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Epidemiological Studies of Chemical Accidents Using EPA's 5-Year Accident History Database

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Paper presented at the 1st Annual Symposium of the Mary Kay O'Connor Process Safety Center,
"Beyond Regulatory Compliance, Making Safety Second Nature",
George Bush Presidential Conference Center, College Station, Texas
March 30-31, 1998.

ABSTRACT

Epidemiological studies have made major contributions to the understanding and prevention of human disease. They are particularly valuable in regard to discovering the risk factors associated with low probability-high consequence diseases with a complex etiology. In many cases, once such factors are uncovered, preventive measures can be taken to reduce their contribution to the risk that the disease will manifest itself.

Major accidental releases of chemicals are also low probability-high consequence events and also often have a complex etiology. However, there has not been a significant application of epidemiological techniques in regard to major accidental chemical releases. In large part this is because a suitable database on the incidence of such events has not existed, a situation which will be remedied when the EPA 5-year Accident History database becomes available.

The paper will discuss how epidemiological studies using this database can be used to uncover predictors (risk factors) and underlying causes of major accidental chemical releases.

Investigation of a possible parallel between the influence of human socio-economic status on disease and organizational sociotechnical status on accidental chemical releases will also be discussed.

Epidemiological Studies of Chemical Accidents Using EPA's 5-Year Accident History Data Base

Irv Rosenthal Ph.D., Lyse D. Helsing Ph.D, Paul Kleindorfer Ph.D
and Dr. Bob Lowe M.D.

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The paper will discuss how epidemiological studies using this data base can be used to uncover predictors (risk factors) and underlying causes of major accidental chemical releases. Investigation of a possible parallel between the influence of human socio-economic status on disease and organizational sociotechnical status on accidental chemical releases will also be discussed.

Outline of Presentation

* Epidemiology and Socio-economic Status* as predictor of human health.

* Why are there no epidemiology studies on major chemical release events?

* Socio-economic Status vs. íSocio-technical statusó

* Will there be future epidemiology studies on major chemical release events?

* Some hypotheses on release events under study at Wharton and CEPPO

Classical Definitions of Epidemiology are Health Centered.

* íThe study of predictors and causes of illness in humansó.

íThe study of the distribution and determinants of health related states and events in populations, and the application of this study to control of health related issues

Socio-economic status:

One Definition

íDescriptive term for a persons position in society, which may be expressed on an ordinal scale using such criteria as income educational level attained, occupation, value of dwelling, etc.

Socio-economic status :

A Comment

íSocio-economic status is a somewhat nebulous concept but it can be measured fairly conveniently by the occupation or income of the family headó.

Epidemiology showed the impact of Socio-Economic status on human disease rates.

Table 1

Some Health-Related Outcomes that Vary with Social Class.

Indicators of socioeconomic status

Intermediate Variables

Dependent Variable

[Health Outcomes]

Wealth

-Access to health care, etc.

-Access to dietary choices -Detection & treatment of disease, etc.

-Obesity, blood press. cholesterol levels

Education

- Attitude & behavior about diet, smoking, alcohol, exercise, sexual practices, illegal drug use, family planning, prenatal care, etc. - Changes in risk factors for

heart disease, lung cancer, AIDS, low birth weight, etc.

Occupation

- Exposure to hazards, physical activity, psychological stresses, etc. - Cancer, miscarriages, heart disease, birth defects, accidents, etc.

Intermediate variable

íA variable that occurs in a causal pathway from an independent to a dependent variable. It causes variation in the dependent variable, and is itself caused to vary by the independent variable. Such a variable is statistically associated with both the independent and dependent variables.

Explanation for absence of íepidemiological studies on chemical releases.

Simple Answer:

NO SUITABLE BODY OF DATA WITH BOTH NUMERATOR AND DENOMINATOR.

We have no answers to questions about chemical release events such as:

* Has incidence rate of Major chemical release events changed over time?

* Do ípooró firms have more release events than írichó firms?

* Do union plants have lower rates of release events than average?

* Is type of PHA used by facility associated with event incidence rates?

Will RMP* Info accidental release history data support epidemiological studies?

* What information will be available on each reportable incident?

* How many organizations and incidents will the report contain?

* What descriptive info will be available on the reporting facilities?

* How accessible is this information?

What is the quality of the available information?

Socio-technical status

A socio-technical system is a community of individuals interacting and interdependent with one another and a technology chosen to meet a community (business) goal under the constraints of the culture, regulations, laws and economic factors making up the communityós external environment.

Socio-technical Status and íAccidentsó and Causation

Typically failures arise from ícomplex, multiple (causes) rooted in the social and organizational properties of the overall socio-technical system associated with any hazardous technologyó.

Question

Are there provable relationships between socio-technical systems/status (independent variable) and process safety (dependent variable) analogous to those found with socio-economic systems and human health?

Socio-technical status/systems and Process safety

I. Analogy with socio-economic status/systems and human health:

-Firmós socio-technical status/systems is independent variable.

-Its process safety management system is intermediate variable.

-Process safety is dependent variable.

Socio-technical status/systems and Process safety

II. Other intermediate variables that could affect the íhealth of a processó are the way the organization approaches:

- selection of process technology,

- process siting,

- terms of employment and compensation,

- reporting relationship between process design and manufacturing

- supervision of production : (horizontal) versus (vertical)

Question

* Is process safety related to any single attribute of socio-technical systems:

- level of group-think?

- attitude to employees who report near misses?

- concern for quality?

- hierarchial rigidity? etc.

* If so, are they causally related?

* Independent variables? Intermediate variables?

Descriptive studies of major accident rates as a function

of time, place and organization.

* Time- 1993-1999

* Place- Houston Ship Channel vs Contra Costa County

* Individual- CMA members vs Non members

Hypothesis A

Organization íprofitability ratiosó in the lowest quartile for its industry, leads to the creation of determinants that increase the likelihood of a major accident associated with the organization.

Hypothesis B

Organization íprofitability and solvency ratiosó in the ílowest quartile for its industryó, over the time period a given process was designed and built, leads to the creation of permanent intermediate causes which increase both the likelihood of major accidents associated with the given process and the magnitude of its consequences.

Hypothesis C

An organizationós total quality management (TQM) practice that is in the lowest quartile for its industry, leads to the creation of determinants that increase the likelihood of a major accident associated with the organizationós processes.

Hypothesis D

There is no correlation between a facilityós OII frequency and its EPA defined chemical release frequency.

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