Training and Service in Public Health Practice, 1951–90—CDC's Epidemic Intelligence Service

STEPHEN B. THACKER, MD, MSc
RICHARD A. GOODMAN, MD, MPH
RICHARD C. DICKER, MD, MSc

The authors are with the Epidemiology Program Office of the Centers for Disease Control, Public Health Service. Dr. Thacker is the Director, Dr. Goodman is the Assistant Director, and Dr. Dicker is the Assistant Director for Epidemiologic Development.

Tearsheet requests to EIS Office, Epidemiology Program Office, Mail Stop C08, 1600 Clifton Road, Centers for Disease Control, Atlanta, GA 30333.

Synopsis

The Epidemic Intelligence Service (EIS) was created at the Centers for Disease Control (CDC) in 1951 as a combined training and service program in the practice of applied epidemiology. Since 1951, more than 1,700 professional have served in this 2-year program of the Public Health Service. In the decade of the 1980s, EIS underwent dramatic changes in response to the increased breadth of the CDC mission and the rapid expansion of epidemiologic methods. Modifications in the experience of an EIS Officer have resulted from the increased need for more sophisticated analytic methods and the use of microcomputers, as well as CDC's expanded mission into chronic diseases, environmental health, occupational health, and injury control. Officers who have entered the EIS in the past decade tend to be older than their predecessors, tend to enter the program with more experience and training in epidemiology, and are more likely to stay in public health either at the Federal level or in State and local health departments. The EIS Program continues to be a critical source for men and women to respond to the need and demand for epidemiologic services both domestically and internationally.

THE CENTERS FOR DISEASE CONTROL (CDC) was created following World War II from the wartime organization that had been established to control malaria in military installations throughout the southeastern United States (*1*). In 1951, the Epidemic Intelligence Service (EIS) Program was created at CDC as a combined training and service program in the public health practice of epidemiology. EIS is based on a concept originated by Dr. Joseph W. Mountin, Assistant Surgeon General, and founder of CDC, and implemented subsequently by Dr. Alexander D. Langmuir (*2*).

In July 1951, 22 physicians and 1 sanitary engineer reported for duty in Atlanta, GA, as the first class of EIS officers. Since then, more than 1,700 professionals have served in the EIS, including 64 officers in the class of 1990, who reported to CDC in July to serve 2 years of active duty in the Public Health Service. In the past decade the EIS Program has undergone dramatic changes in response to the increased breadth of the CDC mission and the rapid expansion of epidemiologic methods. In this article, we review the changes in the EIS over the past decade and demonstrate the key role that EIS has played in CDC's evolving role in public health practice.

Program Philosophy and Methodology

The EIS Program is a practically oriented 2-year experience for health professionals who are interested in careers in epidemiology and preventive medicine. The program is based on a philosophy of "learning while doing"; EIS Officers provide service while learning applied epidemiology on the job. The emphasis in the training of EIS Officers is on the development of epidemiologic judgment—the reasoning process that indicates when they have sufficient data on which to make public health decisions. Within CDC the EIS Program is located in the Epidemiology Program Office (EPO), which is charged with the responsibility for selecting and training the officers, as well as assessing the overall EIS experience.

EIS Officers are selected from a pool of approximately 250 applicants. In 1990, 64 officers were matched with assignments based on their interests and skills, as well as program needs. The majority of officers are assigned to specific positions at CDC headquarters or one of its seven field stations located around the country. Additionally, about one-fourth of each class is assigned to State or local health departments. A few officers are assigned to epidemiology positions in other Federal agencies such as the Food and Drug Administration, the Health Care Financing Administration, and the National Institutes of Health. Each EIS assignment is routinely reviewed to ensure the best possible experience for the officers.

