KEYNOTE ADDRESS: A PUBLIC HEALTH PERSPECTIVE ON MINING

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INTRODUCTION

In "Public Health as Social Justice," Beauchamp [1] wrote that the task of public health should be to control "the hazards of this world to prevent death and disability through organized collective action . . . ."

Occupational safety and health is a proud component of this broader mission of public health. It has been the arena of both brilliant discoveries on the etiology of disease and dramatic actions to prevent or ameliorate the unwanted effects. In the process, occupational safety and health has blazed fundamentally important paths toward social justice.

A PUBLIC HEALTH PERSPECTIVE ON MINING

I have come to the field of occupational health late in a career principally devoted to the control of infectious diseases and community environmental problems. In the following paragraphs, I will examine the familiar territory of public health as a whole, then focus on the problems of mining against the larger background.

THE FIRST EPIDEMIOLOGICAL REVOLUTION

Through enlightened collective action, public health practice has produced a dramatic change in American health status in the last 50 years. Called

by Terris [2] "the First Epidemiological Revolution," this dramatic change is usually viewed as the conquest of infectious diseases as major causes of death in the United States. Indeed, the most visible signs are the eradication of smallpox and virtual elimination of poliomyelitis. Moreover, infant mortality has been drastically reduced, and the average life span lengthened by 25 years. These improvements resulted largely from environmental controls and organized epidemiologically directed public health campaigns.

Often forgotten, however, is that a number of noninfectious diseases also have been greatly reduced through environmental controls, especially in recent years. An outstanding example is the control of childhood lead poisoning in urban areas.

Further, although data systems leave much to be desired, it seems clear that the rate of fatal injuries in the workplace has distinctly declined. To be sure, this problem is far from "controlled."

Fries [3] has estimated that about 75% of "preventable" mortality has already been prevented in the First Epidemiological Revolution. Terris and others have called for a Second Epidemiological Revolution to finish the job.

WHAT REMAINS TO BE DONE

To understand what remains to be done, we must look to the most important health problems of Americans today. Let us begin with an appreciation of today's major causes of death. Table I ranks the ten most common causes of death. It is clear that today's top killers are chronic diseases, accidents and violence.

Table I. Ten Leading Causes of Death–Percentage Distribution by Cause of Total Population 1+ Years of Age, U.S.A., 1977 [4]

Cause	Rate per 100,000
1. Heart Disease	336.0
2. Cancer	180.9
3. Cerebrovascular Disease	85.1
4. All Other Accidents	24.7
5. Influenza and Pneumonia	23.2
6. Motor Vehicle Accidents	23.0
7. Diabetes	15.4
8. Cirrhosis of Liver	14.4
9. Arteriosclerosis	13.5
10. Suicide	13.4

Yet simply listing the leading causes of death does not provide especially useful information. In our society, an individual who lives long enough will surely be said to have died of some kind of heart disease. We do better to list the causes of premature death. Table II lists the causes of death according to the aggregated years of potential life lost by the victims. The ranked list differs substantially from the previous one, emphasizing the importance of accidents and violence as causes of premature death. Motor vehicle accidents jump from sixth to third place, suicide from tenth to sixth, and homicide from "the pack" to seventh place.

Dealing with average death patterns obscures the very large variations in the frequency of death by age, poverty, sex, race and specific cause. Age has a dramatic effect on the conditions that kill us. Accidents and violence kill the young. In the middle years, cancer emerges as the leading cause. Finally, with advancing age, cancer is preempted by heart disease as the major risk.

The government of Canada [5] introduced a useful approach to the analysis of health problems with the "Health Field Concept." This model views all health problems as resulting from four contributing elements: (1) human biology, (2) the environment, (3) lifestyle, and (4) health care organization. Using the Canadian concept, Dever [6] developed a method for quantitating the relative contributions of each of the four factors into a list of health problems (Table III). It should be noted that in Dever's model one's choice of work or occupation is viewed as a part of the "lifestyle" element.

