	93	4	0.32
The vents in the paint mixing room are not blocked or obstructed	89	50	82	-7	0.41
Smoking is not allowed inside the building	82	38	93	11	0.025
Fire extinguishers are mounted on the wall	82	75	84	2	0.71
The paint mixing room has a working ventilation system	74	60	63	-11	0.21
Fire extinguishers have been inspected in the past 12 months	73	92	82	9	0.28
All compressed gas cylinders are chained to prevent falling	73	83	76	2	1.0
O2 cylinders are stored away from flammable and combustible materials and gases when not on an oxyacetylene cart	65	75	67	1	0.48
Electrical panels are easy to access	62	88	71	9	0.32
Airflow is monitored in the paint booth	62	35	69	7	0.26
Electrical panels have labeled breakers	58	89	71	13	0.11
Fire extinguishers are easy to access	56	80	69	13	0.13
Electrical panels are kept closed	49	91	60	11	0.25
Containers for flammable liquids are grounded when liquid is transferred	34	70	55	21	0.03
There are no electrical cords in bad repair	22	71	22	0	1.0
Important items					
The door to the paint mixing room is kept closed when not in use	44	44	49	4	0.64
Emergency exits are labeled with an illuminated exit sign	31	45	33	2	0.78
Extension cords are not used in place of permanent wiring	31	61	62	31	0.008
Eye wash is present when liquids with pH $<$ 2 or pH $>$ 11 are used	24	23	43	19	0.32

*SIP - Shop improvement plan.

- Medical evaluation for respirator users was missing in 39 shops at baseline. This service was provided on-line to 29 shops and in paper format to an additional 2.
- Right-to-Know training had not been done in 42 shops at baseline. It was completed on-line by workers in 24 shops.

Respirator training had not been done in 41 shops at baseline. It was completed on-line by workers in 29 shops.

As seen in Figure 2, very few shops selected recommendations related to the paint booth and mixing

TABLE III. Written Safety Documentation and Records: Percent Shops in Which an Item was Present at Baseline and Follow-up

Item evaluated	% Shops in Which Item				
	Present at Baseline	Chosen for SIP*	Present at Follow-up	Change	*P*
Overall	13	64	56	43	< 0.0001
Critical items					
Written safety programs, procedures, and rules are present	29	34	68	39	0.0002
A written respirator program is present	24	97	73	49	< 0001
Safety programs give oversight to a specific person	16	34	64	48	< 0001
Respirator users have medical certification	13	95	68	55	< 0001
Respirator program includes a written cartridge change schedule.	9	90	61	52	< 0001
Respirator users have been trained in the past 12 months	9	98	73	64	< 0001
Respirator users have been fit-tested in the past 12 months	9	95	66	57	<.0001
A written hearing protection policy is present	9	76	50	41	< 0001
Right-to-Know training was conducted in the past 12 months	7	93	59	52	< 0001
A written disciplinary policy describing consequences of not following the safety rules is present	7	21	20	13	0.02
Important items					
A written emergency action plan is present	16	29	45	29	0.0008
A written policy that objects heavier than 50 lbs must be lifted with assistance is present	0	20	11	11	0.014
Other items					
MSDS sheets are available to all employees	20	58	59	39	0.0002

*SIP— shop improvement plan.

room or ergonomics. Figure 2 also illustrates the number of shops that both selected and completed at least one item from their SIP in each category.

Owners were encouraged to remediate as many problems as possible. However, there was a significant difference in the percentage of recommendations that were implemented if the owner had selected the items compared with recommendations that had not been selected (Table V). Overall, 61% of items selected by owners showed improvement compared with 36% of items that were not

TABLE IV. Personal Protective Equipment: Percent Shops in Which an Item was Present at Baseline and Follow-up

