

Preventing the burden of workplace musculoskeletal disorders: What do we know about what works?

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Lecture 2006**

SHARP | Safety & Health Assessment
& Research for Prevention

Promoting Safer, Healthier Workplaces



<http://lni.wa.gov/Safety/Research/>

Washington State Department of Labor and Industries, USA

Background: Upper extremity musculoskeletal disorders

big problem, high workers' compensation costs, lost time, and reduced earnings for many years.

*	<u>UE</u>	<u>RCS</u>	<u>Epi</u>	<u>CTS</u>
Average #	14,567	2,348	1,578	3,007
WC Average cost	\$10,448	\$27,689	\$10,790	\$19,851
Median cost	\$730	\$ 4,980	\$1,081	\$6,415
Lost time Average	207	296	246	232
Median	62	120	80	85

*1995-2003 Washington State Fund, SHARP TR 40-9-2005

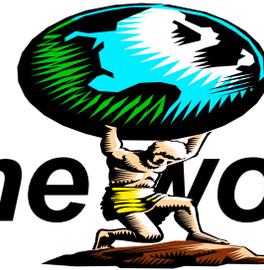


Roadmap



- Introduction with biases and caveats
- What do we know? Summary of intervention studies
- What do we do in the face of uncertainty?
- Research and politics

Two views of the world

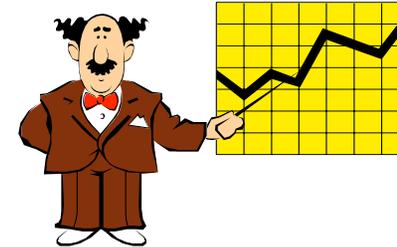


Cure Disease



Why did my patient get this disease?

Find causes of disease



Why does this population have so much disease?

Clinical trials

Epidemiology

Population studies

Medical thinking largely concerned with responding to the needs of sick individuals

Public health thinking focuses on the distribution of health and disease in populations to identify factors/behaviors that can improve health for the population

Comparisons are critical



Science and Practice

What do we know about acute back pain management? Benign & self-limiting, Bed rest & inactivity rarely help (AHRQ guidelines)

- What do medical practitioners advise? Webster et al, JOEM 2006
 - ER physicians least likely to order diagnostic studies but advise inactivity
 - Occ Med physicians less likely to order diagnostics but more likely to advise activity
 - Longer in practice, less likely to advise activity
- 2 Canadian provinces with back pain: 49% avoid activity, 13% go to bed (Gross et al, Spine,)



Changing Practice

Planned change

Technical features: hardware/software (how complex in terms of scope and sophistication?)

Implementation features: The more people affected, more required to change behavior, the greater the focus needs to be on implementation features.

Power: How much “voice” do those required to change have?

