

Ergonomics Rulemaking

Dissecting OSHA's cost-benefit analysis offers insight for future rulemaking

By Dong-Chul Seo and Earl Blair

MMUSCULOSKELETAL DISORDERS (MSDs), such as carpal tunnel syndrome, tension neck syndrome and low back pain, are the most prevalent and expensive work-related injuries in the U.S. (NIOSH; Wright and Howard 4). Also referred to as cumulative trauma injuries and repetitive motion disorders, MSDs are injuries and disorders of the muscles, tendons, ligaments, nerves, joints, cartilage and supporting structures such as spinal discs; these injuries account for at least one-third of all work-related injuries [OSHA(b); NIOSH; Bird(b) 2; Ergoweb 4; Melhorn 107; MDLI]. According to OSHA, 1.8 million workers report work-related MSDs and about 600,000 workers miss work due to MSDs each year [AFL-CIO; CNN(b); OSHA(b) Chapter 1]. These disorders cost employers \$15 to \$18 billion a year in direct workers' compensation (WC) costs—or about one of every three WC dollars [CNN(a); OSHA(b) Chapter 1; Wright and Howard 4].

Controversial Rulemaking

Considering the sizable damage caused by MSDs and technical feasibility of ergonomics, OSHA began working on ways to prevent repetitive stress injuries in 1979 and accelerated its efforts in the early 1990s [Ergoweb 2; OSHA(a); CNN(b); MDLI]. The agency published its final ergonomics standard on Nov. 14, 2000. It took effect Jan. 16, 2001, but President George W. Bush signed a repeal of the standard into law on March 20, 2001, after Congress passed a Joint Resolution of Disapproval, invoking the Congressional Review Act of 1996 [OSHA(a); Watchman 26; CNN(a)].

Opponents emphasized the excessive cost of the rule. "It is the most expensive, intrusive regulation ever promulgated, certainly by the Dept. of Labor, maybe by government entirely," argued Sen. Don Nickles (R-OK) [CNN(a)]. The U.S. Chamber of Commerce and Bird asserted that the standard would cost the business community \$129 billion in the first year of its implementation and more than \$90 billion annually thereafter [Bird(c); CNN(b)]. These esti-

mates are more than 20 times OSHA figures. The agency estimated that implementing the standard would cost businesses only \$4.2 billion annually and generate benefits of \$9.1 billion a year for each of its first 10 years [Bird(a), (b); OSHA(b) Chapters 4-5].

Some jurisdictions—including California, Washington, Sweden and the European Union—have adopted ergonomics standards (MDLI). California was the first state to adopt an ergonomics standard, which became effective on July 3, 1997. When OSHA promulgated its standard in 2000, several states had begun necessary rulemaking to adopt ergonomics standards. Following the congressional repeal, most states withdrew their proposals—except the state of Washington, which adopted WAC 296-62-051 in May 2000. The rule became effective July 1, 2002, and was subsequently upheld by the Thurston County Superior Court in the face of the lawsuit filed by a business coalition on July 12, 2002 [WSDLI(c)]. Comparison of the Washington state rule and the rescinded federal rule suggests implications since they are very parallel. For example, both are similar in terms of awareness education elements, scope of hazard analysis, hazard analysis methods, evaluation, training, employee involvement and hierarchy of controls [WSDLI(c)].

This article explores the need for government intervention regarding the prevention of MSDs and dissects the cost-benefit analysis OSHA conducted in promulgating its ill-fated rule. OSHA's comprehensive plan to reduce ergonomic injuries in industry—announced in April 2002—is discussed and implications for future rulemaking are reviewed.

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The Need for Government Intervention

Classical microeconomic theory suggests that market mechanisms cannot operate adequately if some assumptions about pricing, product definition, cost conditions or entry barriers are violated (Callan and Thomas 63-93). The result will be inefficient market conditions that are collectively termed market failures ("Glossary" sidebar). These include imperfect information, imperfect competition, incomplete mobility of production factors, public goods and externalities (Callan and Thomas 63-76). In the authors' opinion, current market mechanisms are not adequate enough to address the ergonomic risk factors of workplaces for various reasons. This is confirmed by the fact that 80 to 85 percent of firms have not implemented training designed to prevent ergonomics-related hazards, let alone evaluated ergonomic hazards and implemented corrective measures (Fletcher 54).

