FINAL PROGRESS REPORT

Title of Project: Isocyanate Exposure Intervention Study in Body Shops
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ABSTRACT

In October, 2002, the Yale Occupational and Environmental Medicine Program initiated the Safe Methods for Autobody Shop Health (SMASH) study, a NIOSH funded intervention study, with the goal of determining some effective methods of reducing isocyanate exposures to workers in autobody shops.

Aims: The main objective of this study was to implement an integrated exposure interventional program in selected auto body shops, and evaluate the effectiveness of various program components in reducing isocyanate exposures. Our specific aims were as follows: Aim 1: Implement an educational training program that includes safe handling of body shop products, respiratory protection and use of other personal protective equipment. Aim 2: Implement a product (process) change and engineering intervention program that includes the use of iso-free paints, possible installation of better booth type, local exhaust fans and area ventilation, scheduled change of booth filters and use of HVLP spray guns. Aim 3: Implement an administrative program that includes the increased use of proper types of respirators, replacement of latex gloves with nitrile gloves, use of protective clothing and use of surface and skin decontamination products. Aim 4: Implement a behavioral intervention program with an observational process to monitor and provide feedback on the target safety practices. Aim 5: Evaluate the success of the overall intervention program by using qualitative assessments from individual shop owners (management) and workers, as well as biological monitoring of urinary metabolites of HDI isocyanate.

Methods: The design of the study required 3 contacts with each shop at baseline, 6 months and 1 year. Fourteen autobody shops were enrolled and randomly divided into a control group and an intervention group. In all shops, information was collected at each visit, including equipment available, work practices, respirator fit tests, worker attitudes and knowledge regarding isocyanates, and environmental samples of air (inside and outside of respirator exposures), skin and surface contamination. A group educational session with a video and a question and answer period was presented to intervention group shops during the first week of the study and to control shops during the 6-month visit. Personal protective equipment recommended by NIOSH for protection against isocyanates and cleaners designed for the removal of isocyanates were provided to the shops monthly for the 6 months following the educational session. The intervention shops were visited monthly for the first 6 months by a trained observer who scored each worker and provided encouragement to upgrade their work practices.

Results: Scores on knowledge tests increased after the training session and were sustained for at least 6 months or a year. Most workers who failed the respirator fit testing on their first try were able to pass after being given some instruction. The promotion of product change and improvements in engineering controls was not very effective, with few changes occurring over the year. Changes in administrative controls were somewhat more successful, with more shops providing and using nitrile gloves and HEPA respirators. Testing of isocyanate decontamination products showed the effectiveness of many products, including those already in use in many shops. Our behavior modification program in intervention shops was very popular with the workers. However, it is difficult to see a difference between the behaviors of control shop workers after intervention without behavior modification and those who had it. Substudies showed the potential for skin exposure to isocyanates in this industry. Overall, we demonstrated improvements in proper respirator, glove and coverall use by these workers, in both control and intervention shops, after intervention.

Discussion: This intervention study demonstrated the feasibility of conducting educational training for health and safety among workers in the auto body industry. Our results showed that providing educational training, use of safety products and behavioral modification to these workers increased their safety knowledge, scores on respirator fit testing and safe work practices.

HIGHLIGHTS/SIGNIFICANT FINDINGS

An educational training program that includes safe handling of body shop products, respiratory protection and use of other personal protective equipment has shown its effectiveness in increasing safety knowledge, respirator fit test pass rates and safe work practices.

Uncured isocyanates remain on the car surface and worker's skin for prolonged times which poses a risk for dermal exposure. Decontamination products can significantly reduce isocyanate exposures. Gloves and protective clothing are effective tools for decreasing isocyanate skin exposures. Workers should be encouraged to use more protective equipment and skin cleansers available in their shops.

Behavior modification was very popular with workers but we failed to demonstrate its incremental benefit over educational training in improving work practices.

TRANSLATION OF FINDINGS

The SMASH intervention study demonstrated the feasibility of conducting educational training for health and safety among workers in the auto body repair and refinishing industry. Our results show that providing educational training to auto body workers can increase their safety knowledge, scores on respirator fit testing and safe work practices. Our follow up project [Painters & Repairers Education Program (PREP)] has produced a DVD based upon the results of the SMASH study. We are also preparing a supplementary website to be used by shop managers to train their workers. In the near future, the DVD and training program will be available to anyone via the internet.

