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Recent Risk Rates of Occupational Fatalities, Injuries, and Illnesses in U.S. Industries and Their Use in Planning Environmental Controls

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Cost/benefit justifications are now required for new environmental regulations. The benefit is related to the difference between the currently existing health risk rate and the rate corresponding to the proposed permissible exposure limit. The adoption of many permissible exposure limits has been delayed by the lack of supporting human data and the use of animal data instead. This has resulted in difficulties and controversies not likely to be resolved soon. Meanwhile, a review of currently existing occupational risk rates can provide a perspective for best use of available funds.

Tables and text are presented summarizing published occupational risk data for 1996. Transportation incidents cause 42 percent of occupational fatalities. Proper selection and training of workers and proper work rules should be cost-effective, also especially in other listed dangerous industries. Annual risk rates per *hundred* workers for occupational nonfatal injuries and illness were surprisingly high: for manufacturing 10.6, and for the entire private sector, 7.4. Seven worst industries ranged from 25.8 to 30.3.

The benefit from controlling such high rates is almost the same whether the final rate is 10^{-3} or 10^{-6}. Thus, specifying a good low-cost procedure that reduces most of the initial risk can provide the lowest cost/benefit ratio, eligible for priority use of available funds.

Keywords Occupational Risk Rates, Dangerous Occupations, Occupational Fatalities, Occupational Injuries and Illnesses, Planning Environmental Controls

In 1970 the newly created Occupational Safety and Health Administration (OSHA) adopted the existing threshold limit values (TLV®) as the initial levels for its enforcement programs. The 10^{-6} level of allowable adverse effects used by the Food and Drug Administration (FDA) for carcinogens was psychologically satisfying and was adopted. Some officials refused to trade human lives for money by considering costs of control regulations. Since then environmental hazard control has evolved into a multibillion-dollar enterprise, with its own set of vested special interests that must compete with the special interests of other programs and groups. All have claims on the limited available funds. Congress and the courts have demanded cost/benefit justifications for proposed new environmental standards.

Human lives can be saved and the general welfare promoted by spending money also on fighting uses of tobacco, alcohol, and drugs and on other public health programs, on medical research and insurance, on fighting crime with police and prisons, on building safer automobiles and roads, and even by fighting international terrorism and promoting world peace and nuclear disarmament.

The response for controlling exposures to pollutants has been three stepwise procedures:

1. to establish a desirable low risk level as a goal
2. to determine an attainable long-term, permissible concentration level that will achieve the goal
3. to show that the costs of control are reasonable.

The necessary human dose-response data unfortunately is usually lacking, for ethical and cost reasons, and sometimes because of the long time delay before the adverse effect appears. Toxicological animal data is usually substituted, resulting in controversy as to the scientific validity of such use, and about the very large safety factors that are usually included to allow for some uncertainties. This risk assessment work is really an attempt to establish the low end of the human dose-response curve. A companion article[1] has proposed a theoretical method for establishing these human curves from limited epidemiological data, but it remains to be tested. These studies can be lengthy and costly, and the difficulties and controversies are not likely to be resolved soon.

In the meantime, there is a need to prioritize the needs and to make best use of the available resources for environmental control. As with most social problems, we must make decisions

before complete information is available. As a start, a review of currently existing risk rates in industries[2–4] will provide a perspective for action.

RATES OF OCCUPATIONAL FATALITIES, INJURIES, AND ILLNESSES IN THE UNITED STATES

The total rate of fatalities in 1996 for all industries[2] was 4.8 per 100,000 workers per year. The components of this rate were:

- Transportation incidents, 42 percent
- Assaults and violent acts such as robbery, 19 percent
- Being struck or caught by objects or equipment, 16 percent
- Falls, 11 percent
- Exposure to harmful substances or environments, only a minor 9 percent
- Fires and explosions, 3 percent

For comparison, the risk of death from motor vehicle accidents voluntarily accepted by the general public in 1995 was much higher, 15.9 per 100,000 per year. Table I lists the total number of fatalities and the risk rates for death in the most dangerous U.S. occupations in 1996.

