Minnesota Machine Guarding Program

David Parker, MD, MPH
Lisa Brosseau, Sc.D
Yogi Samant, MBBS.
Wei Pan, Ph.D
Min Xi, Ph.D
The Advisory Board

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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.
- In the United States, it is estimated that 9,000 workers suffer a work-related amputation each year.

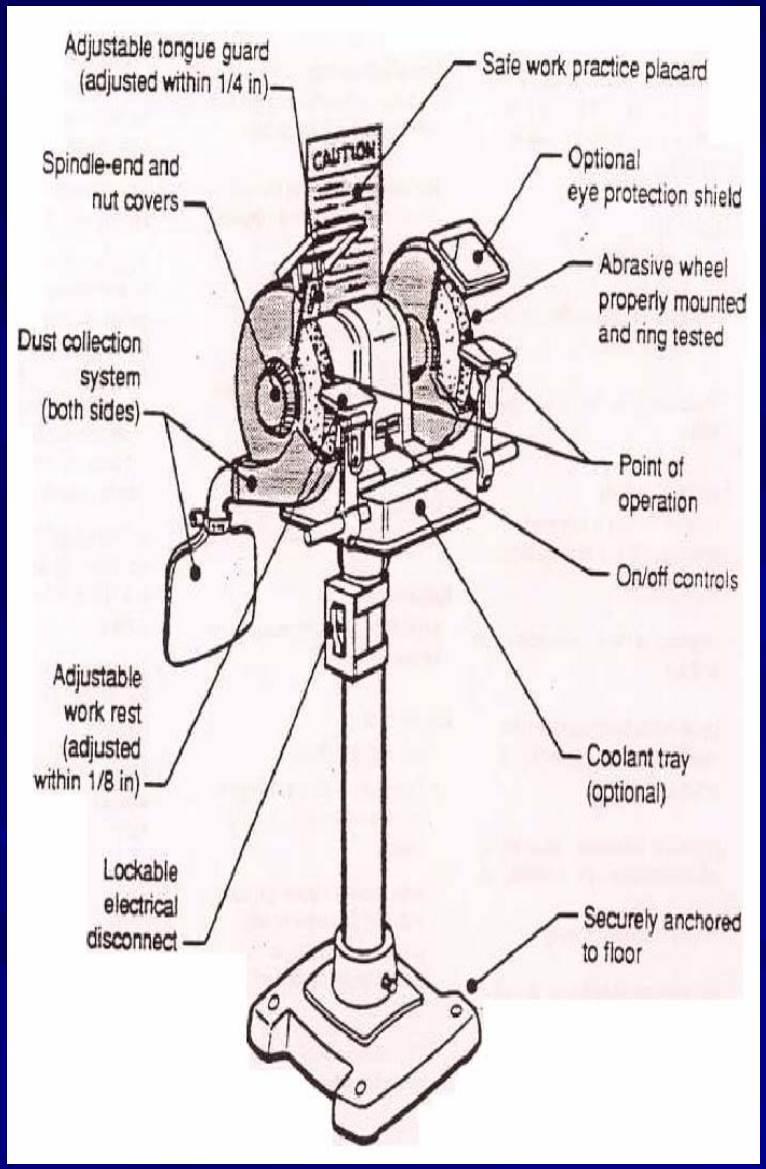
Recruitment Eligibility Criteria

- 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**

Machine safety score card: Pedestal Grinder Checklist



	Yes	No	Priority[a]
Tongue Guard			**1**
• Present	☐	☐	--1---
• Distance from wheel not more than ¼ inch	☐	☐	--2---
• Good condition (no cracks, clean)	☐	☐	--1---
• Yellow color	☐	☐	--3---
Tool-rest			**1**
• Distance from wheel not more than 1/8 inch	☐	☐	---1--
• Good condition (no cracks, broken pieces, and modifications[b])	☐	☐	---1--
• Yellow color	☐	☐	---3--
Moving Parts (belts, pulleys, chains, sprockets) guard			**1**
• Guard present	☐	☐	---1--
• Guard yellow in color	☐	☐	---3--
• Moving parts orange in color	☐	☐	---3--
• Guard in good condition (no cracks, clean)	☐	☐	---1-
Abrasive wheel			**1**
• Good condition (not cracked, ringed test okay) – can assume this if operator says that the ring test is performed regularly, and can correctly explain the procedure for the test.	☐	☐	--1---
• Coasting time less than 1 min after the power is shut off	☐	☐	--3--
• RPM adjusted each time wheel is changed (i.e., the rated speed of the grinding machine does not exceed the rated speed of the grinding wheel)	☐	☐	--1--
Wheel guard (spindle/nut/flange guard)			**1**
• Guard present	☐	☐	---1--
• Guard yellow in color	☐	☐	--3--
• Spindle, nuts, flanges orange in color	☐	☐	-3---
• Guard in good condition (no cracks, clean)	☐	☐	--1--
• No more than 90° exposure of wheel	☐	☐	---1--
• Exposure begins at a point not more than 65° above the horizontal plane of wheel spindle	☐	☐	---1--
Eye Shields			
• Present	☐	☐	---2--
Operational controls			**1**
All legibly marked	☐	☐	---1-

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).

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.

Comparison of two intervention groups

- There were minimal differences between shop characteristics in the two intervention groups.
- There were similar numbers of shops in the two leading SIC codes 34 (fabricated metal products) and 35 (industrial and commercial machinery).
- Twelve out of 40 shops (30%) were unionized, six in each group.
- There were similar numbers of shops with safety committees in each group.

Baseline machine and safety scores

- No differences were seen between the two groups for either the machine or business safety scores.
- The baseline average machine score was 63% in the owner-employee group and 64% in the owner only group.
- The average business safety scores were 66% and 64% respectively for the owner-employee and owner only groups.
- These scores indicate that machine guarding and related safety programs were frequently missing or inadequate.

Machine scores

- When stratified on the median score, we found the largest improvements in businesses in the owner-employee group that started with the lowest scores (7.5; SD = 5.7%) followed by businesses with no baseline safety committee (7; SD = 6.2%).
- Businesses in the owner intervention group that had the lowest baseline score experienced the greatest changes (5.0; SD = 3.2) followed by businesses with a union (4.6; SD = 2.3%) and those with a safety committee (4.5; SD=2.1).

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; $p = 0.0003$).

Multi-variate models

- The fixed effects included the difference between baseline and follow-up machine scores or business safety levels, safety committee (present or absent), shop size (<25, >=25), and union status (present or absent).
- The presence of a safety committee had the greatest influence on improvements in machine and business safety.
- The presence of a safety committee had the largest effect on business safety levels.
- None of the other variables was a significant modifier of machine or business safety.

Conclusions

- This study confirmed our ability to significantly decrease machine-related hazards and to improve machine-related work practices.
- The 10% target for change represents a meaningful improvement in machine guarding and related safety practices.
- The greatest changes in machine safe guards were in businesses that had the lowest baseline measures.
- The magnitude of changes seen in the business safety score indicates the apparent ease with which important administrative programs were remedied.
- For example, at baseline there was evidence of bypassing machine guarding in 19% of business compared with just under 5% at follow-up ($p > 0.05$).