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Epidemic Intelligence Service of the Centers for Disease Control and Prevention: 50 Years of Training and Service in Applied Epidemiology

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The Epidemic Intelligence Service (EIS) was established in 1951 at the Centers for Disease Control and Prevention (CDC), Atlanta, Georgia, as a combined training and service program in the practice of applied epidemiology. Since then, nearly 2,500 professionals have served in this 2-year program of the US Public Health Service. The experience of an EIS Officer has been modified because of the increased need for more sophisticated analytical 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 20 years are more likely than their predecessors 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 health professionals trained to respond to the demand for epidemiologic services both domestically and internationally. *Am J Epidemiol* 2001;154:985–92.

history; training support

Initially known as the Communicable Disease Center, the Centers for Disease Control and Prevention (CDC), Atlanta, Georgia, was created after 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 formed at CDC as a combined training and service program in the public health practice of epidemiology. EIS is based on a concept originated by Joseph W. Mountin, Assistant Surgeon General and founder of CDC, and subsequently implemented by Alexander D. Langmuir (2).

In July 1951, 22 physicians and one sanitary engineer reported for duty in Atlanta as the first class of EIS Officers (3). Since then, nearly 2,500 professionals have served in the EIS, ranging from 11 in the class of 1953 to 80 in 1992. During its 50 years, the EIS Program has undergone dramatic changes in response to the increased breadth of the CDC mission and the expansion of epidemiologic methods. In this article, we review the changes that have occurred in the EIS Program and demonstrate the key role that EIS has played in CDC's evolving public health mission.

PROGRAM PHILOSOPHY AND METHODOLOGY

The EIS Program is a hands-on, 2-year experience for health professionals interested in careers in epidemiology and public health. The program is based on a philosophy of "learning while doing"; EIS Officers provide service while learning epidemiology on the job (4). The emphasis of the training of EIS Officers is on development of epidemiologic judgment—the reasoning process that indicates when they have sufficient data on which to make public health decisions. During the 1950s and 1960s, many physicians became aware of the EIS Program as an alternative means to fulfill their Selective Service obligation. Because of this awareness and little exposure to public health during their training, physicians entered the program having limited familiarity with epidemiology and public health. Still, the most important method of recruitment for EIS has long been word of mouth from EIS alumni and others familiar with the program. Other methods include a program described on the CDC Website (http://www.cdc.gov/epo/dapht/eis/index.htm), display booths at major public health and clinical meetings, and targeted recruiting in selected settings. In addition, CDC sponsors a 6–8-week epidemiology elective rotation for medical and veterinary students, many of whom subsequently apply to EIS after completing their clinical training (5).

EIS Officers are chosen from among 250–300 applicants each year. Selected Officers are matched with assignments on the basis of their interests and skills as well as agency needs. The majority of Officers are assigned to specific positions at CDC headquarters in Atlanta or one of its field stations located around the country. In most years, a majority of the incoming EIS Officers have been matched with their first or second choice of assignments (e.g., 87 percent in 1999 and 79 percent in 2000). About one fourth of each class is assigned to state or local health departments under the supervision of experienced local epidemiologists to help build epidemiologic capacity in those states, provide convenient access to CDC resources for health department staff, and gain valuable field experience. During 2000–2001, 37

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Abbreviations: CDC, Centers for Disease Control and Prevention; EIS, Epidemic Intelligence Service.

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EIS Officers were assigned to state and local health departments in 25 states and to the Indian Health Service in New Mexico. Each EIS assignment is reviewed regularly to ensure the best possible experience for the Officers.

THE EIS CURRICULUM

For each cohort of EIS Officers, training begins with a 3-week course that features up to 10 interactive case studies, didactic sessions in applied epidemiology and biostatistics, and a field exercise. Most of these cases are based on epidemiologic investigations conducted by EIS Officers (6); some are available to the public health community for teaching purposes at the following CDC Website: http://www.cdc.gov/epo/dapht/eis/case.htm. In 2000, the field exercise included observational surveys of the implementation of restaurant smoking restriction laws in two Georgia counties. The success of the EIS course has been reflected by its adaptation for state and local health department professionals enrolled in the 2-week Epidemiology in Action course as well as in the development of the 4-week International Course in Applied Epidemiology. Both courses are conducted by the Emory University Rollins School of Public Health (Atlanta) in collaboration with CDC. In addition, the US Department of Agriculture, the Quebec Center for Epidemiologic Investigations (Canada), the Merieux Foundation (Lyon, France), the National School of Public Health in France, and more than 20 applied epidemiology training programs internationally have sponsored similar courses with the assistance of CDC.