OUTCOMES/RELEVANCE/IMPACT

We have encouraged all participating shops and workers to use more safe work practices, personal protective equipment and effective skin cleaners. These methods significantly reduce workers' exposure to isocyanates and organic solvents, and improve their work practices as reflected in the results below. Shop managers have gained information, awareness and attentiveness, and are becoming more OSHA/EPA compliant. Worker awareness is demonstrated in many small ways, such as avoiding the touching of uncured car surfaces and increasing the frequency of changing gun cleaning solvents. A significant impact may have come after we disseminated some of our results and recommendations to a National Autobody Congress & Exposition meeting and press conference. As a result, local distributors have moved towards providing more protective nitrile or double latex gloves to auto body shops. Our findings are being translated into safer actions beyond the shops we have worked with. Furthermore, in a follow up project, we have produced a DVD with similar training components, supplemented by materials on a website, and are currently conducting a study of body shops independently implementing the training program. This training program will become available to all body shops via the internet.

SCIENTIFIC REPORT

Background

The auto body repair and refinishing industry is composed of small family-owned businesses that employ 168,000 to 205,000 workers nationwide. Workers in this industry are exposed to a variety of respiratory and dermal chemicals including isocyanates and organic solvents that can potentially cause occupational asthma, skin diseases and other health problems. Reactive isocyanate chemicals (R-N=C=O), widely used as the essential cross-linker for producing polyurethane, have been a leading cause of occupational asthma for over 50 years. Little is known about the effectiveness of exposure control strategies in the auto body industry. In October, 2002, the Yale Occupational and Environmental Medicine Program initiated the Safe Methods for Autobody Shop Health (SMASH) study, with the goal of determining some effective methods of reducing isocyanate exposures to workers in auto body shops.

Specific Aims

The main objective of this study was to implement an integrated interventional program in selected auto body shops, and evaluate the effectiveness of various program components in reducing isocyanate exposures.

Our specific aims were as follows:

Aim 1: Implement an educational training program that includes safe handling of body shop products, respiratory protection and use of other personal protective equipment. Evaluate the effectiveness of this training by pre- and post-training tests of knowledge achievements, attitude change and increased rate of passing the respirator fit test.

Aim 2: Implement a product (process) change and engineering intervention program that includes the use of iso-free paints, possible installation of better booth type, local exhaust fans and area ventilation, scheduled change of booth filters and use of HVLP spray guns. Evaluate these changes qualitatively by a checklist and quantitatively by exposure measurements.

Aim 3: Implement an administrative program that includes the increased use of proper types of respirators, replacement of latex gloves with nitrile gloves, use of protective clothing and use of surface and skin decontamination products. Evaluate the effectiveness of this program by a checklist and qualitatively and quantitatively by isocyanate exposure measurements.

Aim 4: Implement a behavioral intervention program with an observational process to monitor and provide feedback on the target safety practices and evaluate the effectiveness.

Aim 5: Evaluate the success of the overall intervention program by using qualitative assessments from individual shop owners (management) and workers, as well as biological monitoring of urinary metabolites of HDI isocyanate.

Methods

The design of the study, with input from shop owners and managers, required 3 multiday contacts with each shop at baseline, 6 months and 1 year. Fourteen autobody shops were enrolled and randomly divided into a control group and an intervention group. In all shops, information was collected at each visit, including equipment available, work practices, respirator fit tests, worker attitudes and knowledge regarding isocyanates, and environmental samples of air (inside and outside of respirators), skin and surface contamination. A group educational session in the shop during work time with a video and a question and answer period was presented to intervention group shops during the first week of the study and to control shops during the 6-month visit. Personal protective equipment (PPE)

recommended by NIOSH for protection against isocyanates (tyvek and coated tyvek coveralls, nitrile gloves, replacement respirator cartridges) and cleaning solutions designed for the removal of isocyanates were provided to the shops monthly for the 6 months following the educational session. The intervention shops were visited monthly for the first 6 months by a trained observer who scored each worker and provided encouragement to upgrade their work practices. Thus, the intervention shops were given the educational session, supplies and monthly feedback for the first 6 months, while the control shops were left alone. The control shops were given the educational session and supplies for the second 6 months, while the intervention shops were left alone. Assessments at baseline, 6 months and one year could be compared to evaluate the efficacy of the educational session and the work-practice feedback, as well as the willingness of the shop to purchase the recommended PPE which had been supplied to the workers.

