DoD Global Emerging Infections System

- Armed Forces Institute of Pathology
- Military Infectious Disease Research Program
- Uniformed Services University of the Health Sciences
- United States Army
- United States Navy
- United States Air Force
- Office of the Asst. Secretary of Defense (Health Affairs)
- US Regional Unified Commands
- DoD Overseas Laboratories
- US Centers for Disease Control & Prevention
- United States Department of State
- Pan American Health Organization
- World Health Organization

Partnering in the Fight Against Emerging Infections

Annual Report
Fiscal Year 1999

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Executive Summary

President Clinton recognized that the United States was inadequately prepared to address the problems of emerging infections and issued Presidential Decision Directive NSTC-7 in June 1996. This directive formally expanded the mission of the DoD to address the global threat of emerging infectious diseases. The Global Emerging Infections Surveillance and Response System (GEIS) was established in 1997 as the DoD focus for responding to the directive. FY99 core Defense Health Program funding to implement the eight presidential actions of the directive was set at $3.3 million. A strategic plan specifying the DoD approaches and planned activities was published in November 1998.

DoD-GEIS operates in three primary realms: the Military Health System (MHS), the DoD Overseas Medical Research Units, and through partnerships with other federal agencies, foreign countries, and international organizations such as the World Health Organization (WHO). The regional Unified Commands (CINCs) are key partners in the third realm.

The DoD-GEIS response to the five most relevant directives of the President follows.

A. "Enhance the surveillance and response components of our domestic and international public health infrastructure."

Within the MHS, the major DoD-GEIS focus has been to improve public health laboratory capacity and laboratory-based surveillance. Efforts included strengthening capabilities for respiratory disease surveillance and expanding DoD influenza surveillance. A high point was the three-day Military Public Health Laboratory Symposium and Workshop, which brought together more than 100 DoD public health and laboratory leaders to develop a framework to address current deficiencies.

Improving surveillance for bioterrorism events was another major focus. Several pilot projects moved forward, including one that uses MHS ambulatory data for daily assessment of the incidence of "syndromes" that could suggest bioterrorism in the National Capital Region.

The overseas research labs focused on surveillance for drug-resistant malaria, antibiotic-resistant enteric organisms, influenza, and unexplained febrile diseases. Several public health surveillance capacity building engagement projects were conducted with CINC and WHO support to help foreign health ministries improve their ability to participate in an international electronic network for emerging infections surveillance.

B. "Enhance biomedical and behavioral research efforts on emerging infectious diseases."

Although the primary DoD-GEIS mandate is not research, close collaboration with the Military Infectious Disease Research Program (MIDRP) has helped ensure that GEIS-generated surveillance data can help guide research efforts in areas such as drug development. This collaboration also helps improve the efficiency of both efforts. DoD-GEIS has, through its coordination mandate, helped articulate the increased potential of the MIDRP to the White House Office of Science and Technology Policy.

C. "Expand formal training and outreach to health care providers."

Presidential Decision Directive NSTC-7 specifically challenged the overseas laboratories to support training of foreign scientists and technicians. Most overseas

labs actively supported this training through not only in-house training but also joint efforts. For example, the Navy Medical Research Unit 2 in Jakarta, Indonesia, developed an outbreak investigation course with WHO that has been given in several locations in Southeast Asia.

Major efforts were undertaken to improve the DoD-GEIS website and the websites of its funded partners so that more information can be delivered rapidly. At the DoD-GEIS central hub, major investment has also begun into computer hardware and procedures to enable the use of "push" technologies so that information can be efficiently and proactively delivered.

D. "Encourage other nations and international organizations to assign higher priority to emerging infectious diseases."

E. "Support the WHO and other bodies in playing a stronger role in the surveillance, prevention, and response to emerging infectious diseases."

DoD-GEIS has collaborated with the White House Emerging Infections Task Force, the State Department Emerging Infections Office, and other federal agencies and has interacted with more than 20 foreign governments. DoD-GEIS has been active in military-to-military forums, especially in Europe, Latin America, and Southeast Asia. Considerable progress was made during FY99 in helping WHO to establish a civil-military liaison activity in Geneva to network military laboratories for emerging infections surveillance, to help address biological warfare and terrorism, and to foster improved disease control coordination for United Nations peacekeepers.

The central hub will continue to manage implementation of the Presidential Decision Directive as presented in the DoD-GEIS five-year strategic plan. A primary objective of the MHS realm of GEIS will be to convene a working group to develop consensus on those elements of a syndromic surveillance system for biological terrorism detection and response.

The overseas laboratory program will continue surveillance in the areas of malaria, drug-resistant enterics, influenza, and undiagnosed febrile diseases. Increased emphasis will be placed on partnerships with WHO, ministries of health, and regional military health care systems. To ensure that DoD-GEIS efforts at the overseas labs are effectively contributing to global security, the DoD-GEIS overseas laboratory program is undergoing an external review by the Institute of Medicine.

DoD-GEIS is clearly a key national asset for emerging infection detection and response. The confidence placed in the DoD by the President to handle this expanded mission is bearing much fruit with respect to both health and security.

1999 Consolidated Summary Report of DoD-GEIS Activities

In Presidential Decision Directive NSTC-7 President Clinton noted the following.

"…the national and international system of infectious disease surveillance, prevention, and response is inadequate to protect the health of United States citizens from emerging infectious diseases."

The President called for a series of eight implementing actions that, where relevant, were to be coordinated with Presidential Decision Directive 39 on U.S. policy on counterterrorism.

In directive NSTC-7, the President also stated the following:

"The mission of the DoD will be expanded to include support of global surveillance, training, research, and response to emerging infectious disease threats. DoD will strengthen its global disease reduction efforts through: centralized coordination; improved preventive health programs and epidemiological capabilities; and enhanced involvement with military treatment facilities and United States and overseas laboratories."

"DoD will ensure the availability of diagnostic capabilities at its three domestic and six overseas [research] laboratories....DoD will make available its overseas laboratory facilities, as appropriate, to serve as focal points for the training of foreign technicians and epidemiologists."

Indicative of the broadly recognized value of the DoD's role in the U.S. response to emerging infectious diseases, committees of the House of Representatives and the Senate provided supportive comments.

DoD-GEIS was formally established in 1997 as a structure for establishing the centrally coordinated DoD program directed by the President. DoD-GEIS received core funding of $2.9 million in FY98 and $3.3 million in FY99 and operates in three primary realms. In the first realm, which is under the MHS umbrella, each service executes specific surveillance operations directed against emerging infectious disease manifestations in DoD health care beneficiaries.

The second realm is collaborative international surveillance and response managed on a regional basis through the six DoD tropical overseas medical research laboratories in Egypt (NAMRU-3), Kenya (USAMRU-K), Thailand (AFRIMS), Indonesia (NAMRU-2), Brazil (USAMRU-B), and Peru (NMRCD). The overseas lab program emphasizes use of DoD expertise to establish and then transfer to host countries capabilities to conduct timely, sensitive, and specific laboratory-based surveillance for infectious diseases of interest to both DoD and the host country. In reality DoD-GEIS is active not only in the specific six host countries but throughout the surrounding regions of each.

The U.S. Unified Commands (CINCs) are key partners in the third realm, which focuses on training and external relations. The CINCs have recognized DoD-GEIS as a valuable tool for engagement and have supported high level international emerging infections training and capacity building to supplement the activities of the overseas labs. The external relations dimension of DoD-GEIS also extends to active collaborations with other federal agencies, especially the CDC, international entities such as the WHO and its subordinate agencies, and health and defense ministries of other nations.

The President's Eight Implementing Actions

The President enumerated eight specific implementing actions. Within that framework, DoD-GEIS has sought to make creative and valuable contributions that capitalize on DoD's unique assets and capabilities. This report will highlight substantial accomplishments in 1999 for each implementing action.

"1. Enhance the surveillance and response components of our domestic and international public health infrastructure."

Activities Based in the Military Health System

Most activities of DoD-GEIS fall under the category of enhancing surveillance and response capabilities. Within the MHS realm of GEIS, the focus has been on reconstituting basic public health laboratory infrastructure and improving the capture of surveillance data through laboratory-based reporting. A high point of the year was the three-day Military Public Health Laboratory Symposium and Workshop conducted at the Armed Forces Institute of Pathology in September 1999. The symposium and workshop were dedicated to developing recommendations for improving public health laboratory services within DoD through the creation of a virtual public health laboratory. Proceedings of the symposium and workshop will be published in a special issue of *Military Medicine* in July of 2000. The workshop focused on two areas: the pubic health laboratory system and laboratory-based surveillance. Key recommendations follow.

Public Health Laboratory System

- The Office of the Assistant Secretary of Defense, Health Affairs will direct the development, fielding, and maintenance of a web-based DoD Directory of Infectious Disease Laboratory Services. (GEIS central hub has developed and placed on its website such a "virtual public health laboratory" directory). As the highest tier public health laboratory in DoD, the Armed Forces Institute of Pathology will be a leading agency for ongoing maintenance and coordination.
- The proposed DoD directory of laboratory services will inform physicians, laboratory scientists, and infection control officers about how to access public health laboratory capabilities within DoD.
- The three service laboratory consultants will address the issue of providing advanced technology to deployable laboratories in a shorter time.
- DoD (Health Affairs) will develop a formal agreement with the CDC to include provision of laboratory support. Also, all DoD medical laboratories will develop formal agreements for public health laboratory support with their local and state laboratories.
- A DoD plan will be developed for the archiving of selected clinical specimens from people with diseases of known or probable infectious etiology.