The 3-week course is only the beginning of an EIS Officer's training in applied epidemiology. The practical, in-service training in epidemiology is primarily a function of the 2-year assignment, where the EIS Officers learn the basic skills of epidemiology under the supervision of an experienced mentor. The Officers conduct epidemiologic investigations and research either in a specific program area, such as chronic or infectious diseases if assigned to CDC, or during state or local health department assignments, which 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 focusing on public health surveillance methods and more advanced epidemiologic techniques. As part of the course, each Officer evaluates an existing public health surveillance system by using a published evaluation framework (7). Not infrequently, the Officer's evaluation subsequently is used to improve that surveillance system. In 1994, the EIS Program introduced scientific writing and prevention effectiveness methods (economic tools for public health) to the EIS curriculum as a 1-week course for second-year Officers (8, 9). In December of that first year, 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 2000, over 1,300 persons attended this conference, which included 120 oral and poster presentations. Throughout the year, the Officers present the results of their investigations at a weekly seminar series.

In the early spring, EIS Officers meet with CDC staff to review their experience. From these meetings of groups of 8–10 Officers, the staff is able to modify the experience to improve the educational opportunity as well as the service the Officer provides.

During the 2 years of training, each Officer is expected to fulfill a minimum set of specific Core Activities for Learning (table 1), including conduct of field investigations, analysis of large databases, practice of public health surveillance, scientific writing, effective oral communication, and

TABLE 1. Core Activities for Learning, Epidemic Intelligence Service, Centers for Disease Control and Prevention, Atlanta, Georgia

The Epidemic Intelligence Service (EIS) Officer will perform the following activities:	
CAL* 1.	Conduct or participate substantively in a field investigation of a potentially serious public health problem that requires a rapid public health response.
CAL 2.	Design, conduct, and interpret an epidemiologic analysis on a new or preexisting database that has a sample size that permits assessment of confounding and effect modification. As a result of the analysis, appropriate public health recommendations should be made.
CAL 3.	Design, implement, or evaluate a public health surveillance system and deliver a written and/or verbal report on this system as required during the fall EIS course.
CAL 4.	Write (as first author) a scientific manuscript for submission to a peer-reviewed journal.
CAL 5.	Write and submit a report to the *Morbidity and Mortality Weekly Report* (MMWR).
CAL 6.	Participate in the EIS Conference by giving an oral presentation or a poster presentation.
CAL 7.	Give an oral presentation at the Tuesday Morning Epidemiology Seminar at the Centers for Disease Control and Prevention or at a national scientific meeting with a substantial epidemiologic constituency (such as the Society for Epidemiologic Research or the American Public Health Association).
CAL 8.	Respond appropriately to written or oral public health inquiries from the public, the media, government officials, or other health professionals.

* CAL, Core Activity for Learning.

responsiveness to the public. These core activities are used as a guide for developing the requisite skills of a practicing epidemiologist.

Since 1980, the content of the training of EIS Officers has evolved. There has been an increasing emphasis on public health surveillance, noninfectious diseases, and more advanced analytical methods, such as logistic regression analysis in case-control studies, application of time-series-analysis methods to surveillance data, and use of geographic information systems. Since the 1980s, EIS Officers have been trained to use computers in their daily work; laptop computers are now routinely carried on all field investigations. In more recent years, the Internet has become an integral part of the EIS experience, not only for rapid communication and distance-based training but also to transmit and analyze essential public health data. EPI INFO, a computer software package, was 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 (10). EIS Officers also use EPI INFO to disseminate surveillance data between state and local health departments and CDC, and as a tool for analysis of surveillance data.

EPIDEMIOLOGIC FIELD INVESTIGATIONS AND SERVICE CONTRIBUTIONS

Since the EIS Program began, EIS Officers have participated in landmark epidemiologic investigations (table 2). At the request of state health departments, other countries, or international organizations, headquarters-based EIS Officers have taken part in more than 4,000 epidemiologic investigations or Epi-Aids of national and international importance since 1951 (11). Officers assigned to state and local health departments conduct an additional 400 investigations each year.