What primary factors contribute to this misallocation of scarce resources? First, economic externality ("Glossary" sidebar) leads to market failure. Economic externality is defined as a spillover effect that occurs when a third party (outside the market) receives benefits (positive externality) or assumes costs (negative externality) from production or consumption of a commodity (Callan and Thomas 74-79; McGuigan, et al 719). In the case of externality, the price of a commodity fails to capture all the costs and benefits associated with a market transaction. Accordingly, the price is unreliable as a signaling mechanism and, in turn, the market fails.

The effects of industrial pollution on nearby residents is an example of negative externality. Firms may damage air and water quality, cause noise and odor problems and reduce the value of residential property. Unless employers are forced to pay external costs for the pollution, the price of the commodity they produce will not capture the price of the pollution. The effects of scrubbers used to clean emissions from smokestacks are an example of positive externality. If a firm purchases and installs a scrubber system, the benefits of cleaner air accrue to all nearby residents. Unless the residents are forced to pay for the cleaner air, the external benefits are not captured in the price of the scrubber system. As a result, resources are misallocated and fewer scrubbers are exchanged in the marketplace than should be (Callan and Thomas 74-79).

Employers' production activities may yield work-related injuries and illnesses—the unintended and uncompensated effect on workers and society. Even though WC programs and the tort liability system compensate part of these unintended results, they have failed to adequately compensate workers. Part of the original goal of the WC system was to compel employers to internalize the social costs of such injuries and illnesses [OSHA(b) Chapter 8]. In reality, however, WC falls short of this goal—and is especially insufficient in permanent disability cases due to time limits on benefit entitlements or ceilings on compensation payments [OSHA(b) Chapter 8].

OSHA reports that WC payments restore only 64 percent of the value of the worker's lost after-tax income and nonwage benefits for temporary total disabilities and 42 percent for permanent partial disabilities [OSHA(b) Chapter 8].

This situation is confounded by the fact that an individual firm's safety and health record is rarely assessed in determining the level of its premiums. About 80 percent of U.S. firms are not rated individually; instead, most firms are class-rated, which means the premiums may decrease only if the entire class of firms experiences fewer injuries and illnesses [OSHA(b) Chapter 8]. Moreover, health insurance programs share some of the burden when workers see their private physicians rather than the company's physicians for treatment of occupational injuries and illnesses. Taxpayer-supported programs such as welfare, social security disability payments and Medicare share the burden as well.

The tort system, in which a worker may sue his/her employer to recover damages based on exposure to workplace risks, has limited applicability. Generally, tort law can be applied only to third-party manufacturers or suppliers of hazardous products or equipment [OSHA(b) Chapter 8]. From a practical standpoint, it is difficult to prove that occupational injuries have resulted from defective products or equipment. The authors believe these factors converge on the limited effectiveness of WC and tort systems in providing incentives for employers to reduce occupational safety and health risks.

Second, lack of usable information leads to market failure. If perfect information on occupational risks were available, labor markets should be able to reflect the presence of different degrees of risk across different workplaces through differential wage premiums. In other words, workers who perform more-hazardous jobs would be paid higher wages to compensate for the extra risk. Accordingly, employers would be motivated to reduce risks in order to reduce labor premiums. From a firm's perspective, an optimal level of safety and health would result when marginal savings in labor premiums are equal to marginal cost spent on safety and health. In reality, however, workers have imperfect information regarding the nature and magnitude of workplace hazards. Many do not recognize the MSD risks in their jobs. Even if they do, workers may discount long-term occupational risks when making employment decisions. As a result, the markets do not adequately address the problems.

Dissecting OSHA's Cost-Benefit Analysis

The rescinded ergonomics standard covered all U.S. employers except those in agriculture, construction, railroad and maritime industries. One of the most controversial employer obligations was "work restriction protection" (WRP) provisions, which dictated full wage and benefits replacement for employees on restricted duty due to an MSD incident [CNN(b); Watchman 26-28].

Critical review of the preliminary economic analysis OSHA provided with its standard reveals several flaws that likely led to an overestimation of

benefits and an underestimation of costs. The following analysis reveals several issues that would need to be addressed in future rulemaking.

