Pilot Test Training Program to Promote Awareness of Welding Fume Hazards and General Principles in the Correct Use of LEV Among Apprentice Welders

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as part of project:
Adoptions of Innovations to Minimize Exposure to Dusts and Fumes in Construction, (AIMs)

Study Objective

- Develop, validate, and test training materials for their effectiveness in promoting the development and retention of knowledge:
  - On welding processes
  - On health effects associated with welding fumes exposure
  - Regulations on the subject
  - LEV use

Methodology

- Materials Development
  - Online survey to assess needs for content
  - First exposure to Apprentice Center in Philadelphia
  - Revised and presented for content validation in Apprentice Center in Atlanta
- Pilot test in two regions across the US (CO and OH)
- Evaluation (quiz, questionnaire, hands-on)
  - Pre
  - Post
  - Retention
- Revise and pack training materials to make them available for training centers instructors

Training Content

- Introduction
- Gases, fumes & related welding fume hazards
- Measuring and evaluating exposure to welding fumes
- Preventing welding fume exposure and the role of OSHA
- LEV system components, design & use
- Evaluating performance
- Using OSHA & why your employer should use LEV

Training Groups

Evaluation Tools - Quiz

- General Knowledge
- Regulations
- Health Effects
- LEV

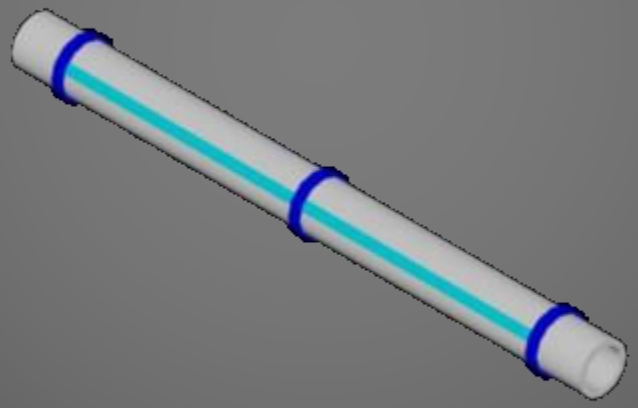
Evaluation Tools - Questionnaire

- Familiarity with LEV
- Confidence on the use of LEV
- Awareness of operating and environmental parameters affecting LEV performance
- Level of understanding on general knowledge , health effects, OSHA regulations, and LEV operation and pros and cons
- Perspective on the possibility of using LEV's in the workplace, and their effect on the work

Evaluation Tools – Hands On Evaluation

- Random sample of apprentices to weld on standardized experimental specimen
  - Denver, CO & Cambridge, OH

    2 feet of 2” Schedule 40 steel pipe coupons



welded with 1/8” 7018 electrode at 115 amp DC reverse polarity

Evaluation Tools-Hands On Evaluation

- Samples taken with TSI AM 510 Real Time Aerosol Monitors connected to Dorr-Oliver Cyclones at 1.7 lpm.
- Samples were taken with Dorr-Oliver cyclones clipped to apprentices' shirt outside welding helmet