Forty-three years after an EIS investigation of vaccine-associated polio cases helped to rescue the first national polio vaccine program (12), EIS Officers played a critical role in identifying another vaccine-related epidemic (13). On August 31, 1998, the first rotavirus vaccine was licensed in the United States for use in infants. *Rotavirus*, the most common cause of infectious diarrhea in small children in this country, causes 20–40 deaths and more than 50,000 hospitalizations annually. After receiving reports of intussusception among infants who had been vaccinated, CDC recommended suspending use of the vaccine on July 16, 1999, and immediately launched a nationwide study to examine the association between rotavirus vaccine and intussusception. EIS Officers assigned to state health departments were mobilized in 12 states that had received large quantities of the vaccine, and Officers from Atlanta were sent to three other states. These EIS Officers obtained crucial information by interviewing parents and physicians of affected infants, and they reviewed medical and vaccination records. For comparison, they gathered similar information on a group of healthy infants, matched by age and hospital. The investi-

TABLE 2. Selected investigations in which Epidemic Intelligence Service Officers have participated, United States, 1951–2000

1951–1960
- Contamination of killed poliovirus vaccine with live virus
- Asian influenza epidemics
- Nosocomial staphylococcal epidemics
- Childhood lead poisoning from peeling paint

1961–1970
- Cases of poliomyelitis associated with oral vaccine
- Smallpox epidemics through 1977
- Hong Kong influenza epidemics
- Hurricane Camille aftereffects
- Salmonellosis in commercial chicken

1971–1980
- Salmonella in pet turtles
- Oyster-associated hepatitis
- Bacteremia from contaminated intravenous fluids
- Childhood lead poisoning from environmental exposure
- Norwalk virus epidemic
- Vinyl-chloride-associated liver cancer
- Legionnaires' disease
- Ebola virus in Zaire and the Sudan
- Guillain-Barré syndrome associated with swine influenza vaccine
- Toxic shock syndrome
- Heat-wave-associated morbidity and mortality in Missouri
- Aspirin-associated Reye's syndrome
- National study of the efficacy of nosocomial infection control (SENIC)
- National cancer and steroid hormone study
- Investigation of the health effects of the Three Mile Island nuclear incident (Pennsylvania)

1981–1990
- Health effects of the Mount St. Helens volcano eruption (Washington State)
- Acquired immunodeficiency syndrome
- Accutane-associated birth defects
- *Escherichia coli* O:157:H7 associated with hemorrhagic diarrhea and hemolytic uremic syndrome
- Role of parvovirus in erythema infectiosum (fifth disease)
- Toxic oil syndrome in Spain
- Eosinophilia-myalgia syndrome
- Clusters of suicides by teenagers
- Vietnam veterans studies
- Mercury poisoning from commercial paint

1991–2000
- Multistate outbreak of *E. coli* O157:H7- associated diarrhea and hemolytic uremic syndrome from hamburgers
- Hantavirus pulmonary syndrome
- Health effects of Hurricane Andrew
- Cryptosporidiosis from contaminated public drinking water in Milwaukee (Wisconsin)
- Acute renal failure in Haiti from acetaminophen contaminated with diethylene glycol
- Impact of physician-assisted suicide in Oregon
- Multistate outbreak of salmonella associated with commercial ice cream
- Suicide after natural disasters
- Rotavirus vaccine recall
- West Nile virus epidemic
- Cardiac valvulopathy associated with fenfluramine (fen-phen)
- Violence against mothers of newborns of unintended pregnancies
- Definition of excessive weight gain in pregnancy

gation confirmed that intussusception occurred with significantly increased frequency in the first 1–2 weeks after vaccination with the rotavirus vaccine, particularly after the first dose.

On the basis of this investigation, the Advisory Committee on Immunization Practices withdrew its recommendation for use of the vaccine on October 22, 1999, and the manufacturer removed the product from the market. The results of the investigation changed national vaccine policy and protected infants from a potentially fatal complication of a new vaccine. Having a cadre of EIS Officers ready to respond immediately and to focus intensely on this problem made CDC's timely response possible.

