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Cost-Effective Priorities for Cancer Prevention

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Summary. Faced with limited resources, the United States must set priorities for research to identify preventable causes of cancer. A quantitative approach to priority setting, based on principles of decision analysis and cost-effectiveness analysis, can offer guidance in this process. An illustrative application of such a model suggests that the National Institutes of Health–supported clinical trial of dietary β-carotene offers a greater expected reduction in cancer mortality per research dollar than carcinogen bioassays of high-volume industrial chemicals such as *p*-dichlorobenzene. National research priorities should reflect the relative cost-effectiveness of such investments.

Environmental factors are responsible for 80 to 90 percent of cancer deaths in the United States (*1, 2*). This conclusion, which once aroused considerable controversy, is now generally accepted, provided that the "environment" is broadly defined to include not only industrial chemicals and pollution, but also diet, reproductive behavior, and other elements of life-style and culture, as well as such natural phenomena as infectious agents and nonionizing radiation. Doll and Peto have placed the contribution to U.S. cancer mortality of occupational and environmental exposures to industrial chemicals at less than 5 percent, including 2 percent due to asbestos (*2*).

Growing hope during the 1970's that cancer could be controlled in large part by detecting and eliminating carcinogens has been tempered during the 1980's by the sober realization that preventing cancer will not be simple. Epidemiologic data firmly support the proposition that most cancers are preventable in principle, but current understanding leaves us far short of being able to prevent most cancer in fact. The challenge of the coming decades will be to identify the specific agents that cause or prevent cancer and, after identifying them, to develop and implement interventions to alter human exposure to them.

The problem of identifying carcinogens in the environment seems formidable enough when attention is focused on the 70,000 or so industrial chemicals in production. The cost of testing this inventory of chemicals, let alone the thousands of new chemicals entering production each year, would be huge. Even if financial cost were not a constraint, the limited supply of toxicologists and laboratories would constrain the volume of long-term bioassays.

Epidemiologic insights should, however, lead us to examine the priority-setting problem in a broader framework. If industrial chemicals other than asbestos account for 3 percent of cancer deaths, the prospect of saving 12,000 lives each year (out of 400,000 cancer deaths) should encourage us to discover the key industrial agents and control exposure to them. But if 35 percent of cancer deaths are related to diet (*2*), efforts to discover dietary factors in cancer might deserve an even greater claim on resources.

Toxicologic studies of industrial chemicals and epidemiologic studies of dietary agents are, in general, funded from different budgets, and might seem not to be in competition for the same limited resources. For the society as a whole, however, it is imperative to ask how best to spend resources in the general domain of cancer prevention. Priorities need to be set among alternative research strategies for detecting carcinogenic and anticarcinogenic agents, and such priority setting should encompass the full range of environmental factors (broadly defined) in cancer prevention.

This article illustrates a quantitative approach to priority setting, based on principles of cost-effectiveness and decision analysis. It also shows how the approach may be used to compare the cost-effectiveness of toxicologic studies of industrial chemicals and prospective trials of dietary constituents. The industrial chemical examined is *p*-dichlorobenzene, the active ingredient in mothballs. The cost-effectiveness of a randomized prospective trial of dietary β-carotene, a close relative of vitamin A, is also assessed. This comparison and other considerations lead to policy implications regarding the optimal use of resources in investigating the cancer-related effects of environmental agents.

Uncertainty is inherent in this kind of prospective analysis, and the attempt to quantitate this uncertainty may make some readers uncomfortable. However, policy decisions must and will be made in the face of uncertainty, and analysis

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