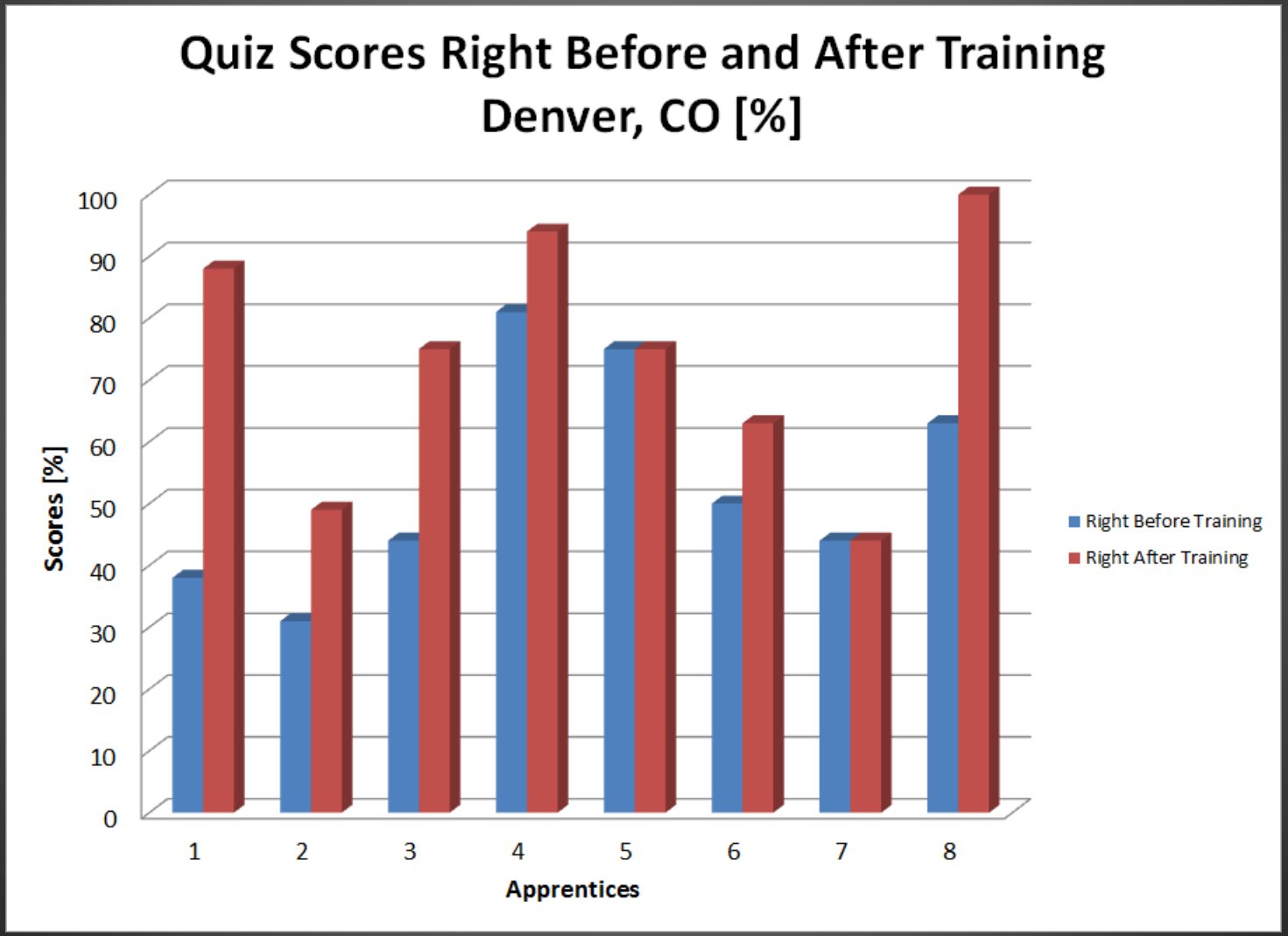
Evaluation Tools-Hands On Evaluation

- Local Exhaust Ventilation systems were available in every welding booth

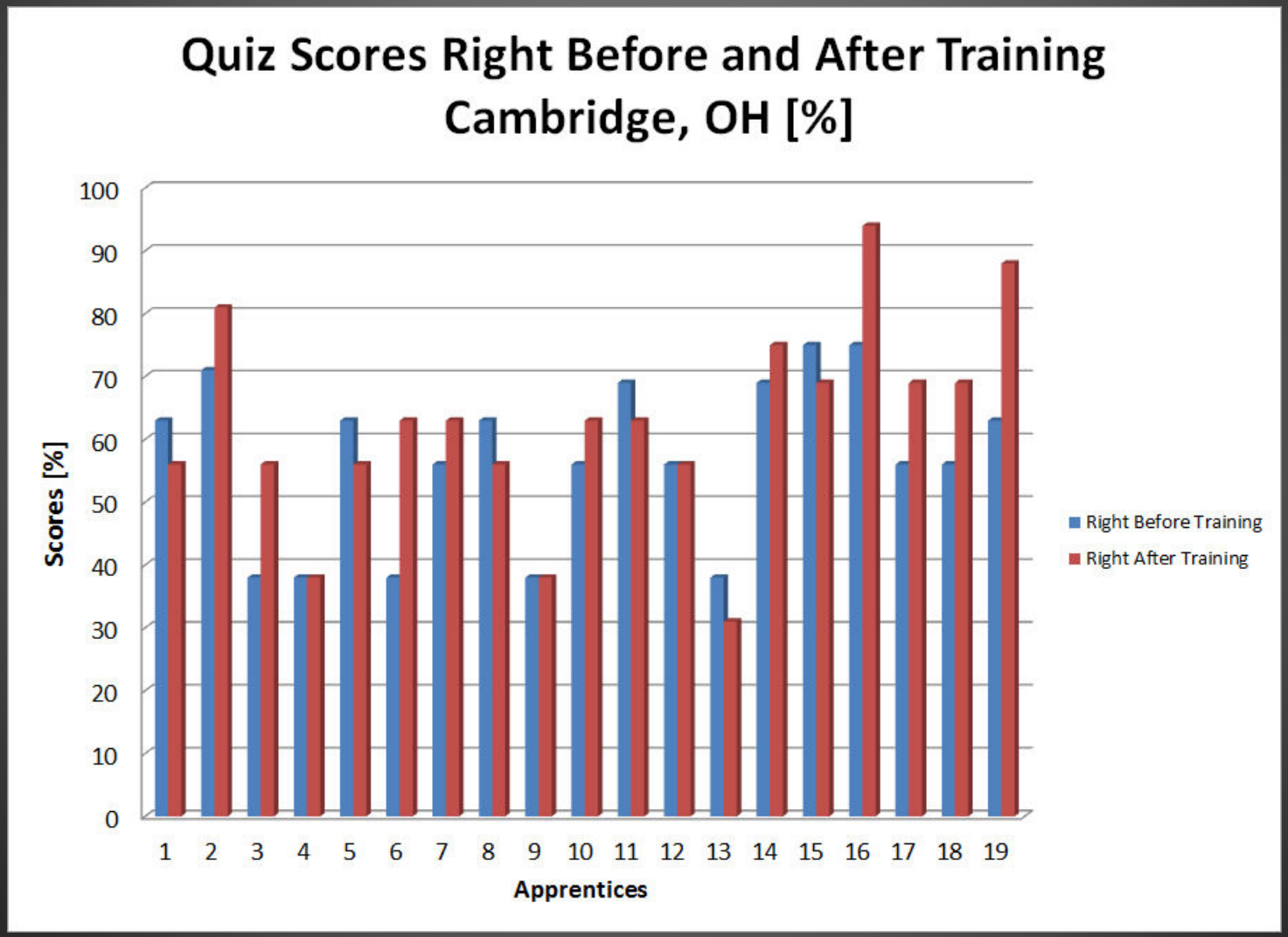
Data Analysis (Preliminary)