Laboratory-based Surveillance

- DoD policy will be formulated to establish an integrated laboratory-based surveillance program for reportable diseases and antibiotic resistance based on a common system solution for the entire DoD.
- The DoD-GEIS website be used to post current military training facility antibiograms.
- Existing functional CHCS ad hoc reports designed to capture diagnostic laboratory data for reportable diseases will be identified and made available through a website.

- CHCS II and electronic patient record functional requirements will be reviewed to determine their suitability for effective antibiotic resistance and infectious disease surveillance at all levels in the MHS.

- DoD's laboratory-based surveillance efforts will parallel national and global initiatives to promote sharing of standardized data and capacity building (e.g., CDC and state public health laboratory initiatives for electronic reporting of laboratory data on reportable diseases).

Other MHS activities focused on emerging sexually transmitted diseases. These include diseases caused by drug-resistant *Neisseria gonorrhoeae, Chlamydia trachomatis,* and human papilloma virus. Under the auspices of the Prevention, Safety and Health Promotion Council, chartered by Secretary of Defense William Cohen, a sexually transmitted disease prevention committee (STDPC) has been formed. The GEIS central hub is a member of the STDPC and has been actively engaged in identifying and evaluating existing surveillance tools, to include laboratory tests and surveillance systems, with the goal of efficiently and economically decreasing the burden of sexually transmitted disease in the military and among other DoD beneficiaries. The sexually transmitted disease burden in DoD is still being defined by high rates compared with some civilian populations.

In addition to higher level long-range planning, DoD-GEIS conducted more local initiatives both within the MHS and internationally to detect and respond to strategically relevant infectious disease threats including those that could stem from bioterrorism.

Domestically the most representative activity of DoD-GEIS with respect to detection and response was developing a rapid syndromic surveillance system for the National Capital Region named the Electronic Surveillance System for Early Notification of Community-based Epidemics (ESSENCE).

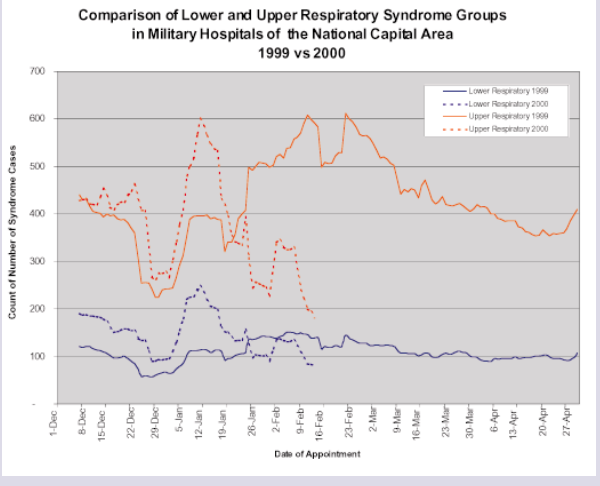
A primary objective of ESSENCE is to facilitate prompt recognition of a bioterrorism event. Swift recognition is also necessary for effective communication about risk and the prioritization of limited response assets. By collaborating with the MHS Corporate Executive Information System, ESSENCE gives the GEIS central hub daily downloads of all ambulatory data system reports from military treatment facilities around the National Capital Region. Specific relevant ICD-9 codings are collapsed into eight syndrome categories (e.g., upper respiratory infection) that are then mapped by the Center for Health Promotion and Preventive Medicine using a geographic information system and compared with expected morbidity levels and distributions.

Another focus of DoD-GEIS activity within the MHS is respiratory disease surveillance. Respiratory viruses, based on well-documented history, are among the most serious naturally occurring emerging infectious threats facing DoD. The concern over pandemic influenza and the difficulty controlling adenoviruses without an available vaccine have highlighted this threat. During FY99 DoD-GEIS developed and the DoD (Health Affairs) promulgated a policy to improve influenza surveillance worldwide.

ESSENCE: A Novel Tool to Detect Outbreaks in the National Capital Region

The need for a quick reaction to disease emergence has been highlighted by the increased awareness of the threat of bioterrorism in the United States. During a large-scale bioterrorist attack or any massive natural exposure to a disease agent, medical personnel may soon know there is a problem. However, if disease appears insidiously or is spread over a large area, detecting and characterizing the growing outbreak would take time and information.

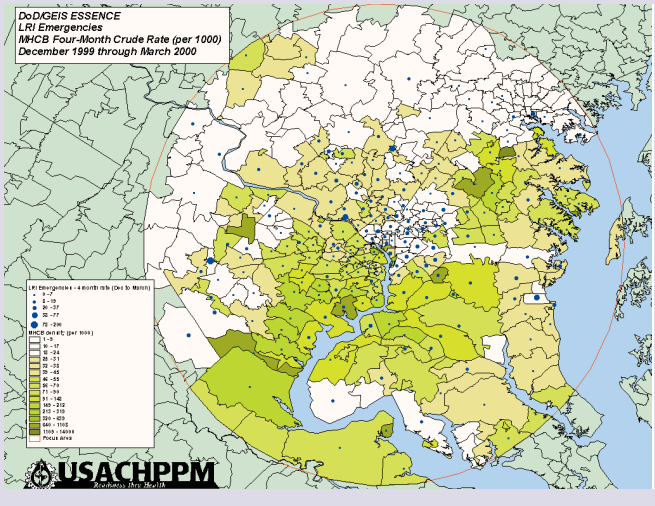
Therefore U.S. cities must have a rapid, real-time, accessible source of infectious disease morbidity information. Information should be based on disease syndromes because most bioterrorism agents would first induce nonspecific symptoms, usually described as "influenza-like." Even with accurate and available diagnostic capabilities, the lag before a specific diagnosis is confirmed can mean hundreds or even thousands of cases. Rapid knowledge of a disease outbreak, including where it is occurring, allows a prompt response, the optimal targeting of limited resources, and the ability of spokespersons to communicate effectively with an anxious public. DoD-GEIS has developed a prototype for the National Capital Region called the Electronic Surveillance System for the Early Notification of Community-Based Epidemics (ESSENCE).



In late December 1999-2000 the media started reporting increased cases of influenza in Washington DC. Newspaper headlines and lead television news stories reported overflowing hospitals and high work absenteeism from this epidemic of flu. At that time, DoD-GEIS had just started to receive data from ESSENCE and could track upper and lower respiratory syndromes as the outbreak unfolded.

During the outbreak, the CDC's surveillance systems using sentinel physicians showed an influenza pattern similar to that seen in other years but beginning earlier than in the previous two flu seasons. However, gathering reports from laboratory sources and from the network of physicians took time, and most information from the CDC had at least a 2-week lag. In contrast, ESSENCE compared previous years' historical data broken into the same diagnostic codes to show on a daily basis that the outbreak did not exceed levels in the previous year; it just occurred approximately 6 weeks earlier.

Addition of a geographic information systems component through resources at CHPPM revealed a broad geographic distribution of cases proportionate to the beneficiary population density. This distribution would probably not have reflected a point source exposure or a bioterrorist attack.



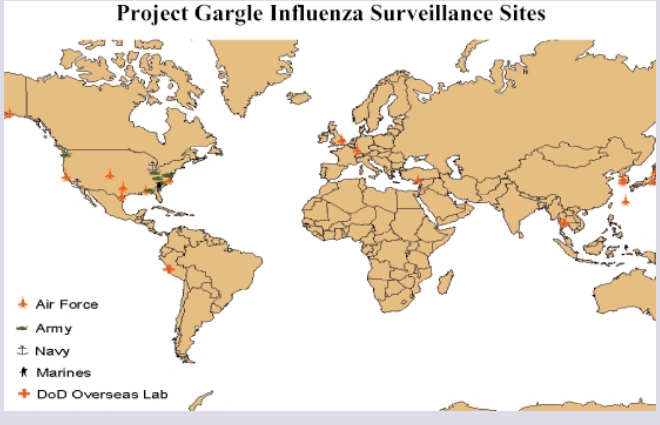
Future plans for ESSENCE include analysis to better understand the expected patterns and therefore to know when to be concerned about an increase in disease cases. For example, despite the media attention, the influenza pattern noted in 1999-2000 was, in fact, though early otherwisetypical. Other plans for ESSENCE include incorporating data from other sources, such as pharmacy usage and laboratory test ordering. Finally, inclusion of civilian data and working with the CDC and state and local health departments to network other jurisdictions with similar systems would greatly increase the public health capacity of the United States.

DoD Influenza Surveillance: Goes Where Others Don't

The 1999-2000 influenza surveillance season established DoD-GEIS as a responsive leader in filling critical gaps in the global influenza surveillance efforts. Expansion of the Air Force's Project Gargle laboratory-based influenza surveillance into a DoD surveillance program allowed for receipt and analysis of specimens from new areas of the world. In February 1999, five samples from Peruvian Naval Cadets were identified as a variant strain of influenza A/Beijing/262-Like that had only been seen once before in Los Angeles. Although the vaccine covered this virus, its detection in the southern hemisphere was an important contribution to ensuring a comprehensive global surveillance effort.

In July 1999, the CDC received reports of an outbreak of flu-like illness in Panama but had been unsuccessful in obtaining isolates to confirm the reports. In response to an urgent request from CDC, personnel at Howard Air Force Base in Panama collected 24 samples. These samples were processed at the Air Force lab, and isolates were forwarded to CDC within 2 weeks. Nine were positive for influenza A and were subtyped as A/Sydney/H3N2-Like, which was consistent with the vaccine strain. However, the serologic reactivity pattern indicated that there were some important antigenic differences in those viruses that warranted continued monitoring. Just as important as the new information was the impressive demonstration that the DoD influenza surveillance system could produce needed data quickly and help the CDC where others could not.

