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SURVEILLANCE FOR AGRICULTURAL SAFETY AND HEALTH

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Mr. Mark Timm: Our next speaker is Dr. William Halperin. He is the Associate Director for Surveillance, Division of Surveillance, Hazard Evaluation, and Technical Assistance, at NIOSH in Cincinnati. Dr. Halperin received his Master's in Public Health and M.D. from Harvard. In 1975 he became an Epidemic Intelligence Officer at the Centers for Disease Control. In 1979 he became the Chief of Industrywide Studies Branch at NIOSH. Dr. Halperin has served on numerous professional and expert committees. He currently serves on the Committee on Risk Assessment Methodology at the National Research Council. Dr. Halperin has published over 100 scientific papers, editorials, and letters to editors. His epidemiological investigations include herbicides, dioxin, and biotechnology. He was a co-author on perhaps the most popular paper in occupational health in the last 10 years—the *Sentinel Health Event: A Framework for Occupational Health Surveillance and Education.* That leads to Dr. William Halperin's topic today, *Surveillance for Agricultural Safety and Health.* Dr. Halperin:

Public health surveillance is central to the process of disease prevention. Surveillance systems are vital tools in targeting the resources of the public health system and in evaluating program effectiveness.

The Institute of Medicine report *The Future of Public Health*[1] found the core functions of public health to be assessment, policy development, and assurance of the availability of services. Surveillance is intrinsic to the assessment function and essential for proper policy development and assurance of service availability.

An ongoing national dialogue is needed on the role of public health education in training future public health professionals; graduates of schools of public health are acknowledging the need for more books and course materials designed to prepare students for public health practice. State and local public health agencies, in particular, have recognized this need as they recruit and hire new professional staff. There is growing recognition of the role of surveillance conducted by agencies of government as well as by industry and labor to advance the mission of public health—"to fulfill society's interest in assuring conditions in which people can be healthy."[2]

Although surveillance is an essential element of the practice of public health, the subject is rarely taught in schools of public health or fully discussed in textbooks of public health or of epidemiology. This gap reflects the diverging cultures of public health between schools of public health and public health practitioners, a divergence recently addressed in a report of the Institute of Medicine, *The Future of Public Health.*

The essence of the motivation for public health was captured by the 16th century poet John Donne, who unfortunately came to the wrong conclusion about surveillance. Donne wrote:

> *No man is an island, entire of itself; every man is a piece of the continent, a part of the main. If a clod be washed away by the sea, Europe is the less, as well as if a*

promontory were, as well as if a manor of they friend's or of thine own were: any man's death diminishes me, because I am involved in mankind, and therefore never send to know for whom the bell tolls; it tolls for thee.

The public health sentiment is captured in the following line:

Any man's death diminishes me, because I am involved in mankind.

This is not a matter of epidemiology or the technology of public health, but rather a matter of the philosophy that motivates public health action.

The antithesis of surveillance is captured in the following line: "Therefore, never send to know for whom the bell tolls." In earlier times, church bells were rung when people died. Currently we have a need for similar information to connect us to the burden of morbidity and mortality and to call forth public health practitioners so that deaths and morbid events can be investigated and recurrences prevented.

Surveillance in modern times is the equivalent of the tolling of the bells with the added commitment to investigation of the causation of morbidity and mortality and dissemination of data and analysis with the goal of prevention. Surveillance, as defined by Alexander Langmuir, the father of modern public health surveillance, and the founder of the Epidemic Intelligence Service of the Centers for Disease Control, "means the continued watchfulness over the distribution and trends of incidence through the systematic collection, consolidation, and evaluation of morbidity and mortality reports and other relevant data"[3,4] for the purposes of prevention of disease or injury.

It is worth lingering over some of the key words in this definition. "Continued watchfulness" implies that the surveillance process continues over time, rather than being a one-time survey or epidemiologic study. Repeated surveys from which trends can be discerned are consistent with surveillance. "Collection, consolidation, and evaluation" should differentiate surveillance as a process from the important, but different enterprise of registering cases in a disease register, such as a cancer registry, if this registry does not include analysis of the data and dissemination of the results.

"Other relevant data" allows for collection of information on risk factors for disease, health or safety hazards, etc., or preventive interventions, such as immunization, rather than limiting surveillance to collection solely of data on disease. To differentiate surveillance from other useful collection of data, such as marketing surveys for a product, "for the purposes of prevention of injury and disease" should be added to Dr. Langmuir's definition.

Surveillance should not be so definitively defined that in-depth investigation of individual or sentinel cases is excluded. A "sentinel health event" represents a failure of prevention, such as a maternal death or an industrial injury.[5]

THE ROLE OF SURVEILLANCE IN PUBLIC HEALTH PRACTICE

The practice of public health can be defined as the logical application of methods of problem recognition, evaluation, and intervention for the purpose of prevention of disease and injury in populations. A working definition of epidemiology should reflect both the traditional broad notion that epidemiology is "the study of the distribution and determinants of disease

frequency in man,"[6] which encompasses interest in epidemic and endemic diseases, as well the inclusion of the supplemental views of theoretical epidemiology. Theoretical or modern epidemiology focuses much more on the use of very sophisticated analytic methodology for understanding the relationship of risk factor and disease, particularly of endemic disease, rather than on the description of epidemics.[7]

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A useful model that specifies the role of surveillance in the practice of public health has been developed by Greenwald,[8] and further elaborated by Layde,[9] and modified here to describe the role of surveillance in the prevention of occupational injury and disease.

