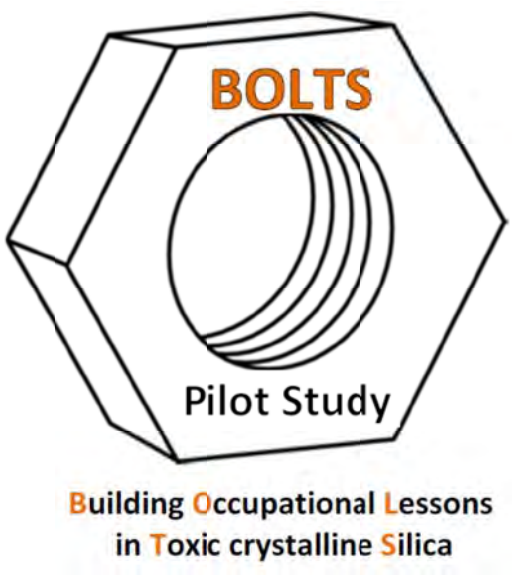
Building Occupational Lessons in Toxic Silica (BOLTS) Pilot Research Project

SECOND & FINAL DELIVERABLE REPORT



University of Miami, Miller School of Medicine
Department of Public Health Sciences, Division of Environment and Public Health
Principal Investigator: Alberto J. Caban-Martinez, DO, PhD, MPH, CPH
Project Leader: Henry Olano, MPH

A project in collaboration with the NIOSH-Funded Occupational Health Surveillance Program of the Florida Department of Health and the Department of Public Health Sciences at the University of Miami, Miller School of Medicine

Today's Date: June 20, 2015

BOLTS Pilot Study Final Report

EXECUTIVE SUMMARY

The **B**uilding **O**ccupational **L**essons in **T**oxic crystalline **S**ilica (**BOLTS**) study was a research collaboration between the Department of Public Health S**c**iences at the University of Miami, Miller School of Medicine and the Occupational Health and Safety Program in the Florida Department of Health, Bureau of Epidemiology conducted between September 2014 to June 2015. This pilot research project was designed to develop, implement and evaluate a construction worksite-based educational intervention to increase the use of personal protective equipment (PPE; 3M™ N95 Particulate Respirator mask) to reduce crystalline silica exposure and increase worker knowledge and awareness of silicosis at construction worksites. Across five commercial construction sites in South Florida, we collected 260 baseline surveys, 268 post toolbox talk surveys, and 143 one-week follow up surveys from construction workers employed at the sites. Two construction sites were randomized to a new interactive educational toolbox talk on silica and dust reeducation while three sites were randomized to a standard toolbox talk on the same topic. There were no significant differences in the worker's demographic characteristics between the intervention and control arms. Workers assigned to the intervention group showed an increased use of PPE at one week post-intervention, while the control group showed a decrease in PPE use. In addition, a significantly greater increase in knowledge of silica workplace hazards and sources of exposure was measured among workers in the intervention than in the control group. The interactive component of our intervention's

toolbox talk showed promising results in construction worker health behavior change. Future worksite-based educational interventions should consider interactive adult-learning components that enhance the curriculum of existing toolbox talks as well as provide evaluation of the intervention beyond a 1-week follow up period.

A. CHALLENGES/AMENDMENTS TO STUDY DESIGN AND METHODS

Challenges

The successful implementation of our BOLTS pilot study was not without slight challenges. Composed of a diverse racial/ethnic worker population, construction sites in Miami required our study staff to translate and modify recruitment protocols to be culturally and linguistically competent. The languages spoken by the workers included Spanish, Creole, and English. Our team included Spanish and English speakers; therefore, those workers whom only spoke Creole were a bigger challenge during recruitment and might have been underrepresented in our sample. Future studies of South Florida construction workers warrant Creole-speaking capabilities by at least one of the study group members.

Our recruitment protocol was initially tested on the first recruitment site. The recruitment and study completion challenges faced in this first site allowed us to modify the protocol for the subsequent sites. Our protocol was optimized and subsequently carried out successfully by the fifth site visit. The modifications to the original protocol, and the recommended modifications for future studies, are outlined in the next section.

To ensure that all workers filled out the first two survey time points and attended the toolbox talk during our site visits, we asked them to turn in both surveys together only after the toolbox talk.