Calculation of Expected Benefits

OSHA regarded direct cost savings that accrue to employers, employees and society as key outcomes of the rule. The direct cost savings cited were 1) avoided lost output; 2) reduced medical expenses; 3) lower costs of WC insurance administration; and 4) fewer indirect costs to employers. OSHA apparently conducted shadow pricing (“Glossary” sidebar) to calculate the value of lost output by totaling a worker’s after-tax income, estimated taxes and fringe benefits. In addition, medical expenses were estimated to be 38.5 percent of the average costs of WC claims, which presumably include first-aid expenses incurred by the employer and the costs to transport an employee to a medical facility. To calculate WC-related savings, OSHA used the weighted average, estimated to be 23.4 percent of the average costs of WC claims. It also included indirect costs to employers that refer to the costs of occupational injuries which are borne directly by employers but are not included in WC claims costs; examples cited included lost production associated with the injured worker’s return to work and lost productivity of other workers.

Effectiveness Rate of the Ergonomics Program

The benefits analysis depended primarily on the effectiveness of the ergonomics program imposed by the standard. Almost all benefits would have accrued when employers fixed ergonomic problems, which would, in turn, reduce the number of MSD incidents. OSHA assumed that the program would have a 50-percent effectiveness rate [OSHA(b), Chapter 4]. This assumption appears biased.

MSDs are multifactorial; they have complex etiology, including both physical aspects of people’s activities and psychosocial factors (Feyer, et al 116+). Aging, genetics, lack of muscle strength and endurance, and gender are examples of intrinsic risk factors that can contribute to the onset of MSDs (Melhorn 107+). Such factors can negate any ergonomic intervention programs or produce large variability in their effects. Many extrinsic risk factors also exist. Any forceful movement, improper posture, repetition, continuous activity, extreme temperature or vibration can cause and aggravate MSDs (Melhorn 109-115). Therefore, nonwork activities such as recreational sports or hobbies can contribute to or exacerbate MSDs. In addition, many scientific studies that include carefully designed prospective cohort studies have identified psychological factors as predominant causal factors of MSDs (NIOSH; Papageorgiou, et al 500).

This evidence highlights the limited effectiveness of job-based mechanical ergonomic intervention. A recent study concluded that it is impossible to quantify the contribution of a job to the clinical MSD problem, pointing out that most MSD models are incomplete (Melhorn 115-116). A National Research Council study found it “inadequate to conclusively

Glossary of Economic Terms

Market Failure

The result of an inefficient market condition such as imperfect competition, imperfect information, public goods and externalities. Under the market failure, resources are not efficiently allocated (Callan and Thomas).

Externality

A spillover effect that occurs when a third party outside the market receives benefits (positive externality) or assumes costs (negative externality) from production or consumption of a commodity (Callan and Thomas).

Shadow Pricing

Valuation that is made to find the true opportunity cost of inputs or willingness-to-pay (WTP) for outputs when the market prices are distorted. The true prices are also called social prices, shadow prices, or social accounting prices (Treasury Board of Canada Secretariat).

Contingent Valuation

One of the benefit estimation methods to measure the reduction in health, environmental and other social damages associated with a policy initiative. This method is the most well-developed among stated preference valuation methods. It uses surveys to inquire about individuals’ WTP based on hypothetical market conditions (Callan and Thomas; U.S. EPA “An SAB Report”).

Sensitivity Analysis

In cost-benefit analysis (CBA), the results are typically influenced by several uncertain factors or assumptions. To ensure the reliability of the CBA results, the results’ sensitivity to each input parameter is analyzed. If a relatively small change in the value of an input parameter changes the CBA results significantly, the estimates for that input parameter should be re-examined (Treasury Board of Canada Secretariat; National Institutes of Health “Cost-Benefit Analysis”).

establish an expected effectiveness rate for the type of universal ergonomic controls imposed by the OSHA standard,” noting the person- and task-specific nature of MSD risks (Berkman and David). Berkman and David also contend that most of the studies OSHA cited are severely biased and lack peer review. They note that the firms studied had voluntarily implemented ergonomics controls, which means the studies may have had selection bias. Furthermore, OSHA did not include studies that found no effect of ergonomic controls on MSDs (Berkman and David 75+). It is noteworthy that Washington’s Dept. of Labor and Industries estimated that the state’s ergonomics rule would have a 40-percent effectiveness rate—not 50 percent as suggested by OSHA (under the condition that all programs are fully effective) [WSDLI(a)]. This implies that the cited rate was overstated, which in turn means the benefits estimates may have been overestimated.