PROFILE OF THE EIS OFFICER

The profile of the EIS Officer has changed in the past two decades. Before 1980, 430 of the 461 EIS Officers (93 percent) were physicians, and 416 (90 percent) were male (14). Only one epidemiologist with a nonmedical doctoral degree had served in EIS before 1980, and the first non-US citizen entered the class in 1975. Through 2000, 221 nonmedical doctoral-level scientists had entered EIS, 122 (55 percent) with an advanced degree in epidemiology and others with degrees in demography, anthropology, behavioral and social sciences, statistics, and other health areas (15) (table 3). From 1975 through 1998, 174 non-US citizens from 62 countries had enrolled in EIS (16). About half of the physicians entering recent classes have completed masters-level training in public health; before 1980, few physicians came to EIS with this background. Another important change in the profile of the EIS class has been the increasing number of racial/ethnic minorities in each class, growing from an average of less than 1 percent per class in the first two decades of the program to approximately 25 percent in recent EIS classes. The 73 Officers in the class of 2000 include 44 women, 17 US minorities, 13 non-US citizens, 50 physicians, 22 nonmedical doctoral-level scientists, and 1 dentist.

IMPACT OF EIS ON PUBLIC HEALTH PRACTICE

The graduates of the EIS Program have made a major impact on the health of the nation and the world as a result of their subsequent career choices. During the first 25 years of the program, approximately 35 percent of graduates stayed in public health, approximately 33 percent returned to academic careers, and 25 percent went into private practice. Today, because of increasing interest in epidemiology and public health among applicants (and no Selective Service influence), nearly 90 percent of EIS graduates embark on public health careers at the local, state, federal, or international level.

The health agencies of the federal government, especially CDC, are the most frequent employers of EIS graduates (table 4). Compared with EIS graduates from the 1960s, 1990s graduates were more likely to be employed by CDC (52 percent vs. 2 percent), a state or local health department (11 percent vs. 3 percent), or an international health agency (7 percent vs. 1 percent) (table 5). These more recent graduates were less likely than those from the 1950s and 1960s to be employed on a university faculty (9 percent vs. 24 percent) or to work in private practice or in business (5 percent vs. 42 percent).

When we examine cohorts of Officers over time (namely, the classes of 1955, 1965, 1975, 1985, and 1995), we find

TABLE 3. Numbers of Epidemic Intelligence Service Officers, by professional category and period of entry into the program, Centers for Disease Control and Prevention, Atlanta, Georgia, 1951–2000

Professional category	Period of entry (years)					Total
	1951–1960	1961–1970	1971–1980	1981–1990	1991–2000	
Physician	150	384	430	505	475	1,944
Veterinarian	33	36	13	36	71	189
Epidemiology/Public Health	0	0	3	47	72	122
Statistician, Demographer	21	22	2	6	3	54
Nurse	5	1	5	13	16	40
Biologist/Microbiologist	7	6	1	0	0	14
Anthropologist, Sociologist	1	0	1	5	10	17
Sanitary Engineer, Industrial Hygienist	2	1	0	4	0	7
Other doctoral degrees	0	0	0	3	56	59
Dentist	1	1	2	2	11	17
Public health advisor, Health Services Officer	0	1	3	0	0	4
Chemist/Biochemist/ Toxicologist	0	0	0	2	4	6
Pharmacist	0	0	1	1	2	4
Subtotal	220	452	461	624	720	2,477
Honorary	0	1	2	3	1	7
Total	220	453	463	627	721	2,484

TABLE 4. Current employment positions of 1951–1998 alumni of the Epidemic Intelligence Service, by type of employer and professional category on entry to the program