The first survey was handed out either the day before or the morning before the toolbox talk. The second survey was handed out after the toolbox talk, and was, therefore, immediately collected after completion. The follow-up data collection was conducted over the phone, a week after each site visit. Half of the study staff conducted data collection in Spanish, while the other half worked on the data collection in English. A majority of participants preferred to complete the study in Spanish. The surveys were filled out by the study staff according to the oral responses of each worker. The staff worked around the workers' schedules and made sure to call back every single participant. One of the lessons learned is that the best time to contact construction workers over the phone in South Florida is after 4:30 PM, once their shift is over and before they get home.

Due to the large number of workers participating at each site, and the short amount of time they were allowed for study completion by their managers, we had to streamline the on-site process

of survey collection and participant incentive distribution to be as efficient as possible. We used a foldable, portable table to create an assembly-line-like system, in which workers formed a single line and moved through different processing stages. The first stage included two study team members collecting and double checking the completion of both surveys. The second stage included a team member distributing participant incentives, and the third stage included two study members collecting participant signatures for IRB petty cash reconciliation purposes. This system quickened the survey collection process and allowed us to complete the toolbox talk and data collection for about 60 participants in close to 30 minutes.

A very important factor that led to our recruitment success was the collaboration with on-site Safety Officers. The Safety Officers had reserved blocks of time with the entire construction crew in

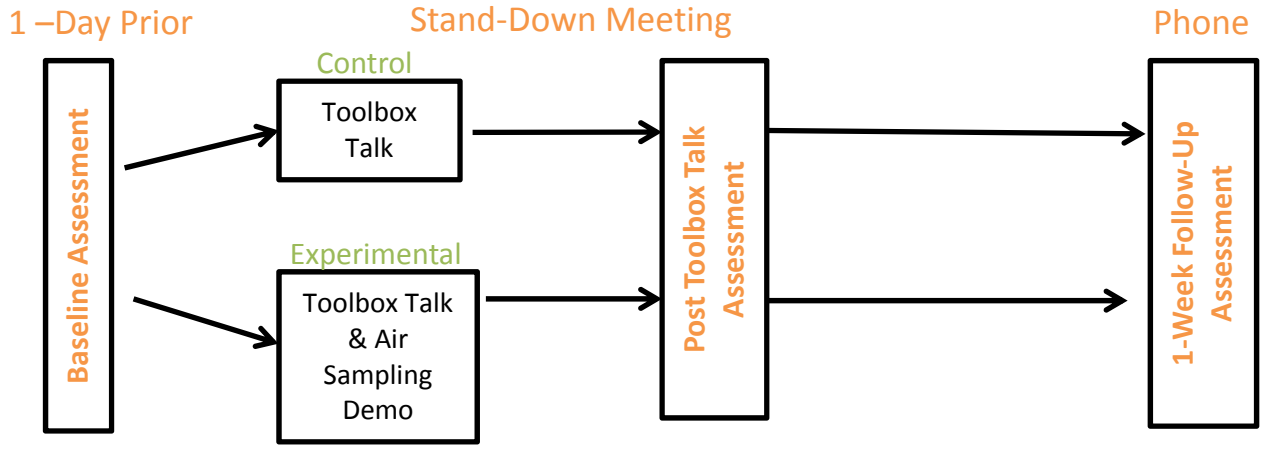
the mornings that allowed us to address and deliver the toolbox talk at once in one place. This allowed us to recruit many more workers per site, as well as provided us with enough time to conduct toolbox talks and data collection without taking much of the company's work time. This aspect is very important as the construction managers do not like to see their workers participating in the study during scheduled working time.

During our site visits, a few questions were raised by workers and Safety managers that we would like to highlight in this report. Workers seemed interested in knowing more about the combined effects of smoking and dust exposure.

Additionally, certain workers complained about not being provided with the right type of PPE masks. Finally, some workers were interested in receiving health screenings on site, as most did not have health insurance coverage. Safety managers were eager to collaborate in further studies, including other topics of construction site health and safety.