- Pair T-test on quiz scores:
  - Before and after the training
- Pair T-test on apprentice respirable particulate exposures (% exposure reduction):
  - Before and after the training
  - Before and 2-5 months after training (retention)
- Pair T-test on questionnaire semi-quantitative responses:
  - Before and after the training (Denver so far)
- Apply AIHA Exposure Assessment Model to characterize respirable particulate exposure in apprentice welders:
  - Before, right after the training, and 2-5 months after training

Preliminary Results (Quiz)



Preliminary Results (Quiz)



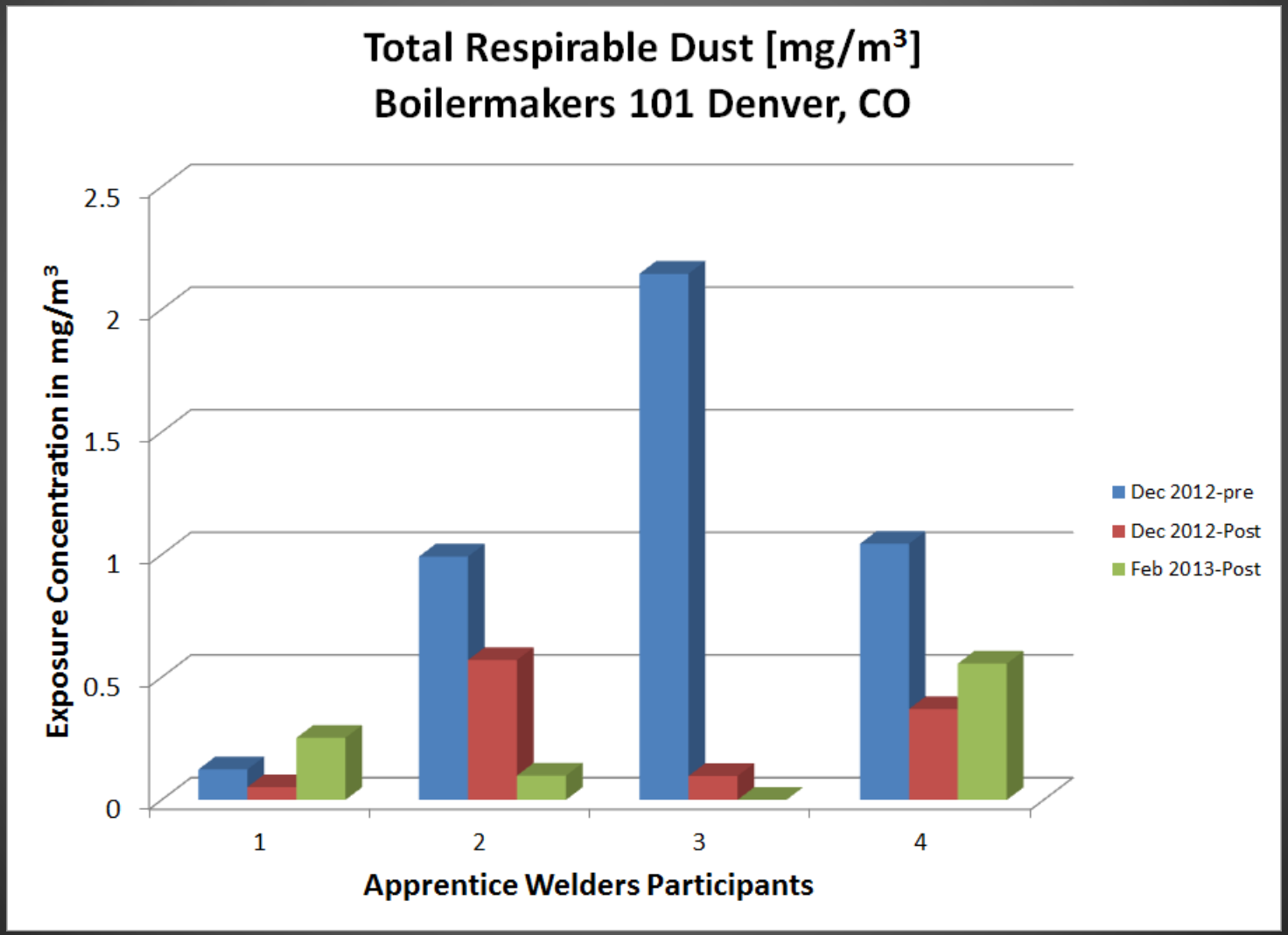
Preliminary Results (Quiz)