The nonfatal occupational injury and illness rates in 1996 in the United States are much higher.[3] The figures per hundred workers per year (1 yr = 2000 hr) are as follows:

- Entire private sector, 7.4
- Manufacturing, 10.6
- Agriculture, forestry, and fishing, 8.7
- Transportation, public utilities, 8.7
- Wholesale and retail trade, 6.8
- Services, 6.0
- Mining, 5.4
- Finance, insurance, real estate, 2.4

Table II lists the U.S. industries with the highest incidence rates. To properly allow for overtime and part-time workers, all these rates are per 200,000 man-hours worked in 1996 (1 worker = 2,000 man-hours).

TABLE I
U.S. occupations at high risk of a fatal work injury in 1996[2]

Occupation	Total number of fatalities	Risk rate per 100,000
Fishers	66	178.4
Timber cutters	118	157.3
Airline pilots	100	87.7
Structural metal workers	52	85.2
Extractive occupations	87	66.9
Water transportation occupations	42	60.9
Construction laborers	291	35.7
Taxicab drivers	65	32.0
Roofers	61	31.0
Truck drivers	785	26.0
National average	6,112	4.8

TABLE II
U.S. industries with highest total case incidence rates for nonfatal injuries and illnesses in 1996[3]

Industry	Rate per 100 workers
Meat packing plants	30.3
Metal sanitary ware	29.4
Ship building and repairing	27.4
Steel foundries	26.4
Mobile homes	26.2
Motor vehicles and car bodies	26.1
Gray and ductile iron foundries	25.8
Automotive stampings	23.2
Steel springs except wire	22.7
Secondary nonferrous metals	21.0
Truck and bus bodies	21.0
Public building and related furniture	20.6
Structural wood members	20.6

The total costs of unintentional deaths and injuries in the United States in 1996, including wages and productivity losses, medical expenses, and motor vehicle damage, has been estimated as $444.1 billion.[4] This includes costs for motor vehicles of $176.1 billion, work $121.0 billion, home $95.7 billion, and other $65.3 billion. (There is some overlapping of these items.)

DISCUSSION

From inspection of the data, it appears evident that transportation incidents, causing 42 percent of the fatalities, are the greatest problem. Simple and relatively inexpensive work rules for drivers probably would provide a large benefit. Control of harmful exposures to hazardous materials and environmental pollutants would be much more expensive, and could only reduce the 9 percent portion of the fatalities. The six most dangerous occupations listed in Table I have fatality rates ranging from 13 to 37 times the national average of 4.8 per 100,000 per year. More careful selection and training, and work rules for workers, as is done for airline pilots to protect passengers and planes, should be very cost-effective.

The occupational rates for nonfatal injuries and illness are surprisingly high. The 1996 rate for manufacturing was 10.6 percent per year, and for the entire private sector 7.4 percent. The seven most dangerous industries listed in Table II ranged from 25.8 percent to 30.3 percent. Concern about risk rates in the 10^{-6} range would appear superfluous when, again, simple low cost training, work rules, and tools would seem to be obvious choices.

Best use of the available funds will occur when the priorities are given to the hazards that can be controlled at the lowest

cost/benefit ratio. Planning for control of exposures to contaminants can be greatly simplified when the current risk rates approach the percentage levels. The benefit is a figure related to the difference in risk rates before and after the controls. If the initial rate is high, the difference changes very little if the final rate is 10^{-3} or 10^{-6}. Rather than specifying a permissible low final rate, one can specify a good low-cost procedure that is effective enough to reduce most of the risk. That should yield the lowest cost/benefit ratio.

Control of health hazards is a complex process involving technical considerations, public perceptions, and the legal and political pressures of various interest groups.[5,6] Media publicity may arouse public emotions and produce political pressure for regulations sometimes contrary to those recommended by scientific experts. The data should help to focus a rational response to the most serious problems. Knowledge of risk rates currently being tolerated should relieve public anxieties about possible risks at the 10^{-6} level.

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