The EIS curriculum. For each cohort of EIS Officers, training begins in July in Atlanta with a 3-week course

Selected Investigations in Which EIS Officers Have Participated, 1951–90

1951–60

- Contamination of killed poliovirus vaccine with live virus
- Asian influenza epidemics
- Nosocomial staphylococcal epidemics

1961–70

- Cases of poliomyelitis associated with oral vaccine
- Smallpox epidemics through 1977
- Hong Kong influenza epidemics
- Hurricane Camille after effects
- Mortality associated with intrauterine devices

1971–80

- Bacteremia from contaminated intravenous fluids
- Norwalk virus epidemic
- Legionnaires' disease
- Guillain-Barré syndrome associated with swine influenza vaccine
- Toxic shock syndrome
- Heat wave associated morbidity and mortality in Missouri
- Study of the efficacy of nosocomial infection control
- Three Mile Island investigation

1981–90

- Mount St. Helens volcano eruption
- AIDS
- Accutane-associated birth defects
- Aspirin-associated Reye syndrome
- Cancer and steroid hormone study
- *Escherichia coli* 0:157:H7 associated with hemorrhagic diarrhea and hemolytic uremic syndrome
- Eosinophilia-myalgia syndrome
- Clusters of suicides by teenagers
- Vietnam veterans studies
- Mercury poisoning from commercial paint

that is modelled on the traditional case-study method; most of these cases are based on epidemiologic investigations conducted by EIS Officers. Up to 10 case studies are complemented by didactic sessions in applied epidemiology and biostatistics, as well as a field exercise. In 1990, the field exercise combined observational and telephone surveys of injuries and infections related to out-of-home child care. The success of this course has been reflected by its adaptation for State and local health department professionals enrolled in the "Epidemiology in Action" course, as well as in the development of the International EIS Course. Both of these courses are now conducted by Emory University in collaboration with CDC . In addition, the U.S. Department of Agriculture, the Merieux Foundation, and the National School of Public Health in France have sponsored similar courses with the assistance of CDC.

The EIS Course given each July represents only the foundation of the EIS Officer's training in applied epidemiology. The inservice training in epidemiology is primarily a function of the 2-year assignment to a CDC program, a State or local health department, or another Federal agency. In these assignments, EIS Officers learn the basic skills of epidemiology under the supervision of an experienced mentor while they conduct epidemiologic investigations and research in the public health setting either in a specific program area, such as chronic or infectious diseases, or in a State or local health department. The State health department assignments tend to be more general and usually provide the broadest spectrum of experience in the public health practice of epidemiology.

In the fall of the first year, all EIS Officers participate in a 1-week course that focuses on the methods of public health surveillance and more advanced epidemiologic techniques. In December, each officer is expected to submit an abstract of a completed study for presentation at the annual EIS Conference held at CDC in April. In 1990, more than 1,000 persons attended this conference, which encompassed 90 full-length oral presentations, 19 poster presentations, 11 brief, "late-breaker" presentations, and a special evening international session of 6 papers. The process of matching EIS Officers to their new assignments takes place on the weekend following the conference in April, before the officers are due to report to CDC for duty.

In the 2 months prior to the conference, current EIS Officers meet with EPO staff to review their experience. From these meetings of groups of 8 to 10 officers who have filled various assignments, EPO is able to modify the experience so as to improve the educational opportunity as well as the service provided by the officer.

During the 2 years, each officer is expected to fulfill a minimum set of specific professional experience guidelines. These guidelines were developed during the 1980s as a measure of what is expected from each EIS Officer and are used as a means for developing the requisite skills of a practicing epidemiologist, including the conduct of field investigations, the analysis of large data bases, the practice of public health surveillance, scientific writing, effective oral communication, and responsiveness to the public.

Since 1980, both the content and nature of the training of EIS Officers has evolved dramatically. Specifically, there has been an increasing emphasis on more advanced and sophisticated analytic methods, such as logistic regression analysis in case-control studies and the application of time-series-analysis methods to surveillance data. Greater emphasis has also been placed on public health surveillance, in the nature of the statistical and epidemiologic tools used, as well as in the applications to noninfectious disease areas. Prior to the mid-1980s, EIS Officers were equipped first with slide rules and then with calculators. In 1990, EIS Officers

are trained in computer skills and provided access to computers for their regular use. EPI INFO, a computer software package, has been developed by CDC for use by EIS Officers and other epidemiologists for questionnaire development, word processing, data entry, statistical analysis, development of tables and figures, and manuscript preparation (*3*). EIS Officers also use EPI INFO to disseminate surveillance data between State and local health departments and CDC, and as a tool for the analysis of surveillance data.