An outbreak of influenza A among a group of new, previously unvaccinated Army recruits at the Defense Language Institute at Lackland AFB caused 30 of these recruits to be hospitalized and many more confined to quarters. A total of 95 patient specimens was sent to Brooks AFB and cultured between 22 July 1999 and 5 August 1999. Influenza A was isolated in 33 of the samples. Antigenic subtyping confirmed that the samples were A/Sydney/05/97-Like (H3N2). This is both the 98-99 and 99-00 H3N2 component of the influenza vaccine. Preliminary molecular studies confirmed that all outbreak specimens were from the same source and were closely related to the vaccine strain. Some 1,100 Defense Language Institute personnel were at risk of becoming infected. To prevent further spread of influenza, public health officials instituted a 14-day regimen of amantadine, isolated those infected, and provided the vaccine to other students and instructors.



DoD-GEIS substantially funded the Air Force's Project Gargle at the Institute for Environment, Safety, and Occupational Health Risk Analysis (IERA) (Brooks Air Force Base, Texas) and the Naval Health Research Center's (NHRC) Respiratory Disease Laboratory (San Diego, California). Both are involved with surveillance and response to respiratory viruses, including influenza. During the 1998-1999 influenza season Project Gargle processed 2,532 throat swabs from 17 sentinel U.S. military bases, 43 nonsentinel bases, and overseas locations in Argentina, Peru, Ecuador, Panama, Japan, Korea, Thailand, and Nepal. Independently NAMRU-3 (Cairo) added specimens from Egypt and Syria. The Air Force has also developed the ability to correlate the immunization status of Air Force personnel with influenza morbidity, thus allowing insight into vaccine efficacy.

Another notable capability developed under GEIS at IERA is the Molecular Epidemiology Branch, which can sequence influenza isolates and help monitor immunologically significant drifts and shifts. This lab has also improved the DoD's public health laboratory capabilities in the area of reference and rapid diagnostics for enteric agents.

The unique contribution of DoD to global influenza surveillance was recognized in Project Gargle's invited presentation at the Food and Drug Administration annual meeting to develop the composition of the 1999-2000 influenza vaccine for the United States. Project Gargle was the first lab to identify H1N1 influenza in Latin America in 1999, and it successfully responded to an urgent CDC request to obtain and isolate viruses causing an influenza epidemic in Panama. Although all surveillance data are shared with CDC and WHO, the Air Force has developed an influenza surveillance website to broaden dissemination of these data within the DoD (http://pestilence.brooks.af.mil).

The NHRC has been outstanding in supporting DoD-GEIS through conduct of population-based respiratory disease surveillance at tri-service basic training centers. Nine military training sites were monitored for the frequency of febrile respiratory illness. Based on ascertainment of whether ill trainees meet a specific case definition for febrile respiratory illnesses, weekly counts are sent to NHRC and published on their website (http://pc176.nhrc.navy.mil/disease). More than 2,400 throat swabs were also forwarded for specific etiological diagnosis to the NHRCs laboratory, which was recently certified by the College of American Pathologists. This work has graphically demonstrated the increased burden of respiratory infection, largely owing to adenovirus because of the loss of that vaccine.

The NHRC also has been monitoring antibiotic-resistant *Streptococcus pyogenes* in military trainees. Of 196 isolates tested between February 1998 and October 1999, over 20% were resistant to erythromycin, the primary back-up prophylactic for trainees allergic to penicillin. As such, they may serve as a reservoir of this bacteria in the community despite efforts at mass eradication through prophylaxis.

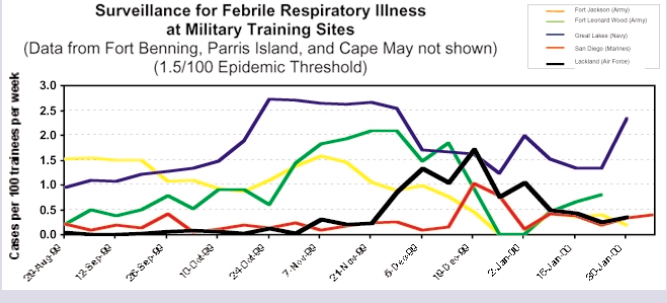
Adenovirus Outbreaks in 1999: All Services Suffer

Surveillance established by DoD-GEIS at the Naval Health Research Center in San Diego has been critical in defining the impact of the cessation of adenovirus vaccine manufacture on military recruits. Not long after the last supplies of vaccine were depleted in early 1999, outbreaks of febrile respiratory illness were experienced at many recruit-training centers. Adenoviruses have been isolated from more than 60% of the throat swab samples received at NHRC from these sites. Adenovirus type 4 has been implicated as the primary cause of the outbreaks discussed here.

It is notable that Air Force recruits training at Lackland AFB in Texas have not been exempt from recent adenovirus challenges. The Air Force has not given adenovirus vaccine to recruits since the mid-1980s and had not generally experienced respiratory illness problems. Yet as the other services lost the ability to vaccinate, and recruits from different services mixed in specialty schools, outbreaks have appeared in the Air Force.

During 3 months beginning in late November 1999, 473 Air Force basic trainees were diagnosed with febrile respiratory infections, with over 80% yielding adenovirus isolates. Adenovirus type 4 was the only serotype isolated. Morbidity from this outbreak was characterized by fever, nonproductive cough, headache, pharyngitis, and lost time from usual training.

Continued surveillance for the pathogens that cause febrile respiratory illness will be crucial in developing the next generation of adenovirus vaccines and other prevention efforts.



Population-based surveillance at five sites in late 1999. Reported by NHRC, San Diego (LCDR Margaret Ryan, MC, USN; CAPT Gregory Gray, MC, USN; Anthony Hawksworth, Dawn Taggett, and Marietta Malasig), and Infectious Disease Department, Wilford Hall Medical Center, Lackland AFB (Lt Col Matthew Dolan, MC, USAF).

NHRC has also continued to document what may be an increasing problem with *S. pneumoniae* resistance in military installations. Full or partial resistance to penicillin was documented in 30.9% of 136 isolates; 23.5% had resistance to three or more antibiotics. The outstanding public health laboratory capability for diagnosing respiratory pathogens developed at NHRC with GEIS support also allowed NHRC to assist the Army in studies of outbreaks in Korea and among Rangers at Fort Benning, Georgia.

The Armed Forces Institute of Pathology began another aspect of surveillance, the DoD Medical Mortality Registry, with partial DoD-GEIS sponsorship. Because many emerging infections have first presented as unexplained deaths, one capability of this developing system is to receive daily e-mail reports of Army casualties to facilitate rapid follow-up of suspicious cases.

Activities at DoD Overseas Medical Research Laboratories

The overseas medical research units of the Naval Medical Research Center and the Walter Reed Army Institute of Research receive 65% of the DoD-GEIS budget, largely to execute collaborative surveillance relevant to both the DoD and the host country. Consistent with its global mission, DoD-GEIS also has collaborations with many countries beyond those that actually host the overseas labs. Some of these collaborations reflect the role of NAMRU-2 as a WHO Collaborating Centres for Emerging and Reemerging Infectious Diseases.

Institutions in the following countries had substantive 1999 DoD-GEIS collaborations:

Antigua	Indonesia	Syria
Argentina	Kenya	Thailand
Bolivia	Korea	Trinidad
Brazil	Laos	Turkey
Cambodia	Nepal	Uganda
Ecuador	Peru	Vietnam
Egypt	Sudan	

Within the overseas laboratory program, the FY99 focus was on surveillance for influenza, antibiotic-resistant malaria, antibiotic-resistant enteric organisms, and fevers of undetermined etiology. Extensive surveillance data were collected and have been disseminated in various ways. Some of the most important programmatic highpoints and findings follow.

The Naval Medical Research Unit-2 (NAMRU-2) in Jakarta, Indonesia, in collaboration with the Indonesian ministry of health, established the automated symptom-based Early Warning Outbreak Recognition System (EWORS) in five sites around the Indonesian archipelago. Every day information is electronically transferred to Jakarta to monitor the frequency of symptom complexes occurring in patients. EWORS captured more than 10,000 case entries from these sites in its first 6 months of operation and detected enteric illness outbreaks on the islands of Sulawesi and Bali.

NAMRU-2 supplemented syndromic surveillance with laboratory-based surveillance. More than 3,000 cholera surveillance specimens were collected from eight hospitals throughout the archipelago. Cholera outbreaks were investigated on Sulawesi and in Laos. In parallel with this collection, 1,139 specimens were examined for antibiotic-resistant enteric agents. In follow-up to the emergence of Nipah virus in Malaysia, NAMRU-2 was the first to recognize Nipah-like virus in the bat population of the province of North Sumatra. A human anthrax outbreak was investigated in Ruteng on the island of East Nusa Tenggara. The DoD-GEIS program at NAMRU-2 was supplemented by $300,000 in funding from Pacific Command to develop outbreak response capabilities in Indonesia, Laos, and Cambodia.