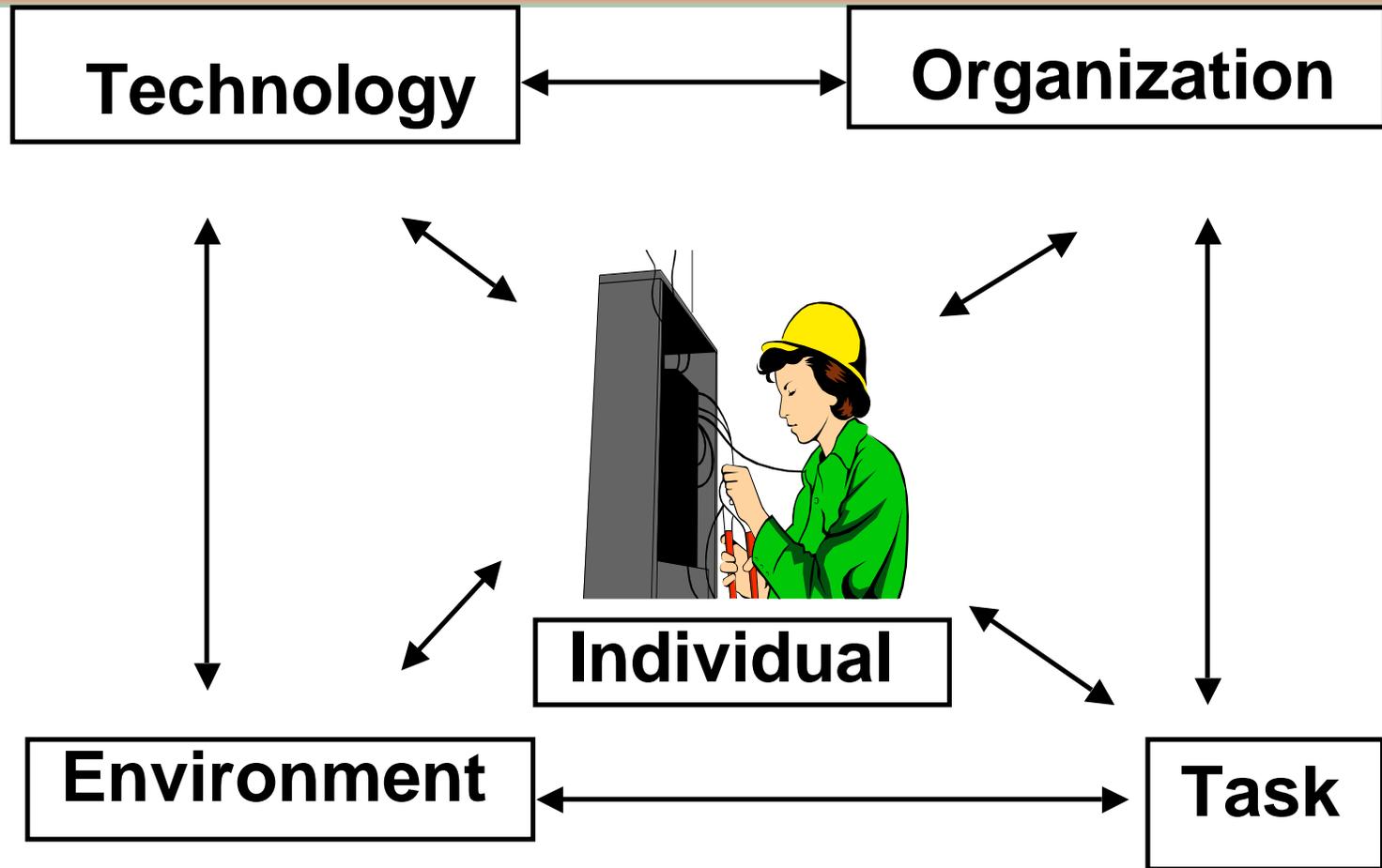


Making the Connection with Intervention Studies (when life was easy)

- **exposure prior to effect**
- **decrease exposure → decrease effect**
- **increase exposure → increase effect**
- **nothing else explains the change**



Which components of the work system are considered in the intervention?



Basic Issues in Intervention Studies

Is the study population representative of the population you want to generalize to?

Comparison

Selection bias

Measurement bias

Confounding (associated w disease & exposure)

Power to detect a significant difference

Appropriate statistical analysis





What to do?

What do we think we know?

What do we do in the face of uncertainty?

What is different about workplace intervention studies?



Treating complaints of the arm, neck & shoulder: ergonomics & physiotherapy

Verhagen 06a

Systematic review (Cochrane registers, other databases 3/05)

21 trials/ 25 interventions, non-randomized controlled trials:
“work-related”: 2 CTS, 1 shoulder impingement, 17 chronic nonspecific complaints (n=12-135 subjects)

- **Exercises** (14) limited evidence compared to massage, conflicting compared to none (8)
- **Massage/manual therapy** + exercise (2) Limited evidence
- **Strength & endurance exercise** (4): no difference
- **Breaks** during computer work (1): limited evidence
- **Some keyboard designs** (1+, 1-) Limited evidence
- **Ergonomic programs** (2) Conflicting evidence

One high quality study positive for intensive ergo guidance in office environment. One low quality PT/ergo study showed no difference



Treating complaints of the arm, neck & shoulder: ergonomics & physiotherapy

Verhagen 06c

Generally poor quality studies

- unconcealed randomization,
 - unblinded participants,
 - no “intent to treat” analysis:
-
- *Heterogeneity of participants, interventions & outcomes,*
 - *low power,*
 - *unclear work-related definitions*
 - *Length of follow-up short*

Conclusion: “ The benefit of (expensive) ergonomic interventions in the workplace is not clearly demonstrated.”

Did any of these studies look at the work system?



Keyboard use & MSD outcomes

among keyboard users Gerr, Occ Rehab 2006

1966-2005: 39/558 papers (included epi studies)

- Most consistent finding-association between hours of keying & hand/arm outcomes
- Keyboard below elbow height, limiting head rotation & resting arms associated with less neck/shoulder outcomes
- Minimizing ulnar deviation, keyboard thickness associated with less hand arm outcomes
- Methodological limitations: Heterogeneity of studies, potential biases



RCTs: computer workers, 1999-2005

- Participatory training & workstation modification ↓ problems in younger workers (Brisson)
- Intensive **ergo training & participation** ↓ symptoms in the short term, but not long term (contamination) (Ketola)
- No difference in symptoms with **simple workstation changes** after 3 months (Mekhora)
- No difference in symptoms with software **stimulated breaks and microbreaks** (van den Hout)
- **Training + chair** ↓ symptoms in office workers (Amick 2003)
- No difference in symptoms incidence: **Self-adjusted workstations, posture instruction** (Gerr 2005)

Visual & musculoskeletal symptoms & disorders among computer users

IWH Systematic Review 2006

Moderate evidence

- No impact of workstation adjustment, rest breaks with exercise
- Positive effect of alternate pointing devices

Mixed evidence

- Ergonomic training, arm supports, alternative keyboards, rest breaks, screen filters

Insufficient evidence

- Exercise, stress management ergo + adjustment, new chair, lighting + adjustment + glasses, eyedrops, VDT glasses



Participatory Ergonomics RCT in a regulated environment, Straker et al 2004

117 small-medium size workplaces audited under Australian Manual Handling Regulation

48 randomized, 31 participatory ergo program

- 4 sessions over 3 months (4 hr training)
- using risk assessment tool,

Follow-up 9 months

Significant **decrease** in manual handling task risk and better compliance in experimental group

Change in health effects not reported



Participatory Ergonomics

IWH Systematic Review of 23 studies, 2005

9/10 studies with medium or higher quality related to health outcomes reported positive effects (had different foci)

“Partial evidence”

- Small positive impact on musculoskeletal symptoms
- Positive impact on reducing injuries & WC claims, lost workdays or sickness absence

Note: Straker RCT study (2004) reduced hazards in MH regulated workplaces (health effects not reported)



Workplace RCT in Aluminum

Workers, Morken et al 2002 (a)

Large sample size (thousands)

Intervention: participatory ergonomics approach
training, coping, psychosocial factors

- 3 intervention groups: supervisors only, workers only, workers & supervisors. 2 control groups

94% had symptoms 12 months prior to baseline

Changes: redesign, aids and tools, reduced repetitive motion, increased job variety

Results: psychosocial parameters: no change
coping skills increased for workers group only
no significant reductions in symptoms in any intervention group.