Teske [7] of the Centers for Disease Control (CDC) applied Dever's methods to the ten leading causes of death in the United States in 1977. Figure 1 shows the results of three different mortality analyses done in this way, clearly showing that the Dever-Teske approach attributes more than half of U.S. mortality to lifestyle factors, including personal consumption and

Table II. Years of Potential Life Lost in the Total Population, Ages 1–74, U.S.A., 1977 [4]

Cause	Total Years Lost
Heart Disease	4,295,603
Cancer	3,931,209
Motor Vehicle Accidents	2,005,688
All Other Accidents	1,442,526
Suicide	898,388
Homicide	780,710
Cerebrovascular Disease	775,483
Cirrhosis of Liver	559,097
Influenza and Pneumonia	309,243
Diabetes	252,566

Table III. Proportional Allocation of the Contributing Factors of Mortality to the Four Elements of the Health Field (ten leading causes of death among the total population 1+ years of age, U.S.A., 1977) [6]

Ten Leading Causes of Death	No. of Deaths	Rate per 100,000	% of Total	Cumulative % Distribution	Health System	Life Style	Environment	Human Biology
Heart Disease	717,976	336.0	38.8	38.8	12	54	9	28
Cancer	386,529	180.9	20.9	59.7	10	37	24	29
Cerebrovascular Disease	181,741	85.1	9.8	69.5	7	50	22	21
All Other Accidents	52,706	24.7	2.8	72.3	14	51	31	4
Influenza and Pneumonia	49,497	23.2	2.7	75.0	18	23	20	39
Motor Vehicle Accidents	49,234	23.0	2.7	77.7	12	69	18	0.6
Diabetes	32,976	15.4	1.8	79.5	6	26	0	68
Cirrhosis of Liver	30,804	14.4	1.7	81.2	3	70	9	18
Arteriosclerosis	28,745	13.5	1.6	82.8	18	49	8	26
Suicide	28,668	13.4	1.5	84.3	3	60	35	2
					10.8	48.4	15.9	26.3

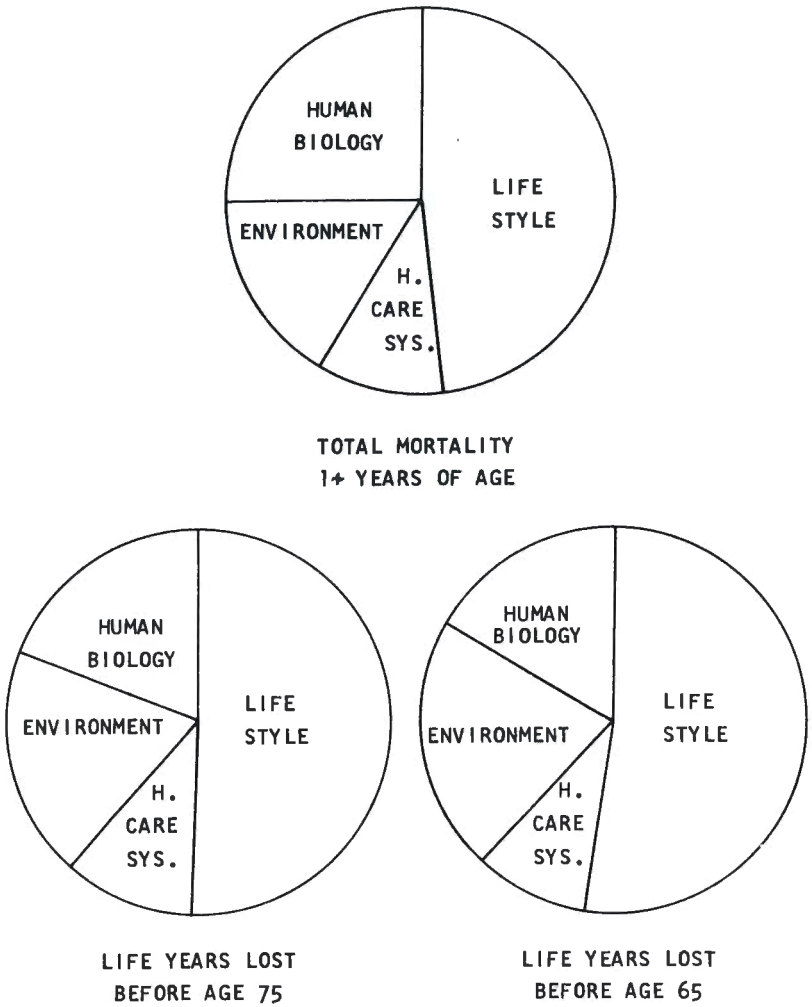

Figure 1. Proportional allocation of the contributing factors of mortality to the four elements of the health field [6], U.S.A., 1977.