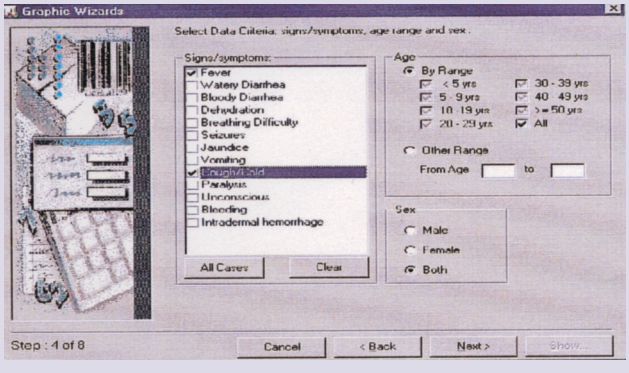
The Armed Forces Research Institute of the Medical Sciences (AFRIMS) in Bangkok, executed a full spectrum of DoD-GEIS surveillance and response activities involving not only Thailand but also Nepal and Vietnam. The U.S. Cobra Gold ‘99 deployment was a

NAMRU-2 and Indonesia Collaborate in EWORS

In many areas of the world, diagnostic capabilities are lacking, so most diagnoses reflect clinical presentation. Consequently disease surveillance in these situations is often not performed or is based on questionable data. Because many emerging or reemerging diseases will come from areas where good surveillance data do not exist, it will be difficult to detect the disease outbreak early enough to institute preventive measures. One way to still recognize a change in disease occurrence, even with poor or no diagnostic capabilities, is to perform surveillance on disease syndromes or symptom clusters rather than specifically diagnosed illnesses. The Early Warning Outbreak Recognition System (EWORS) was developed by NAMRU-2 in Jakarta, Indonesia, to detect disease outbreaks early throughout the archipelago without relying on slower and often nonexistent laboratory methods.

EWORS is based on a simple computer program that allows a remote clinic to enter basic demographic data on the patient and document whether they have symptoms such as fever, diarrhea, breathing difficulty, cough, or vomiting.

These data are downloaded daily from remote sites around the country to the central NAMRU-2/Indonesian Ministry of Health site in Jakarta. Either remotely or locally, data can then be graphed based on variables such as date, age, race, and symptoms and presented geographically by area of residence to determine clustering by location.



In 1999, EWORS recognized two enteric outbreaks on Sulawesi and Bali. The outbreak on Sulawesi was caused by cholera, and early recognition facilitated specimen collection and treatment of patients. Because symptomatology does not require data confirmation in the laboratory, EWORS could detect the increase in diarrhea cases in real-time and transmit the data immediately to the Ministry of Health. In November 1999 personnel from NAMRU-2 noted an increase in a combination of fever, bleeding, and intradermal hemorrhage syndromes reported on EWORS in Pontiniak, Indonesia. In collaboration with the ministry of health, a disease outbreak investigation confirmed an outbreak of dengue hemorrhagic fever. Such prompt response allows the institution of preventive measures, e.g., mosquito control.

In FY99, EWORS sites included five in Indonesia, with a further 10 planned for startup in FY00. Expansion to Laos, Vietnam, and Cambodia is also planned for FY00. The expansion of EWORS is linked closely with the ministries of health in these countries and has been supported energetically by WHO. One key Indonesian collaborator, Wita Larasati, successfully defended her Master's thesis at the University of Indonesia with her project, "EWORS Functioning as Early Detection Supporting Tool of Unusual Event/Outbreak of Communicable Diseases: Trial at Four Hospitals in Indonesia, 1998-1999."

major surveillance event. Enteric surveillance of those U.S. troops indicated that *Campylobacter* accounted for 59% of the isolates followed by enterotoxic *Escherichia coli*, which accounted for 19%. *Campylobacter* is now resistant to all drugs except azithromycin (95% of isolates are resistant to ciprofloxacin/ofloxacin). Azithromycin resis-

tance was noted in about 15-25% of *Salmonella* and *Shigella* isolates, so no single drug gives complete coverage. AFRIMS also assisted with three cholera outbreak investigations in Thailand.

Febrile disease surveillance performed by AFRIMS was centered at the Kamphaeng Phet Provincial Hospital. About 515 patients fit the case definition for febrile illness and were evaluated. Diagnoses included malaria (176), dengue-like illness (60 including dengue, scrub typhus, typhoid, and leptospirosis), encephalitis (10), respiratory illnesses (180), viral hepatitis (10), and unexplained illness (approximately 25). Influenza surveillance resulted in 62 samples from Nepal positive for influenza A, all Sydney strain. A deadly outbreak of flu-like illness in western Nepal was also investigated.

DoD-GEIS surveillance activities at the Naval Medical Research Unit-3 (NAMRU-3) in Cairo, Egypt, revolved around meningitis, influenza, acute febrile illnesses, and antibiotic-resistant enteric organisms. Malaria is not a major focus of activities at NAMRU-3 because its endemicity in the region is relatively limited. Meningitis surveillance involved a network of nine infectious disease hospitals in Egypt with bacterial analysis conducted locally and virologic analysis conducted at NAMRU-3. These core hospitals have become the focal points for emerging infections surveillance in Egypt.

Results of this meningitis surveillance were presented and discussed at a workshop attended by NAMRU-3, CDC, WHO, and senior laboratory and preventive medicine officials from the Egyptian ministry of health. Meningitis surveillance has resulted in a substantial growth in the laboratory capabilities of both NAMRU-3 and the participating hospitals and includes many new assay technologies for diagnosis of various agents plus the establishment of quality assurance procedures in the Egyptian labs.

GEIS-supported increases in laboratory activities encompassed more than 15,000 separate serologic assays that detected active cases of meningitis caused by West Nile, Sindbis, and sandfly fever (Naples) viruses. Approximately 10,670 cerebrospinal fluid virus isolations were also attempted on these patients, yielding 107 suspected virus isolates. About 2,400 polymerase chain reaction tests of cerebrospinal fluid identified cases of enterovirus and herpes infection. In August 1999, five meningitis surveillance hospitals also began surveillance for various viral and rickettsial pathogens.

Under the antibiotic-resistant enterics protocol, more than 600 enterotoxic *E. coli,* 200 *Shigella,* and 400 *Campylobacter* strains have been tested. *Campylobacter* strains displayed a low overall resistance to erythromycin and an increasing level of resistance to quinolones. Nalidixic acid resistance increased from 13% in 1996 to 34% in 1998. Over 95% of the nalidixic acid-resistant strains were also resistant to ciprofloxacin. In *Shigella* testing, less than 1% of the strains were resistant to nalidixic acid, but resistance to other antibiotics was substantial. Less than 1% of enterotoxic *E. coli* strains were also resistant to nalidixic acid, but resistance to most other commonly prescribed antibiotics was high. All *Shigella* and all enterotoxic *E. coli* strains were sensitive to ciprofloxacin.

In 1999 NAMRU-3 developed internal capabilities to perform influenza virus isolations. About 994 clinical samples were submitted from sites in Cairo and Alexandria for influenza virus isolation. A third site was established in Damascus, Syria, which submitted 67 clinical samples last year. Isolates were forwarded to CDC for further analysis and use by WHO. Relevant training in virus isolation and subtyping was also provided to individuals from the ministries of health in Egypt and Syria.

NAMRU-3 personnel also had a major impact on surveillance through making WHO consultant visits to Yemen, Palestine, Qatar, and Pakistan. Under WHO auspices, a NAMRU-3 scientist also helped investigate a meningitis outbreak in Sudan. Direct laboratory-based surveillance and outbreak control support was provided to U.S. units on the Sinai Peninsula and in Turkey.

The U.S. Army Medical Research Unit-Kenya (USAMRU-K) faces the biggest infrastructural challenge of all DoD overseas laboratories owing to conditions in the host country and region. The quantity of trained personnel who can serve as collaborators and the general capabilities of the local health care system make it much harder to use DoD-GEIS as a source of leverage. Despite these challenges, USAMRU-K made substantial progress in building capacity for outbreak investigations in East Africa through collaborations with the WHO Virus Reference Lab (Nairobi, Kenya), Kenya Medical Research Institute (Nairobi, Kenya), CDC (Fort Collins, Colorado, and Atlanta, Georgia), Oxford Wellcome Trust Centre (Kilifi District, Kenya), and African Medical and Research Foundation (Nairobi, Kenya).

USAMRU-K focused febrile disease surveillance at Kilifi on the coast of Kenya where 50% of the hospitalized children have fevers of undetermined etiology. From this surveillance, the DoD-GEIS program of USAMRU-K isolated the first dengue virus in Kenya in 18 years. Further work demonstrated additional dengue-2 cases and Coxsackie B virus. Another major capability established in late FY99 by USAMRU-K through DoD-GEIS was a lab to perform antimalarial drug resistance testing. This lab has begun studying 246 Plasmodium falciparum specimens collected throughout Kenya in FY99. Routine testing is being performed against 12 antimalarials.

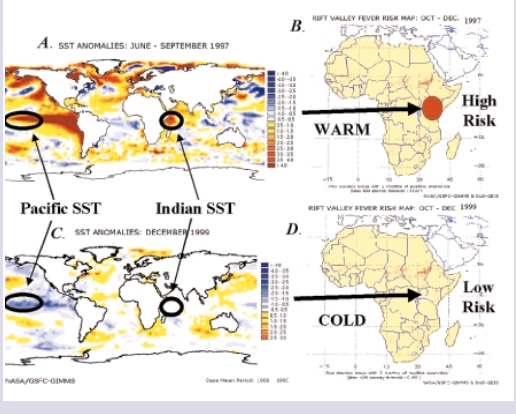
Sea Temperatures Measured by Satellites Are Used to Forecast Risk of Mosquito-Borne Rift Valley Fever in Africa

By collaborating with USAMRU in Kenya, AFRIMS in Thailand, NAMRU-3 in Egypt, and the Goddard Space Flight Center/NASA, DoD-GEIS has made significant progress in understanding the link between global climatic conditions caused by El Niño and La Niña and outbreaks of human disease.