Item Evaluated	% Shops in Which Item				
	Present at Baseline	Chosen for SIP	Present at Follow-up	Change	*P*
Overall	70	58	84	14	< 0.0001
Highly important items					
Dust masks are not used for protection during paint spraying operations	100	n/a	100	0	n/a
Respirators used for painting are fitted with OV cartridges	100	n/a	100	0	n/a
Respirators used for painting are fitted with OV cartridges	100	n/a	100	0	n/a
Safety glasses are provided to employees	84	43	95	11	0.059
Safety glasses are provided to employees	84	43	95	11	0.059
Employees are required to wear a respirator every time they spray inside or outside the paint booth	82	75	91	9	0.157
Body techs do not use medical grade latex gloves	56	90	82	26	0.001
Employees are instructed to use hearing protection whenever they operate compressed-air driven tools	42	73	64	21	0.033
The use of safety glasses is required for grinding, working under cars, and cleaning with compressed air operations	24	71	52	28	0.005

OV, organic vapor.

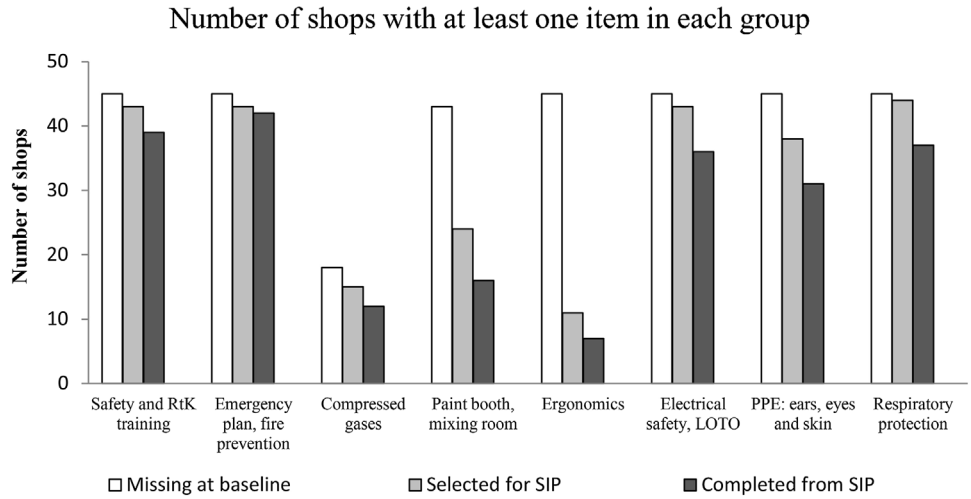

FIGURE 2. Number of shops with one or more recommendations at baseline, selected for SIP, and completed at follow-up in each survey section.

selected ($P < 0.0001$). However, the differences were statistically significant only in two survey areas: safety in the shop and Right-to-Know training (63% vs. 46%, $P = 0.006$) and emergency planning (61% vs. 34%, $P < 0.001$). Significantly more improvements were completed if they were selected for SIP in two topic areas: facility and equipment safety (60% vs. 33%, $P = 0.008$) and written safety documents and records (64% vs. 29%, $P < 0.001$).

Using a two-sample t-test, the difference between baseline and final evaluations was analyzed using the following criteria: past or ongoing use of a safety consultant, AASP MN membership status at the time of recruitment, business size (< 10, $11 +$ employees), owner age (< 50, $50 +$ years), owner education (high school graduate vs. other), owner technical education (any technical school vs. none), and owner experience in the collision industry (< 30, $30 +$ years).

TABLE V. Percentage of Recommendations Implemented by Status of Inclusion in the Shop Improvement Plan

	Percent of Recommendations Implemented				
	Selected for SIP		Not Selected for SIP		
	Mean (%)	SD (%)	Mean (%)	SD (%)	*P*
Overall	61	24	36	22	<0.0001
Survey section					
Compressed gases	77	42	62	48	n/a*
Respiratory protection	66	40	34	48	0.17
Safety in the shop and Right-to-Know training	63	37	46	32	0.006
Emergency planning, first aid and fire prevention	61	28	34	28	<0.0001
PPE: ears, eyes and skin	57	36	67	40	0.91
Paint booth and mixing room	53	45	26	36	0.09
Ergonomics	55	47	22	34	0.81
Electrical and machine safety and lockout/tagout	52	32	38	40	0.29
Health and safety topic					
Written safety documentation and records	64	37	29	27	<0.0001
Facility and equipment safety	60	24	33	33	0.0008
PPE	58	37	68	41	0.71

PPE, personal protective equipment.
*P cannot be calculated due to very low number of questions in this survey section (3 questions).