What happened???



Workplace RCT in aluminum workers, Morken et al 2002 (b)

Behind the scenes: *What happened???*

Contamination between control group A and intervention groups

Follow-up survey: completed almost immediately after interventions

Restructuring of the 8 plants took place while the interventions were being implemented, perhaps overwhelming modest job improvements

Important to document planned and unplanned changes



Systematic Reviews: Low back pain primary prevention RCTs (2004)

Van Poppel et al (2004): 1997-2002,
Tveito et al (2004): 1980-2002

- ✓ No evidence for lumbar support
- ✓ No evidence for education
- ✓ Limited evidence for exercise on sick leave, cost, episodes
- ✓ Limited evidence of multidisciplinary intervention on pain
- ✓ Moderate evidence of pamphlet treatment on sick leave, episodes



Patient Handling: What do we know?

- Research has shown that manual patient handling increases risk of injury for care givers and patients
- Injury statistics shows manual patient handling is dangerous to caregivers and patients
- Even with 'good' lifting technique, it is not possible to lift patients manually without exceeding NIOSH Action Limit



Mechanical lifting devices are essential



Systematic Reviews: Patient Handling & WMSDs

Hignett (2005) (1960-2001) n=63

Moderate evidence (10) for multifactor interventions based on risk assessment, not based on risk assessment (4)

- ✓ Moderate evidence for single factor intervention (provide equipment) (2), lift teams (3)
- ✓ Strong evidence of no effect of technique training (4), moderate (8)

✓ *3 more studies showing positive impact of programs & mechanical lifts (2003-2005)*

When is there enough information for action? Washington State

Most consistent evidence for decreasing lifting in health care, few RCTs

Nursing homes have highest back claims rates, hospitals high also

RN shortage is acute in hospitals

Sicker, older, heavier patients vs. aging nurses

4 nurse legislators

All hospitals have unions, few in nursing homes



Washington State SPH Legislation for Acute Care Hospitals (EHS1672), 2006 (a)

- SPH Committee (1/2 care staff) develop SPH program
- Training
- Assessment
- Minimum 1 handling device per 10 acute care beds/unit
- Right to refuse unsafe handling
- Annual evaluation
- Provides incentives for implementation
 - Tax credit
 - Reduced workers compensation premium class
 - Department of Health audit
 - Evaluation

Legislation supported by both labor and business



Washington State SPH Legislation for Acute Care Hospitals: Dates (EHS1672), 2006 (b)

- *1/1/07*: new WC premiums for fully implemented SPH
- *2/1/07*: establish SPH committee to recommend implementation process
- *Dec 1, 2007*:
 - establish program (policy all shifts/units: phase-in equipment)
 - Hazard assessment (tasks, units, population, physical environ)
 - Process to identify appropriate use
 - Annual performance evaluation of program
 - New or remodeling: consider lifts, tracks, storage
- *12/30/10*: complete equipment, train staff annually
- *12/30/10*: end of \$1,000 tax credit/ acute care bed for equipment
- Right to refuse risky manual handling
- *2010 & 2012* evaluation report to legislature



Public Policy and WMSDs in Washington State

In Washington State: WMSDs account for

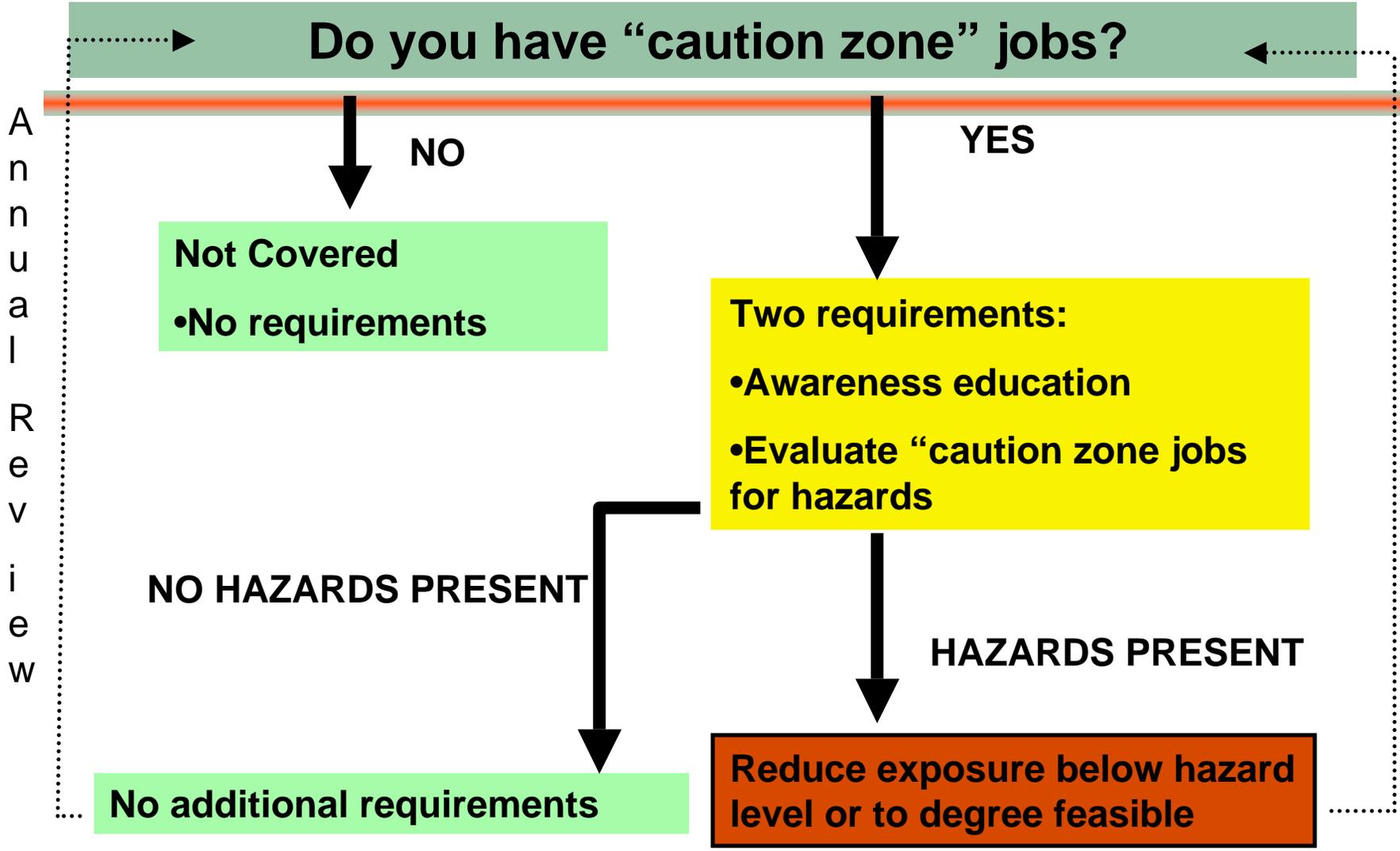
- More than 30% of workers compensation claims
- More than 40% of costs