Temperature data are recorded daily on National Oceanic and Atmospheric Administration satellites and composited for every month. *Maps A* and *C* display global sea surface temperature anomalies as degree differences from the long-term average for different dates.

Concurrent warmer than average temperatures in the eastern Pacific and western Indian Ocean in June-September 1997 signaled heavy rainfall in east Africa (*red on map A*). These data were then used to forecast the time and location at high risk for having Rift Valley fever in Africa (*red on map B*). Conversely, colder than average temperatures in December 1999 (*blue on map C*) are used to forecast geographic areas with a low risk of disease transmission (*map D*).

Historically, Rift Valley fever epidemics have occurred periodically and unpredictably in sub-Saharan Africa, causing significant human morbidity and mortality. Now global sea surface temperatures and Rift Valley fever risk maps are posted monthly on the DoD-GEIS website and can be used by international and local public health officials to predict outbreaks up to 5 months before their occurrence in human populations. This information could allow time for vaccination of domestic animals and pretreatment of mosquito habitats adjacent to domestic animal herds and human habitations. Further studies are underway to understand how global climate patterns affect other diseases in Africa, Asia, and the Americas.



SST, sea surface temperature. Red, warmer than average (positive anomalies) ocean temperatures; blue, colder than average ocean temperatures (negative anomalies).

Work on antibiotic-resistant enteric infections also demonstrated some important findings. With specimens from 367 persons it was found that 24.7% of 109 children younger than 2 years had rotavirus infections. Among these children, 11.4% had *Campylobacter* spp, 11.4% had *Shigella* spp, and 1% had *Salmonella*. Overall 9.9% of the patients had *Campylobacter* spp, 9.3% had *Shigella* spp, and 1.4% had *Salmonella*. Drug sensitivity patterns are pending. Various parasites were also documented, and of note *Cyclospora* was not found.

Another key finding is that in surveillance of 320 patients at a rural hospital, an unusually high prevalence of *Shigella* infections (28%) was noted, and the *Shigella* isolates were resistant to all first line drugs recommended by the Kenyan Ministry of Health. There was no resistance to ciprofloxacin and nalidixic acid. The age distribution of *Shigella* infections was unusual, showing an upward shift. There was no outbreak, and multiple serotypes were represented. This finding may reflect increasing HIV rates in adults and bodes poorly for increasing the risk of secondary exposure in the community with particularly bad consequences for young children.

Another area of DoD-GEIS work executed in East Africa, in collaboration with NASA, involved the use of remote sensing technologies to predict disease transmission. One important project demonstrated how monitoring El Niño/Southern Oscillation can allow prediction of Rift Valley fever epidemics in East Africa several months before they would begin. Another geographic information system project is attempting to use remote sensing data to monitor malaria risk in the highlands of western Kenya.

DoD-GEIS surveillance in South America shifted entirely to the Navy during FY99 when the U.S. Army Medical Research Unit-Brazil was closed. Reasons for closure related to insufficient active duty resources for staffing, a constrained DoD infectious disease research budget, and other administrative issues in Brazil that slowed the conduct of research. Fortunately, the Naval Medical Research Center Detachment (NMRCD) in Lima, Peru, has an extensive network and staff for surveillance in South America.

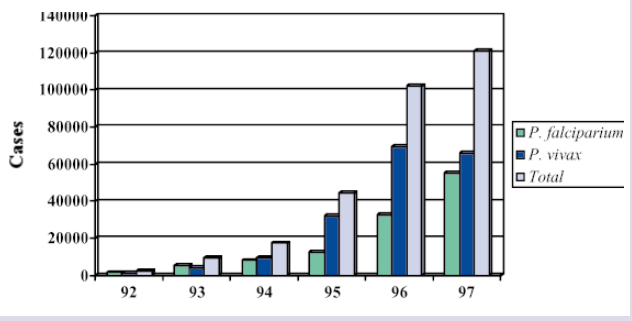
The NMRCD program made tremendous contributions to expanding influenza surveillance in Latin America in 1999. This is particularly significant now that the WHO has instituted an annual influenza vaccine formulation meeting for the southern hemisphere. NMRCD has developed collaborations with clinicians in Peru, Ecuador, and Argentina to obtain samples. Specimens from 567 cases were worked up by the Project Gargle lab in Texas. Important insights were made into the spectrum of viruses responsible for respiratory disease morbidity in the region to include the detection of a variant of A/Beijing/262/95-Like (H1N1) in an outbreak in Lima in February 1999. This was the first indication of the circulation of H1N1 influenza virus in Latin American in 1999.

Sentinel surveillance for antibiotic-resistant enteric infections was also conducted in Peru, Bolivia, and Ecuador. A total of 568 enteric bacterial isolates was obtained from patients in eight sites in Bolivia and Peru. *Shigella* spp were the most frequently recovered species (44.6%). Again, antibiotic resistance in these isolates is substantial.

A third focus of DoD-GEIS work in Peru was to document the extent of resistance to specific antimalarial drugs. In an evaluation of 59 cases of *P. falciparum* in Padre Cocha that were treated with sulfadoxine-pyrimethamine (the usual drug in Peru), 24% were early treatment failures and 30% were late treatment failures. A similar study of 40 cases in Caballococha showed a 5% early treatment failure rate and a 49% late treatment failure rate. These findings provided the impetus to the government of Peru to change national drug policy regarding treatment of malaria in the Peruvian Amazon. As soon as feasible, a

Malaria Emerges in the Amazon Basin of Peru (Department of Loreto) 1992-1997

During the last 10-15 years, malaria has emerged as a major public health problem in the Amazon basin of South America. In Peru the total number of malaria cases reported annually from the Peruvian Amazon increased more than 100-fold from 850 to 102,000 between 1991 and 1996. Even more striking was the increase in *P. falciparum* cases from 125 in 1991 to 30,000 in 1996. Although the cases of both *P. falciparum* and *P. vivax* have fallen somewhat during the last 2 years, the Amazon region, which has only 4% of the country's population, still accounts for more than one-third of all malaria reported in Peru. Similar but less dramatic trends have been seen in other countries of the Amazon basin. These changes are probably caused by increased migration to and settlement of the area; extension of the geographic range of the major malaria vector, *Anopheles darlingi*; and increasing antimalarial drug resistance.



Adapted from Aramburu-Guarda J, et al. Malaria reemergence in the Peruvian Amazon region. Emerg Infect Dis 1999;5:209-15.

The spread and intensification of antimalarial drug resistance in the Amazon basin are particularly serious because this region is the second most drug-resistant area in the world, after Southeast Asia. Strains of *P. falciparum* resistant to chloroquine were first reported in 1960 in northeastern Columbia. By the late 1960s, chloroquine resistance was widespread in the Brazilian Amazon, and different first-line drug regimens, including high-dose chloroquine and amodiaquine, were used for short periods. These were supplanted with sulfadoxine-pyrimethamine (Fansidar) in the early 1970s. By the mid-1970s, reports of sulfadoxine-pyrimethamine resistance appeared from the Brazilian and Colombian Amazon, and physicians in Brazil returned to the use of quinine alone or in combination with sulfadoxine-pyrimethamine or tetracycline. By the late 1980s, mefloquine became increasingly popular; however, even this drug is in danger because of indiscriminate use for both treatment and prophylaxis, particularly in areas where mining is the primary occupation.

Up-to-date information about *P. falciparum* drug resistance in the nine countries of the Amazon Basin is limited, both in terms of the number of studies conducted and the geographic distribution of those studies. Consequently many current national malaria treatment policies in the region are not based on sound scientific evidence.

The DoD-GEIS program at NMRCD in Lima has begun to address malaria through a series of regional, coordinated in vivo, in vitro, and molecular studies. The initial focus has been on Peru because sulfadoxine-pyrimethamine had been the front-line therapy in the Amazon and consequently of prime importance to the Peruvian national health system. In FY99, two therapeutic efficacy trials were conducted using sulfadoxine-pyrimethamine for the treatment of acute uncomplicated *P. falciparum* malaria. One study was conducted in the village of Padre Cocha near Iquitos, Peru, and the other was conducted near the village of Caballacocha, along the frontier with Columbia and Brazil.

These carefully conducted studies based on the PAHO protocol for studying in vivo malaria resistance showed a 54% sulfadoxine-pyrimethamine treatment failure rate in Padre Cocha and also a 54% failure rate in Caballacocha. Results were presented at the Peruvian national antimalaria drug policy meeting and compelled national health authorities to promulgate a change in national drug policy for the Peruvian Amazon. Peru will drop sulfadoxine-pyrimethamine as its first-line therapy for acute, uncomplicated *P. falciparum* malaria and replace it as soon as logistically and economically feasible with a combination of artesunate and mefloquine.

During FY00 and subsequent years DoD-GEIS, in partnership with MIDRP, expects to develop additional Amazon malaria sentinel surveillance sites in Peru, Suriname, Ecuador, and Bolivia. Training to increase the capacity of local clinicians and scientists to perform this surveillance in a sustainable fashion will be integral.

combination of artesunate and mefloquine will be the first line of treatment of acute uncomplicated *P. falciparum* malaria.

