AMERICAN JOURNAL OF INDUSTRIAL MEDICINE 29:285–288 (1996)

# Intervention Research: Science, Skills, and Strategies

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*Despite a rich history of etiological research, the field of occupational safety and health does not a have a rigorous history of research on what works and does not work to prevent and control occupational diseases and injuries. National and global transformations of economies and workplaces with enhanced competitiveness require more attention to options for interventions. A three-pronged approach to building a body of knowledge on intervention research in occupational health and safety is identified in this paper. The approach focuses on the science, skills, and strategies that can be useful in intervention research. Scientifically, researchers can draw on constructs and techniques from epidemiology, evaluation practice, and clinical trials. Experimental and nonexperimental approaches have value for occupational studies. The skills needed represent a range of disciplines beyond those traditional of health and safety; social scientists, economists, and organizational theorists often need to be part of research teams. Strategic approaches involve more labor–management partnerships, prospective study designs, and the use of intermediate and surrogate indicators. The strategic challenge will be to conduct intervention research against a backdrop of overriding political and economic pressures.* © *1996 Wiley-Liss, Inc.**

***KEY WORDS: intervention research, health services research, clinical trials, evaluation occupational health, disease prevention***

## INTRODUCTION

The field of occupational safety and health has historically focused on etiological research, disease diagnosis, industrial hygiene, and control. Little research, however, has been conducted on the effectiveness of programs and services, or for selecting among options for preventing and controlling exposures and diseases. To deliver effective prevention and control programs, decision makers require timely and valid information about the potential effectiveness of proposed prevention measures to reduce occupational and environmental exposures and strategies designed to alter health-related behaviors.

The number of technical, programmatic, and policy options for consideration is rapidly expanding, and these require systematic review and evaluation. Moreover, efforts at cost containment may prove counterproductive if not guided by solid information about the relative effectiveness of alternative strategies and tactics for preventing occupational diseases and injuries.

What will it take to be prepared to conduct research and evaluation of occupational disease and injury interventions? In organizing this workshop, we have identified the need to focus on science, skills, and strategies in preparing to conduct intervention research on a broader scale.

## INTERVENTION SCIENCE

A well-established scientific basis already exists for conducting research on interventions. In fact, many seemingly disparate fields of science promote the importance of intervention research and discuss techniques for conducting it. For example, epidemiology has a long tradition of evaluating health services. In his classic "Effectiveness and

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Accepted for publication August 25, 1995.

Efficiency: Random Reflections on Health Services," Cochrane [1972] provided a framework for assessing health interventions by viewing health problems and health care programs in terms of the entire population, rather than just those who avail themselves of medical care. A whole epidemiologic context has been described by Morris [1964], Dever [1984], Ibrahim [1985], and others that involves viewing the impact of health services on disease outcomes. Within that context, knowledge of risk factors and the stage involved in the natural history of diseases provide opportunities for early detection and prevention. The epidemiological approach views a disease prevention program as one of the independent variables affecting the health conditions of populations. In describing the future of epidemiology, Milton Terris [1993] challenged epidemiologists to give "much greater attention to research on the effectiveness of health services" and to review such interventions using the "critical tools of epidemiology in order to determine their effect on disease outcomes."

The field of epidemiology, in the area of "molecular epidemiology," has contributed further tools for intervention research [Schulte et al., 1993]. Molecular epidemiology provides a framework for describing the causal pathway between an exposure and resultant disease allowing for identification of intermediate markers of disease. These markers can be used as outcome variables in intervention research if they are valid surrogates for later developing disease. Even when markers represent a toxic effect that is not yet validated, they still can be useful for intervention research if they vary with change in exposure [Hallier et al., 1994]. Markers of exposure and markers of susceptibility also can be useful in intervention research by helping to target or stratify populations for specific interventions.

The Centers for Disease Control and Prevention has presented a comprehensive framework for assessing the effectiveness of disease and injury prevention programs [Teutsch, 1992]. This includes two complementary frameworks for conceptualizing prevention programs: one based on delivery of prevention technologies (clinical, behavioral, environmental), and one based on targeting intervention stages of disease or injury (primary, secondary, tertiary). The framework suggests process and outcome measures that should be assessed at each point.