Location or type	Professional category			Total	%
	Physician	Veterinarian	Other		
Federal government	583	68	94	745	31.9
Centers for Disease Control and Prevention	491	41	79	611	26.1
Other US Department of Health and Human Services	74	11	12	97	4.1
Other federal government	18	16	3	37	1.6
State and local health departments	147	26	2	175	7.5
International agency/government	98	4	10	112	4.8
Other health agency	66	5	16	87	3.7
University faculty	331	15	39	385	16.5
Medical school	189	2	12	203	8.7
Other university	142	13	27	182	7.8
Residency, fellowship, other graduate study	14	0	1	15	0.6
Private practice, business	464	22	26	512	21.9
Other	95	8	18	121	5.2
Retired	72	23	20	115	4.9
Deceased	50	11	10	71	3.0
Total	1,920	182	236	2,338	100.0

other trends (table 6). For example, during the early decades, when training was sometimes interrupted by Selective Service pressures, about half of the graduates returned for additional academic clinical training, whereas, in subsequent years, fewer Officers sought academic training immediately after completing the EIS Program, and many of them entered the CDC Preventive Medicine Residency Program, a public health rather than clinical training program established in 1972. The class of 1995 included 75 Officers; 13 (17 percent) sought further training after finishing EIS, 12 were in the CDC Preventive Medicine Residency, and only 1 entered a clinical residency.

Looking at these same five cohorts, we found that while CDC retained large numbers of Officers in each cohort (33–48 percent), the number of those choosing academic careers or private practice dropped dramatically over the

TABLE 5. Current employment positions of 1951–1998 alumni of the Epidemic Intelligence Service, by type of employer and decade of entry in the program

Location or type	Decade of entry										All decades (1951–1998)	
	1950s		1960s		1970s		1980s		1990s			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Federal government	5	2.5	20	4.7	85	18.4	267	43.0	368	57.8	745	31.9
Centers for Disease Control and Prevention	1	0.5	8	1.9	66	14.3	207	33.3	329	51.6	611	26.1
Other US Department of Health and Human Services	3	1.5	8	1.9	16	3.5	42	6.8	28	4.4	97	4.1
Other federal government	1	0.5	4	0.9	3	0.6	18	2.9	11	1.7	37	1.6
State and local health departments	2	1.0	14	3.3	25	5.4	61	9.8	73	11.5	175	7.5
International agency/government	1	0.5	4	0.9	15	3.2	48	7.7	44	6.9	112	4.8
Other health agency	4	2.0	21	5.0	23	5.0	19	3.1	20	3.1	87	3.7
University faculty	42	21.3	101	23.9	93	20.1	94	15.1	55	8.6	385	16.5
Medical school	20	10.2	63	14.9	47	10.2	46	7.4	27	4.2	203	8.7
Other university	22	11.2	38	9.0	46	10.0	48	7.7	28	4.4	182	7.8
Residency, fellowship, other graduate study	0	0.0	0	0.0	0	0.0	1	0.2	14	2.2	15	0.6
Private practice, business	26	13.2	177	41.8	178	38.5	98	15.8	33	5.2	512	21.9
Other	18	9.1	26	6.1	25	5.4	23	3.7	29	4.6	121	5.2
Retired	68	34.5	39	9.2	4	0.9	4	0.6	0	0.0	115	4.9
Deceased	31	15.7	21	5.0	14	3.0	4	0.6	1	0.2	71	3.0
Total	197	100.0	423	100.0	462	100.0	619	100.0	637	100.0	2,338	100.0

TABLE 6. Selected characteristics regarding the professional experience of five cohorts of Epidemic Intelligence Service Officers following completion of the program

Class year (no. of Officers)	Clinical residency		CDC Preventive Medicine Residency*		Initial employment								Career public health employment	
					CDC		Other public health		Academic		Private practice			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1955 (36)	18	50			12	33	3	8	10	28	11	31	20	56
1965 (31)	21	68			11	35	7	23	10	32	3	10	16	52
1975 (49)	23	47	7	14	20	41	6	12	16	33	7	14	30	61
1985 (67)	3	4	18	27	32	48	24	36	8	12	3	4	59	88
1995 (75)	1	1	12	16	31	41	35	47	5	7	4	5	66	88

* The Centers for Disease Control and Prevention (CDC) Preventive Medicine Residency was established in 1972.

years. Other federal agencies as well as state and local health departments retained the services of EIS graduates in increasing numbers during the past two decades. While a majority of graduates of all EIS classes spent at least part of their careers in public health practice, nearly 9 of 10 Officers in recent years have made public health practice a career choice. Looking at the 75 graduates of the class of 1995, 31 (41 percent) found their first jobs at CDC, 6 (8 percent) found jobs at other federal agencies, 21 (28 percent) immediately found jobs in state or local health departments, 8 (11 percent) worked for international agencies, 5 (7 percent) joined university faculties, and 4 (5 percent) entered private medical practice.