occupational factors; of the rest, another quarter is attributed to the environment. It is evident that modern plagues have changed from typhoid to self-destructive behaviors, from poliomyelitis to the effects of a synthetic environment, from infantile diarrhea to occupational accidents, etc.

The role of work as a cause of health problems is difficult to define

precisely because few comprehensive surveillance efforts have been systematically directed at work-related deaths. It is clear from Dever's and Teske's studies, and from our own general awareness of overall death patterns, that work is a very significant cause of premature mortality. There are well-established relationships between workplace exposures and a number of cancers. Similarly, fatal workplace accidents comprise a large part of the mortality attributed to accidents other than those involving motor vehicles. Moreover, in the workplace there are unique opportunities for synergistic interactions between behavioral factors such as smoking and alcohol consumption and environmental exposures to toxic chemicals and physical agents. Nonetheless, there is no generally agreed-on listing of the leading work-related health problems.

Early in 1982, to better target NIOSH's resources to the existing disease burden, its Division and Office Directors met together to develop their collective thoughts on the ten leading work-related health problems, based on three parameters: (1) the perceived frequency of the health problem; (2) the perceived severity of the problem to its victims; and (3) the vulnerability of the problem to preventive action. Further, they were to make their best judgments wherever data were inadequate or conflicting. The results of their deliberations appear in Table IV.

Table IV. Ten Leading Work-Related Health Problems

1. Occupational Lung Disease
   - Lung cancer
   - Pneumoconiosis
   - Occupational asthma
2. Musculoskeletal Injuries
   - Back injury
   - Carpal tunnel
   - Vibration white finger disease
3. Occupational Cancer—Other Than Lung
4. Traumatic Death, Amputations, Fractures and Eye Losses
5. Cardiovascular Disease
   - Myocardial infarction
   - Stroke
   - Hypertension
6. Reproductive Problems
7. Neurotoxic Illness
8. Noise-Induced Hearing Loss
9. Dermatological Problems
   - Dermatoses
   - Burns
   - Contusions
   - Lacerations
10. Psychological Disorders

As shown in Table IV, the health problems known to be related to mining are quite prominent. Indeed, occupational lung disease, which heads the list, has been the focus of considerable preventive and rehabilitative activity in the field of occupational safety and health. With this list in mind, let us focus our public health perspective on mining.

Examining the public health perspective in more detail, the four basic functions are: (1) to identify the disease or health effect; (2) to investigate the problem epidemiologically and determine its vulnerability to control; (3) to define a control method; and (4) to apply the control method to those at *risk*. In short, public health practitioners never simply study a problem; they also move to contain it and prevent it.

Identify the Disease or Health Effect

Most exposures in the crustal environment are not pure; they involve exposure to a number of dust components. The signs and symptoms of health effects are so complex that they are called "mixed dust pneumoconioses," having characteristics of several "pure exposures," or are labeled with the name of the principal dust alone, such as asbestosis or silicosis.

Epidemiologically Investigate the Problem and Determine Its Vulnerability to Control

Existing reporting systems have not adequately identified mining health problems, estimated to involve 500,000 workers; therefore, society fails to grasp their severity. The limitations of most existing data bases make it hard to make reliable interpretations. Often, data are scattered throughout nonuniform and inaccessible medical records. A partial list of existing automated data bases that contain information about adverse health effects of mining include the NIOSHTIC files, NIOSH Mine Health Hazard Evaluations, Social Security Administration files (which, however, contain limited health data and focus principally on injury), National Center for Health Statistics, medical files from medical clinics serving mining communities, cancer and disease registries, workers' compensation files (where, again, the focus is on injury), union pension funds, third-party claims from mine employers, Mine Safety and Health Administration (MSHA) illness and injury reports, and indirect evidence of adverse health effects from animal toxicity studies, which can be retrieved from NIOSH's Registry of Toxic Effects of Chemical Substances (RTECS). All these data bases have an indigenous problem—none is comprehensive.