Using regression analysis, baseline business safety scores were inversely related to the magnitude of improvement. For all shops, controlling for shop size (< = 10, 11or more) each percent increase in the baseline score resulted in a 0.45% decrease in how much the shop improved by the final evaluation. However, when the presence of a risk consultant was included in the model the importance of baseline score disappeared. This is likely due to the strong correlation the presence of a risk consultant and baseline score ($r^2 = 60\%$).

How a business was recruited into the study (random selection, other), the timeframe in which the business was recruited, and years of owning/managing the shop (< 10, 10 + years) had no impact on baseline or final safety scores. Data simulation confirmed that there was no time effect on baselines or outcome measures. Prior engagement of a safety consultant was the only variable that was found to be statistically significant. As seen in Table VI, at baseline the businesses that had engaged a safety consultant (past or current) had higher safety scores ($P < 0.05$) in four out of eight sections and two out of three topics when compared with shops that had not. However, at the final evaluation this difference was not observed.

At each quarterly meeting, owners were asked to report the number of selected items that had been improved in the previous three months. At the end of the study, owners had consistently over-reported their achievements, stating that 71% (SD = 28%) of items were completed compared with the 61% (SD = 24%) found by CARSS staff to have been completed ($P < 0.0001$) (data not shown).

DISCUSSION

The CARSS intervention resulted in important changes, many of which were related to worker training and shop programs and policies. Consistent with our original hypothesis, a recommendation for improvement was more likely to be implemented if it was included in a formal SIP developed with the employer than if it were simply included in a report (Table V). Regular follow-up helped ensure that owners continued to work on their SIP. Online services most likely provided an important means of reaching both owners and workers—and thus increased the overall success of CARSS.

Not surprisingly, improvements were greatest where CARSS was able to offer technical assistance, such as respiratory protection, Right-to-Know training, and personal protective equipment for the ears, eyes, and skin. The smallest improvements were seen in areas related to electrical and machine safety and the paint booth and mixing room. Although several items worsened during the course of the intervention, none of these changes were statistically significant.

Based on two comparison samples, businesses enrolled in CARSS were similar to independent collision repair shops elsewhere in the nation. In a survey of 494 shops conducted by the Department of Labor in Washington State, the average shop had 7.2 employees and 25% of shops contracted with a safety professional [Whittaker and Reeb-Whitaker, 2009]. In CARSS, the average shop also had 7.2 employees (SD = 4.8) and 24% of shops had engaged a safety consultant.

TABLE VI. Shop Performance by Presence of a Safety Consultant

	Baseline		*P*	Follow-up		*P*
	w/sc* (n = 11)	wo/sc** (n = 34)	Baseline	w/sc (n = 11)	wo/sc (n = 34)	Follow-up
Overall	67	50	<0.0001	76	70	0.1
Survey section						
Storage and use of compressed gases	91	77	0.18	85	80	0.84
Electrical and machine safety and lockout/tagout	78	66	0.006	80	74	0.15
Personal protective equipment: ears, eyes, and skin	68	55	0.05	83	76	0.2
Respiratory protection	67	33	<0.0001	77	78	0.86
Emergency planning, first aid, and fire prevention	66	58	0.13	76	72	0.22
Ergonomics	66	63	0.51	73	74	0.83
Shop safety and Right-to-Know training	62	30	<0.0001	74	66	0.38
Paint booth and mixing room	61	46	0.09	69	52	0.051
Health and Safety Topic						
PPE	81	71	0.07	90	84	0.3
Facility and equipment safety	77	68	0.01	79	75	0.08
[Written safety documentation and records	46	9	<0.0001	64	58	0.48

PPE, personal protective equipment.
*w/sc – with safety consultant.
**wo/sc – without safety consultant.