Another measure of the impact of EIS is the number of EIS alumni currently holding positions of leadership in public health. In 2000, 43 percent of state and territorial epidemiologists were EIS graduates (http://www.cste.org). The current CDC Director (and two previous Directors) and a Deputy Director are graduates of the program, as are the directors of 9 of the 11 major CDC organizational units and much of the CDC leadership throughout the organization. Currently, EIS alumni are serving as deans of 10 schools of public health; two EIS alumni have each served as dean of two schools of public health. Numerous other EIS alumni have been departmental chairs in both schools of public health and schools of medicine. Two alumni have served as Surgeon General of the United States.

Although difficult to quantify, the networking and camaraderie among EIS graduates continues to strengthen the overall public health infrastructure by facilitating information exchange among alumni located in key public health positions throughout the nation and world. Publication of an annual alumni directory and a quarterly alumni bulletin, as well as the annual EIS Conference each April, facilitates such networking.

The EIS Program has had a major effect on other public health training programs. The Public Health Prevention Service, CDC's new program to train masters-level professionals to design, implement, and evaluate public health interventions (http://www.cdc.gov/epo/dapht/phps.htm), was developed in part because of CDC's long experience in training EIS Officers.

The international impact of EIS has been dramatic. In the past 3 years, 61 percent of EIS Officers have participated in at least one international assignment ranging from an Ebola virus investigation in Uganda to post-hurricane health needs assessment in Central America, an inquiry into war-related deaths in Kosovo, and a childhood lead poisoning investigation in Bangladesh. Since 1999, in collaboration with the World Health Organization, 49 EIS Officers have completed 3-month assignments in Africa and south Asia as members of STOP (Stop Transmission of Polio) teams dedicated to the global eradication of polio. Short-term international assignments contribute to the professional growth of EIS Officers and lead to the development of a cadre of experienced health professionals able to respond to public health emergencies anywhere in the world. Today, 160 EIS graduates are working outside of the United States in 54 countries on six continents. Many EIS alumni are serving or have served in leadership roles for the World Health Organization, the Pan American Health Organization, the World Bank, and other international organizations and foundations.

An important aspect of international training has been the role of EIS graduates in replicating the EIS training model in more than 20 developed and developing countries around the world (17). A network of these applied epidemiology training programs, known as TEPHINET, was created in 1997 to facilitate interchange among these programs (18). Nearly 900 epidemiologists have graduated from these programs in the past two decades.

DISCUSSION

The first priority of the EIS Program is to train a highly motivated group of capable health professionals who are able to respond to future public health needs both domestically and internationally. From its initial group composed primarily of White male physicians focused on infectious diseases, the EIS Program has evolved to better reflect the growing diversity of health professionals and public health problems that are important in today's society. The increasing number of women and racial/ethnic minority professionals in EIS results from active efforts by CDC to increase diversity in the public health workforce. The increased

range of professional backgrounds among EIS Officers—veterinarians, doctoral-level epidemiologists, social and behavorial scientists, nurses, and dentists—reflects the agency's need to be able to respond to public health problems of social, behavioral, environmental, occupational, genetic, and infectious etiologies. EIS recently expanded admission eligibility to include physician assistants and pharmacists, as well as lawyers with prior public health training and an interest in epidemiology.

The EIS Program has been very successful, but there have been many challenges over the years. First, because it is based in a federal agency, the program is required to follow government rules and guidelines. Compliance with the procedures of the civil service and the Commissioned Corps results in salary differentials among Officers, a problem that became more visible as increasing numbers of nonphysicians and non-US citizens entered the program. As a federal program, it also must have the resilience to adapt to the effects of political decisions made by both the executive and legislative branches of government. Second, the federal role versus that of the state causes tension that can affect the ability to conduct investigations or assign Officers to states. CDC's role is clearly stated in the Public Health Service Act to be one of assisting the states and territories; in other words, the authority to respond to public health problems resides first with the states. As a result, to carry out the EIS mission effectively, it is essential to maintain a collaborative relation with states. Third, because there are many more good assignments than Officers both at CDC and in the states, disappointment in not receiving an Officer can affect state/federal relations. Finally, the nature of epidemic investigation requires making decisions rapidly; therefore, EIS is open to criticism for not maintaining sufficiently rigorous standards of analysis. An extensive internal peer review is used to ensure quality, even before the standard peer review process is undertaken.