A further serious problem in assessing the public health perspective of mining is that many of the medical and epidemiological data collected on

miners are not matched by environmental data collected in the time interval over which exposures occurred. Hence, the epidemiology of the problem is often incompletely understood, making it difficult to design convincing control strategies and limiting the number of proper occupational health standards that have been set for the mining workforce.

Define a Control Method

Modern technology now allows us to measure substance exposures to the nearest part per billion. It has also revealed that materials whose existence was unknown twenty years ago now appear to cause mutation within living cells. Often, we don't know the significance of these findings for human disease. Much of our knowledge of disease and carcinogenicity in man has originated in epidemiological studies of occupational cohorts. Too few such studies have been done with mining populations, especially in newer aspects of the industry.

Apply the Control Method to Those at Risk

We are beginning to develop highly sophisticated clinical diagnostic methods that will eventually allow reliable assessments of pre-disease health effects arising from occupational exposures. These, coupled with epidemiological and environmental observations, ultimately will permit the multifactorial etiologies of disease to be defined. We need to encourage laboratory and clinical research to determine the basic biological mechanisms triggered by mining exposures. Also, we need to describe environmental exposures in the mining industry in ways that will permit effective industrial inspections for hazards. There must be a much more comprehensive understanding of risk factors.

Much of this actually is underway already, but we must move toward a national surveillance program, including physician reporting of one or more health effects associated with mining. Occupational lung disease is an obvious one. It is not easy to document because lung disease more commonly causes chronic impairment and discomfort rather than death. Moreover, there is the undeniable interaction with cigarette smoking. Smoking is an important causal factor in the etiology of lung disease, and its effects cannot always be disentangled from occupational exposure in the overall mosaic. Nonetheless, the problem is vast, appears amenable to intervention and is becoming of general public concern. Isn't it time to put this large and accountable problem under meaningful national surveillance?

The health hazards associated with mining may express themselves suddenly as injuries or more slowly as respiratory disease, heart disease, cancer, neurological disorders or other life-shortening health effects. While much of our

medical, engineering, epidemiological and toxicological knowledge of mining health effects is incomplete, there is more than enough information to justify a vigorous, sufficient attack on hazardous mining exposures.

We are faced with the clear need to protect the public health of our miners. In 1977, Congress declared that in passing the Federal Mine Safety and Health Act "the first priority and concern of all in the . . . mining industry must be the health and safety of its more precious resource–the miner."

Moreover, we need a "Second Epidemiological Revolution" to conquer the public health hazards of the late 20th century. Such a revolution will require widespread commitment on a wide front, including collective and individual action. It must involve the use of public health methods to both *protect* and *promote* health. But, as with all revolutions, there is an inestimable need for leadership, which requires imagination, intensity, courage and persistence–the very qualities required for mining itself.

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REFERENCES

1. Beauchamp DE: Public health as social justice. Inquiry XIII (1):3–14, 1976.
2. Terris M: The epidemiologic revolution: national health insurance and the role of health departments. Am J Public Health 66:1155–1164, 1976.
3. Fries JF: Aging, natural death, and the compression of morbidity. New Engl J Med 303:130–135, 1980.
4. Vital statistics of the United States, 1977, Vol. II-Mortality (Part A), USDHHS, PHS, Office of Health Research, Statistics, and Technology, National Center for Health Statistics, Hyattsville, MD, DHHS Publ. No. (PHS) 81-1101, 1981.
5. LaLonde M: A new perspective on the health of Canadians. Ottawa: Canadian Minister of National Health and Welfare, 1974.
6. Dever GEA: An epidemiological model for health policy analysis. Social Indicators Res 2:453–466, 1977.
7. Leading causes of death and probabilities of dying, United States, 1975 and 1976. Atlanta, GA: Centers for Disease Control, 1977.

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