Results

We recruited 14 shops (7 intervention and 7 control) and 103 participants (34 painters, 60 body technicians, and 9 managerial employees) for the study. One control shop was unable to schedule followup visits so only completed the baseline visit; another control shop completed the baseline visit and a brief 6-month evaluation but was in the process of closing so did not have any intervention. All other shops completed all 3 evaluations and interventions during the year of study participation. Due to turnover in the shops, not all study subjects were at the shops for all three evaluation periods during the year. New workers were enrolled and given the intervention as soon as possible after starting at a shop. The mean age of the study participants was 36 (sd=13) but the painters tended to be slightly younger and the office workers older. Racial breakdown was 83.5% Caucasian, 15.5% Hispanic and 1% other race (Table 1). All subjects were male, and about one-third of them were smokers.

Table 1 Baseline demographics for SMASH subjects by job category

Characteristic	**All** n=103	**Painters** n=34	**Technicians** n=60	**Office** n=9
Age mean (sd)	36.2 (13)	31.0 (9.1)	37.7 (13.9)	45.4 (12.9)
Race				
Caucasian	84%	91%	77%	100%
Hispanic	15%	6%	23%	0
Other	1%	3%	0	0
Sex (Male)	100%	100%	100%	100%
Smoking	33%	35%	32%	33%
# per day	16.5	15.8	17.0	15.7

The characteristics of intervention and control shops were similar at baseline (Table 2), and also comparable to the body shops in our SPRAY study.

Table 2 Personnel and Business Factors: Control vs. Intervention Shops

Intervention	***n***	***Mean***	***Median***	***Range***
age of shop (years)	*7*	34.7	35	10.0 - 71.0
cars/month	*6*	69.1	41	18 -160
annual income ($)	*6*	983,333	1,000,000	450,000 -1,500,000
# non-office full-time employees (FTEs)	*7*	7.3	8	5.0 - 10.0
production area (ft^2)	*7*	7357.1	7000	4500 - 11000
clearcoat usage (gal/month)	*7*	10.2	10.8	2.5 - 25
CC usage factor(gal/car)	*6*	0.33	0.08	0.07 - 1.40
hustle factor (cars/month/FTE)	*6*	9.8	6	3.6 - 26.7
crowding factor (FTE/1000ft^2)	*7*	1.1	1.1	0.6 - 1.5
# booths/prep stations	*7*	1.9	2	1.0 - 3.0

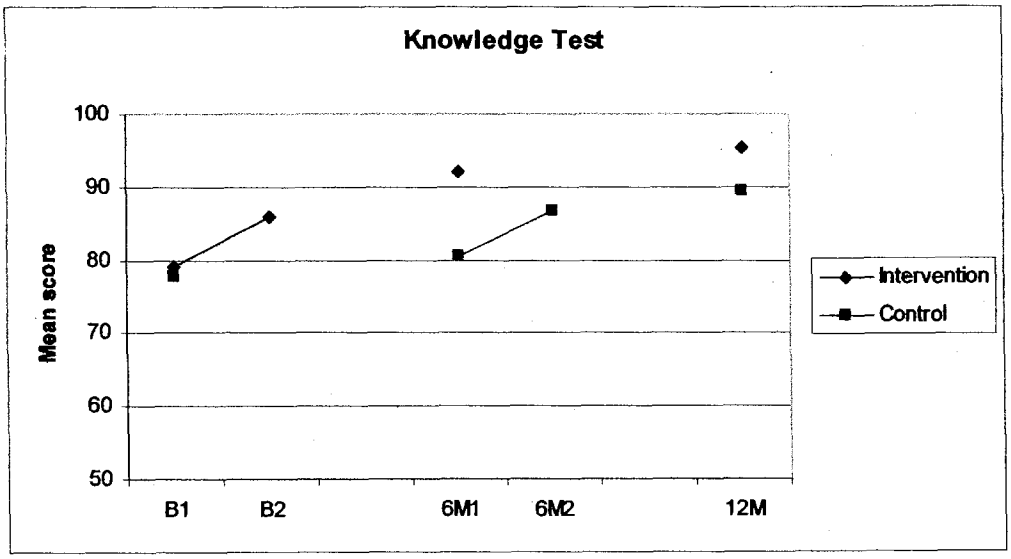
Control	***n***	***Mean***	***Median***	***Range***
age of shop (years)	*7*	31.7	32	1.0 - 57
cars/month	*7*	50.1	51	11 - 115
annual income ($)	*7*	910,714	875,000	250,000 -1,500,000
# non-office full-time employees (FTEs)	*7*	5.4	7	1.0 - 9.0
production area (ft^2)	*7*	10,005.7	7000	2400 - 33000
clearcoat (CC) usage (gal/month)	*6*	5.1	4.9	0.8 - 11
CC usage factor(gal/car)	*6*	0.12	0.08	0.04 - 0.27
hustle factor (cars/month/FTE)	*7*	8.8	7.5	7.2 - 12.8
crowding factor (FTE/1000ft^2)	*7*	0.7	0.9	0.2 - 1.3
# booths/prep stations	*7*	2.3	1	1.0 - 3.0