Ergonomics rule to find and fix WMSD hazards,
with long phase in by size and industry

- Developed (including CBA) and implemented in 2000
- Repealed in 2003



Washington State Ergonomics Rule: Outline



First to Comply: Large Employers (>50 FTEs) in Top 12 Industries by Prevention Index

- Trucking & Courier Services
- Nursing & Personal Services
- Masonry, Stonework
- Air Transportation Scheduled
- General Contractors-Residential
- Roofing
- Carpentry & Floor work
- Residential Care
- Grocery Stores
- Concrete Work
- Landscaping & Horticultural Services
- Sawmills
- *Dept Labor & Industries*



Employer Surveys: changes in employer views, actions, costs

- 10,000 workplaces selected in industry/size weighted samples (6%) based on ergonomics rule implementation requirements

Response

Rule Requirements

- | | | |
|--------|-----|----------------------------|
| • 1998 | 75% | pre |
| • 2001 | 62% | none |
| • 2003 | 62% | identify hazards, training |
| • 2005 | 59% | Fix hazards Group 1&2 |

64% reported WMSDs in last 3 years in Group 1 whereas 12.8% reported in Group 4 in 2005.



Employer Survey Focus

- # of WMSDs in last 3 yrs
- # of employees exposed to different risk factors (duration/frequency)
- Taken prevention steps (yes/no –why)
- Results of efforts
- Ergonomics activities
- Where go for assistance