• The first step in public health is the recognition of a problem; a related goal is tracking the trends of a problem as its incidence increases.

Sam Milham provides an example from the analysis of death certificates for industry and occupation.[10] Usual industry and occupation is entered onto every death certificate; however, only in some states is it coded in order to be machine readable. From 1979 to 1987, about 2.9 million deaths were coded for industry and occupation in approximately 23 states.

In comparison to data purposefully collected for a research study, information from death certificates on industry and occupation and even cause of death will be collected without quality control, by minimally trained observers, and will inevitably contain errors. However, surveillance data, often collected for administrative purposes and secondarily used for disease prevention, is inexpensive and readily available.

Milham and colleagues found that farmers had a substantial excess in the proportion of deaths due to electrocutions. When the deaths were investigated, they found that many were due to contacting electric utility lines with portable aluminum irrigation pipe. While the association of electrocution and aluminum piping must have been evident to the sphere of people involved with each incident, the problem was only brought to the attention of the public health community by the analysis of minimal information available from death certificates, and the dissemination of results for the purpose of prevention.

Data from the Annual Survey of the Bureau of Labor Statistics[11] provide an example of tracking an occupational health problem as its incidence changes. The Annual Survey collects data from a sample of logs of injuries and illnesses kept by employers.

These data demonstrate an upturn in the numbers of cases of repeated trauma. Surveillance has done its job by disseminating information on this apparent epidemic to those with a need to know for the purpose of prevention. The related role of epidemiologic research necessary to determine the reality and etiology of this apparent epidemic should be evident.

• The second step in the process of public health is the definition of the scope of a problem. Two examples reflect the value of ongoing collection of data in this endeavor and the usefulness of periodic surveys.

The first example concerns the surveillance of lead poisoning. In 16 states, laboratories report to the state health department if samples submitted for blood lead determination in adults are in excess of a state standard. This information provides a crude estimate for the burden of occupational lead poisoning for the United States, currently about 17,000 reports each year.[12]

A second example of the role of surveillance in providing an estimate of the scope of a problem comes from survey information periodically collected by the National Center for Health Statistics, Centers for Disease Control.[13] From 1983 to 1987, successive periodic surveys provided information from approximately 2700 white, male farmers.

Farmers report 2.7 cases of skin cancer per hundred farmers. Nonfarmers report less than one case of skin cancer per hundred people.

Farmers have three-fold the amount of skin cancer than do nonfarmers. Thus, the periodic survey provides a crude estimate of the scope of the excess of skin cancer in farmers, in contrast to a research study that would likely include confirmation of each case, and which would estimate in substantially greater detail the exposure of the farmers, and would likely be designed to provide information on etiology or perhaps use of preventive measures.

• The third step in the public health process is to conduct etiologic research to determine the cause of a disease. This step consists of an epidemiologic study, not surveillance. For example, an epidemiologic study might be conducted to determine the differential exposure of cases of eosinophilia-myalgia syndrome as compared to controls without the disease. It does not require the ongoing collection of information about cases; rather, it requires more detailed information about cases occurring during the research period.

• Once an etiologic agent or exposure is identified, the fourth step in the public health process is the design of an intervention that will prevent transmission of the infectious agent, exposure to a chemical hazard, etc. Examples of intervention include immunization, withdrawal of a food contaminant, provision of a ventilation system, etc. This is not surveillance.

• The fifth step involves a trial of the proposed intervention system in an experimental situation where a limited number of important factors are carefully controlled. This type of public health experiment does not involve surveillance.

• Successful interventions in the controlled laboratory environment sometimes do not withstand the more rugged environment of the field test, the sixth step in the practice of public health. Surveillance can play a role in selection of field sites for testing.

• The seventh step in the public health process is targeting scarce preventive resources in order to maximize their effectiveness. A classic example comes from the eradication of smallpox.[14] While the burden of smallpox was reduced by mass immunization, smallpox persisted because

there were sufficient unimmunized to sustain transmission. A turning point in efforts to eradicate smallpox came with the use of intensive surveillance for cases and the targeting of immunization to the contacts of cases.

Similarly, greater success in cancer prevention might be obtained if screening programs for breast cancer and cervical cancer were targeted to high-risk populations. Another example of the use of surveillance for targeting also comes from the surveillance of elevated blood lead based upon laboratory reports. Multiple elevated results from a single worksite almost insure that the work environment is in need of amelioration.[15]

• The eighth step in the practice of public health is the evaluation of the effectiveness of the public health intervention. Tracking the trends of disease is one mechanism for evaluating the effectiveness of intervention.

For example, in 1958, Sweden instituted a law that any new tractor that was produced had to have rollover protection.[16] In the years thereafter, surveillance data indicate a decline in rollover fatalities. In 1978 Sweden instituted another law that any tractor in use had to have rollover protection, and the problem was eradicated.

CONCLUSION

There are four goals for surveillance. These include:

1. The identification of new occupational health problems.
2. The estimation of the scope or magnitude of the problem.
3. The delineation of the trend in incidence of the illness, disease, or hazard.
4. The targeting of opportunities for prevention.

Surveillance is a powerful tool in many parts of the complex continuum of practices that constitutes the public-health problem-solving process.

Epidemiologists have much to owe to the modern father of surveillance and field epidemiology, Alexander Langmuir, who in his wisdom commented, "Good surveillance does not necessarily ensure the making of the right decisions, but it reduces the chances of wrong ones."[13]□

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