Recommendations

We would recommend the study timeline to be modified in the following manner:



Recruitment of participants should be done through collaboration with the Safety Officer during stand-down meetings one day prior to the toolbox talk. This provides participants with ample

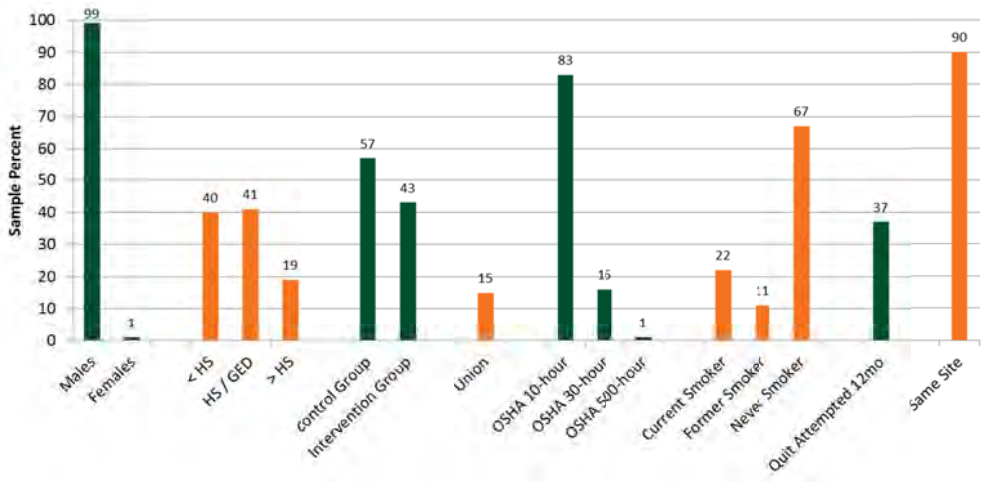
time to complete the lengthy baseline survey overnight. At this point, it is imperative to underline the fact that only participants who bring back their filled out baseline survey will receive the post-intervention survey and will be able to receive the corresponding incentives.

The toolbox talk should be conducted in no more than 5 minutes, as participants will lose focus and attention if the talk is too lengthy. Moreover, the air sampling should also be conducted one day prior to the toolbox talk so printouts of the exposure data can be provided to participants during the experimental toolbox talk. Having this pictographic representation of their exposure is of utmost importance to the interactive component of the intervention. If possible, two or three people should be carrying out the toolbox talk, taking turns to translate the information presented to Spanish and Creole.

The one-week follow-up should be conducted after work on weekdays, or in the afternoon on weekends. Workers get out of work at 4:30 and are usually willing to participate in the follow-up call up until around 7 pm. Staff should be available to conduct this part of the study in different necessary languages.

B. DATA COLLECTED

Figure 1. Socio-demographic characteristics of commercial construction workers participating in the BOLTS pilot study



Baseline data was collected from 260 participants, of which 143 responded to the one week follow-up. Sample demographics are described in **[Figure 1]**. Key demographic data included education levels, medical history, gender, unionization status, OSHA training levels, and smoking status. No age data was collected. The study population was primarily male, and Hispanic. There were no differences detected in baseline demographics between those who completed the one week follow-up and those who did not. Between the intervention and control arms, there weren't any significant differences in the respective demographic characteristics.

Collected data required a large amount of cleaning. Despite instructions, participants selected multiple options on questions with the scale of "Strongly agree" to "Strongly Disagree". These data points were recoded as 998 in the dataset, as interpretation of intention would lead to biased results. On a few limited occasions, participants skipped an entire page of questions on the baseline. The final question about smoking was often left out, as many participants missed the final page containing the last of the three smoking related questions. This suggests the survey may need to be shortened, or printed on one side of the paper only. In addition, many participants would check every single box on the entire survey, another possible indication of time restraints on the survey. For questions where multiple answers were appropriate, data was dummy coded into the dataset. Lastly we collected 8 additional surveys during the post toolbox talk assessment than there were baseline surveys (i.e., 260 baseline and 268 post toolbox talk). This occurred because some workers were not present at the worksite in the morning during the baseline

survey administration, and the research team did not want to make them feel bad by excluding them from participation.

As described elsewhere, the main outcomes of this study were collected at baseline and at one week follow-up. Participants clustered answers on the behavior outcomes around "Always" or "Most of the time". For those with follow-up data, there is a much wider distribution of answers for these behavior outcomes. Change in behavior markers and results are presented in [Figure 2].