Financial Transfers & Omission of Benefits

The benefits analysis also included financial transfers, which is misleading. Benefits of avoided lost output should include the savings of productivity loss of the injured worker, pain and suffering experienced by the workers, depression of the worker and

Aging, genetics, lack of muscle strength and gender are intrinsic risk factors that can contribute to the onset of MSDs. They can also negate ergonomic interventions or produce variability in their effects.

family members, diminished ability to perform family and social roles, and impact on family relationships. OSHA used the sum of a worker's wage and fringe benefits as the value (shadow prices) of avoided lost output. It is questionable that all wages and benefits in the labor market reflect the true productivity contribution of each individual worker. To justify using these figures as a proxy for productivity, OSHA should have shown robustness of those market prices to the distortion of the market. Also, the agency should have attempted to value the benefits of avoided pain and suffering using contingent valuation ("Glossary" sidebar) or similar techniques.

As for medical and WC savings, showing financial transfers and real cost savings would have been more appropriate. For example, medical fees saved would be transfer payments while opportunity cost of time spent for first aid or for transporting a worker to a medical facility would be benefits. Since the magnitude of qualitative benefits omitted from the analysis is unknown, it is impossible to conclude whether the benefits estimate was overestimated. However, if qualitative benefits are excluded from the calculations of benefits, the inclusion of transfer payments appears to cause the benefits to be overestimated.

Biases in Baseline Data

The economic analysis was based on findings from OSHA's 1993 survey of 3,259 establishments (which achieved a 58.4-percent response rate). Two main biases must be considered with respect to this survey, however, even under the assumption of valid and reliable survey procedures:

1) *Low response rate.* This is especially true considering the enforcement power of the surveyor. OSHA provided no profiles of firms that did not participate, a factor which may have biased the results.

2) *Outdated survey data.* Significant changes have occurred with regard to MSD cases and voluntary ergonomics program implementation since 1993—including the percentage of employees covered by an ergonomics program.

According to Bureau of Labor Statistics (BLS), the number of reported MSDs resulting in days away from work fell 20 percent between 1993 and 1999—from about 730,000 to 582,000 per year (BLS). WC reform and increased deductibles also prompted more companies to adopt ergonomics programs voluntarily (Berkman and David 75+). In the years leading up to promulgation of an ergonomics standard, more businesses likely came to expect enforcement which led to increased voluntary implementation of ergonomics programs [OSHA(a)]. Therefore, the baseline data were likely biased. Since annual occurrences of lost-workday MSDs were overstated and the percentage of employees covered by an ergonomics program was understated, the incremental effects of the rescinded standard should be reduced considerably, which means the benefits estimates may have been overestimated.

Phased-In Implementation

The analysis also overlooked phased-in imple-

mentation. It was assumed that all companies would implement full programs and control their ergonomic problems by the end of the first year of implementation [OSHA(b)]—which is extremely unrealistic. The state of Washington reports that ergonomic programs generally achieve full effectiveness within two years of being fully implemented [WSDLI (a)]. Its cost-benefit analysis reflects not only the two-year lag, but also the delayed benefits of the rule due to a seven-year phase-in period. Thus, in this case, both benefits and costs were overestimated. Since most costs accrue at the beginning of a project while benefits do not, the analysis overestimated benefits more than costs.

Cost Calculation

Costs associated with this standard fell into five categories: 1) familiarization costs; 2) basic program costs; 3) full program costs; 4) costs of job control interventions; and 5) expenditures employers incur in accordance with WRP provisions. OSHA estimated the unit costs of each provision per affected employee and establishment. It then multiplied estimated unit costs of each provision by the number of affected employees or establishments in order to calculate total costs. To determine each unit cost, hours of commitment required to comply with each provision were estimated. For example, OSHA estimated that familiarization with overall requirements would take one hour of managerial time. In total, the annualized costs were estimated at \$4.2 billion. Job control costs accounted for \$2.3 billion (54 percent) and WRP provisions accounted for \$875 million (21 percent). Because job control costs were offset by \$1.3 billion of productivity improvement associated with job controls, actual job control costs amounted to 65 percent out of total costs.