Essential to the DoD-GEIS work to detect emerging infectious diseases is access to high-level reference laboratory resources. For this reason GEIS provides support to the U.S. Army Research Institute for Infectious Diseases (USAMRIID) to support maintenance of a uniquely capable DoD reference center for isolation and identification of etiologic agents and diagnosis of infectious diseases requiring high levels of biocontainment. In FY99 the reference center completed about 985 assays against exotic agents including Hantavirus, anthrax, Filovirus, toxins, Arenavirus, and Rift Valley fever. USAMRIID also helped other laboratories maintain various diagnostic capabilities through manufacture and distribution of many antigens, antibodies, and ELISA kits.

"2. Enhance biomedical and behavioral research efforts on emerging infectious diseases."

The second implementing activity of the presidential directive focuses on research. DoD has for many years had a major infectious disease research program. The mandate of DoD-GEIS is not research, but it is clear that the operational activities of DoD-GEIS and the emerging infections research activities of the MIDRP of the Army Medical Research and Materiel Command are mutually reinforcing. For example, to stretch limited funds, overseas sites maintained for surveillance can also serve as research sites and vice versa. Similarly, specimens collected for surveillance or outbreak control can also be used to validate new, rapid diagnostic technologies. Infrastructure funded with one program (e.g., electronic communications links) frequently assists the other. In this way, DoD-GEIS has enhanced DoD emerging infectious disease research efforts.

In addition, at the federal level, planning for emerging infections surveillance, research, training, and response is integrated. By working closely with the MIDRP, DoD-GEIS has been able to help ensure that resource issues pertaining to military emerging infectious disease research are duly addressed. Also DoD-GEIS has been an active advocate for dealing with serious shortages of preventive medicine and infectious disease personnel that handicap effectiveness.

"3. Expand formal training and outreach to health care providers."

Training is a high priority for DoD-GEIS because it would otherwise be impossible to establish and sustain a significant global program. The presidential directive specifically charged the DoD overseas labs to support the training of foreign scientists and technicians. This training has been accomplished in several notable ways. Most DoD-GEIS surveillance activities have been collaborative efforts with host county personnel. For example, in the NMRCD program, 20 technical and professional personnel were trained in relevant field and laboratory techniques. NAMRU-2 not only taught joint WHO-NAMRU-2 Outbreak Response Training Workshops in Laos, Indonesia (island of Irian Jaya), and Cambodia (with AFRIMS assistance), they also organized and managed a WHO-funded meeting to introduce ministers of health from Laos, Cambodia, Vietnam, and Singapore to EWORS.

NAMRU-3 sponsored formal training for personnel from the Egyptian and Syrian ministries of health who are involved in various aspects of the NAMRU-3 GEIS program. In January 1999, NAMRU-3 organized a workshop to review the meningitis surveillance efforts; participants included the first undersecretaries of preventive and laboratory sectors of the Egyptian ministry of health. A

joint NAMRU-3/Egyptian Central Public Health Lab Workshop was also conducted in July 1999 to teach quality assurance and antimicrobial susceptibility techniques for laboratorians participating in DoD-GEIS surveillance. In July 1999 a workshop was also held on blood culturing. Long-term training in virology was provided to technicians from the Egyptian and Palestinian ministries of health. The 6-month training for the Palestinian technician was paid through a WHO grant. NAMRU-3 staff also supported a WHO-sponsored workshop on epidemic preparedness in the Eastern Mediterranean Region.

GEIS-supported personnel have published many papers this year in the peer-reviewed literature and have given formal presentations to several DoD and other U.S. physicians. The September 1999 DoD-GEIS Military Public Health Laboratory Symposium and Workshop was certified for 9 hours of continuing medical education by the Office of the Army Surgeon General.

A primary vehicle for outreach is the DoD-GEIS website (www.geis.ha.osd.mil). This frequently updated site aspires to become a "one-stop source" of documentation and related links for infectious disease control information pertaining to DoD populations.

A major effort developed by DoD-GEIS in FY99 for execution in FY00 was a $50,000 program to offer competitive travel grants to junior DoD physicians, medical students, and scientists to spend 1-2 months at a DoD overseas lab becoming familiar with emerging infections surveillance and research methods. This program is designed to help overcome one of the DoD's greatest challenges in addressing emerging infections, a rapidly dwindling cadre of capable scientific expertise. It is hoped that these introductory experiences will facilitate recruiting personnel to do this work.

"4. Review and update regulations, procedures, and resources for screening and quarantine at ports of entry into the United States."

"5. Make information about ill international travelers with communicable diseases more accessible to domestic health authorities."

Although screening and quarantine of travelers are primarily the responsibility of the Quarantine Division of the CDC, DoD-GEIS personnel have met with CDC action officers about these tasks. A CDC goal is to improve sharing of DoD surveillance information, particularly as it pertains to redeploying U.S. forces. A senior staff member from the CDC Quarantine Division addressed the DoD overseas lab commanders about supporting their attempts to identify and control potential importations of disease through recruiting travel clinics in their regions to the GeoSentinel Surveillance System that CDC operates jointly with the International Travel Medicine Society.

"6. Encourage other nations and international organizations to assign higher priority to emerging infectious diseases."

"7. Support the World Health Organization and other bodies in playing a stronger role in the surveillance, prevention, and response to emerging infectious diseases."

DoD-GEIS has supported the White House Emerging Infections Task Force [Committee on International Science Engineering and Technology (CISET)] and the State Department's emerging infections activities.

Under CISET, the CDC and the DoD have partnered to sponsor a project under the umbrella of the Asia Pacific Economic Cooperation's International Science and Technology Working Group to assess infrastructure needs in the Asia Pacific region.

DoD-GEIS participated in a meeting of the U.S. European Union Task Force on Emerging Infections held at the State Department and in the Institute of Medicine Forum on International Aspects of Emerging Infections.

DoD-GEIS has been active in various military-to-military forums to encourage other nations to assign high priority to emerging infections.

In addition to several presentations at the Asia-Pacific Military Medicine Conference in Bangkok in March 1999, DoD-GEIS central hub staff gave formal presentations to military organizations in Germany, France, Netherlands, and Argentina. DoD-GEIS staff spoke at the SOUTHCOM Emerging Infections Conference for military medical personnel from Latin America and the Caribbean in September 1999. With SOUTHCOM financial support, DoD-GEIS has continued a major project to establish, in collaboration with the Caribbean Epidemiology Centre, an automated network for laboratory-based public health surveillance in the Caribbean. To date this project has trained more than 200

SOUTHCOM Supports DoD-GEIS Partnership with Pan American Health Organization

One of the first capacity-building projects of DoD-GEIS was to collaborate with the Pan American Health Organization's Caribbean Epidemiology Centre (CAREC) to build the infrastructure and knowledge base needed to implement a regional public health laboratory surveillance program. CAREC (Port of Spain, Trinidad) provides public health consulting, information, training, laboratory reference, and epidemiology services to its 21 member nations.

In 1996, the Centre and individual Caribbean countries recognized the need for improving disease surveillance throughout their region. In late 1997, the Division of Preventive Medicine at the Walter Reed Army Institute of Research and U.S. Atlantic Command, along with the CDC, began providing computers and training to help CAREC and its members establish effective public health laboratory surveillance. The Caribbean surveillance infrastructure assistance project is now administrated by DoD-GEIS with financial support from SOUTHCOM through its humanitarian assistance program. To ensure that the program remains focused on the needs of the region, CAREC has hired a PhD-level epidemiologist to manage the project.

Mi-Suk Kang of Walter Reed Army Institute of Research leads PHLIS training session at the Ministry of Health in Barbados.

The computerized surveillance system is built around the Public Health Laboratory Information System (PHLIS). PHLIS was developed and is maintained by the CDC. It is a simple but powerful tool for collecting surveillance data and reporting them from local to national and regional agencies. Since 1997, the Caribbean public health surveillance infrastructure project has donated 95 Pentium-based systems for use at the ministries of health and national labs in 15 countries. Eight of those countries have also received expanded training. More than 200 ministry of health personnel have been trained on PHLIS to date.

In addition to country-specific training, DoD-GEIS co-sponsored with CAREC a weeklong training conference in Trinidad in December 1997. GEIS had PHLIS translated into Spanish to foster its use in the Spanish-speaking countries of the Caribbean and Central and South America. DoD-donated equipment to help CAREC establish a website (www.carec.org) to improve distribution of surveillance reports. The website has improved public health communications throughout the region. At the end of FY99 several countries are transmitting data to CAREC through PHLIS. CAREC is working closely with all nations to ensure rapid and accurate data collection.

regional public health personnel and donated nearly 100 new computer systems and software for this network.

During three days in December 1998 in Washington DC, DoD-GEIS hosted BG Raffaele D'Amelio, an Italian Air Force physician detailed part-time to WHO. Subsequently, DoD-GEIS has developed a strong relationship with senior WHO staff as a result of two visits to Geneva and meetings in the United States with other WHO personnel. A proposal was jointly drafted by WHO and DoD-GEIS to establish at WHO headquarters in Geneva a civil-military liaison activity to focus on engaging military health care systems in other countries in emerging infections surveillance. WHO has an explicit desire to see military health care facilities contribute more to antibiotic resistance surveillance and influenza surveillance. The current expectation is that the DoD will detail one active duty preventive medicine physician to WHO headquarters in the summer of 2000.