Percent of Employers with Any Employees Exposed

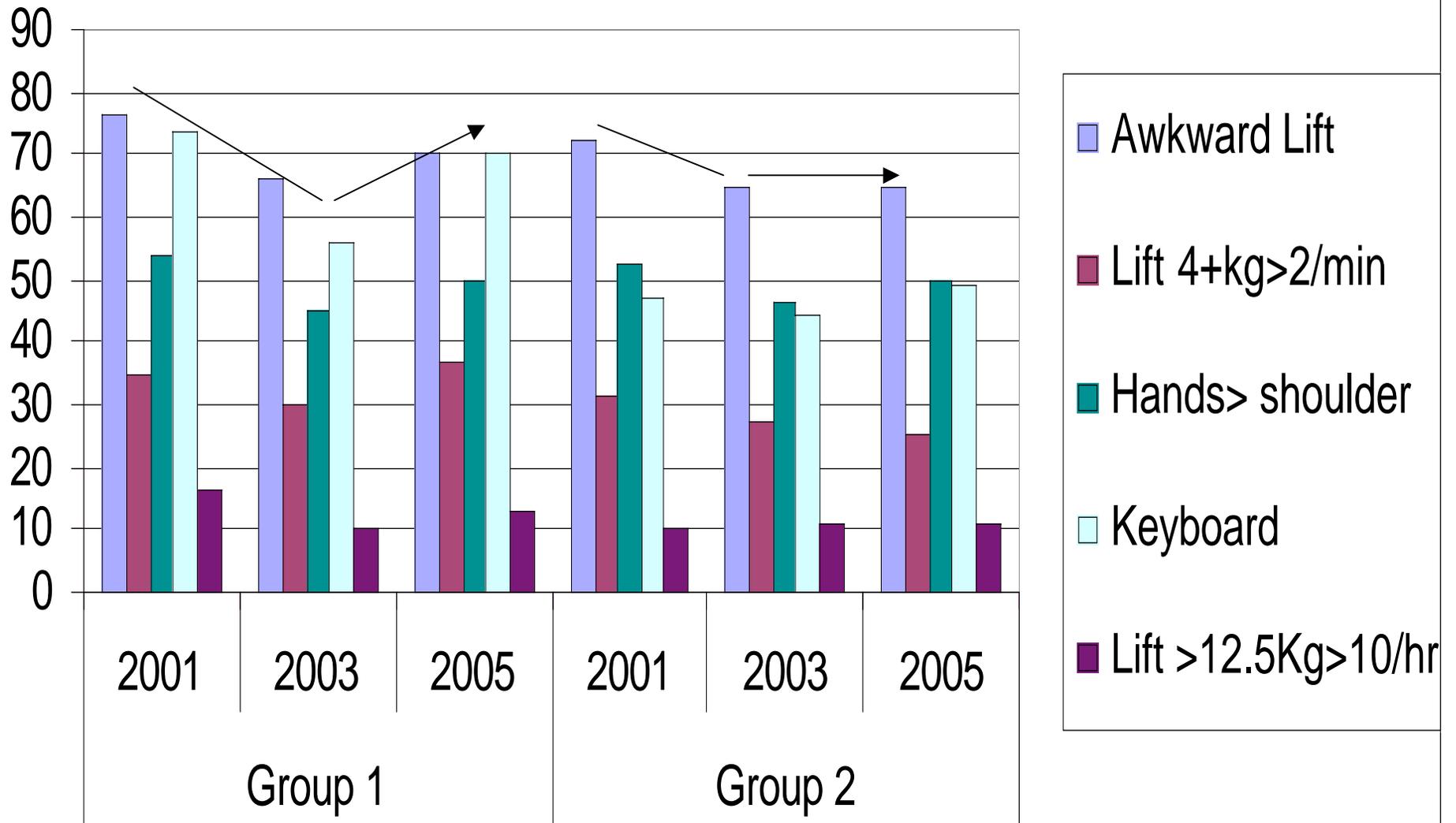


Figure 1. Exposed > 4 hours by Year