Aim 1. Educational Training Program

We implemented the comprehensive educational training program in all 7 intervention shops at baseline and in 5 control shops at the 6 month visit. Safety knowledge and attitudes were assessed of workers before and after the training, and at all the other evaluation visits. Preliminary analyses show that knowledge was increased in both groups after intervention and the increase was sustained for at least 6 months (Figure 1).

We performed baseline respirator fit tests on 87 workers, with 87% passing the first test. After brief training, 65% of those who failed were able to pass the test, bringing the total pass rate up to 95%. We have also collected 118 pairs of inside/outside respirator air samples to evaluate the effectiveness of respiratory protection against isocyanates under actual working conditions. Analysis of these data is currently underway and preparation of a manuscript for publication. Preliminary results show that supplied air respirators and powered air purifying respirators perform well, although sometimes half facepiece cartridge respirators do not adequately protect the wearer.

Figure 1 Knowledge scores by study phase for intervention and control subjects
[B1=baseline assessment pre-intervention, B2=baseline post-intervention, 6M1=6 month assessment, pre-intervention for control shops, 6M2=post-intervention for control shops, 12M=12 month assessment]



Aim 2. Product Change and Engineering Control Program

For all 14 shops, a certified industrial hygienist thoroughly evaluated the shop ventilation, hazardous product use, employee safety programs, work practices and booth quality. Recommendations were then made to both intervention (at baseline) and control (at 6-months) shops to improve their engineering controls. Evaluation was conducted at baseline, 6-months and 12 months to compare changes. As can be seen in Table 3, very little change was observed in the first 6 months of the study, with no real differences between intervention and control shops. The second 6 months produced similar results.

Table 3 Process and Engineering Changes - Baseline to 6 Months

	Intervention Shops			Control Shops		
	Baseline	**6 Months**	**Change**	**Baseline**	**6 Months**	**Change**
Process and Engineering Control Change						
Use iso-free primers	1/7 (14.3%)	1/7 (14.3%)	0	2/7 (28.6%)	2/6 (33.3%)	0
Improve shop ventilation by providing make-up air	0/7 (0%)	1/7 (14.3%)	1	1/7 (14.3%)	1/6 (16.7%)	0
Improve shop ventilation by maintaining bay doors open when priming	7/7 (100%)	7/7 (100%)	0	6/6 (100%)	6/6 (100%)	0
Provide additional booth for priming or painting			0			0
Improve booth ventilation by increasing frequency of filter change			0			1 shop changed from M to 3M
Provide local exhaust ventilation for mixing areas	4/7 (57.1%)	4/7 (57.1%)	0	5/7 (71.4%)	5/6 (83.3%)	1
Provide portable or central dust vacuum collectors for mechanical sanding of paint/bondo	1/7 (14.3%)	1/7 (14.3%)	0	2/7 (28.6%)	2/6 (33.3%)	0
Provide enclosed gun cleaning system	6/7 (85.7%)	7/7 (100%)	1	5/7 (71.4%)	4/6 (66.7%)	0
Use vacuum instead of dry sweeping dust	4/5 (80%)	4/5 (80%)	0	6/7 (84.7%)	6/6 (100%)	0
Regularly change spray gun cleaning solvents			1 shop changed from 6M to 3W			1 shop changed from N to W, another Y to 6M

Aim 3. Administrative Program

All shops were evaluated for personal protective equipment (PPE) programs, such as respiratory and skin protection, and use of isocyanate decontamination products. The intervention shops were more likely to have the PPE programs in place than the control shops at baseline (Table 4). In the intervention shops, for the first 6 months, we provided workers with respirators, nitrile gloves, Tyvek and coated Tyvek suits, and surface and skin decontamination products to reduce isocyanate exposures and evaluate the efficacy of these products. Note that some factors could not be analyzed at 6 months since we were providing the supplies to the shops – hence the ?s in the table. Although very little change is reflected in the table, we observed that there was improvement in the intervention shops by the 12 month visit – e.g. an additional 3 shops were providing nitrile gloves and one more shop provided eye protection and another HEPA filter respirators.