In an annual survey conducted by the trade journal *Body Shop Business* (2013), the average collision shop in the United States had 8.8 employees (median = 7). In the *Body Shop Business* survey, 68% of shops were independently owned and operated compared with 100% of the CARSS sample. However, participation in CARSS was limited to independently owned and operated establishments. Nationally, 36% of owners had graduated from high school compared with 32% of owners in CARSS. Nationally, 25% of owners had attended vocational school compared with 40% of owners participating in CARSS. Based on these data, it is likely that CARSS participants were similar to independently operated collision repair businesses elsewhere in the United States.

Intervention mapping provided a step-by-step framework for CARSS development, implementation, and evaluation. Intervention mapping was chosen for its applicability to different settings where there may be a wide range of needs and it is important to set site-specific performance objectives [Bartholomew et al., 1998; Perez-Rodrigo et al., 2005; Itani et al., 2006].

Developmental activities included advisory board meetings with AASP MN as well as suppliers, shop visits, focus groups, and pilot testing of all materials. In combination, these activities provided a perspective on the needs of owners and employees and helped ensure that services addressed serious hazards and regulatory deficiencies [Bejan et al., 2011; Parker et al., 2012; Brosseau et al., 2013].

Important barriers to improving health and safety in small enterprises that have been identified by other researchers were also identified by CARSS: (1) workers in small enterprises often believe they have the same responsibilities as owners, and (2) most collision shops lack a personnel infrastructure for managing health and safety [Marlow, 2001; Eakin et al., 2010; Hasle et al., 2011; Parker et al., 2012]. CARSS materials were designed assuming that owners are responsible for ensuring shops have implemented effective health and safety programs. Materials were also designed to simplify and expedite the administrative aspects of managing health and safety programs.

Programs fostered changes by providing easy-to-use materials and bridging the relative isolation that makes collision shops hard to reach [Hasle et al., 2011; Hung et al., 2011; Parker et al., 2012]. AASP MN played an important role in (1) helping assure the needs of its members were being met, (2) providing access to its advisory board and member shops, and (3) assisting with the recruitment of businesses. Sinclair et al. (2013) labeled organizations, such as AASP MN as "intermediary" and noted their important role in aligning the interests of their members with health and safety.

Even though necessary, owners chose not to make changes related to the paint booth and mixing room, and ergonomic hazards. As seen in Table II, the overall change in facility and equipment safety was only six percent. Among those who did select items in these two areas, little improvement was observed. This is not surprising because problems related to a paint booth and mixing room or other areas of the physical plant are often costly to repair and may entail a temporary cessation in shop operations. However, some situations that were highly dangerous did show substantial improvement, such as assuring there is a fire-extinguishing system in the paint booth, not locking emergency exits on the inside, and ensuring that electrical equipment is not used in wet areas unless GFCI outlets are present.

In addition, as most workers are required to provide many of their own tools, owners may not have been comfortable asking employees to make an investment in replacing their personal equipment and left any possible changes up to workers. Owners' reluctance to mandate changes directly impacting workers has been observed elsewhere [Eakin and MacEachen, 1998; Hasle et al., 2011].

Owners were reluctant to ask workers to take time away from production for safety and health training because it decreases shop income and may be perceived as unwelcome and paternalistic. Workers are frequently paid based on how many repairs they complete and are reluctant to take time for training for which they feel they are unfairly compensated [Parker et al., 2012]. Online training overcame this problem by allowing workers to complete mandatory training at a time they found convenient. Online medical certification allowed workers who use respirators to complete the OSHA-mandated medical evaluation without taking a half-day from work to do so.

Contrary to owner statements during CARSS focus groups, workers expressed a need for formal attention to health and safety [Parker et al., 2012]. The apparent *laissez faire* attitude toward safety and other aspects of human resources management by small business owners may be counterproductive. There is evidence that human resources programs and policies add to the likelihood of business success [Hornsby and Kuratko, 1990, 2003; Wagar, 1998; Torp, 2008].