Intervention science also draws on the rich tradition of evaluation research. As defined by Rossi and Freeman [1993], evaluation is the systematic application of social research procedures for assessing the conceptualization, design, implementation, and value of social intervention programs. They trace the history of evaluation research to the seventeenth century with the emergence of the general acceptance of the scientific method as a means of dealing with social problems. They link it more strongly to the growth and standing of the social sciences. Early efforts beginning prior to World War I were directed at the assessment of educational programs concerned with literacy, job training, and public health initiatives to reduce morbidity and mortality from infectious diseases. By the 1930s, social scientists were advocating the application of rigorous social science research methods to the assessment of community action programs. Following World War II, large-scale evaluation programs were designed to coincide with programs conceived to meet the needs for urban development and housing, technological and cultural education, occupational training, and preventive health activities. During the 1960s, the practice of evaluation research grew dramatically. It was spurred on by federal programs such as the "war on poverty" and the Great Society, which emphasized innovations and the testing of local and national demonstration projects. By the 1990s, almost a dozen journals were devoted to evaluation research.

Evaluation research has a history of assessing interventions from the multiple levels of the intervention itself, to that of the program that houses it, and the policies that foster it. The experiences of evaluation research may serve as useful models for evaluating occupational health and safety programs.

Evaluation research and epidemiologic research are also inheritors of the seminal thinking in experimental design and statistical analysis of experiments built on random allocation of subjects to treatments. This logic is well described by Fisher [1935] and Cox [1958]. More recently, Fleiss [1986] carries that theme forward and provides a benchmark against which to judge experimental methods.

Because of the ethical and practical realities of society, research on interventions in the social realm generally cannot avail itself of the highly controlled designs possible in evaluation settings. The challenge of intervention research, then, is to conduct credible studies where truly rigorous experimental research methods are not possible. Three solid works serve as the foundation on which to build this type of research. Cook and Campbell's work [1979] has become a classic for intervention researchers. Two other notable contributions are those by Anderson and colleagues [1980] and Cochran and Cox [1957]. In developing intervention research in occupational health and safety, it will be useful to review, learn from, apply, and expand the approaches from this existing methodological literature.

The necessary reliance on nonexperimental and quasi-experimental methods in intervention and evaluation research makes the development of sound methods of interpretation all the more crucial. Lipsey's work [1993] provides a practical approach for opening the black box that hides the nature and details of the change mechanisms through which an intervention of interest is expected to produce the effects of interest. Having a theoretical basis in the first place, so that the research can be "theory-driven," may be a desirable criterion for judging an intervention's potential for being evaluated.

## SKILLS

While the scientific foundation for intervention and evaluation research appears to be well established, few skilled practitioners of this craft seem to be working in the area of occupational health and safety. This may be occurring for at least three reasons. First, little emphasis has been placed on conducting occupational health and safety intervention research and thus, few experienced practitioners have chosen this route. Second, such research is often difficult to conduct because it is inextricably linked with the economic, social, and political issues in the workplace. Third, the mix of disciplines and skills required to conduct such research effectively has not been achieved. Intervention research requires disciplines not historically involved in occupational safety and health research. These include psychologists, sociologists, anthropologists, economists, organizational theorists, engineers, and communication specialists, to name a few. This workshop is the first step toward bringing those disciplines together with the more traditional occupational safety and health researchers.

Fruitful conduct of intervention research will require not only interdisciplinary teams, but also the understanding and respect of each discipline by the others. Communication among disciplines can be a problem because of disparate paradigms, divergent motivations, and status differentials. Thus, the challenge will be not only to construct interdisciplinary teams, but also to foster their ability to work together meaningfully.

## STRATEGIES

Intervention research is challenging on all levels. Technically, randomized field experiments are difficult and are not likely to be conducted; quasi-experimental and nonexperimental approaches may be more common. Further refinements of methods for evaluating interventions in the occupational safety and health field are needed. Practically, intervention research will either be retrospective and cross-sectional or prospective. Evaluation of new interventions, particularly for acute health problems and injuries rather than chronic diseases, generally will use prospective approaches. They will require the passage of time and hence will not be amenable to yielding quick results, hence the need for intermediate indicators to serve as surrogates for disease outcomes [Shatzlein et al., 1990]. These could be exposure measurements, behavioral or attitudinal changes, knowledge, or biological markers of intermediate effects. They also could be process indicators. More effort at developing and validating such indicators will be necessary.