Wipe samples of shop surfaces and worker skin were used to evaluate decontamination products. The use of decontamination products significantly ($p<0.001$) reduced total isocyanate reactive groups (μg $NCO/inch^2$, geometric mean) from 1.904 to 0.005 for surface and 0.026 to 0.0025 for skin, based upon quantitative wipe sampling. Products used in shops and those we recommended were equally effective in reducing isocyanate contamination on the surface and skin.

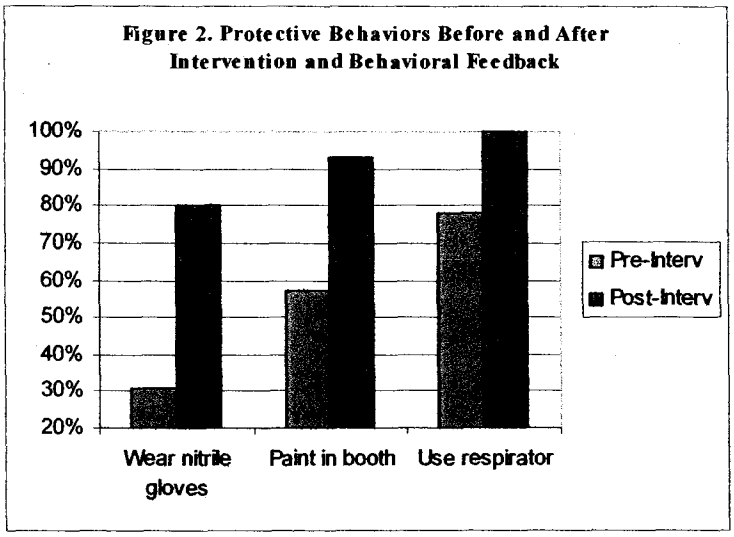
Surface and skin wipe samples were taken qualitatively and quantitatively for many tasks and objects in the shops, including under various PPE. Analysis is currently underway with these data.

Table 4 Administrative Changes - Baseline to 6 Months

	Intervention Shops			Control Shops		
	Baseline	**6 Months**	**Change**	**Baseline**	**6 Months**	**Change**
Set up and Implement a Respiratory Protection Program						
Provide supplied air respirators for painting	5/6 (83.3%)	6/7 (85.7%)	1	5/7 (71.4%)	4/6 (66.7%)	The 1 loss was missing at 6M
Provide OV cartridge respirators for priming and bondo application	7/7 (100%)	1/1 (100%)	0	6/7 (85.7%)	5/6 (83.3%)	The 1 loss was missing at 6M
Provide HEPA filter respirators for sanding, grinding, and welding	5/7 (71.4%)	N/A	?	4/7 (57.1%)	3/6 (50%)	The 1 loss was missing at 6M
Set up and Implement a Glove Use Program						
Provide nitrile gloves for tasks with contact with paint <24 hrs old	4/7 (52.1%)	N/A	?	2/7 (28.6%)	3/6 (50%)	1
Set up and Implement a Protective Clothing Program						
Provide coveralls and hoods for painting and priming	6/7 (85.7%)	1/1 (100%)	?	3/6 (50%)	3/5 (60%)	1
Provide uniforms	4/7 (57.1%)	4/7 (57.1%)	0	6/7 (85.7%)	4/6 (66.7%)	-1 (1 shop yes at base, no at 12M)
Launder uniforms	3/7 (42.9%)	3/7 (42.9%)	0	3/6 (50%)	3/6 (50%)	0
Set up and Implement an Eye Protection Program						
Provide eye protection for mixing, spraying, grinding, sanding	5/7 (71.4%)	3/3 (100%)	0	7/7 (100%)	5/5 (100%)	0
Provide an eyewash station	4/6 (66.7%)	4/6 (66.7%)	0	3/6 (50%)	4/6 (66.7%)	1