Health and safety ought not be viewed as something that is simply present or absent in a small enterprise; rather it is part of a broad array of human resources management ranging from gender policies, health insurance, worker promotion, and sickness leave, to name a few. CARSS data show an absence of health and safety programs even when mandated by law. Although not specifically evaluated by CARSS, it is apparent that the lack of human resources infrastructure needs to be addressed if interventions in small enterprises are to be successful and sustainable.

From the vantage point of business development, formal human resources practices enhance employee perception of

fairness and may lead to greater levels of employee commitment, especially in enterprises where employee satisfaction may be low [Eakin et al., 2003; Saridakin et al., 2013] Although large firms have formalized human resource practices, many small firms may lack the resources and technical knowledge necessary to develop and implement these practices [Allen et al., 2013]. As firms grow, there are pressures to formalize human resource management [Storey et al., 2010].

From an enforcement perspective, regulations are often perplexing in their complexity and have the appearance of being expensive to implement. Addressing gaps in safety management systems was an essential component of CARSS. Relatively simple, cost-effective options to reduce workers' risk and to enhance regulatory compliance were developed. Intervention programs were constructed around activities that have been associated with reduced injury rates and found to be acceptable to workers. This was accomplished by (1) assessing industry-wide injuries and hazards, and (2) qualitative evaluation of workers and owners perceptions of risks and perspectives on health and safety [MacEachen et al., 2010; Parker et al., 2012].

Previous investigations in understanding and perception of safety and health hazards in collision repair shops show that owners are poorly informed about regulatory requirements as well as hazards and their health effects [Parker et al., 2012; Reeb-Whitaker et al., 2012]. Misconceptions are likely fostered by the low likelihood of an injury in a business with only a few employees [Hasle et al., 2009]. Even a dangerous establishment with three employees may go several years with no injuries. A typical of comment made by owners during the CARSS recruitment process was "they had never had an injury" and things were "fine as is."

In another large study of the collision repair industry, Enander et al. (2007) describe the results of a state-wide, voluntary self-certification program for environmental compliance and health and safety. The study was carried out in 367 Rhode Island collision repair businesses of which 171 completed the self-certification forms. Technical assistance was provided regarding the interpretation of regulations, compliance methods, and engineering and pollution controls. The results indicate that medical evaluation for respirator users increased from 33% to 46%, the presence of a respiratory protection program increased from 33% to 61%, and PPE programs increased from 9% to 63%. These results are similar to those of CARSS, where the presence of easily implemented administrative and PPE programs showed significant improvement.

Shoemaker et al. (2007) describe the results of the Boston Safe Shops Project. This was a collaborative effort between public institutions and collision repair shops. The intervention included shop assessment, employee and owner training, written information and hands-on assistance with improvements, and connecting people with local financial and health care resources. The Safe Shops Project showed significant improvement in regulatory compliance, such as emissions control and worker training. As with CARSS, these changes were facilitated by both worker and owner training.

Strengths and Limitations

CARSS used a checklist as a means of evaluation. Steps were taken to ensure ongoing data quality over a prolonged period of time. We created documentation for each survey question, and a log was kept of evaluation decisions in order to assure consistent responses. Inter-rater reliability was assessed between study staff and external raters. Overall, the kappa statistic showed a high degree of concordance between raters.

The greatest limitation in this study is that participants were recruited by a variety of means, not entirely at random. This was necessary because of the difficulty encountered in recruiting an entirely random sample. Breslin et al. (2010) identified only five high-quality randomized interventions targeting health and safety in businesses with fewer than 100 employees. Although randomization is often considered the "gold standard" for intervention studies [Des Jarlais et al., 2004; Breslin et al., 2010], in reality this is not possible with small businesses.

True randomization is hindered because baseline data are needed to assess control shops. Once baseline data are obtained, we believe it is unethical to not provide this information to owners. Hence, there must be at least a minimum intervention (e.g., Lazovich et al., 2002). Furthermore, owners are not interested in taking time to consider participation unless there is a clear benefit to their business.