Epidemiologic field investigations and service contributions. Since the creation of the EIS Program in 1951, EIS Officers have played important roles in landmark epidemiologic investigations (see box). At the request of State health departments, other countries, or international organizations, EIS Officers have participated in more than 3,000 epidemiologic investigations since 1951 (*4*) of national and international importance. Officers assigned to State and local health departments participate in an additional 400 investigations each year. Between 1951 and 1979, for example, EIS Officers investigated the contamination of poliovirus vaccine with live virus, the effects of the Asian and Hong Kong influenza pandemics, a nationwide epidemic of staphylococcal nosocomial infections, increased mortality associated with intrauterine devices, the health effects of disasters (including hurricanes, earthquakes, famine, and flooding), bacteremia associated with contaminated intravenous fluids, the first recognized epidemic of Legionnaires' disease, and the association of Guillain-Barrè syndrome with swine influenza vaccination. They also participated in the global smallpox eradication program.

Since 1980, EIS Officers have continued to play a critical role on behalf of CDC in the investigation of emerging public health issues. For example, in 1980, EIS Officers led the study of toxic shock syndrome (*5*) and, in 1981, an EIS Officer assigned to the Los Angeles County Department of Health Services was involved in the identification of the first cluster of cases of the acquired immunodeficiency syndrome (AIDS) (*6*). EIS Officers have continued to play an integral role in the identification of emerging infectious pathogens, investigating, for example, the association of *Escherichia coli* 0 157:H7 infection with the ingestion of improperly cooked hamburger meat and the subsequent implication of that organism as a cause of hemolytic-uremic syndrome. Other infectious disease problems investigated by EIS Officers during the 1980s included the transmission of salmonellosis from chickens to eggs, the spread of Lyme disease, the identification of hepatitis C and the delta agent, the demonstration of *Ehrlichia* as a human pathogen, the elucidation of the epidemiology of Brazilian purpuric fever, the causal role of parvovirus in Fifth disease, and the resurgence of sexually transmitted disease through sex-for-drugs activities.

A recent example of the responsiveness of the EIS Program was the rapid assessment in 1987 of available data on human immunodeficiency virus (HIV) infection in the United States and assistance in the implementation of the HIV family of surveys. Thirty officers were pulled from their primary assignments to undertake this task. Some worked in pairs with public health advisors to collaborate with local health departments in 30 cities to develop plans for the rapid implementation of the HIV seroprevalence surveys. Nine other officers were assigned at headquarters to obtain currently available HIV seroprevalence data to provide insight into both the prevalence of HIV in the United States and relevant risk factors. The task force was organized in a few weeks and lasted 2 months, providing in a rapid fashion an analysis of the national picture of HIV infection and AIDS that was critical to the understanding of this severe public health problem. The findings were vital for establishment of policy and for the rapid implementation of a national sentinel surveillance system for HIV infection.

The decade of the 1980s has also been marked by a dramatic increase in the investigation by EIS Officers of problems of noninfectious etiology. For example, in 1980, a team of EIS Officers characterized the dramatic morbidity and mortality associated with a protracted heat wave in Missouri. EIS Officers subsequently conducted epidemiologic investigations of clusters of suicides by teenagers, demonstrated the association between exposure to Accutane and severe birth defects, documented the risk of injury related to the use of all-terrain vehicles, unraveled the cause of a cluster of deaths related to flour inadvertently contaminated with parathion, investigated unexplained deaths of hospital patients, documented fatal hepatic encephalopathy associated with unintentional consumption of aflatoxin by Malaysian children, and in 1989–90 helped to lead the investigation of eosinophila-myalgia syndrome and uncovered the hazard to children associated with mercury in commercial paint. These investigations reflect the EIS Officers' critical role in the dramatic increase in CDC involvement in noninfectious concerns of public health.