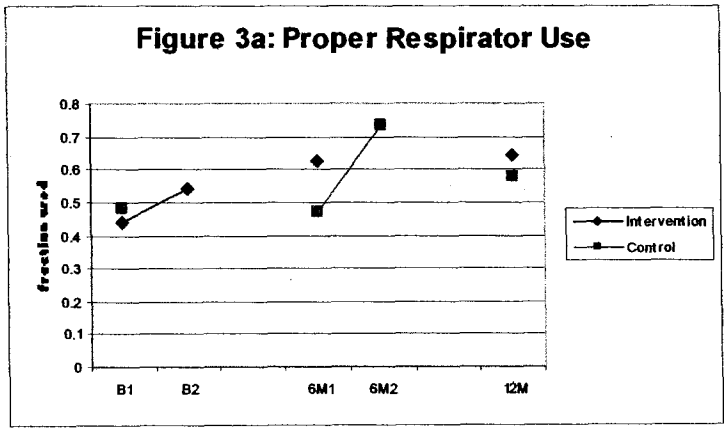
Aim 4. Behavioral Intervention Program

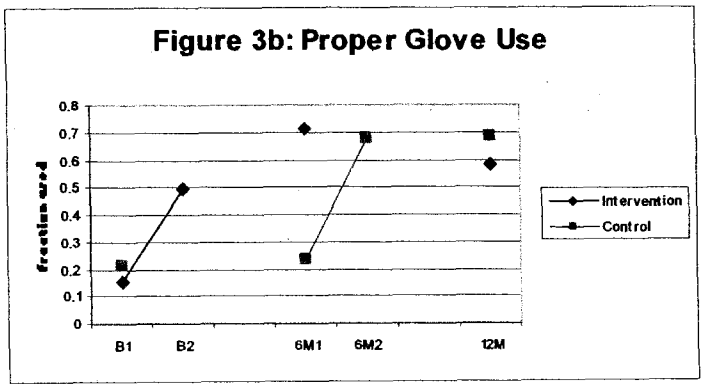
We implemented a behavioral intervention program (feedback process) only in intervention shops, although both intervention and control groups received the educational training intervention. We observed and recorded target work behaviors from all workers in both groups of shops. Frequencies of safe behaviors were calculated and can be compared between worker groups and among intervention phases (baseline, 6 months, and 1 year) to show the efficacy of the intervention and possible differences due to the feedback process. Preliminary analysis has indicated that the training and behavioral feedback process significantly reduced the rate of some concerned work practices, such as not painting in the booth, and not using nitrile gloves and a respirator for painting (Figure 2).

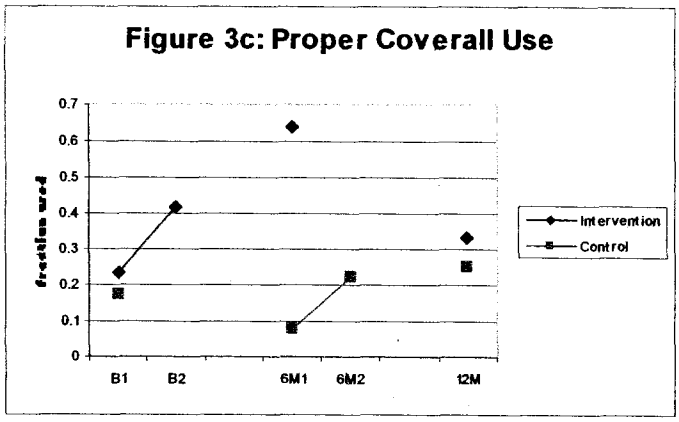


Comparing work practices in intervention and control shops over the year (Figure 3), it appears that there is no observable difference due to the behavioral feedback. Respirator use was similar in both groups at baseline and increased by a similar amount by 1 year (Figure 3a). Glove use showed a more notable increase in both groups over the year – more than 40% (Figure 3b). Coverall use is more sporadic, infrequent at baseline and increasing only slightly over the year (Figure 3c). There is no apparent difference in the increases due to intervention between the intervention and control shops, so it appears that behavioral feedback did not add to the effectiveness of the educational training.

Figure 3 Observed work practices by study phase for intervention and control workers

