Outcomes of a Revised Apprentice Carpenter Fall Prevention Training Curriculum

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Washington University School of Medicine
Carpenters’ District Council of Greater St. Louis and Vicinity
Carpenters’ Joint Apprenticeship Program of St. Louis

NIOSH Grant #1- U54- OH008307
Research Collaborators

- Washington University School of Medicine
- Duke University
- Carpenters District Council
  - Currently 900 apprentice members, was 2,400
  - 90% of residential workforce in STL is unionized
- Carpenters’ Joint Apprenticeship Program
  - Apprentices work residential, commercial or both
  - Jointly supported by the union and local contractors
  - Instructors are journeymen with college degree
  - 4-year on-the-job training program
  - Attend 2-week training sessions every 6 months
  - Facilities include classrooms and large shops
Background

- Construction is a dangerous industry
  - 1,178 fatal work injuries in 2007 (BLS 2007)
  - 35% fatalities due to falls

- Residential construction
  - 43% fatalities due to falls (BLS 2007)
  - Challenges in residential construction
    - Small work crews, fast-paced
    - No permanent job sites, geographically dispersed, rapidly changing environment

- Falls remain a leading cause of morbidity and mortality in construction
Fall Prevention Project

Use the results from comprehensive needs assessment to improve the fall prevention curriculum at carpenters’ apprenticeship training program.

Phase I
Comprehensive Needs Assessment

Phase II
Fall Prevention Training Curriculum Changes

Phase III
Evaluation of Effectiveness
Methods - Phase I

Phase I
Comprehensive Needs Assessment

- Current Fall Prevention Training
- Focus Groups
- Residential Worksite Audits
- Questionnaires

Phase II
Fall Prevention Training
Curriculum Changes

Phase III
Evaluation of Effectiveness
Needs Assessment

- 5 focus group of apprentices at different stages of training
  - 36 total participants
- 197 worksite audits
  - 510 brief worker surveys
  - 95.5% of those asked for interviews agreed
- 1,025 questionnaires
  - 98.8% response rate
Work at heights early in career
Apprentices perform many tasks prior to training, including tasks at elevations
Frequently assigned high risk tasks
Crewmembers frequently perform tasks unsafely & instruct them to do the same
Are hesitant to ask for instruction or to question methods that appear unsafe
Fear layoff if refuse to do a task they don’t know how to do or they think is too risky
Worksite Audits

- 52-item observational audit – St. Louis Audit of Fall Risks (SAFR)
  - General Safety (3)
  - Floor Joist & Sub-floor (3)
  - Floor Opening (6)
  - Wall Opening (2)
  - Truss Setting (6)
  - Roof Sheathing (7)
  - Ladders (10)
  - Scaffolds (13)
  - Personal Fall Arrest (2)
- Brief worker interview
- Trained carpenters perform audit
- All or none scoring
  - Meets safety criteria
  - Does not meet criteria
  - Not observed during audit
- Mean domain scores computed
- Electronic Library of Construction Safety & Health
  - http://www.elcosh.org/
Percent of Time Observed Behaviors Met Audit Safety Criteria

- Safety climate/hskpg: 64%
- Floor joist/subfloor: 42%
- Floor openings/edges: 47%
- Wall openings: 50%
- Truss setting: 28%
- Roof sheathing: 80%
- Ladders: 69%
- Scaffolds: 77%
- PFAS: 89%
- Overall: 59%
Percent of Time Observed Behaviors Met Audit Safety Criteria

- Floor opening guarded: 50%
- CAZ meets criteria: 2%
- Guardrail construction: 65%
- Window opening guarded: 50%
- Truss chain removed safely: 33%
- Slide guards full roof: 70%
- Step ladder not leaned: 51%
- Climb ladders correctly: 64%
Percent of Time Apprentices Reported Safe Crew Behaviors

- Use PFAS: 13%
- Use step ladder correctly: 19%
- Top plate work: 21%
- Walk floor joists: 20%
- Monitor openings/edges: 45%
Questionnaire Results: Fall Statistics

- Falls
  - 16% fell from height in previous year
  - 51% knew someone who had fell from height in last year
  - 29% of all falls were from ladders, 18% truss/top plate, 17% floor openings

- Those who fell
  - Fewer journeymen on site for mentorship
  - 40% more likely to report unsafe crew behaviors
  - Twice as likely to work residential construction
Questionnaire Results

- Risk perceptions by task
  - Steep pitch roofs
  - Setting trusses
  - Working on the top plate
  - Unprotected openings
  - Ladders perceived as low risk