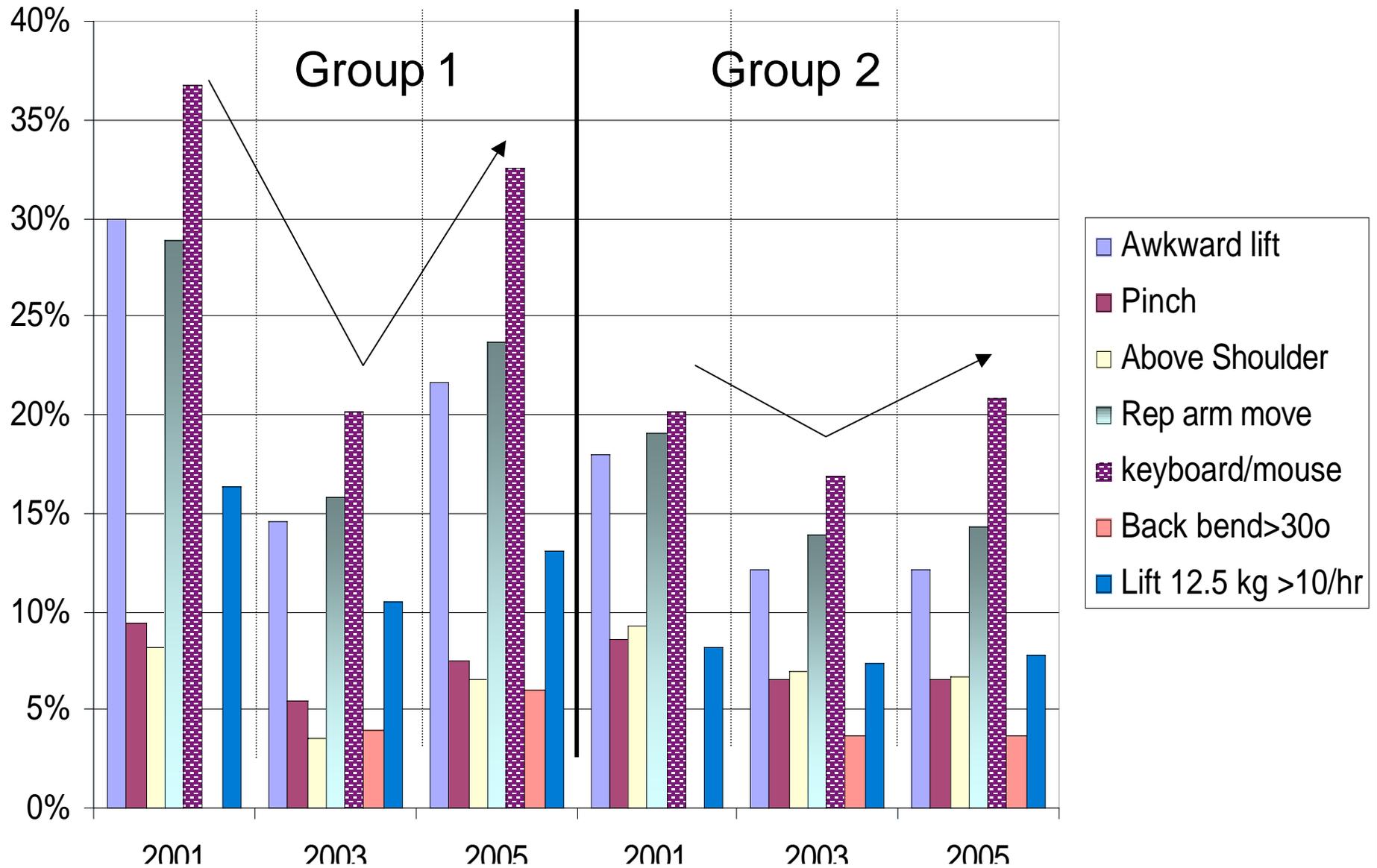


Figure 2. Ergonomics Activity by Rule Group

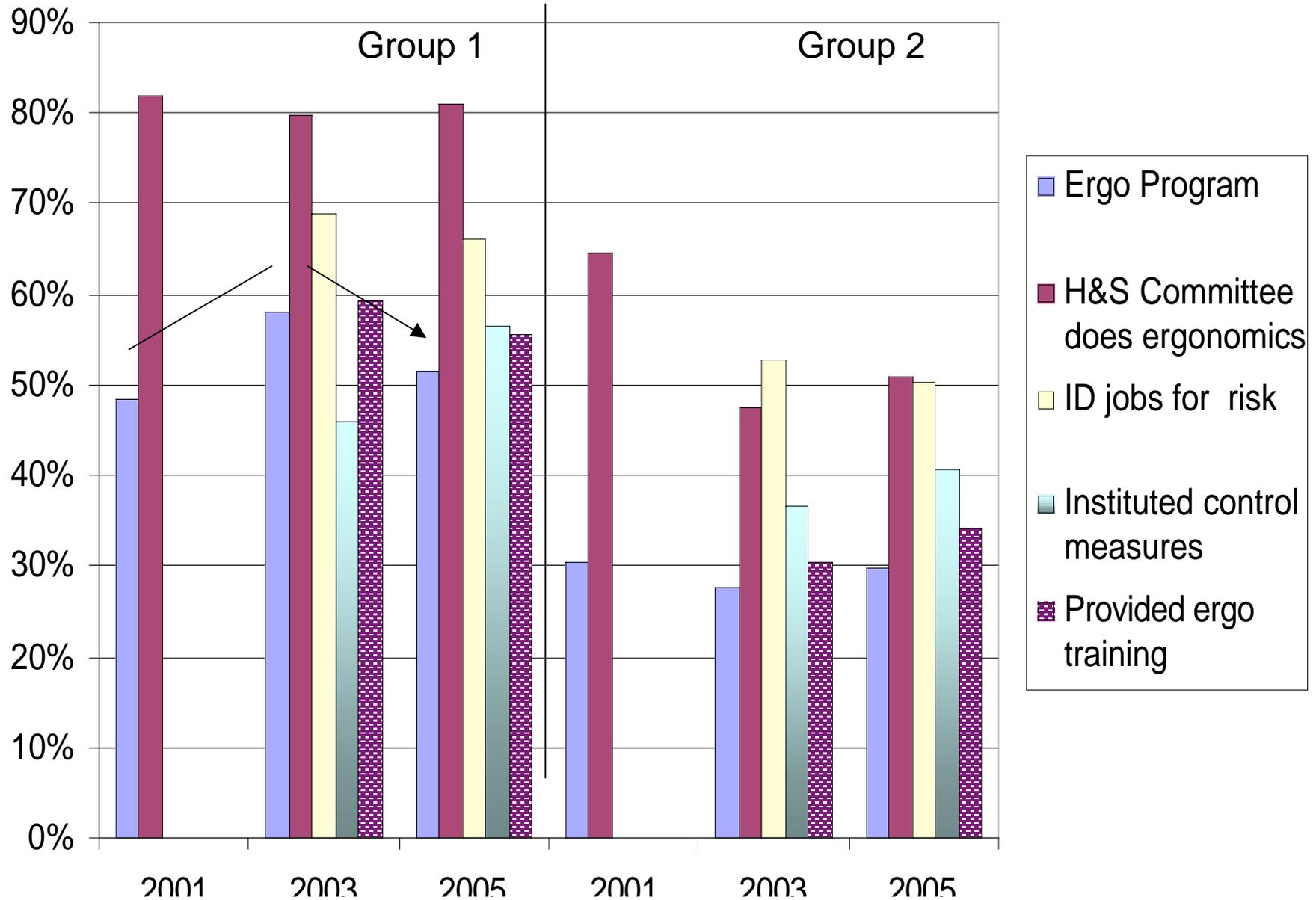
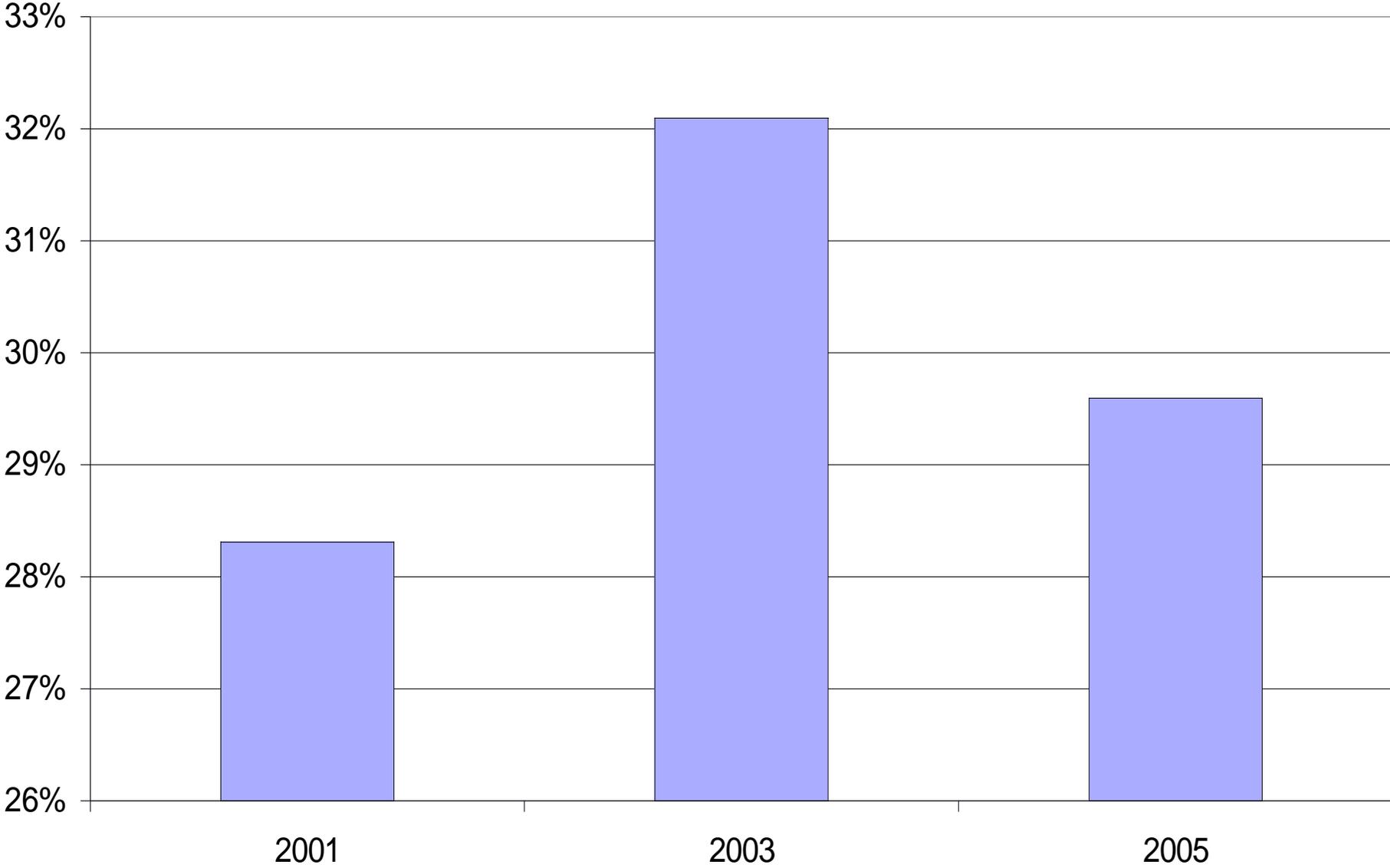