Figure 2. Change in PPE Use Behavior among workers participating in the BOLTS pilot project.

In the past 7-days, how often did you use...	Baseline Control †	Baseline Experimental†	1-week Follow Up Control †	1-week Follow Up Experimental†
...personal protective equipment at the construction worksite?	88.1%	87.5%	72.6%	95.5%
...personal protective equipment to reduce the amount of dust you came into contact with at the construction worksite?	68.2%	52.8%	47.9%	83.1%
... a respirator mask to reduce the amount of dust you came into contact with at the construction worksite?	63.5%	44.0%	34.7%	76.9%
...ventilation to reduce the amount of dust you came into contact with at the construction worksite?	63.7%	44.6%	31.9%	76.2%
... a dry or wet vacuum to reduce the amount of dust you came into contact with at the construction worksite?	47.4%	23.5%	20.9%	66.7%

†Percent of workers responding 'always and most of the time" to the survey questions.

In order to analyze knowledge and behavior, indexes were created four groups of questions, and for overall behavior and overall knowledge. Correlations between component questions were analyzed and then grouped together in the index, if appropriate. All five of the behavior questions were components in the behavior outcome [Figure 2]. The overall behavior index values decrease with increasing personal protective equipment use. On the other hand, knowledge questions were grouped together by type knowledge: silica containing materials, illnesses that silica can cause, activities that release silica, and effective measures in reducing silica exposure. From these four group sets, an overall knowledge index was created. Correctly checked answers were given a score

of 1. For data modeling, each component question for behavior and each group set for knowledge were considered individually. The list of knowledge questions is too lengthy to include in this report. Instead, the three surveys will be included as appendices [Appendix C,D,E]. The change in knowledge and behavior by intervention arm is best represented in [Figures 3 and 5].

Several questions on the survey were not well understood by participants. The survey questions asking for job title and type of work were confusing. Many respondents, instead of checking one of the options (Foreman, Apprentice, etc) would write down their job title (Plumber, electrician). These answers did not always correspond with the type of work. On the baseline survey, there was clear evidence of confusion differentiating between questions where multiple responses were appropriate versus those where it was not.

C. RESULTS/ DISCUSSION

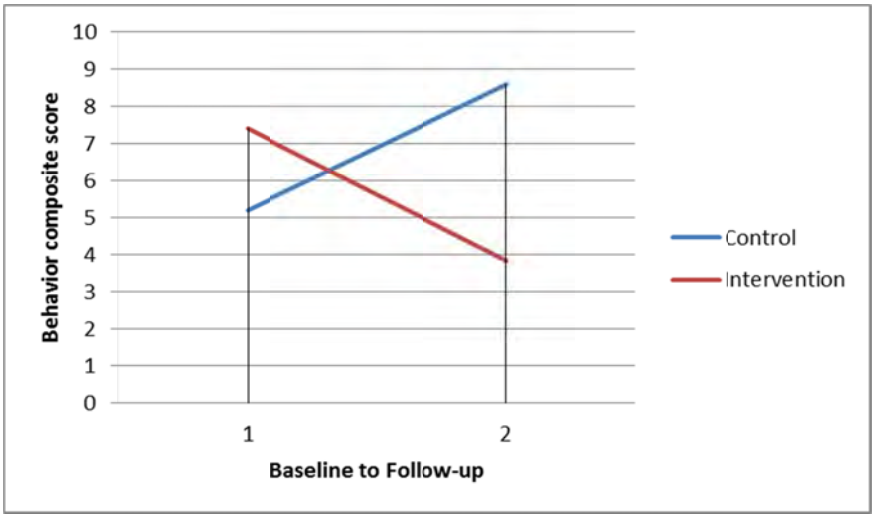
After analyzing the data collected in this pilot study, there are three main results to discuss.