By far the largest strategic hurdles will be the political barriers. For the most part intervention research will require cooperation among management, workers, and researchers themselves. Management and workers may have to accept assignment as an intervention site or a nonintervention site, a loss of control which might not be appealing. Applying an intervention can also be costly. It can have labor relations implications, so that intervention researchers must be cognizant of the existing frictions in the workplace. Related issues could also act as barriers to successful intervention research, such as obtaining informed consent of participants; the tendency to focus change strategies on workers instead of the environment; implications for litigation and workers' compensation. In the negotiations with management and workers, researchers may have to give up some degree of control over the research process, placing themselves in unfamiliar participant observation roles. The strategic challenge will be to figure out how to conduct intervention research against the backdrop of these issues.

Other strategic questions will involve evaluation of large-scale programs and policies related to occupational safety and health. Evaluation on this "macro" level is fraught with political, economic, and social complexity. Each research effort can become a referendum on the policy or program, not simply fact gathering to inform the debate. Clearly, deciding what question to ask in an evaluation is a value-laden act. The values need to be made explicit and those who are affected by the research may need or demand to have a role in its planning.

These are some of the issues we face as we attempt to map out the potential and the process of intervention research within the context of occupational safety and health. The workshop has been designed to assist us in that effort.

## REFERENCES

Anderson S, Auquier A, Hauck WW, Oakes D, Vandaele W, Wersberg HI (1980): "Statistical Methods for Comparative Studies: Techniques for Bias Reduction." New York: John Wiley & Sons.

Cochrane AL (1972): Effectiveness and efficiency; random reflections on health services. Nuffeld Provincial Hospitals Trust, London, England.

Cochran WG, Cox GM (1957): "Experimental Designs." 2nd Ed. New York: John Wiley & Sons.

Cook TD, Campbell DT (1979): "Quasi-experimentation: Design and Analysis Issues for Field Settings." Skokie: Rand McNally.

Cox DR (1958): "Planning of Experiments." New York: John Wiley & Sons.

Dever GEA (1984): "Epidemiology in Health Services Management." Rockville, MD: Aspen Systems.

Fisher RA (1935): "The Design of Experiments." London: Oliver & Boyd.

Fleiss JL (1986): "The Design and Analysis of Clinical Experiments." New York: John Wiley & Sons.

Hallier E, Goergens HW, Hallier K, Bolt HM (1994): Intervention study on the influence of reduction of occupational exposure to styrene on sister–chromatid exchanges in lymphocytes. Int Arch Occup Environ Health 66: 167–172.

Ibrahim MA (1985): "Epidemiology and Health Policy." Rockville, MD: Aspen Systems.

Lipsey NW (1993): Theory as method: Small theories of treatments. In LB Sechrest, Rossi PH, Freeman HE (eds): "Evaluation: A Systematic Approach." Newbury Park, CA: Sage Publications.

Morris JN (1964): "Uses of Epidemiology." 2nd Ed. Baltimore: Williams & Wilkins.

Rossi PH, Freeman HE (1993): "Evaluation: A Systematic Approach." Newbury Park, CA: Sage Publications.

Schatzkin A, Freedman LS, Schiffman MH, Dawsey SJ (1990): Validation of intermediate endpoints in cancer research. J Natl Cancer Inst 82:1746–1752.

Schulte PA, Rothman N, Schottenfeld D (1993): Design considerations in molecular epidemiology. In Schulte PA, Perera FP (eds): "Molecular Epidemiology: Principles and Practices." San Diego: Academic Press, pp 159–198.

AG Scott (eds) (1993): "Understanding Causes and Generalizing About Them." San Francisco: Jossey-Bass, pp 5–38.

Terris M (1993): The society for epidemiologic research and the future of epidemiology. J Public Health Policy 137–148.

Teutsch SM (1992): A framework for assessing the effectiveness of disease and injury prevention. MMWR 41:1–12.