NAMRU-2 (Indonesia) has been formally named a WHO Collaborating Centre for Emerging Infections. As such it is recognized as a valuable source for laboratory and epidemiologic support for civilian authorities in the regions. NAMRU-2 hosted a WHO-funded meeting in Bali to introduce EWORS. Current plans call for extending EWORS to Cambodia, Laos, Vietnam, and Singapore. NAMRU-2, with assistance from AFRIMS, also conducted an outbreak investigation course in Cambodia for WHO. This effort has produced a 250-page joint NAMRU-2/WHO manual on outbreak investigation.

A key contribution to WHO has also been the collaborative efforts led by the Air Force's influenza surveillance lab to collect and characterize influenza isolates throughout the world. This past year the overseas labs supplemented MHS beneficiary-focused efforts by adding active surveillance sites in Nepal, Thailand, Peru, Argentina, Ecuador, Egypt, and Syria. The DoD surveillance from Peru picked up the first H1N1 influenza strains in South America in CY99, a swift indication of the value of these collaborations.

"8. Expand United States agency missions and mandates in order to ensure that responsible agencies are provided with the authority, emergency procurement powers, and resources to respond to worldwide disease outbreaks that have the potential to adversely affect the United States."

DoD-GEIS is a direct outcome of the President's directive to expand the mission of the DoD in emerging infections surveillance and response. Working through the Office of the Undersecretary of Defense (Policy) for Special Operations and Low Intensity Conflict, Peacekeeping and Humanitarian Assistance and with the director of the Emerging Infections Office at the State Department, DoD-GEIS has been able to help clarify DoD's role in responding to worldwide disease outbreaks and identify the mechanisms to be used to invoke such assistance. The DoD overseas laboratories in 1999 contributed to the investigation of and response to several internationally significant disease outbreaks. Considering the spectrum of epidemiologic, logistic, clinical, and political challenges associated with worldwide disease outbreaks, the issue of resources is difficult to address in the abstract and will likely be handled case-by-case.

The Future

The central hub will continue to manage implementation of the Presidential Decision Directive as laid out in the five-year strategic plan. Within the MHS realm of DoD-GEIS, emphasis will be placed on improved functionality of public health laboratory services and establishment of a capacity for laboratory-based surveillance and antibiotic resistance surveillance. Further emphasis will be given to building not only an electronic network but also a human network via the aggressive implementation of "push" technologies for the DoD-GEIS website.

Another key objective of the MHS realm of DoD-GEIS will be to convene a working group to develop consensus on those elements of a syndromic surveillance system for biological terrorism detection and response. A three-day meeting is planned with a particular focus on building civil-military relationships to better protect the National Command Authority and the populace of the nation's capital.

The overseas laboratory program will continue with the primary surveillance modules in malaria, drug-resistant enterics, influenza, and unknown febrile diseases. Increased emphasis will be placed on partnerships with ministries of health and regional military health care systems. Partnerships with the CINCs will be expanded to facilitate building of local capacity through civic assistance. The labs will be increasingly involved in training both DoD and foreign personnel in emerging infections surveillance and esponse. To ensure that the labs are contributing to global security in the most effective manner, the DoD-GEIS overseas laboratory program is undergoing an external review by the Institute of Medicine in FY00-01.

DoD-GEIS is a key national asset for emerging infections detection and response. The faith placed in the DoD by the President to handle this expanded mission is strengthening health and security.

Rapid Diagnostic Capabilities Yield Swift Detection of Salmonella Outbreak

As the new science of molecular epidemiology evolves, timely detection of infectious diseases moves to the forefront. Molecular identification and fingerprinting technology can now be applied to food borne and waterborne outbreaks that are identified within Air Force communities in the United States as well as in deployed locations to identify clusters, resistance patterns, and virulence factors.

The Human Systems Program Office, in conjunction with the 311th Human Systems Wing's Air Force Institute for Environment, Safety and Occupational Health Risk Analysis (AFIERA), the Force Protection Battle lab, the Armed Forces Institute of Pathology, and the Air Force Operational Test and Evaluation Center developed the ruggedized advanced pathogen identification device (RAPID) to meet the need for rapid biological assessment as identified by the Air Combat Command Surgeon General. RAPID employs DNA/RNA binding and polymerase chain reaction amplification technology to identify genetic targets of biological warfare agents, emerging pathogens, and epidemic disease.

In July 1999 RAPID was field tested at Prince Sultan Air Base in Saudi Arabia during a Joint Expeditionary Force exercise where *Escherichia coli* and *Salmonella* were detected in spiked water and blood samples. Laboratory experts from Brooks AFB, Texas, demonstrated the molecular approach using unique DNA sequences found in various pathogens that were amplified by polymerase chain reaction. Identification was achieved within 30 minutes and proved to be both effective and fast in the field. This field test resulted in the development of 25 DNA probe sets against primarily Gram-negative organisms known to contaminate food and water.

Only 5 months later a suspected food borne illness outbreak at Prince Sultan Air Base provided the first opportunity to use RAPID. Between 19 Dec 1999 and 1 Jan 2000, a clustering of 107 acute diarrhea cases occurred on the base. RAPID was used to test 15 of 29 stool samples, and within hours it was determined that the outbreak was due to *Salmonella* enteritis Group D. In contrast, stool cultures and biochemical identification yielded the causative agent a full 2 days after RAPID results were released. The cause of the outbreak was traced to raw poultry, which also tested positive for *Salmonella* using RAPID. Because of the early characterization, the outbreak was limited to approximately 2.5 percent of the base population, preventing a negative and potentially devastating impact on the mission.

Consolidated DoD-GEIS Publications/ Abstracts/Presentations-FY99

Articles

Barraza EM, Ludwig SL, Gaydos JC, Brundage JF. Reemergence of adenovirus type 4 acute respiratory disease (ARD) in military trainees: report of an outbreak during a lapse in vaccination. *J Infect Dis* 1999;179:1531-1533.

Cecil JA, Howell MR, Gaydos JC, McKee KT Jr, Syffus P, Lindner JL, Quinn TC, Gaydos CA. Prevalence and risk factors of *C. trachomatis* and *N. gonorrhoeae* infection in male military recruits. *Clin Infect Dis* 1999;29:1068 (abstract).

Corwin AL, McCarthy M, Larasati W, Simanjuntak C, Arjoso S, Putri M, Ryan D, Foster CA, Campbell JR. Developing regional outbreak response capabilities through a novel Early Warning Outbreak Recognition System (EWORS). *Navy Med*, submitted for publication.

Corwin AL, Purwita Larasati R, Bangs MJ, Wuryadi S, Arjoso S, Sukri N, Listyaningsih E, Hartati S, Namusal R, Anwar Z, Chandra S, Loho B, Ahmad H, Campbell JR, Porter KP. Insights of dengue epidemiology in an endemic area of Southeast Asia: epidemic dengue transmission in southern Sumatra, Indonesia. *Am J Trop Med Hygiene*, submitted for publication.

Corwin AL, Simanjuntak C, Subianto B, Yund J, Petersen HV. CINC supports outbreak response training workshop, Irian Jaya, Indonesia, September 1998. Asia Pacific Defense Forum, in press.

Corwin AL, Soderquist R, Edwards M, White A, Beecham J, Mills P, Purwita Larasati R, Subekti D, Ansari T, Burans J, Oyofo B. Shipboard impact of probable Norwalk virus outbreak from coastal Japan. *Am J Trop Med Hygiene* 1999; 61:6: 898-903.

Corwin A, Soderquist R, Suwanabun N, Sattabongkot J, Martin L, Kelly D, Beecham J. Scrub typhus and military operations in Indochina. *Clin Infect Dis*, in press.

El-Gendy A, El-Ghorab N, Lane EM, Elyazeed RA, Carlin NI, Mitry MM, Kay BA, Savarino SJ, Peruski LF Jr. Identification of *Shigella flexneri* subserotype 1c in rural Egypt. *Clin Microbiol* 1999;37:873-874.

Frances SP, Watcharapichat P, Phulsuksombati D, Tanskul P, Linthicum KJ. Seasonal occurrence of *Leptotrombidium deliense* (Acari:Trombiculidae) attracted to sentinel rodents in an orchard near Bangkok, Thailand. *J Med Entomol* 1999;36: 869-874.

Gambel J, et al. Dengue among United Nations missions in Haiti personnel, 1995: implications for preventative medicine. *Mil Med* 1999;164:300-302.

Gaydos JC, Nang RN, Huck LG, Kortepeter MG, Ludwig SL, Lund ET, Pavlin JA, Coldren RL, McKee KT Jr. Military Public Health Laboratories. *Mil Med* 1999;164:viii (letter to editor).

Gaydos CA, Quinn TC, Gaydos JC. The challenge of sexually transmitted diseases for the military: what has changed? *Clin Infect Dis*, 2000; 30: 719-722.

Gaydos CA, Quinn TC, McKee KT Jr, Gaydos JC. *Chlamydia* infections in female military recruits. *N Engl J Med* 1999;340:237-238 (correspondence).

Gray GC, Callahan JD, Hawksworth AW, Fisher CA, Gaydos JC. Respiratory disease among U.S. military personnel: strategies to counter emerging threats. *Emerg Infect Dis* 1999;5:379-387.

Hastriter MW, Tanskul P, Linthicum KJ. A systematic review of *Acropsylla* (Siphonaptera: Leptopsyllidae) with notes on some fleas from Northern Thailand. *J Med Entomol* 1998;35: 390-395.

Howell MR, Gaydos JC, McKee KT Jr, Quinn TC, Gaydos CA. Control of *Chlamydia* trachomatis infections in female army recruits: cost-effective screening and treatment in training cohorts to prevent pelvic inflammatory disease. *Sex Transm Dis* 1999;26:519-526.