- Confidence is high
  - Feel they can prevent themselves from falling
  - Feel they can perform work tasks safely
Percent of Apprentices who Knew OSHA Standard

- Ext ladder past landing: 59%
- Ht FP required: 72%
- Scaffold FP ht: 80%
- Hole diameter**: 35%
- U platform ht: 36%
- Guardrail force: 50%
- Ext ladder secured: 65%
- Top plate work: 55%
- Overall: 56%
Percent of Apprentices Reporting Trained at School Prior to Performing Task at Work

- Extension ladder: 43%
- Step ladder: 40%
- Pump jack: 70%
- Ladder jack: 55%
- Sheath roof: 26%
- Unprotected edge: 53%
- Set joists: 33%
- Set outside wall: 35%
- Set trusses: 28%
- Use PFAS: 85%
Training Preferences

- Apprentices like
  - Learning by doing
  - Practicing tasks and skills in shop
  - Real world examples and stories

- Apprentices dislike
  - Reading the OSHA regulation book
  - Listening to long lectures
  - Sitting in a classroom
Needs assessment results for ladders

- Most falls occur from ladders
- Ladders used frequently at the worksite
- Most apprentices not trained to use ladders
- Ladder knowledge is lacking
- Ladders perceived least risky work task
- Many unsafe ladder behaviors reported
- Many unsafe ladder behaviors observed
Methods - Phase II

Phase I
Comprehensive Needs Assessment

Phase II
Fall Prevention Training Curriculum Changes
  ➢ Develop
  ➢ Integrate
  ➢ Monitor

Phase III
Evaluation of Effectiveness
Training Priorities - Phase II

- Frequently performed tasks
  - Tasks performed early in career
  - Tasks performed prior to receiving training
  - Tasks reported/observed as unsafe during audits

- Priority tasks include:
  - Ladder use – 9 objectives
  - Floor openings – 6 objectives
  - Truss setting – 8 objectives
  - Scaffold use – 5 objectives
Training Methods

- Use participatory, hands-on learning
- Practice tasks in real-world setting
- Limit lecture & reading OSHA standards
- Present in classroom 1st, then perform in shop
- Share fall stories to personalize
- Use small group discussion to problem-solve
- Focus on attitudes, beliefs, risk perceptions
- Use repetition & reinforcement
- Empower apprentices to identify safe work methods & consistently use them on the job
Target Curriculum Areas

- New apprentices (Introduction)
  - 18 training objectives
- 6 month apprentices (Health & Safety)
  - 8 training objectives
- 1st year apprentices (Residential Framing)
  - 6 training objectives
- 3rd year apprentices (Scaffolding & Rigging)
  - 9 training objectives
## New Apprentice Training

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<thead>
<tr>
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<tbody>
<tr>
<td>Openings</td>
<td>Discuss guardrail</td>
<td>Guardrails – discuss when/where guardrail needed, show how to install safety boot, test to 200#</td>
</tr>
<tr>
<td>Edges</td>
<td>CAZ’s not addressed</td>
<td>Leading edges – show CAZ line, discuss CAZ monitoring, training &amp; restricted access</td>
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<td>Holes – discuss 2” definition of hole, show how to cover hole w/ board &amp; hole coverer</td>
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<td>Brief discussion</td>
<td>Discuss fall stats, sort worksite pictures by risk &amp; discuss in groups, show CPWR fall DVD</td>
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<td>Truss Safety</td>
<td>Discuss in class</td>
<td>In addition to discussion, will point out on prop how to set/secure truss from ladder w/o walking on top plate</td>
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<td>30-min shop training</td>
<td>In shop identify different types of scaffolding &amp; risks associated with scaffold use</td>
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<td>Apprentices choose &amp; apply PFAS</td>
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<tr>
<td>General Fall Protection</td>
<td>OSHA 1926 lecture, fatality pictures, stories</td>
<td>Present fall prevention methods specific to residential construction, choose best fall protection method for various scenarios, CAZ requirements</td>
</tr>
<tr>
<td>PFAS</td>
<td>Lecture, free fall distance computed, instructor demo</td>
<td>In addition to classroom activities each student chooses, inspects, applies PFAS &amp; climbs LJ, attaches to lifeline</td>
</tr>
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<td>Ladder Safety</td>
<td>Highlight in OSHA book, share ladder stories</td>
<td>Share ladder stories, show ladder movie, inspect/set/climb step/extension ladders, discuss how to work from ladders</td>
</tr>
<tr>
<td>Scaffold Safety</td>
<td>Lecture, highlight in OSHA book, stories, pictures</td>
<td>Scaffold hazards shown &amp; discussed, in the shop students climb LJ &amp; tie off, discuss PJ, students erect welded tubular frame scaffold &amp; climb</td>
</tr>
<tr>
<td>Truss Safety</td>
<td>Briefly mentioned</td>
<td>Hook up gable truss &amp; single trusses w/ crane &amp; set in place</td>
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1st Year Apprentice Training