Change in Behavior

The intervention and control groups showed opposing changes in personal protective equipment use one week after the intervention. As seen in [Figure 3], the intervention group showed an increased use of PPE, while the control group actually showed a decrease in PPE use. When the behavior change is examined by construction site [Figure 4], we see a significant increase in PPE use in both experimental sites (Fendi and Surf Club), a decrease in PPE use in all control groups (The

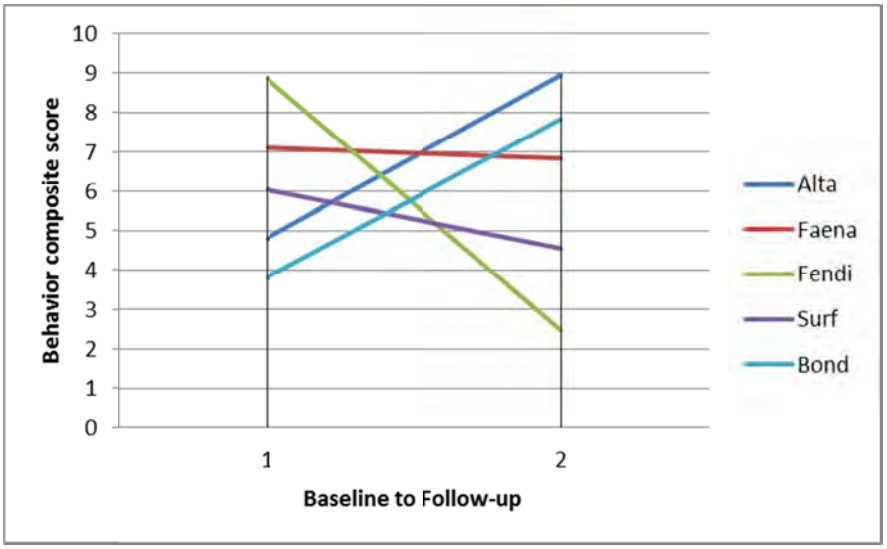
Bond, Alta Dadeland, Faena). Some control groups showed a sharper decrease in PPE use than others. Further studies looking to explain what possible intra-site dynamics could cause this variation are warranted.

Figure 3. Change in Behavior (By Intervention Group)



Note: Lower Behavior composite scores = increased face mask use

Figure 4. Change in Behavior by Construction Site



Note: Lower Behavior composite scores = increased face mask use

Change in Knowledge

Similarly, the intervention and control groups showed different changes in silica knowledge one week after the intervention. As seen in [Figures 4], a significantly greater increase in knowledge was measured among workers in the experimental group than in the control group. When the knowledge change is inspected by construction site [Figure 6], we see a significant increase in knowledge in both experimental sites (Fendi and Surf Club); and a lesser, yet significant increase in knowledge in two control sites (The bond, Faena). A decrease in knowledge was measured in the Alta Dadeland site. This might have been due to systematic error and further studies looking to explain what possible intra-site dynamics could cause this variation are warranted.

Figure 5. Change in Knowledge by Intervention Group

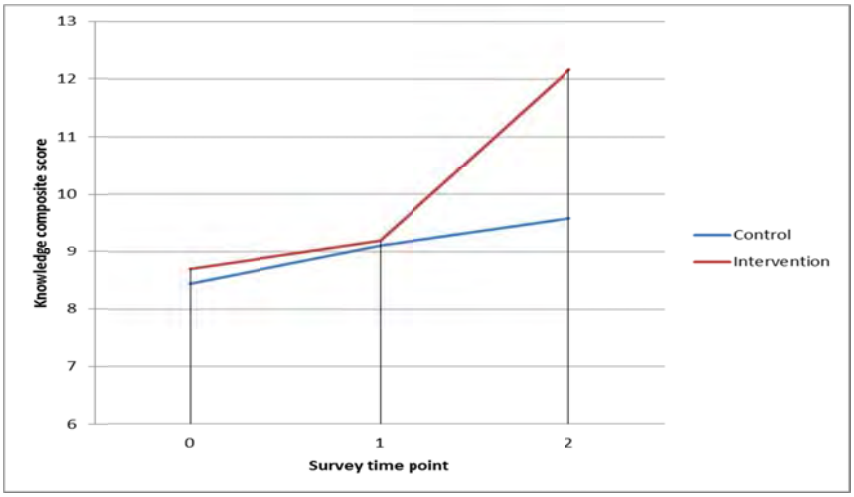
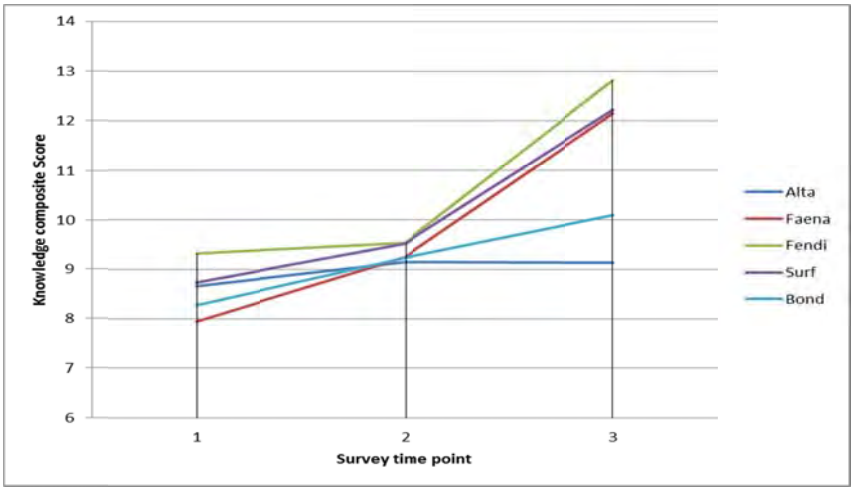