- Quiz scores right after the training were statistically higher than right before the training (Paired T test with 5% level of significance)
  - 17% higher in Denver, CO

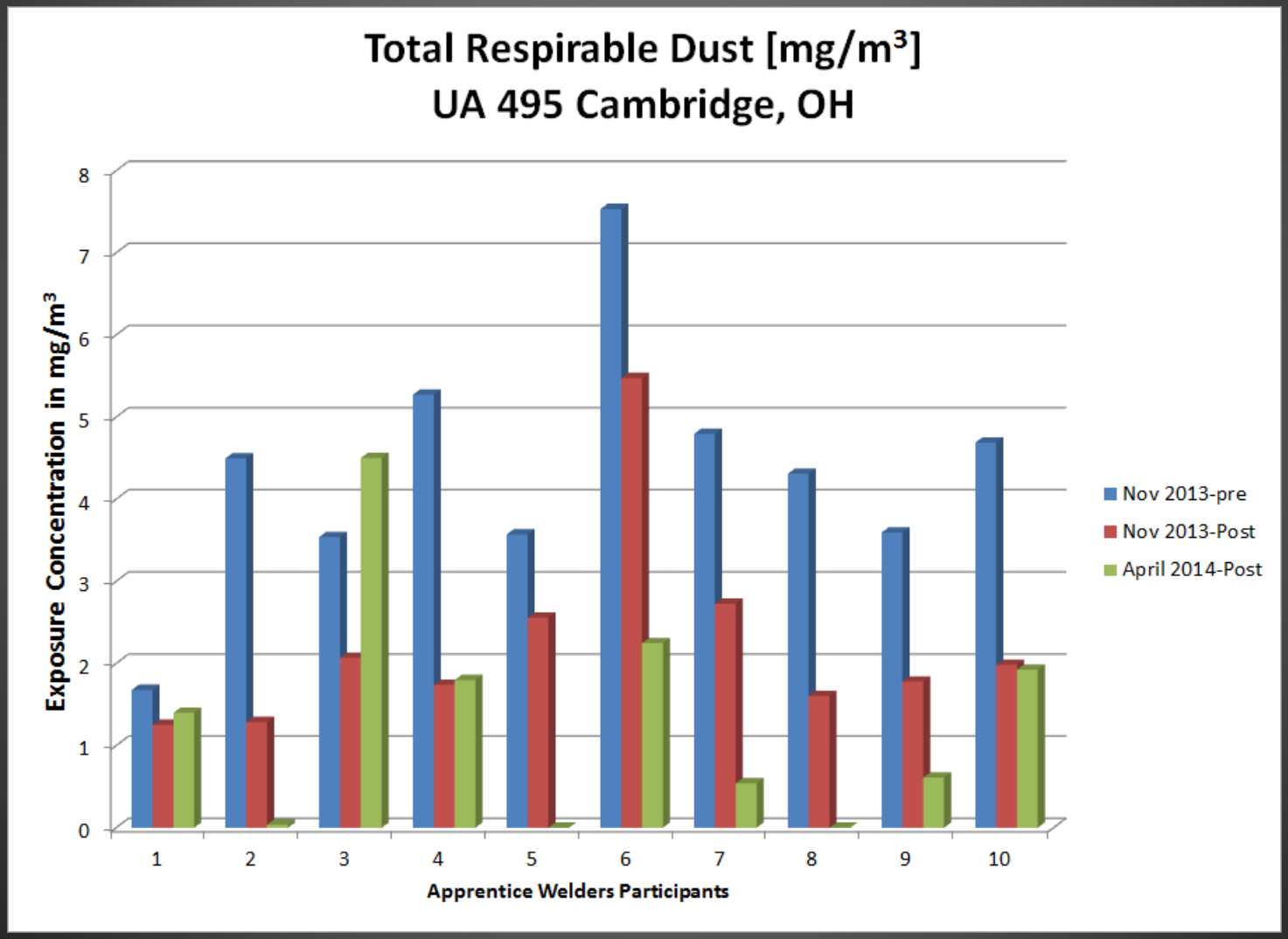
    n=8 workers; p-value = 4.83%
  - 1.5% higher in Cambridge, OH

    N=19 workers; p-value = 4.99%

Preliminary Results (Hands-on)