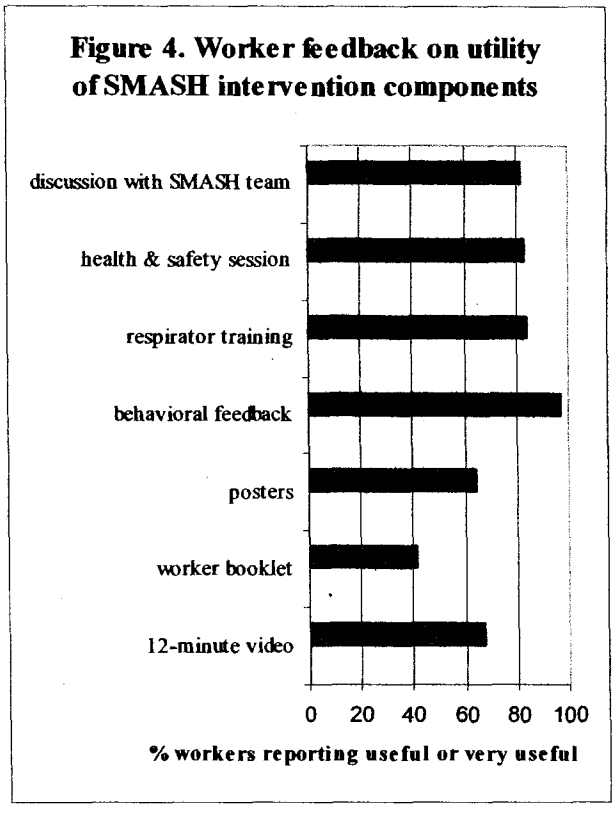






Aim 5. Intervention Overall Evaluation

Figure 3 above shows that all observed work behaviors showed a marked improvement immediately after the educational training session (indicated by the 2 dots connected by a line) and a substantial increase was sustained over the 6 months after we left the intervention shops. Further statistical analysis of these data is underway. Urine sampling of these auto body workers was discontinued when analysis of similar data from our SPRAY study found no correlations between isocyanate metabolites and measured isocyanate exposures. Further work on this methodology is needed before use in the field.



Questionnaires for subjective evaluation by shop owners and workers were collected in all shops at the end of the survey weeks and the completion of the study. Comments about our intervention programs, protective equipment and decontamination products have been received from all shops. As can be seen in Figure 4, workers were very pleased with the program and especially liked the SMASH educational components which included personal attention from the research team. A large majority (85%) of workers accepted nitrile gloves as comfortable and protective, and most (91%) workers considered them to be more protective than latex gloves. Regular Tyvek suits did not receive a high evaluation on comfort or perceived protection, but acceptance was poorer for coated Tyvek suits due to complaints regarding heat.

In-vitro FTIR Investigation of Isocyanate Skin Absorption Using Hairless Guinea Pig Skin

We conducted an in-vitro testing of isocyanate absorption through guinea pig skin using attenuated total reflectance-Fourier transform infrared (ATR-FTIR) spectrometry. The results showed that some polymeric hexamethylene diisocyanate (pHDI) and polymeric isophorone diisocyanate (pIPDI) remains on the guinea pig skin as unreacted species for many hours, while smaller compounds such as octyl isocyanate and diphenylmethane diisocyanate (MDI) disappear more rapidly from the skin surface by a diffusion process. The fraction of all isocyanate that disappears penetrates the skin largely as unreacted NCO.

Field Testing on Isocyanate Surface Curing Time

Twenty-three metal or plastic automobile pieces in 4 different shops were freshly painted and the presence of isocyanates was tested by wipe sampling. Uncured isocyanates remain on the surface for up to 120 hours, or even a month, with geometric mean curing time of 56 hours.

Discussion

This intervention study demonstrates the feasibility of conducting educational training for health and safety among workers in the auto body repair and refinishing industry. Our results show that providing educational training to auto body workers has increased their safety knowledge, scores on respirator fit testing and safe work practices. Scores on knowledge tests increased after the training session and were sustained for at least 6 months or a year. Most workers who failed the respirator fit testing on their first try were able to pass after being given some instruction. The main reason a few workers were not able to pass the test was facial hair which interferes with the respirator's seal. Our inside-outside respirator testing for isocyanates demonstrated the superiority of supplied air and powered air purifying respirators, although cartridge respirators were often sufficient.

The promotion of product change and improvements in engineering controls was not very effective, with few changes occurring over the year. Since many of these changes are quite expensive, we had not expected to make too much difference – especially in only one year. However, these results emphasize the need for more effort in this area – our study put most of our efforts into changing worker practices and it is now evident that shop-wide changes should be more strongly promoted. Managers need to be educated about the hazards of shop exposures, the benefits of new controls and especially the cost/benefit relationship of installing these controls.

Changes in administrative controls were somewhat more successful. Although difficult to document over the time period of our study, and complicated by the fact that we were supplying many of the PPE items, we definitely saw an improvement in many of the PPE programs during our study. Shop managers asked us for sources for some of the items and many shops began purchasing the safer products during the study. We documented the increase in use of nitrile gloves in Figure 3. Our testing of isocyanate decontamination products showed the effectiveness of many products, including those already in use in many shops.