Although EIS has proven successful over many years, CDC continues to examine ways to improve the service and training aspects of the program. In a trend expected to continue, in recent years EIS Officers conducting field investigations have been joined by other CDC fellows whose special expertise in selected areas complements that of the Officers. For example, EIS Officers working on surveillance for possible bioterrorism events at the 2000 Democratic and Republican national conventions were joined by Public Health Informatics fellows who developed and maintained hospital surveillance databases. An EIS Officer investigating a syphilis outbreak in North Carolina was joined by a Public Health Prevention Service fellow who focused on developing the intervention program needed to help eliminate syphilis in that state (19). In addition, a Colorado-based EIS Officer worked with an Atlanta-based Prevention Effectiveness fellow to examine the costs and benefits of a subtype-specific surveillance system to identify *Escherichia coli* O157:H7 outbreaks (20).

In the past, CDC has delivered training to its field assignees in EIS and other programs by bringing them together for periodic short courses and by distributing materials such as audiotapes on selected topics. With the rapid expansion of Internet technology, CDC is examining increased use of distance learning methods to provide more training to CDC field assignees. For example, CDC and its partners have developed an Internet-based Public Health and Law course (http://www.cdc.gov/phtn/legal-basis/mainmenu.htm) appropriate for general public health audiences and a CD-ROM-based course focusing on human subjects research and other ethical issues specifically for CDC employees. Any new training materials developed for field assignees that are appropriate for broader audiences will be shared with staff at state and local health departments to help build the overall public health infrastructure.

In the next decade, EIS Officers may expect to use new technologies that have become available recently. With electronic mail access becoming more ubiquitous, urgent surveys may be conducted electronically rather than by telephone. For example, an EIS Officer recently used electronic mail questionnaires to investigate a Norwalk-like viral gastroenteritis outbreak in Alaska (21). Rapid electronic communication may also be expected to lead to more efficient case finding and reporting during both investigations and routine public health surveillance. In addition, handheld global positioning satellite system receivers may be used to improve the quality of mapping and cluster surveys in remote areas. In a 1999 study of incomplete vaccination among children in western Kenya, an EIS Officer used Geographic Information System mapping in conjunction with household surveys to calculate and map the probability of complete vaccination by household location (22).

EIS Officers may also expect more investigations to involve multiple states and/or multiple countries as people and pathogens travel across state and national borders more freely than in the past. Such multijurisdictional investigations require substantial coordination among responsible health agencies. For example, in June 1999, the EIS Officer assigned to the Washington State health department investigated an outbreak of *Salmonella* serotype Muenchen infections among patrons of a Seattle restaurant chain. By July 9, the health department had identified 85 case-patients in Washington State. This investigation revealed that illness was associated with consumption of a commercially distributed, unpasteurized orange juice produced by a single distributor. Illnesses caused by *S.* Muenchen with an identical pulse field gel electrophoresis pattern were soon identified in other states. By the end of the investigation, 360 cases, including 40 hospitalizations and one death, had been identified among residents of 16 states and three Canadian provinces. Juice produced by the implicated company was squeezed in Mexico and transported by tanker truck to a production facility in Arizona, where it was combined with domestically produced orange juice without a final pasteurization step. An environmental investigation isolated the outbreak strain of *S.* Muenchen from unopened containers of juice in Seattle, from holding tanks at the Arizona facility, and from the trucks used to transport the juice from Mexico. This juice-related outbreak has been the largest reported to date (23).

The impact of Alexander D. Langmuir on CDC and global public health was extraordinary (24), but his greatest legacy was undoubtedly the EIS Program. It continues to

evolve as we grapple with new health problems such as interpersonal violence and chronic disease. A large, closely knit group of alumni often work together to address new public health problems, including the emergence of new pathogens and infectious diseases as well as the practice of new areas of applied epidemiology. The EIS Officer is an applied epidemiologist who uses epidemiologic practice and research to improve public health. Because the EIS Program is rooted in public health practice and is based on a philosophy of "learning while doing," it maintains a spontaneity and relevance that are essential to addressing the public health challenges of the 21st century (25).

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