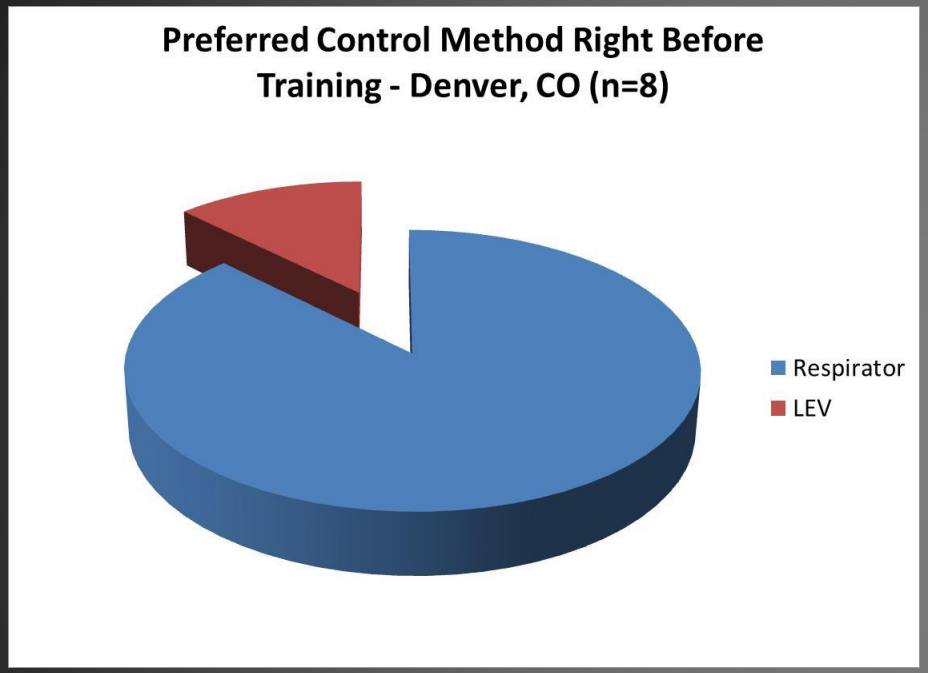
Preliminary Results (Hands-on)

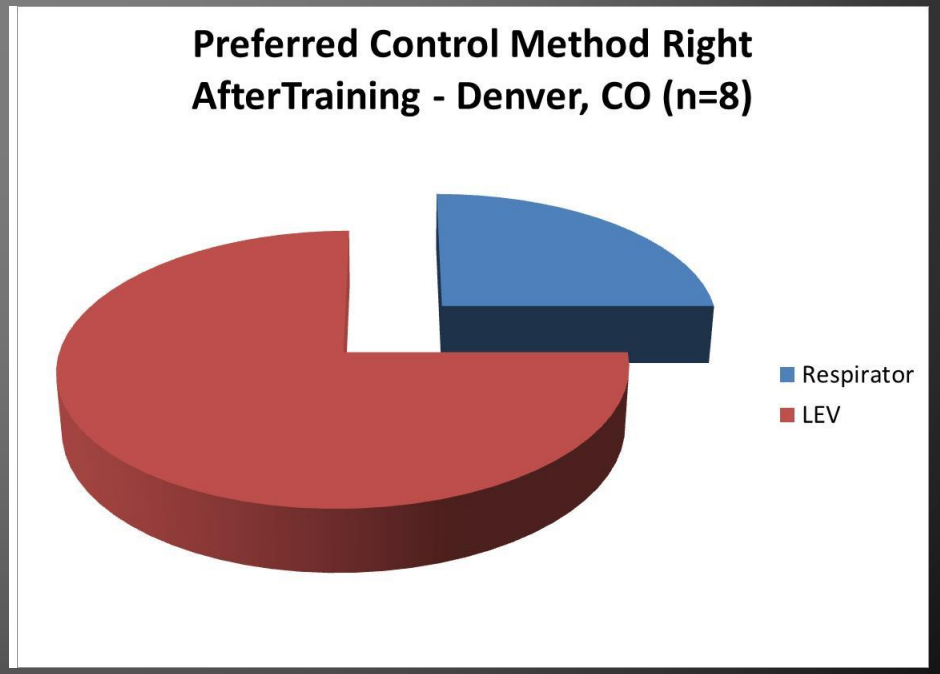


Preliminary Results (Hands-on)