Our behavior modification program in intervention shops was very popular with the workers (see Figure 4). Workers told us that it was a good reminder to use the proper safety precautions. However, it is difficult to see a difference between the behaviors of control shop workers after intervention without behavior modification and those who had it (Figure 3). More experience with this intervention method is needed.

Overall, we demonstrated improvements in proper respirator, glove and coverall use by these workers, in both control and intervention shops. The various components of the intervention were well received (Figure 4) but especially those which included personal contact with the researchers. As a practical matter, we recommend videos and posters to be used for training purposes. If the shop management is motivated to provide the behavioral feedback, it might be useful in changing worker practices. In a followup study to this one [Painters & Repairers Education Program (PREP)], we have produced a DVD with similar training components, supplemented by materials on a website, and are currently conducting a study of shops independently implementing the training program.

Our concerns about skin exposure to isocyanates led to two additional sub-studies conducted during this study. ATR-FTIR was used to determine the rate of absorption of various isocyanate species through guinea pig skin, and showed great variation in the rate, depending upon species and concentration. Curing time of isocyanate-containing paints was investigated and showed that some paints can transfer isocyanates to skin for prolonged periods, up to a month.

In summary, this study provided isocyanate exposure intervention effectiveness data that were not previously available. Educational training, use of safety products and behavioral modification appear to be effective in reducing exposures to isocyanates and other respiratory and dermal chemicals in this industry.

PUBLICATIONS

Bello D, Woskie SR, Streicher RP, Stowe MH, Sparer J, Redlich CA, Cullen MR, Liu Y. A laboratory investigation of the effectiveness of various skin and surface decontaminants for aliphatic polyisocyanates. J Environ Monitoring 2005; 7(7):716-721.

Bello D, Smith TJ, Woskie SR, Streicher RP, Boeniger MF, Redlich CA, Liu Y. An FTIR investigation of isocyanate skin absorption using in-vitro guinea pig skin. J Environ Monitoring 2006; 8: 523-529.

Bello D, Sparer J, Redlich CA, Ibrahim K, Stowe MH, Liu Y. Slow curing of aliphatic polyisocyanate paints in automotive refinishing: a potential source for skin exposure. J Occ Env Health 2007; 4:406-411.

INCLUSION OF GENDER AND MINORITY STUDY SUBJECTS

See chart on next page

INCLUSION OF CHILDREN

Two workers under 18 years of age participated in the study. One was 16 and the other 17 years old. No other workers under age 18 were eligible for the study.

MATERIALS AVAILABLE FOR OTHER INVESTIGATORS

Ouimet T, Stowe MH, Sparer JA, Walsh F, Liu Y. 2003. Auto Body Shops: Safe Work Habits for Limiting Exposures to Hazardous Chemicals. New Haven: OEHS/Yale University. Videocassette.

Principal Investigator/Program Director (Last, First, Middle): Liu, Youcheng

Inclusion Enrollment Report

This report format should NOT be used for data collection from study participants.

Study Title: Isocyanate Exposure Intervention Study in Body Shops

Total Enrollment: 102 **Protocol Number:**

Grant Number: 5 R01 OH04246

PART A. TOTAL ENROLLMENT REPORT: Number of Subjects Enrolled to Date (Cumulative) by Ethnicity and Race

Ethnic Category	Sex/Gender			
	Females	Males	Unknown or Not Reported	Total
Hispanic or Latino		16		16 **
Not Hispanic or Latino		87		87
Unknown (individuals not reporting ethnicity)		0		0
Ethnic Category: Total of All Subjects*	0	103	0	103 *
Racial Categories				
American Indian/Alaska Native		1		1
Asian		0		0
Native Hawaiian or Other Pacific Islander		0		0
Black or African American		0		0
White		86		86
More Than One Race		1		1
Unknown or Not Reported		15		15
Racial Categories: Total of All Subjects*	0	103	0	103 *

PART B. HISPANIC ENROLLMENT REPORT: Number of Hispanics or Latinos Enrolled to Date (Cumulative)

Racial Categories	Females	Males	Unknown or Not Reported	Total
American Indian or Alaska Native		1		1
Asian		0		0
Native Hawaiian or Other Pacific Islander		0		0
Black or African American		0		0
White		0		0
More Than One Race		0		0
Unknown or Not Reported		15		15
Racial Categories: Total of Hispanics or Latinos**	0	16	0	16 **

* These totals must agree.
** These totals must agree.