During the 1980s, EIS Officers also became more involved in conducting formal, planned studies, while retaining their traditional role of responding to public health emergencies. For example, EIS Officers have participated in two landmark studies conducted by CDC epidemiologists. First, the cancer and steroid hormone (CASH) study was initiated in 1980 to examine the relationship between contraceptive use and estrogen replacement therapy and the occurrence of breast, cervi-

Table 1. Epidemic Intelligence Service Officers, by professional category and period of entry into the Service

Professional category	1951–60	1961–70	1971–80	1981–90	Total
Physician	150	384	430	505	1,469
Veterinarian	33	36	13	36	118
Graduate epidemiologist	0	0	3	50	53
Statistician, demographer	21	22	2	6	51
Nurse	5	1	5	13	24
Microbiologist	5	6	1	0	12
Anthropologist, sociologist	1	0	1	5	7
Sanitary engineer, industrial hygienist	2	1	0	4	7
Other doctoral degrees	0	2	1	4	7
Dentist	1	1	2	2	6
Public health advisor, health services officer	0	1	3	0	4
Total	218	454	461	625	1,758

Table 2. Locations and occupations of Epidemic Intelligence Service Officers who entered on duty from 1978 through 1987

Location	Physicians	Veterinarians	Others	Total	Percent
Federal Government	198	14	42	254	44.2
Centers for Disase Control	174	6	33	213	37.0
Other Health and Human Services agencies	7	1	3	11	1.9
Other Federal agencies	17	7	6	30	5.2
State and local health department	74	4	6	84	14.6
Other health agency	15	0	0	15	2.6
University faculty (full-time)	62	2	6	70	12.2
Residency, fellowship, or other graduate study	1	0	0	1	0.2
Private practice, business	94	4	12	110	19.1
Other	38	2	1	41	7.1
Total	482	26	67	575	100.0

cal, and ovarian cancer; EIS Officers have published or coauthored more than 30 articles related to this study in scientific journals. Second, EIS Officers and graduates have also been integrally involved in the study of the health effects of duty in Vietnam on U.S. veterans. The first of a series of studies of this issue documented the absence of risk that Vietnam veterans would father children with birth defects. Subsequently, a retrospective cohort study of more than 18,000 veterans examined the health consequences of the Vietnam experience and a case-control study of several thousand veterans documented an increased risk of non-Hodgkin's lymphoma among Vietnam veterans and the absence of risk for other types of cancer previously hypothesized to be of concern in this population.

Profile of the EIS Officer

EIS Officers are selected each year from a variety of professional categories, including physicians, veterinarians, nurses, graduate epidemiologists, and others (table 1). Compared with earlier decades, persons applying to the EIS during the 1980s tended to be older (in their early to mid-thirties, rather than late twenties), more experienced in public health, and more extensively trained in public health. Among the nearly 1,000 persons who had served in the EIS prior to 1980, there had been only one graduate (doctoral level) epidemiologist. Since then, 52 incoming EIS Officers have held doctoral degrees in epidemiology. In addition, prior to 1980 few physicians had master's-level degrees or training in epidemiology and public health; in the EIS class entering in July 1990, 51 percent of the physicians already had obtained such degrees.

To respond to the increasing breadth of CDC responsibilities in public health, efforts to recruit EIS Officers have been actively expanded beyond traditional recruitment (that is, from residency and fellowship programs) to schools of public health, departments of preventive medicine, and other settings in which greater interest exists in the epidemiology of problems of noninfectious etiology. In addition, because of the intensified public health focus on specific populations such as ethnic and racial minorities, the homeless, and the poor, recruitment has been expanded to professional fields such as sociology and anthropology, as well as to health professionals representing racial and ethnic minority groups. Prior to 1980, 33 (3.0 percent) EIS Officers represented minorities; since 1980, 78 (11.5 percent) EIS Officers have been from minority populations, including 11

(17.2 percent) in the 1990 class. During this same period, the representation of women in the EIS has increased dramatically. In the 1979 class, 8 (15.4 percent) of 52 officers were women; in the 1990 entering class, 32 (50 percent) of the 64 officers are women.