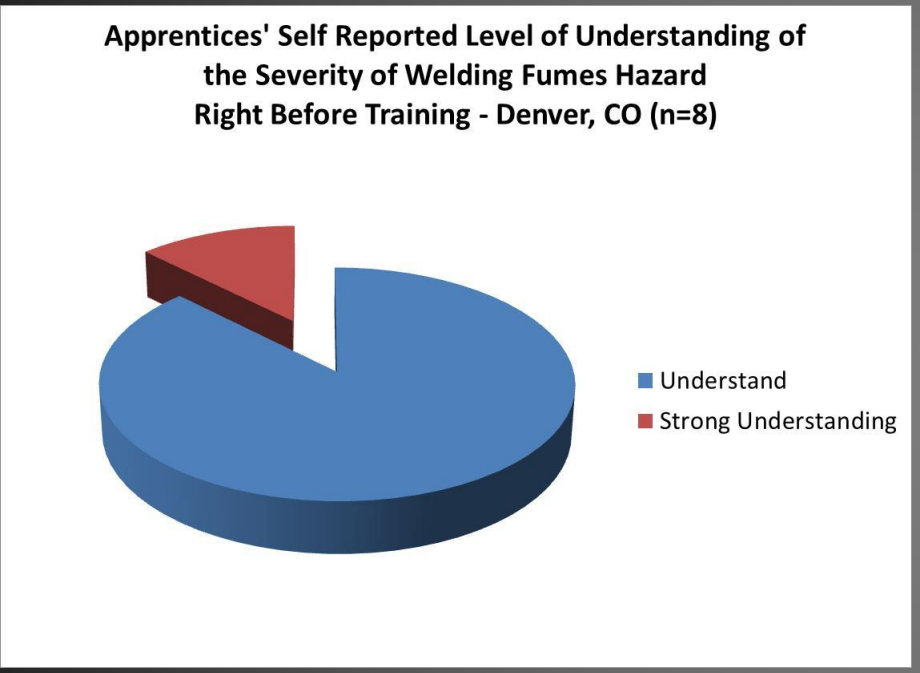
- Total respirable particulate exposure was statistically lower right after the training and also 2-5 months after the training (paired T test on percent exposure reduction)
- Right After the Training
  - 43% lower after the training (2 centers combined)
    n=14; p-value = 4.5%
  - 17% lower after 2-5 months (2 centers combined)
    n=12; p-value = 4.8%

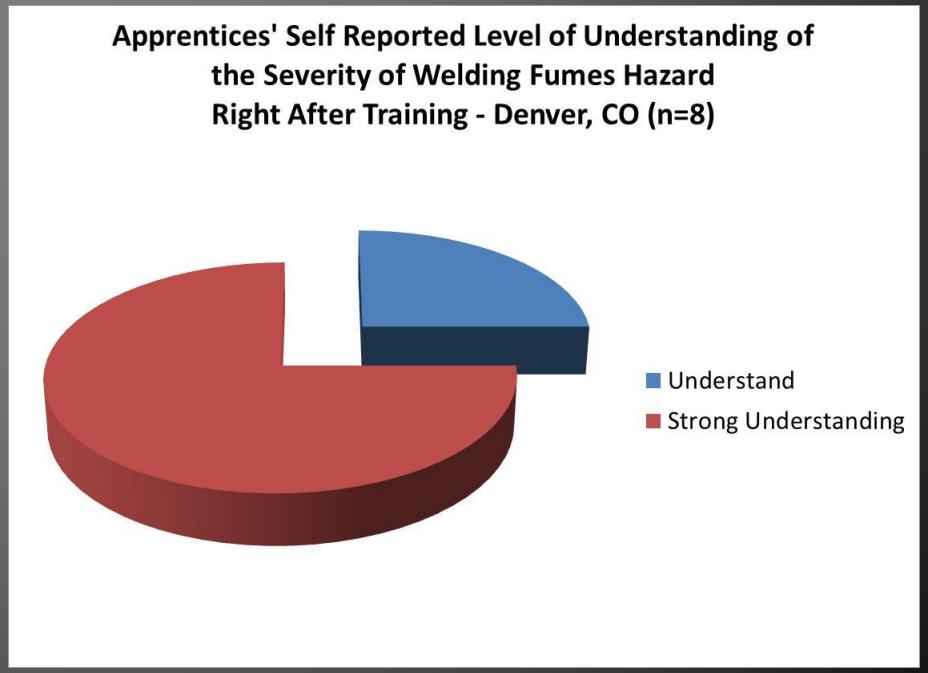
Preliminary Results (Questionnaire) Apprentices' Preferred Control Method





Preliminary Results (Questionnaire) Apprentices' Level of Understanding of Severity of Welding Fumes Hazard





Preliminary Results (Questionnaire) Level of Significance – 5%

- 26% ↑ in Apprentices' Self Reported Level Confidence on Their Ability and Knowledge to Use LEV in an Effective Manner
- 16% ↑ in Apprentices' Self Reported Level of Awareness with Respect to Operating and Environmental Paramenters
- 3.5% ↑ in Apprentice's already high (86%) Rating on the Severity Level Associated with Welding Fumes Hazard
- 1% ↑ Apprentices' already high Self Reported Level of Trust (82%) on the Effectiveness of LEV to Control their Welding Fume Exposure