Omission of Costs & Underestimation of Time Requirements

Time estimates used to develop costs for the various provisions are generally underestimated as well. For example, OSHA assumed that familiarization would take only one hour of managerial time. However, Washington estimates that this process takes two hours of managerial time for small businesses and six hours for large businesses [WSDLI(a)]. The state's analysis even accounts for presentation time to safety committees for businesses with 11 or more employees. OSHA should have reflected similar considerations in its analysis.

The time estimate for recordkeeping requirements provides another example. These requirements would have included documents such as employee reports of MSDs, episodes of persistent symptoms, responses to those reports, results of job hazard analyses, hazard control records, ergonomic program evaluations and MSD management records. OSHA assumed it would take a supervisor only 15 minutes to handle these records for each MSD [OSHA(b) Chapter 5]. It is hard to imagine that anyone could complete the complicated paperwork in 15 minutes.

Questionable Estimates of Job Control Costs

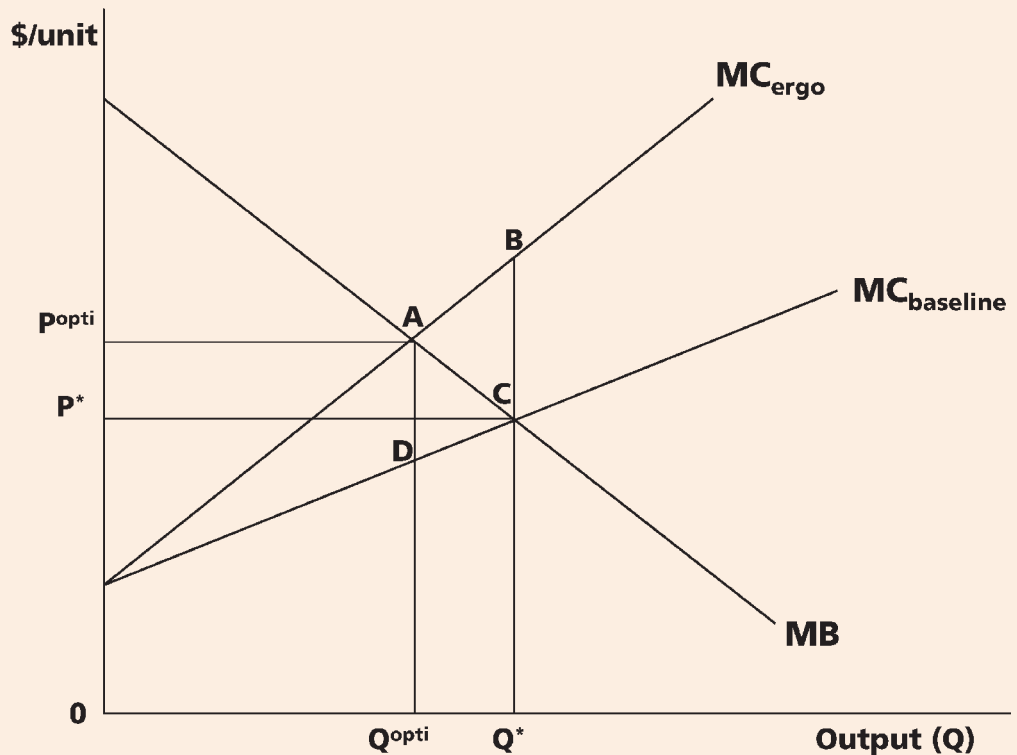
As noted, job control costs accounted for 65 percent of the total cost estimates. Despite this large proportion, OSHA relied on three ergonomists to obtain the average unit cost of interventions rather than on careful industry-by-industry cost studies [OSHA(b) Chapter 5]. The agency also concluded that someone with little background in ergonomics could fix about 50 percent of all problem jobs and that as much as 85 percent of all problem jobs could be fixed in-house without the help of outside expertise. This was based on a single study conducted which suggests that only five to 25 percent of problem jobs require professional ergonomists [OSHA(b) Chapter 5]. OSHA used the midpoint of this study estimate—15 percent. However, if more than 15 percent of problem jobs require outside consultancy, job control costs would increase sharply. Therefore, the estimates regarding intervention costs should have been based on multiple studies with validity and reliability or should have used different estimates from different industries to reduce errors.