Impact of EIS on Public Health Practice

The demand for epidemiologists has increased in the Federal Government, as well as in State and local health departments (*7*). Because of its focus on applied epidemiology, the EIS Program plays an important role in meeting this large need. EIS Officers who graduated since 1979 are more likely than their predecessors to work in public service (44 percent versus 21 percent in the Federal Government and 15 percent versus 6 percent in State and local health departments) and less likely to list their primary job as a university faculty member or private practice (table 2). Notably, in 1983, 40 percent of all State epidemiologists were EIS alumni(ae) (*8*). In addition, EIS alumni(ae) are increasingly involved in noninfectious disease programs in other Federal agencies, as well as State and local health departments.

Every country needs a minimum capacity for epidemiologic services to help to ensure the quality of health promotion and disease and injury control programs. To address this need, in 1980 CDC, the World Health Organization (WHO), and the Kingdom of Thailand implemented the first Field Epidemiology Training Program (FETP) (*9*). FETPs are modelled on the EIS Program and adapted to the needs and resources of individual nations. Since 1980, FETPs similar to that in Thailand have been established in Indonesia, Mexico, Taiwan, the Philippines, Saudia Arabia, and Peru. Collaboration on an FETP is generally based on extensive consultations between CDC and a Ministry of Health, and a formal plan is developed to fit national needs. Startup resources, generally needed for the first 5–7 years, include the support for a trained epidemiologist supplied by CDC as a resident consultant. Financial support for an FETP comes from multiple sources, but primarily the host country and international organizations such as the WHO. CDC provides continued technical support to the FETPs through the Global Epidemic Intelligence Service headquartered in Atlanta.

By the fall of 1989, 111 trainees had graduated from FETPs and 83 persons were currently in training. To date, 98 percent of FETP graduates have remained in Government service in their respective countries as medical epidemiologists and medical officers at local, district, provincial, and Federal levels. Program trainees had investigated 638 disease outbreaks and carried out 328 research projects. The long-term goal is the creation of strong, fully institutionalized training programs; the FETP programs in Thailand and Taiwan have attained this goal.

'... in addition, because of the intensified public health focus on specific populations such as ethnic and racial minorities, the homeless, and the poor, recruitment has been expanded to professional fields such as sociology and anthropology, as well as to health professionals representing racial and ethnic minority groups.'

Discussion

The EIS Program has changed dramatically during the decade of the 1980s. This change reflects, in part, the diversification of problems addressed by public health agencies at all levels and the resultant change in the CDC mission. The development of the 1990 objectives for the nation and the current development of the year 2000 objectives have established a priority set of public health problems. Each of these problems creates demands for epidemiologists at local, State, and Federal agencies. This demand, in turn, has reflected a broader acceptance and legitimatization of epidemiology in public health practice.

Changes in the composition of EIS classes reflect, in part, the increasing demand on CDC epidemiologists to keep at the cutting edge of epidemiologic practice. In the late 1970s and throughout the 1980s, the public visibility of CDC investigations—including those of Legionnaires' disease, toxic shock syndrome, the association of aspirin use with Reye syndrome, and the AIDS epidemic—as well as greater responsibility in chronic disease, occupational and environmental health, and injury control, have placed CDC investigations under even greater public scrutiny than ever before. In the same time frame, EIS Officers have been provided with highly sophisticated epidemiologic and statistical tools to meet these increasing demands.

The EIS Program continues to evolve as we grapple with new health problems. A large, closely knit group of alumni(ae) often work together to address new problems of public health, including the emergence of new pathogens and infectious diseases, as well as the practice of new areas of applied epidemiology. The hallmark of the EIS Program is the practice of epidemiology as it applies to public health needs. The program continues to be an integral part of CDC's response to the prevention needs of the nation and continues to contribute significantly to the development of experts and expertise in applied epidemiology.