Figure 6. Change in Knowledge by Site



Workers' Smoking Status

Smoking status for workers, defined as current smokers, former smokers, and never smokers, was determined by combining information regarding current smoking habits and whether they have consumed 100 cigarettes in their life time. Smoking rates in this sample is slightly elevated compared to Florida (22.8% vs 19.3%). Smoking was more prevalent in the control group than the intervention group (28.0 vs 16.5%, p=.039, respectively). Overall, the intervention group had less smoking history. No other differences were detected among other control variables, including union status, OSHA training, education, or medical history.

A multivariable least squares regression was set up to assess any associations between the intervention and personal protective equipment use and knowledge about silica after one week. These models controlled for possible confounders such as safety training, smoking status, and membership of a union. As shown in [Tables 1 and 2], the only factors that significantly predicted the behavior and knowledge of workers one week after the intervention were the intervention itself and exposure to dust.

Table 1. Multivariable Regression of Behavior After One Week

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DustContactFromTask_	4	170.588	42.6471	1.62	0.1778
UnionMember	1	60.9381	60.9381	2.32	0.1322
OSHA10	1	0.0011	0.0011	0	0.9948
EducationLevel	5	87.9428	17.5886	0.67	0.6478
AsthmaHistory	1	0.01655	0.01655	0	0.98
COPDHistory	0	0	.	.	.
SilicosisHistory	0	0	.	.	.
LungCancerHistory	0	0	.	.	.
Control	1	253.643	253.643	9.66	0.0027
smoking	2	79.3437	39.6719	1.51	0.2279

Table 2. Multivariable Regression of Knowledge After One Week

Source	DF	Type III SS	Mean Square	F Value	Pr > F
DustContactFromTask_	4	141.08	35.27	3.18	0.0183
UnionMember	1	34.1191	34.1191	3.08	0.0836
OSHA10	1	39.429	39.429	3.56	0.0633
EducationLevel	5	32.3427	6.46855	0.58	0.7123
AsthmaHistory	1	5.39084	5.39084	0.49	0.4878
COPDHistory	0	0	.	.	.
SilicosisHistory	0	0	.	.	.
LungCancerHistory	0	0	.	.	.
Control	1	421.73	421.73	38.06	<.0001
smoking	2	21.9135	10.9567	0.99	0.3771

In a separate analysis of the repeated measures of knowledge and behavior throughout the different survey time-points of the study, an association surfaced with smoking status [Tables 3]. Multiple repeated measure ANOVAS were run, analyzing the relationship of smoking status on each behavior outcome and knowledge question. Smoking status was only significantly associated with use of PPE to prevent dust exposure in a model controlling for OSHA 10 and 30 training, education level, union status, dust exposure from their work tasks. Former smokers exhibited worse behavior patterns related to PPE use when compared to current or never smokers (Pr>|t| =.0081, .0069 respectively).