Inclusion of Financial Transfers

Like the benefits analysis, financial transfers were included in the cost analysis, which is misleading. For example, expenditures incurred from WRP provisions, which is simply a financial transfer from employers to employees, were included. WRP would have required employers to maintain current wages and benefits for workers on restricted duty, and 90 percent of wages and 100 percent of benefits for workers removed from work, for up to 90 days. This element may be included in the distributional impact analysis among parties in the accounting domain but should be excluded from the net social benefit analysis. To calculate the value of job control costs, the analysis included employers' financial outlays. Since the accounting domain is the U.S., transfer payments captured by another party in the domain should be excluded from the net social benefits analysis.

Figure 1

Market Impact of the Standard



MB = Marginal Benefit (the incremental change in total benefits that occurs from the consumption of an additional unit of output)

MC = Marginal Cost (the incremental change in total costs that occurs from the production of an additional unit of output)

MC_{baseline} = MC before the implementation of the Ergonomics Standard

MC_{ergo} = MC after the implementation of the Ergonomics Standard

Q, Q^{opti} = Equilibrium output levels before and after the implementation of the Ergonomics Standard, respectively*

P, P^{opti} = Equilibrium price levels before and after the implementation of the Ergonomics Standard, respectively*

Instead, opportunity cost of forgone or displaced resources including production time lost due to installation of new equipment or facilities for the control of MSDs should be included. In addition, it was implicitly assumed that the market price accurately represents the marginal social opportunity cost of using one unit of resources in the estimation of costs. This is an unrealistic assumption because the real market is distorted for various reasons. Therefore, shadow pricing is necessary to obtain more-accurate cost estimates.

Omission of Monitoring & Enforcement Costs

In addition, an important cost category—monitoring and enforcement costs—was not considered. The enforcement of a new set of regulations always incurs additional monitoring and enforcement costs.

Perhaps OSHA can use the voluntary-guideline-making process as an opportunity to develop a reasonable, workable and cost-beneficial standard that reflects varieties of work settings.

More frequent and lengthy compliance inspections, and creation of additional education and information materials for the standard are part of these costs and should have been accounted for in estimating the standard's net social effect.

Failure to Consider Market Impact

The standard's market impact was neglected as well (Figure 1). The proposed regulation would have increased marginal cost in output market significantly (from MCbaseline to MCergo in Figure 1). But, it would have affected marginal benefit (MB) of consumers only modestly because product quality would not likely vary due to implementation of the standard. Accordingly, the new optimal equilibrium (A in Figure 1) would result, which means higher prices and lower product quantity. Thus, it would have produced significant deadweight loss, the net loss of consumer and producer surplus (triangle ACD in Figure 1).

Therefore, in the short run, where firms have limited ability to adjust themselves to changes, costs were underestimated. In the long run, however, market adjustment would occur as firms would employ more capital-intensive input factors than labor-intensive input factors. As a result, they would be able to reduce economic burden, another neglected factor. More importantly, distribution effect was underestimated. It was assumed that industry would bear the whole cost, which is naive. Firms will transfer much of the costs incurred due to compliance to consumers depending on price elasticity of demand (the ratio of the percentage change in product quantity demanded to the percentage change in price).

A New Strategy: OSHA's Four-Pronged Plan

On April 5, 2002, about one year after the controversial standard was rescinded, OSHA announced a comprehensive plan designed to reduce ergonomic injuries. The four-pronged plan includes development of voluntary guidelines, enforcement, outreach and assistance, and research [U.S. DOL(c); U.S. DOL(d)]. The Dept. of Labor has formed the National Advisory Committee on Ergonomics and has begun to develop industry- and task-specific guidelines based on current incidence rates and available information about effective solutions. To date, the agency has published draft guidelines for nursing homes and is working on similar guidelines for retail grocery stores and poultry processing facilities.