In CARSS, no differences were seen between shops recruited at random and those recruited via other means. Nor were differences seen between shops recruited over the course of the intervention. It is unknown if there are characteristics of non-participants that make them substantively different from participants. When complete randomization was simulated at the end of the study, it was again found that neither order nor date of recruitment impacted outcome.

Another limitation is that intervention programs were directed towards owners as the primary agents of change. This is problematic because employees were not engaged in selecting items for the SIP. However, owners remain the gatekeepers to small establishments [Hasle et al., 2009]. While not engaging employees in decision-making processes is problematic, more problematic was owner non-participation, which eliminates any possibility of outreach.

An important question remains as to the sustainability of our intervention programs. Preliminary data indicate that

owners continue to use the CARSS materials. CARSS (www.repairsafety.com) is now providing free services to prior participants and very low cost services to other businesses.

Conclusions and Future Directions

Simple, easy-to-use programs in combination with a small amount of input from CARSS industrial hygienists fostered significant changes in participating businesses. Programs were developed to bridge barriers to worker and owner participation. For workers, this entailed readily accessible training that did not remove them from work. For owners, it entailed easily implemented administrative options that did not detract from daily business operations.

The findings from CARSS and other small-business research (e.g., Eakin and MacEachen, 1998; Wagar, 1998; Lazovich et al., 2002; Parker et al., 2009; Hasle et al., 2011) provide guidance on directions for future small business intervention programs:

- Programs should address the lack of personnel and administrative infrastructure. Health and safety are present as part of, or in addition to, other programs. Although most small businesses may lack safety and health programs, one underlying reason may be that they also lack other basic personnel programs and resources.
- Owners require constant reminders to complete basic programs. Even when resources were freely available, other factors, primarily lack of time, may prevent owners from implementing and maintaining safe work places.
- It is helpful to engage owners with assistance and support from industry groups. For CARSS, the AASP MN provided invaluable support in assuring its members that CARSS was a trusted partner.
- Owners have repeatedly mentioned that a lack of knowledge and time were the primary barriers to improving and maintaining health and safety conditions in their shops. Tailored information regarding hazards, solutions, and regulatory compliance, along with technical assistance, were available at no cost.

ACKNOWLEDGMENT

This article was funded by National Institute for Occupational Safety and Health (R01 OH009086).

REFERENCES

Allen MR, Erickesn J, Collins CJ. 2013. Human resource management, employee exchange relationships, and performance in small businesses. Hum Resource Manage 52:153–173.

Baranowski T, Perry CL, Parcel GS. 2002. How individual environments, and health behavior interact: Social Cognitive Theory. In, Glanz K, Lewis FM, Rimer BK, editors. Health Behavior and Health Education: Theory. Research and Practice. 3rd Ed. San Francisco, CA: Jossey-Bass Publishers. P 165–184.

Bartholomew LK, Parcel GS, Kok G. 1998. Intervention mapping: A process for developing theory- and evidence-based health education programs. Health Educ Behav 25:545–563.

Bejan A, Brosseau LM, Parker DL. 2011. Exposure assessment in auto collision repair shops. J Occup Environ Hyg 8:401–408.

Body Shop Business. 2013. Industry Profile. May 2013. Found at: http://www.bodyshopbusiness.com/Article/113202/2013_industry_profile.aspx (November 27, 2013).

Bradshaw LM, Curran AD, Eskin F, Fishwick F. 2001. Provision and perception of occupational health in small and medium-sized enterprises in Sheffield, UK. Occup Med 51:39–44.

Breslin FC, Kyle N, Bigelow P, Irvin E, Morassaei S, MacEachen E, Mahood Q, Couban R, Shannon H, Amick BC. 2010. Small Business Systematic Review Team. Effectiveness of health and safety in small enterprises: A systematic review of quantitative evaluations of interventions. J Occup Rehabil 20:163–179.

Brosseau LM, Bejan A, Parker DL, Skan M, Xi M. 2013. Workplace safety and health programs, practices and conditions in auto collision repair businesses. J Occup Environ Hyg. 25. [Epub ahead of print].