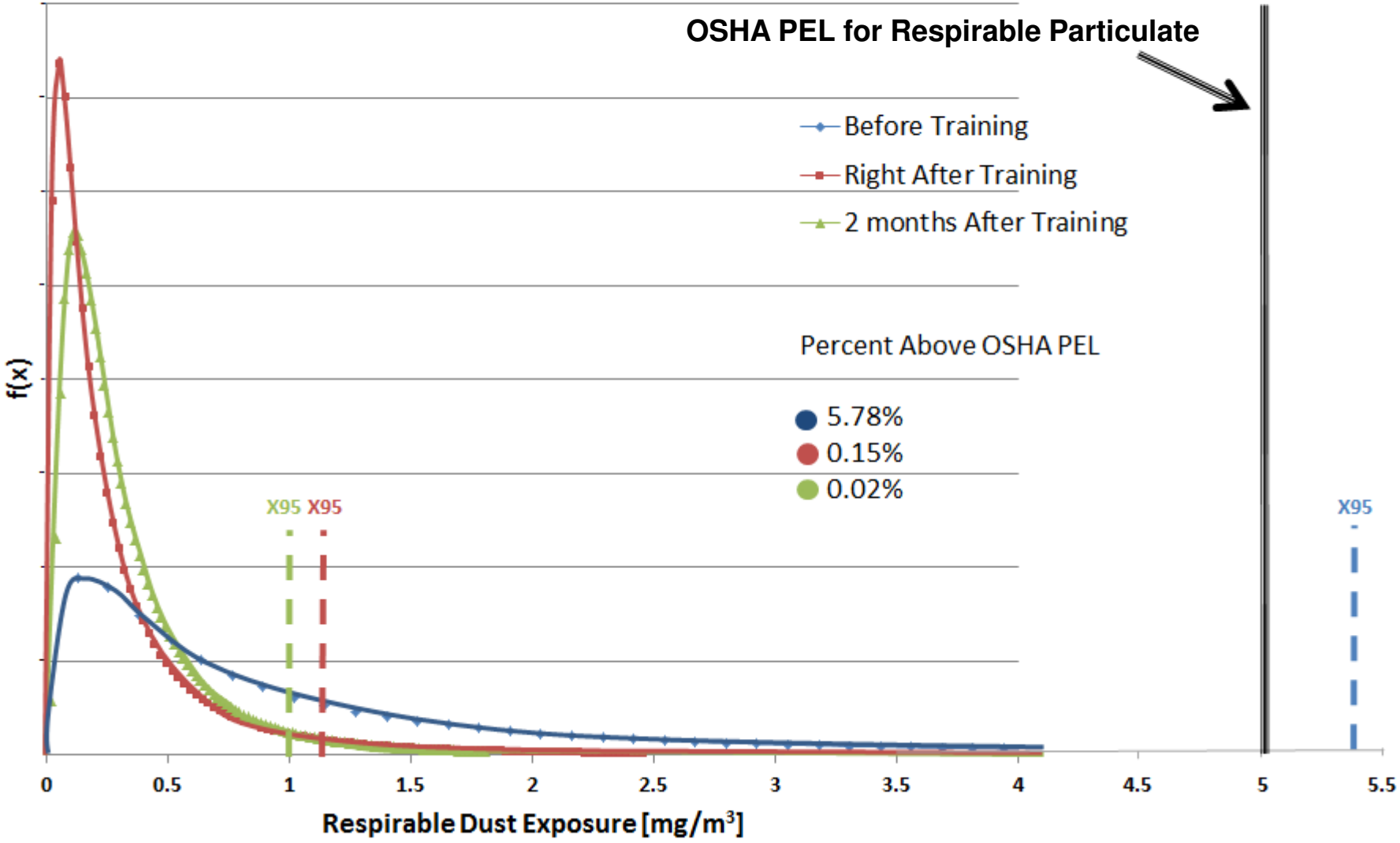
Preliminary Results (Questionnaire) - Denver Level of Significance – 5%

- 6% ↑ in Apprentices' Self Reported Level of Trust that LEV will not Interfere with Shielding Gases
- **No change in Apprentices' already low Self Reported Belief they will be able to use LEV on the job**
- 12% ↑ in Apprentices' Self Reported Degree to which they believe OSHA Standards support the use of LEV's on the job
- **No change in Apprentices' already low Self Reported Degree to which they believe LEV use affects their Productivity**