The four-pronged plan may seem a practical strategy for reducing or preventing ergonomic risks at workplaces. However, one must question how many employers will be willing to follow voluntary guidelines that would cost a considerable amount of money, time and resources—particularly when failure to implement them will not violate any law. Even though OSHA announced that its inspectors would use the General Duty Clause to cite employers who take no steps to abate ergonomic hazards, it is likely that few employers will be affected. That clause has been in effect for more than 30 years; there is nothing new. It appears the policy instrument OSHA truly wants to use is information and technical assistance.

Conclusion

OSHA justified its ill-fated ergonomics standard on the basis of a flawed cost-benefit analysis. Many benefit estimates were overestimated by assuming high effectiveness rate, not accounting for phased-in implementation and including financial transfers in its analysis. Conversely, many cost estimates were underestimated by assuming modest time requirements and omitting cost elements. It should be noted, however, that consideration of long-term market adjustment effects and inclusion of qualitative benefits such as avoided pain and suffering, depression and negative impact on family relationships should offset some of these concerns.

It is difficult, if not impossible, to quantitatively analyze the net social cost or benefit of a federal ergonomics standard because many parameters are inaccurate or unclear. Also, rigorous cost and benefit calculation excluding financial transfers requires shadow pricing, which is quite challenging. In terms of distributional impact, it seems likely that the standard would have cost employers more than it would have benefitted them over a 10-year period. However, counterclaims that the standard would have cost the business community more than \$90 billion annually (which is more than 20 times OSHA estimates) seem groundless as well. The Employment Policy Foundation's study on which that claim is based depended on a survey of occupational safety and health managers in Fortune 500 companies [Bird(c) 1-3]. The survey was based on a convenience sampling and the subjects represented an extremely small segment of the target population, which suggests biased results.

OSHA's current strategy, as reflected in its four-pronged approach, seems to be an antithesis to a thesis (the regulatory approach) based largely on political considerations rather than on sound science and economic assessment. The agency abandoned a major project that involved many people's hard work, consumed enormous resources and entailed the long-term accumulation of scientific evidence. That change does not appear justified in the authors' opinion. The rescinded standard failed primarily because of 1) rushed rulemaking (Ergoweb); 2) poor strategy; and 3) flawed cost-benefit analysis. The standard also overwhelmed many people with its pages of complicated rules and wide scope of application [Bird(a) 1-4].

The authors recommend that OSHA explore regulatory approaches to the ergonomics problems based on more-rigorous empirical studies and economic assessment. The agency may use the voluntary guideline-making process as an opportunity to develop a reasonable, workable and cost-beneficial standard that reflects varieties of work settings. With respect to future rulemaking, the authors offer the following suggestions:

1) OSHA should conduct additional scientific studies regarding the effectiveness of ergonomics programs and initiate careful industry-by-industry cost studies (Gostin 3118+). The agency should also

conduct and provide sensitivity analyses ("Glossary" sidebar) that incorporate a range of effectiveness rates and time requirement estimates. Those studies should be peer-reviewed and conducted based on rigorous criteria, keeping threats to internal validity in mind. Unbiased pilot studies, such as the demonstration projects in the state of Washington, would help to confirm various cost-benefit assumptions [Sarkis 21; WSDLI(b)].

2) Any future standard must be more focused on those industries where net social benefits most likely occur. These include meatpacking and poultry processing industry, food warehousing and distribution industry, automotive assembly and health services, as their employees are highly susceptible to MSDs. If the standard's scope is limited to the most hazardous industries, it will likely yield much less negative distributional impact or financial burden on employers and should easily pass the cost-benefit test. Then, OSHA may be able to extend the scope of application to other industries where ergonomic hazard levels are high enough to pass the cost-benefit test at the time of its implementation.

3) OSHA must account for diverse capabilities and characteristics of different businesses. It should simplify the rules in order to reduce familiarization costs and employer resistance—which was merely exacerbated by publication of a complex 600-page document. Perhaps it would be best to incorporate minimal essential rules and regulations in the standard, then cover technical rules or specific details in the form of voluntary guidelines. ■

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