Table 3. Use of PPE to prevent Dust contact and Smoking Repeated Measures

Type 3 Tests of Fixed Effects				
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**
trial	1	88	0.39	0.5338
Site	4	157	0.28	0.8903
trial*Site	4	88	5.17	0.0009
smoking	2	157	4.29	0.0154
OSHA10	1	157	0.43	0.5129
EducationLevel	5	157	0.76	0.5771
UnionMember	1	157	0.30	0.5853
dusty	4	55	1.37	0.2563
OSHA30	1	157	0.49	0.4865

smoking	_smoking	Estimate	Standard Error	DF	t Value	Pr > |t|
Current	**Former**	-0.8686	0.3238	157	-2.68	0.0081
Current	**Never**	-0.0636	0.2348	157	-0.27	0.787
Former	**Never**	0.8051	0.294	157	2.74	0.0069

D. FUTURE IMPLICATIONS

Data collected in the BOLTS pilot project suggest that commercial construction workers exposed to interactive toolbox talk on workplace silica and dust exposures are more likely to increase their use of personal protective equipment (i.e. face mask) and identify greater relevant workplace sources of dust/silica when compared to workers participating in a regular toolbox talk. Elements of adult learning theory that incorporates facts and tangible, hands-on activities (i.e., air sampling exposures levels) appears to improve worker safety behaviors and knowledge at least in the 1-week follow up period. Future studies should consider moving from ambient air sampling at the worksite to individual worker air sampling to provide a more personalized individual exposure level. Furthermore, the follow up time period should be increased to 3-4 weeks post intervention in order to ascertain the longer-term impact of the interactive toolbox talk on worker behavior. The BOLTS data supports the idea the flat lecture-based toolbox talks may limit the impact the message has on worker knowledge and behavior, although more rigorous study design and follow up periods are needed.

E. PUBLICATIONS AND STUDENT TRAINING

As of the date of this second deliverable report, the BOLTS research team has presented preliminary findings of the pilot project at two venues that include research study, governmental and construction industry partners:

1. Olano H, Chen C, Sznol J, Kling H, Arheart KL, Watkins S, Chalmers J, Harduar-Morano L, Cavicchia P, and Caban-Martinez AJ. Preliminary findings from the Building Occupational

Lessons in Toxic crystalline Silica (BOLTS) Pilot Study. Presented at the Florida Occupational Coalition Meeting on Monday, February 9, 2015 in Tallahassee, Florida, USA.

2. Caban-Martinez AJ, Olano H, Chen C, Sznol J, Kling H, Arheart KL, Watkins S, Chalmers J, Harduar-Morano L, and Cavicchia P. Reducing Silica and Dust Exposure among Commercial Construction Workers: Preliminary findings from the Building Occupational Lessons in Toxic crystalline Silica (BOLTS) Pilot Study. Presented at the South Florida Safety Alliance Meeting on Wednesday, May 8, 2015 in Miami, Florida, USA.

In addition, two scientific abstracts were submitted and subsequently accepted for presentation at the 143rd American Public Health Association Annual Meeting in Chicago, IL to be held October 31 - November 4, 2015.

1. Olano H, Sznol J, Chen C, Kling H, Arheart KL, Chalmers J, Harduar-Morano L, Cavicchia P, Watkins S, Lee DJ, and Caban-Martinez AJ. Interactive toolbox talk influences knowledge and use of N95 respirator mask among commercial construction workers: Evidence from the Building Occupational Lessons in Toxic crystalline Silica (BOLTS) Pilot Study. Abstract ID: 331108. Presented at the 143rd American Public Health Association Annual Meeting from October 31 - November 4, 2015 in Chicago, IL, USA.

2. Sznol J, Olano H, Chen C, Kling H, Arheart KL, Chalmers J, Cavicchia P, Harduar-Morano L and Caban-Martinez AJ. Former smokers employed at commercial construction sites are less likely to use respiratory protection. Abstract ID: 332743. Presented at the 143rd American Public Health Association Annual Meeting from October 31 - November 4, 2015 in Chicago, IL, USA.

Two scientific manuscripts based on the data collected in this pilot project are in preparation by Henry Olano and Josh Sznol under the supervision of Dr. Alberto J. Caban-Martinez. Lastly, the BOLTS pilot project supported the training of four graduate public health students (i.e. Henry Olano, Charles Chen, Hannah Kling, and Joshua Sznol) in occupational health and safety.

F. APPENDICES

A. Manuscript draft – For submission at AJPH

B. Final Data set

C. Baseline Survey

D. Post-Intervention Survey

E. Follow-up Survey