References

1. Foege, W. H.: Centers for Disease Control. J Public Health Policy 2: 8–18 (1981).
2. Langmuir, A. D.: The Epidemic Intelligence Service of the Centers for Disease Control. Public Health Rep 95: 470–477, September-October 1980.
3. Dean, A. D., Dean, J. A., Burton, A. H., and Dicker, R. C.: EPI INFO, Version 5: a word processing database, and statistics program for epidemiology on microcomputers. Centers for Disease Control, Atlanta, GA, 1990.
4. Goodman, R. A., et al.: Epidemiologic field investigations by the Centers for Disease Control and Epidemic Intelligence Service, 1946–87. Public Health Rep 105: 604–610, November-December 1990.
5. Shands, K. N., et al.: Toxic shock syndrome in menstruating women. N Engl J Med 303: 1436-1442, Dec. 18, 1980.
6. Pneumocystis pneumonia—Los Angeles, MMWR 30: 250–252, June 5, 1981.
7. Williams, S. J., et al.: Epidemiologists in the United States: an assessment of the current supply and the anticipated need. Am J Prev Med 4: 231–238 (1988).
8. Gunn, R. A. et al.: State epidemiology programs and State epidemiologists: results of a national survey. Public Health Rep 104: 170–177, March-April 1989.
9. Music, S. I., and Schultz, M. G.: Field epidemiology training programs: new international health resources. JAMA 263: 3309–3311, June 27, 1990.

Epidemiologic Field Investigations by the Centers for Disease Control and Epidemic Intelligence Service, 1946–87

RICHARD A. GOODMAN, MD, MPH
CINDY F. BAUMAN, MPH
MICHAEL B. GREGG, MD
JANIS F. VIDETTO
DONNA F. STROUP, PhD
NANCY P. CHALMERS

The authors are or were with the Epidemiology Program Office (EPO) of the Centers for Disease Control (CDC), Public Health Service, when the study was conducted. Dr. Goodman is the Office's Assistant Director, Ms. Bauman was assigned to EPO as an intern through the Association of Schools of Public Health–CDC Internship Program, Dr. Gregg was Acting Director, Ms. Videtto was a Program Analyst, Dr. Stroup was Chief, Statistical Services Branch, and Ms. Chalmers was a Statistical Assistant.

The paper was presented in part at the International Scientific Conference on Epidemiology, in Beijing, China, on April 27, 1989.

The authors are indebted to the State Epidemiologists who have served the people of their States and Territories and to more than 1,700 EIS Officers who have participated in epidemiologic field investigations.

Tearsheet requests to Richard A. Goodman, MD, Epidemiology Program Office, Mail Stop C08, Centers for Disease Control, 1600 Clifton Road, Atlanta, GA 30333.

Synopsis

The epidemiologic field investigation is an important tool used by the Centers for Disease Control (CDC) to provide assistance to State, local, and international public health agencies. The Epidemic Intelligence Service (EIS) of the CDC is an ongoing program that gives physicians and other health professionals opportunities to learn and practice epidemiology.

In the period 1946–87, EIS Officers and other professional staff based at CDC headquarters participated in 2,900 epidemiologic field investigations requested by State, local, and international public health agencies. Nearly two-thirds of the investigations involved infectious disease problems, while 13 percent involved noninfectious conditions; for 21.1 percent, the etiology of the problem was unknown when the investigation was initiated. Among the specific subcategories, bacterial causes were the most common, accounting for 864 (29.8 percent) of all investigations. During this 41-year period, an increasing proportion of the field epidemiologic investigations involved public health problems of noninfectious etiology. Trends in the types of investigations done probably represent the influence of such factors as CDC's priorities, organizational structure, and budget; the size of the EIS Program; national health initiatives; and the States' needs and programs.

SINCE ITS INCEPTION, the mission of the Centers for Disease Control (CDC) has required the agency to combine the science of epidemiology with the approaches of other public health disciplines in providing assistance to State, local, and international health agencies. Because CDC represents a service-oriented resource for public health constituencies, the programs and methods that it uses emphasize the provision of services in the "field" setting—that is, at the site of the problem or need. The epidemiologic field investigation (*1*) is one of the most important tools used by CDC to assist constituents.

In July 1946, the Communicable Disease Center was