Figure 3. % with WMSDs Taking Steps



Assumptions in Ergonomics Rule CBA

(a) 1/3 of jobs “caution zone”, 1/6 “hazard zone”

Initial rule mgmt review:	sm 2 hr, lg 6 hr
Rule review-safety comm	sm 1 hr, lg 8 hr
Job identification	5-10 min/job
Job analysis	1-5 hr mgmt, ergo, 0.5 ee
Awareness education	1 hr ee, instructor
Hazard job training	1 hr ee, 2 hr instructor
Train evaluator	12 hr class, \$250 fee
Find & Fix jobs	2-16 hr ee, supervisor, 0-8 hr consultant
Program management	sm 6hr/yr, lg 40 hr/hr



Assumptions in Ergonomics Rule CBA (b)

32.8% pop in “caution zone”, 16.8% in “hazard zone”

- 10 yr annualized costs (eng & admin controls, job ID, job analysis, job hazard training)
- 3 yr annualized costs (ergo aware) & 5 yrs (job review)
- Mgmt costs computed as recurring annual values
- 5% discount rate used to discount future costs & benefits,
- Population: 1:Entire workforce, 2: caution, 3: hazard
- 2 & 3 digit SIC occupations reviewed by ergonomists for exposures, 1993 OSHA process survey, case studies, etc. to estimate population exposures. Control costs per job from OSHA 1999 PRIA
- Wages from BLS and ESD



Estimated Worker Population Affected by Industry (in thousands)

	Level 1	Level 2	Level 3
Agriculture	74.7	20.7	17.8
Mining/Construct	108.1	34.2	22.9
Manfg-nondur	134.2	27.1	20.5
Manfg-durable	238.2	153.6	68.1
Transport/Utility	155.1	61.1	30.6
Whole/retail trade	491.7	167.4	94.8
FIRE	111.2	24.9	11.7
General Service	206.1	57.0	9.3
Professional Svs	476.5	104.4	14.9
Public Admin	133.5	48.4	30.2
TOTAL	2,129.7	698.9	359.0

Fulltime equivalent employees



Annualized Total Estimated Costs by Industry \$

	Total (m)	Per EE	Per Estab	% profits
Agriculture	4.7	63	429	2.5
Mining/Construct	13.7	127	777	1.4
Manufac-nondur	4.0	30	956	0.2
Manufac-durable	11.8	50	3,237	0.4
Transport/Utility	8.7	56	1,608	1.1
Whole/retail trade	14.9	30	435	0.4
FIRE	2.2	19	216	0.1
General Service	5.8	28	314	0.4
Professional Svs	9.9	21	212	0.5
Public Admin	4.8	36	5,659	
Total	80.4	38	529	0.4

Engineering/admin controls =67% costs



Social Benefits: Reduction in WMSD Costs

- Workers compensation expenditures (1995-97): average **\$410.3m**
- Long-term wage loss
- Taxes & fringe benefits
- Indirect employer costs **\$308m**
- Unreported WMSDs: **\$102m**
Effectiveness rate
- Unquantified benefits
(household losses, relationships, social roles-not monetized)

Full Productivity Losses associated with WMSD indemnity payments:

Full Wage & Fringe Benefits: \$903 million

WC admin costs: \$30 million

Total: \$933 million

Medical & admin, unreported, indirect employer **\$1.6 billion**



Ergonomics Rule CBA 2000:

4.2:1 Benefits:Costs

Estimated WMSD costs/year	\$1.6 billion
Estimated annualized compliance costs for all businesses	\$80.4 million (\$38/employee)
Social benefits (annualized) 40% decrease in WMSDs 50% decrease in costs	\$340.7 million

Estimated rule effectiveness

Surveys showed 30-50% exposure reduction 2001-2003 (id hazards, train employees in place)



Estimated cost of NOT having the ergonomics rule fully implemented

- ✓ WMSD claims rate has not been decreasing as fast as other claims
- ✓ Severity (LWD rate) and cost increasing in 2004
- ✓ Present value annualized net benefits ~\$260 million/year over 10 years.
- ✓ Only 10-15% **fewer** employers reporting hazard level exposure reduction in 2005 survey, thus 15% (*vs. estimated 50%*) cost reduction could be hypothesized: **~\$182 million** annualized present value [$0.7 * \$260m$] including partial implementation costs has been **lost per year**



Discussion

- Extended rule controversy overwhelmed phased-in implementation process
- Some reduction in exposure seen between 2001 & 2003 and then reversal
- Social costs of not reducing exposures present a significant burden to society

Special Thanks to Michael Foley, SHARP
research economist



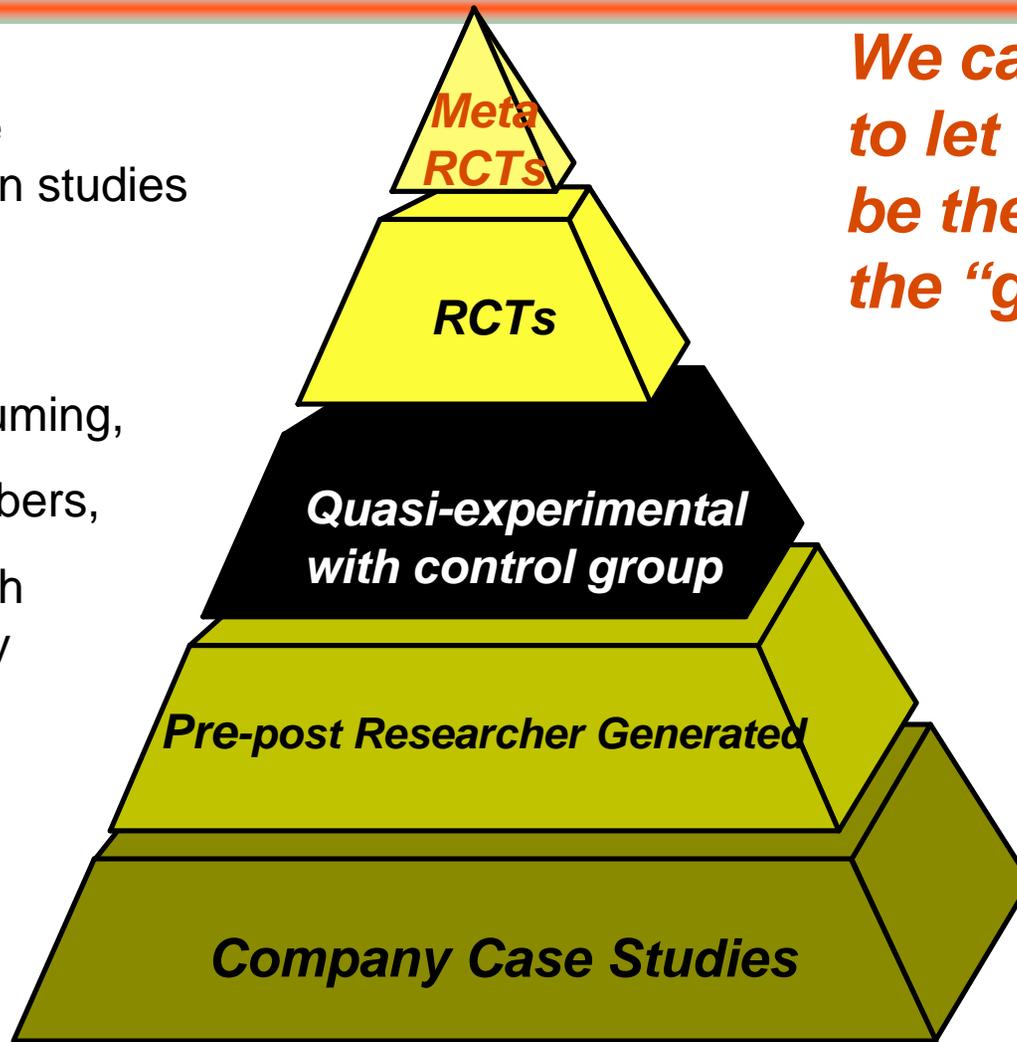
Conclusions: Absence of evidence ≠ evidence of absence

- Much progress has been made in strengthening intervention study designs, more needed
- All designs face possibility of being overwhelmed by external factors
- Primary prevention interventions addressing multiple components continue to be the most promising, difficult to assess individual components with a “shotgun” approach.
- Individual tool/technology intervention studies are hampered by small samples and short durations
- Need to use a hierarchical approach for workplace intervention studies



Hierarchical approach to intervention studies (Zwerling et al, 1997)

Workplace intervention studies are costly, time consuming, small numbers, fraught with uncertainty



We cannot afford to let the “perfect” be the enemy of the “good”



Science & Public Health Acting in the face of uncertainty

"All scientific work is incomplete...All scientific work is liable to be upset or modified by advancing knowledge. That does not confer upon us a freedom to ignore the knowledge we already have, or to postpone the action that it appears to command at a given time."

Sir Hill, 1965