Cooper TC, Heitbrink WA, Edmonds MA, Bryant CJ, Ruch WE. 1993. In-depth Survey Report: Control Technology for Autobody Repair and Painting Shops at Jeff Wyler Autobody Shop, Batavia, Ohio (Report # ECTB 179-15a). Cincinnati, Ohio: National Institute for Occupational Safety and Health (NIOSH).

Des Jarlais DC, Lyles C, Crepaz N. TREND Group. 2004. Improving the reporting and quality of nonrandomized evaluation of behavioral public health interventions. Am J Public Health 94:361–366.

Eakin JM, MacEachen E. 1998. Health and social relations of work: A study of the health-related experiences of employees in small workplaces. Sociol Health and Ill 20:896–914.

Eakin JM, MacEachen E, Clarke J. 2003. 'Playing it smart' with return to work: Small workplace experience under Ontario's policy of self-reliance and early return. Policy Practi Health Saf 1:19–42.

Eakin JM, Champoux D, MacEachen E. 2010. Health and safety in small workplaces: Refocusing upstream. Can J Public Health 101(Suppl 1): S29–33.

Enander RT, Gagnon RN, Hanumara RC, Park E, Armstrong T, Gute DM. 2007. Environmental health practice: statistically based performance measurement. Am J Public Health 97:819–824.

Fleiss JL. 1981. Statistical Methods for Rates and Proportions. 2nd ed. New York: Wiley Interscience. P. 225–234.

Fonteyn PN, Olsberg D, Cross JA. 1997. Small business owners' knowledge of their occupational health and safety (OHS) legislative responsibilities. Int J Occup Saf Ergon 3:41–57.

Furuki K, Hirata M, Kage A. 2006. Nationwide survey of occupational health activities in small-scale enterprises in Japan. Industrial Health 44:150–154.

Gardner D, Carlopio J, Fonteyn PN, Cross JA. 1999. Mechanical equipment injuries in small manufacturing businesses. Knowledge, behavioral, and management issues. Int J Occup Saf Ergon 5:59–71.

Hartman EA, Tower CB, Sebora TC. 1994. Information sources and their relationship to organization innovation in small businesses. J Small Bus Manage 32:36–47.

Hasle P, Jorgen H, Kallehave T, Klitgaard C, Andersen TR. 2011. The working environment in small firms: Responses from owner-managers. Int Small Bus J 30:622–639.

Hasle P, Kines P, Andersen LP. 2009. Small enterprise owners' accident causation and prevention. Safety Science 47:9–19.

Heitbrink WA, Edmonds MA, Fischbach TJ. 1992. Control Technology for Autobody Repair and Painting Shops at Kay Parks/Dan Meyer Autorebuild, Tacoma, Washington (Report # ECTB 179-12a). Cincinnati, Ohio: National Institute for Occupational Safety and Health (NIOSH).

Heitbrink WA, Cooper TC, Edmonds MA. 1993. In-depth Survey Report: Control Technology for Autobody Repair and Painting Shops at Cincinnati Collision Autobody Shop, Blue Ash, Ohio (Report # ECTB 179-16a). Cincinnati, Ohio: National Institute for Occupational Safety and Health (NIOSH).

Hornsby JS, Kuratko DF. 1990. Human resource management in small business: Critical issues for the 1990's. J Small Bus Manage 28:9–18.

Hornsby JS, Kuratko DF. 2003. Human resource management in U.S. small businesses: A replication and extension. J Dev Entrepren 8:73–92.

Hung YH, Smith-Jackson T, Winchester W. 2011. Use of attitude congruence to identify safety interventions for small residential builders. Constru Manage Econ 29:113–130.

Itani T, Tachi N, Takeyama H, Ebara T, Takanishi T, Murata K, Inoue T, Suzumura H, Kurungkraiong S, Khuvasanont T, Batino JM. 2006. Approaches to occupational health based on participatory methodology in small workplaces. Ind Health 44:17–21.

Kotey B, Slade P. 2005. Formal human resource management practices in small growing firms. J Small Bus Manage 43:16–40.

