# Minnesota Machine Guarding Program

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# Purpose

- …evaluate the effectiveness of a peer-based technical and educational intervention designed to reduce exposure to amputation and other machine-related hazards in small machining/metal working shops.

# Background: Health and Safety in Small Business

- Businesses with fewer than 100 employees are responsible for the employment of 56% of the U.S. private industry workforce
- Approximately 98% of the 6.5 million private U.S. businesses have fewer than 100 employees
- 87% have fewer than 20 employees.
- Employers are reluctant to contact OSHA consultative services.

# Epidemiology

- Amputations are serious injuries which are largely preventable and cause considerable disability and emotional trauma.
- Surveillance data indicate that the lack of safeguards was the most common contributing factor for amputations caused by stationary machinery and hand tools.
- In the United States, it is estimated that 9,000 workers suffer a work-related amputation each year.

# Recruitment Eligibility Criteria

- Select SIC codes
- At least five shop workers
- No more than 100 total employees
- In business for at least one year
- Allow the assessment of the shop at the start of the intervention and one year later

# Shop Assessment

- Machine evaluation
- **Business safety scorecard**

# Business safety scorecard

- A 25-question business safety scorecard was used to audit:
  - (1) general safety conditions (e.g., lighting, safety bulletin board);
  - (2) administrative and management policies (e.g., safety committee meeting minutes); and
  - (3) work practices (e.g., use of protective eyewear, documentation of employee training).

# Worker Assessment

- Pre-and post-intervention evaluation
- Theory-based survey assessing social and environmental issues that may impact safety
  - Social Cognitive Theory
    - Environment
    - Reinforcement
    - Self-efficacy
    - Situation

# Definition of constructs from Social Cognitive Theory

- Environment: Ten questions were used to evaluate perceptions about safety equipment, training, and management support for and commitment to safe work practices.
- Reinforcement: We included four questions to measure perceptions of business policies and procedures that promote safe work practices.
- Self-efficacy: Nine questions were used to measure the levels of confidence about the ability to work safely, identify safety-related problems, and communicate safety concerns.
- Situation: Four questions assessed perceptions of how machine guarding and safety procedures impact the ability to perform and complete job tasks.

# Survey responses

- Questions were answered on a scale ranging from one (strongly disagree) to five (strongly agree).
- Wording of survey questions was adjusted for the respondent (employees or owners/managers).
- Content validity was evaluated using structured interviews with Board members and employee groups.
- Surveys were translated into and evaluated in Spanish.

# Analysis

- Analysis included basic descriptive statistics and the comparison of means using chi-squares. Multiple- and stepwise-logistic regression were used to evaluate the relationship between a business' safety audit results and its average employee and owner construct scores.
- In these latter analyses, the dependent variable was a dichotomous indicator of the presence or absence of a positive response for each item on the business safety scorecard.

# Results: study population

- Forty businesses were enrolled representing approximately 75% of invitees.
- Follow-up was approximately 95%
- Businesses employed an average of 47 employees (range 5–131).
- Of the 231 owners and managers, 156 (68%) completed baseline surveys.
- Of a total of 1,437 production employees, 939 (65%) completed baseline surveys.
- Of the 18% of employees for whom English was not a first language, 61% spoke Spanish.

# Results: worker and owner surveys

- Owners reported higher perceptions of all four constructs.
- Employees and/or owners and managers with less education, less work experience, or for whom English was a second language responded more positively than did their more educated or experienced peers.
- A positive and significant correlation was found between average employee and owner/manager survey responses for two constructs: environment ($R^2 = 0.17$, $p < 0.001$) and reinforcement ($R^2 = 0.39$, $p < 0.0001$).
- Native English speakers tended to have lower construct scores than those for whom English was a second language or who completed their surveys in Spanish.

# Business safety score

- The average business safety score was 65% (SD = 15.4%; range = 44–96%).
- Statistically significant relationship between the number of employees and the business safety score ($p = 0.04$).
- Businesses with safety committees had significantly better average business safety scores (71/100 points) compared to those with no safety committee (55/100 points; $p = 0.0003$).
- No significant relationships were found between business safety scores and personal demographic variables

# Factors impacting safety scores

- Businesses with lockout/tagout records had a better than average business safety score (72 of 100 points) compared to businesses without such records (54 points) ($p < 0.0001$).
- The presence of machine-guarding training records and machine-guarding procedures were associated with higher business safety scores ($p < 0.05$).
- Using regression analyses, the demographic variables of education, union status and business size were not significantly associated with any of the four constructs.

# Odds ratios for a positive response on business safety scorecards and construct responses

- When all four constructs are included in the model, none are significant. This might be due to the fact that the four constructs are strongly correlated. For example, the Pearson correlation coefficient ranges from 0.84 ($p < 0.0001$) for environment and reinforcement to 0.49 ($p = 0.0012$) for situation and self-efficacy.
- Results for the step-wise model suggest that environment is the only survey variable associated with positive audit results; for every increase in perceptions of environment the proportion of positive safety audit items increases by 3.7 times.

# Odds ratios for a positive response on business safety scorecards and different shop factors

- Businesses with safety committees had 1.7–2.1-times greater likelihood of positive items on the safety audit than those without committees.
- Union status and business size were not associated with safety audit results in any of these models.

# Conclusions

- Larger business size and the presence of a safety committee were associated with significantly higher levels of business safety.
- Step-wise regression indicates that perceptions of environment and the presence of a safety committee are the strongest predictors of high business safety scores.
- The environment construct was predictive of a safer working environment.
- Owners need to consider how management practices are likely to influence workplace health and safety, and find ways to engage employees in the health and safety process.