- **Sub-floor framing**: discuss leading edges & covering stairwell opening
- **Wall framing**: discuss guarding window/door openings, covering HVAC holes & not walking ladder blocks
- **Roof framing**: 20-minute discussion of fall prevention methods, fall story shared, show pictures of correct way to set truss, brace & install stay lap, discourage top plate standing
- **In shop**: inform students of safety rules and deduct points from shop grade for all violations
Scaffolding
- Use of ladders, guard rails & PFAS as they relate to scaffolding standards are presented
- Students choose correct size ladder, set, & climb while erecting scaffolding
- While erecting scaffold proper fall practices are used
- Students identify violations in scaffold pictures, discuss what led to the violation, and how to abate the violation

Rigging
- Use of crane, hoists & chain falls practiced in the shop
- Crane setup and truss hook up procedures shown
- Discuss the hook-up, moving & landing of trusses
Monitoring Results - Phase II

- Monitor curriculum delivery
  - Note variations in training each time delivered
  - If change improved training integrate into lesson plans for future sessions

- Monitor objective achievement
  - Initially only 73% in Term 2
  - Modified objectives to be more realistic
  - Overall 90% objective achievement rate

- Continue to modify delivery method and objectives to best meet needs of apprentices and instructors
Focus groups for apprenticeship feedback:
- 96% felt that the prop is an effective training tool
- 81% stated they will change their work habits

Quotes from apprentices:
- “I will use these safety tactics daily, I had no knowledge of them before.”
- “I learned a lot about my own interpretation of risks.”
- “You scared the heck out of me by telling me all the ways I’m going to die!”
Phase III

Phase I
Comprehensive Needs Assessment

Phase II
Fall Prevention Training Curriculum Changes

Phase III
Evaluation of Effectiveness

- Worksite Audits-933
- Questionnaires-200
Percent Reporting Trained at CJAP Prior to Task Performance at Work

* p ≤ .05, ** p ≤ .01

- Extension ladder**: 43, 85
- Step ladder**: 62, 63
- Pump jack: 70, 63
- Ladder**: 71, 55
- Sheath roof**: 67, 40
- Unprotected edge**: 53, 33
- Set joists**: 52, 35
- Set outside wall**: 46, 51
- Set trusses**: 46, 28
- Use personal fall arrest**: 85, 91

Baseline
Follow-Up
Percent Knowing OSHA Regulation

* p ≤ .05, ** p ≤ .01
Percent Reporting Safe Crew Behavior

* p ≤ .05, ** p ≤ .01
Percent of Time Audit Items met Safety Criteria

* p ≤ .05, ** p ≤ .01
Percent of Time Audit Scales met Safety Criteria

* p ≤ .05, ** p ≤ .01
Percent Reporting Fall from Height

- Fell from Height*
  - Baseline: 164 = 16%
  - Follow-Up: 118 = 13%

- Knows someone who fell**
  - Baseline: 516 = 51%
  - Follow-Up: 414 = 44%

* p ≤ .05, ** p ≤ .01
Conclusions

- Falls from heights are common in construction.
- Despite training & mentorship, apprentice carpenters lack fall prevention knowledge.
- Unsafe behaviors at heights are common.
- Instructors can develop training to address knowledge gaps & change behaviors.
- Training can result in improved safety when working at heights.
- Using needs assessment to drive intervention was an effective method to drive training.
- Methods can be replicated.
What’s next?

- Monitor long-term effects of curriculum
- Develop worksite based fall prevention training & foreman mentorship program to decrease falls
  - Use needs assessment to identify current state
  - Develop 1-day foremen training
  - Measure effects of training on fall behaviors
- Increase use of fall prevention technology
  - Measure current use of residential fall technology
  - Pilot fall prevention devices
  - Measure effects
- Disseminate our methods, tools, and results
  - SAFR on the eLCOSH website [www.cdc.gov/elcosh/](http://www.cdc.gov/elcosh/)
Discussion