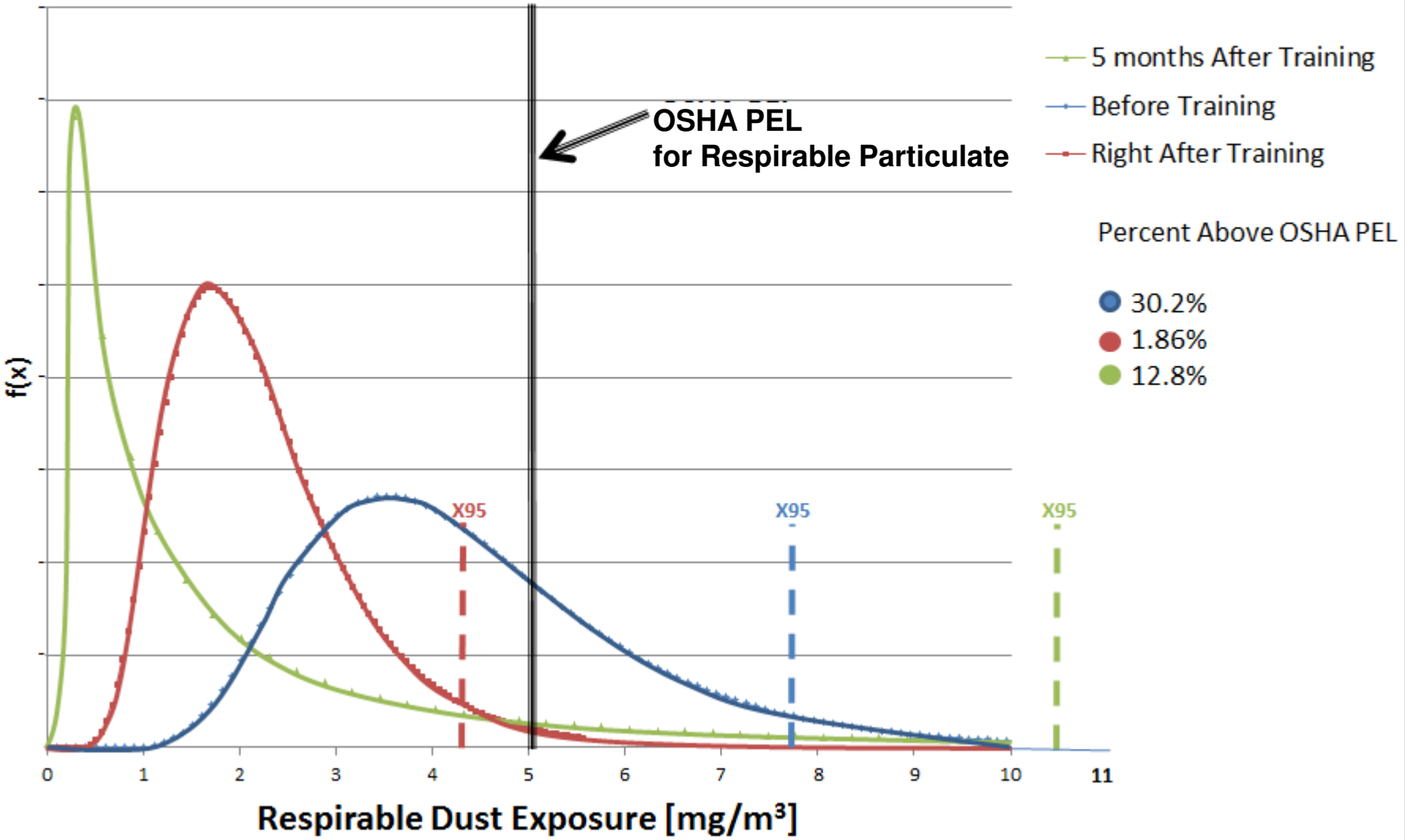
Applying AIHA Exposure Assessment Model

- Idealized Distribution of Respirable particulate Exposure
  - Right Before the Training
  - Right After the Training
  - 2-5 Months After the Training

Idealized Lognormal Distributions for Respirable Particulate Exposures [mg/m³] Before, Right After, and 5 months After the Training Denver Apprentice Center - Boilermakers 101 - CO



Idealized Lognormal Distributions for Respirable Particulate Exposures [mg/m³] Before, Right After, and 5 months After the Training Cambridge Apprentice Center - UA 495-OH



Discussion of Results

- **Questionnaire results** clearly indicate that the topics covered by the training materials are appropriate and in general terms well grasped by the audience:
  - Confidence in the use of LEV increased
  - Awareness of Welding Fumes Hazards increased
  - Preference for LEV over Resp. Protection increased
  - Understanding the role of OSHA increased
  - Understanding employers' responsibilities increased
- **Expectation to be able to use LEV in the workplace has not increased and was low to begin with!**

Discussion of Results

- **Quiz Scores**, although statistically higher after training, were not what we expected! A detailed revision of quiz questions and apprentices' answers was made….
- Some of the poor performance may have been due to:
  - Poor choice of answer alternatives
  - Confusing alternative "all of the above"
  - Poor choice of words in question text "least likely to"
  - Apprentices' priorities in paying attention to information "ACGIH versus AWS"

Discussion of Results

- **Quiz Scores:** Several of the mistakes made in the quiz after training can be minimized by adding a “hands on” component in the training itself to explain important LEV parameters and usage

Discussion of Results

- **Hands-on evaluation** seemed to be affected by the LEV system layout and flexibility
  - Exposure estimates were lower in Denver, CO, as compared to Cambridge, OH.
- Hands-on evaluation results could be higher if we had a hands-on component during the training demonstrating both the parameters and the correct use of LEV's

Conclusion
Remaining Tasks to be Done

- Review training materials to include video on hands on component
- Review and change quiz questions to avoid confusing
- Deploy training in Apprentice Centers and through CPWR network

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Thank You!

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