Lazovich D, Parker DL, Brosseau LM, Milton FT, Dugan SK, Pan W, Hock L. 2002. Effectiveness of worksite intervention to reduce an occupational exposure: The Minnesota Wood Dust Study. Am J Public Health 92:1498–1505.

MacEachen E, Kosny A, Scott-Dixon K, Facey M, Chambers L, Breslin C, Kyle N, Irvin E, Mahood Q. Small Business Systematic Review Team. 2010. Workplace health understandings and processes in small businesses: A systematic review of the qualitative literature. J Occup Rehabil 20:180–198.

Marlow S. 2001. Minding the gap between employers and employees: The challenge for owner-managers of smaller manufacturing firms. Employee Relat 5:523–539.

McCammon C, Sorensen B. 1996. Matrix Autobody, Engelwood, Colorado (HETA 95-0311-2593). Cincinnati, Ohio: National Institute for Occupational Safety and Health (NIOSH).

Parker DL, Bejan A, Brosseau LM. 2012. A qualitative evaluation of owner and worker health and safety beliefs in small auto collision repair shops. Am J Ind Med 55:474–482.

Parker DL, Brosseau LM, Samant Y, Xi M, Pan W. 2009. A randomized-controlled intervention of machine guarding and related-safety programs in small metal-fabrication businesses. Public Health Rep 124(sup):90–100.

Perez-Rodrigo C, Wind M, Hildonen C, Bjelland M, Aranceta J, Klepp KI, Brug J. 2005. The prochildren intervention: Applying the intervention mapping protocol to develop a school-based fruit and vegetable promotion program. Ann Nutr Metab 49:267–277.

Reeb-Whitaker C, Whittaker SG, Ceballos DM, Weiland EC, Flack SL, Fent KW, Thomasen JM, Trelles Gaines LG, Nylander-French LA. 2012. Airborne isocyanate exposures in the collision repair industry and a comparison to occupational exposure limits. J Occup Environ Hyg 9:329–339.

Saridakin G, Munoz-Torres R, Johnstone S. 2013. Do human resource practices enhance organizational commitment in SMEs with low employee satisfaction. Brit J.Manage 24:445–458.

Shoemaker PA, Skogstrom T, Shea J, Bethune L. 2007. The Boston safe shops project – Preliminary findings of a case study in applying the 10 essential services of public health to building environmental health capacity. J Environ Health 70:22–28.

Sinclair RC, Cunningham TR, Schulte PA. 2013. A model for occupational safety and health intervention diffusion in small businesses. Am J Indus Med [Epub ahead of print].

Sparer J, Stowe MH, Bello D, Liu Y, Gore RJ, Youngs F, Cullen MR, Redlich CA, Woskie SR. 2004. Isocyanate exposures in autobody shop work: The SPRAY study. J Occup Environ Hyg 1:570–581.

Storey DJ, Saridakin G, SEn-Gupta S, Edwards PK, Blackburn RA. 2010. Linking HR formality with employee job quality: The role of firm size and workplace size. Hum Resource Manage 49:305–329.

Torp S. 2008. How a health and safety management training program may improve the working environment in small- and medium-sized companies. J Occup Environ Med 50:263–271.

United States Census Bureau: Statistics of U.S., Businesses. 2013. Found at: http://www.census.gov/econ/susb/ (January 21, 2014).

United States Department of Labor. U.S. Bureau of Labor Statistics. Occupational Injuries/Illnesses and Fatal Injuries Profiles. Found at: http://data.bls.gov/gqt/InitialPage (Accessed on 1/13/2012).

Wagar T. 1998. Determinants of human resource management practices in small firms: Some evidence from Atlantic Canada. J Small Bus Manage 36:13–23.

Whittaker SG, Reeb-Whitaker C. 2009. Characterizing the health and safety needs of the collision repair industry. J Occup Environ Hyg 6:273–282.

Disclosure Statement: The authors report no conflicts of interest.

Grant sponsor: National Institute for Occupational Safety and Health; Grant number: R01OH009086