Kelley PW. Emerging infections as a threat to multinational peacekeeping forces. *Med Tropic* 1999;59:137-138.

Kelley PW. Contagion and global security: emerging infections as a transnational issue. *Mil Rev,* May – June 2000: 59-64.

Kijek TM, Rossi CA, Moss D, Parker RW, Henchal EA. Rapid and sensitive immunomagnetic-electrochemiluminescent detection of staphylococcal enterotoxin B. *J Immunol Met*, submitted for publication.

Linthicum KJ, Anyamba A, Tucker CJ, Kelley PW, Myers MF, Peters CJ. Climate and satellite indicators to forecast Rift Valley fever epidemics in Kenya. *Science* 1999;285: 397-400.

Linthicum KJ, Tanskul P. Geographic information systems to predict vector-borne disease threats in South-East Asia. Proceedings of DoD Pest Management Workshop: Force Protection and Environmental Stewardship. Jacksonville, FL, Feb 22-27, 1998.

McKee KT Jr, Shields TM, Jenkins PR, Zenilman JM, Glass GE. Application of a geographic information system to tracking and control of a *Shigella* outbreak. *Clin Infect Dis*, in press.

McNeill KM, Hendrix RM, Lindner JL, Benton FR, Monteith SC, Tuchscherer MA, Gray GG, Gaydos JC. Large, persistent epidemic of adenovirus type 4-associated acute respiratory disease in US Army trainees. *Emerg Infect Dis* 1999;5:798-801.

Myint KS, Linthicum KJ, Tanskul P, Lerdthusnee K, Vaughn DW, Mongkolsirichaikul D, Harnsukjariya P, Hastriter MW. Immunocytochemical methods to study the distribution of *Orientia tsutsugamushi* in *Leptotrombidium* chiggers. *J Med Entomol* 1998;35: 556-560.

Peruski LF, Kay BA, Abu Elyazeed R, El-Etr SH, Cravioto A, Wierzba TF, El- Ghorab N, Shaheen H, Khalil SB, Kamal K, Wasfy MO, Rao M, Clemens JD, Svennerholm AM, Savarino SJ. Phenotypic diversity of enterotoxigenic *Escherichia coli* (ETEC) from a community-based study of pediatric diarrhea in rural Egypt. *J Clin Microbiol* 1999;37:2974-2978.

Putnam SD, Gray GC, Biedenback DJ, Jones RN. Pharyngeal colonization prevalence rates for *Streptococcus pyogenes* and *Streptococcus pneumoniae* in a respiratory chemoprophylaxis intervention study using azithromycin. *Clin Microbiol Infect*, in press.

Rongnoparut, P, Sirichotpakorn N, Rattanarithikul R, Yaicharoen S, Linthicum K. Gene flow estimates of gene flow among *Anopheles maculatus* populations in Thailand using microsatellite analysis. *Am J Trop Med Hygiene* 1999;60:508-515.

Tanskul P, Linthicum KJ. Redescription of *Leptotrombidium (Leptotrombidium) imphalum* (Acari: Trombiculidae), with observations of the bionomics and medical importance in northern Thailand. *J Med Entomol* 1999;36: 88-91.

Tanskul P, Linthicum KJ, Watcharapichat P, Phulsuksombati D, Mungviriya S, Ratanatham S, Suwanabun N, Sattabongkot J, Watt G. A new ecology for scrub typhus associated with a foci of antibiotic resistance in rice farmers in Thailand. *J Med Entomol* 1998;35: 551-555.

Wasfy MO, David JC, Oyofo BA, Ismail TF, El-Gendy AM, Mohran ZS, Peruski LF Jr. Predominance and antibiotic susceptibility of *Salmonella*, *Shigella*, and *Campylobacter* from acute enteric infections in Egypt from 1986-1993. *J Diarrhea Dis Res* (revised manuscript to be submitted).

Wu S-JL, Rossi CA, et al. Comparison of two rapid diagnostic assays for the detection of immunoglobulin M antibodies to dengue virus. *Clin Diagn Lab Immunol*, 2000; 7:106-110.

Abstracts/Presentations

Anyamba A, Linthicum KJ, Tucker CJ, Myers MF. Rift Valley Fever in East Africa: Climate and Disease Connections. Presented at An Ecosystem Approach to Human Health: Communicable and Emerging Diseases. Rio de Janeiro, Brazil, November 1999.

Beaver GM, Cross ER, Linthicum KJ. Using GIS and Remote Sensing to Assess, Predict and Monitor Insect-Transmitted Disease Risk in Egypt: An Overview of Research at U.S. Naval Medical Research Unit Number Three, Cairo. Presented at the 1999 International Conference on Environmental Management, Health and Sustainable Development; Alexandria, Egypt, March 1999.

Canas L. Respiratory Viruses, Air Force Public Health Officers, 10 March 1999 (GEIS supplied PBS video about 1918 pandemic).

Canas L. Respiratory Viruses, Air Force Public Health Officers, 25 August 1999 (GEIS supplied PBS video about 1918 pandemic).

Canas L. Influenza Surveillance Update, AFEB, Uniformed Services University of the Health Sciences, 14 September 1999.

Canas L. Influenza: Antigenic Shift Detection Using an Enhanced Laboratory-Based Sentinel Surveillance System, Military Public Health Laboratory Symposium, Armed Forces Institute of Pathology, Washington DC, 21 September 1999 (poster).

Cecil JA, Gaydos JC, McKee KT, Hendrix RM, Quinn TC, Gaydos CA. Prevalence and Risk Factors of *C. trachomatis* Infection in Male Military Recruits: Multivariate Analysis. Prevention 99, Washington DC, 18-19 March 1999 (poster).

Cecil JA, Howell MR, Gaydos JC, McKee KT Jr, Syffus P, Lindner JL, Quinn TC, Gaydos CA. Prevalence and Risk Factors of *C. trachomatis* and *N. gonorrhoeae* Infection in Male Military Recruits. Infectious Diseases Society of America, Philadelphia, 19-20 November 1999 (poster).

Clark KL, Howell MR, Li Y, Powers TE, McKee KT, Quinn TC, Gaydos JC, Gaydos CA. Decreasing Hospitalization Rates in Female US Army Recruits Associated with a Screening Program for *Chlamydia trachomatis* (CT). International Society for Sexually Transmitted Diseases Research, Denver, 11-14 July 1999 (poster).

Craig SC, Sanchez JL, Kolavic S, Hastings D, Alsip B, Gray GC, Matinez-Lopez L. Pneumococcal pneumonia outbreak in military ranger students. 39th Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, 26-29 September 1999 (abstract 1067).

Crotchfelt KA, Rompalo A, Gaydos JC, McKee KT, Quinn TC, Gaydos CA. Evaluation of Amplicor Neisseria *gonorrhoeae* PCR in Vaginal Self Administered Swabs (SAS). International Society for Sexually Transmitted Diseases Research, Denver, 11-14 July 1999 (poster).

Davis SR. Department of Defense Global Emerging Infections Surveillance and Response System. Society of Armed Forces Medical Laboratory Specialists. Norfolk, VA, 3 March 1999.

Davis SR. A Survey of Antimicrobial Resistance Surveillance Systems. Military Public Health Laboratory Symposium and Workshop, Armed Forces Institute of Pathology, Washington DC, 22 September 1999.

Davis SR. A Vision for Global Antimicrobial Resistance Surveillance. Military Public Health Laboratory Symposium and Workshop, Armed Forces Institute of Pathology, Washington DC, 22 September 1999.

El-Gendy AM, David J, Soliman LA, Teheawy MA, Hamed OM, Kamal KA, Morsy BZ, El-Yazeed RA, Peruski LF Jr. Seasonal variance of enteropathogenic bacterial isolation from environmental sources in Egypt. American Society for Microbiology 99th General Meeting, Chicago, May 30 – June 3, 1999.

Gaydos JC, Fisher CA, Mansfield JL, Kelley PW. Identifying and Responding to Emerging Infectious Disease Threats in the US Department of Defense (DoD) Health Care System. Prevention 99, Washington DC, 19 March 1999 (slide session).

Gaydos CA, Howell MR, Tawes J, Theodore M, Gaydos JC, McKee KT Jr, Rompalo A, Syffus P, Lindner J, Quinn TC. Comparison of Self-Administered Swabs and Urine for the Detection of *Chlamydia trachomatis* Genital Infections in Non-Health Care-Seeking Military Women. Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, 26-29 September 1999 (poster).

Goodman J. Presentation on Air Force Disease Surveillance to the Applied Epidemiology Class, Brooks AFB, Texas, 16 March 1999.

Gray GC. Respiratory Disease among U.S. Military Personnel: Strategies to Counter Emerging Threats. California State Health Department Laboratory, Berkeley, California, 8 September 1999.

Gray GC. Important Infectious Disease Epidemiology Issues in the Military Training Environment. Infectious Disease Epidemiology Course, Uniformed Services University of Health Sciences, Bethesda, Maryland, 22 June 1999.

Gray GC. Respiratory Disease Testing. Fifth Annual Uniformed Services Recruit and Trainee Healthcare Symposium, Beaufort, South Carolina, 30 April 1999.

Gray GC, Goswami PR, Malasig MD, Hawksworth AW, Trump DH, Ryan MA, Schnurr DP. Adult Adenovirus Infections: Loss of Orphaned Vaccines Precipitates Military Respiratory Disease Epidemics.

Gray GC, Hawksworth AW, Malasig MD, Hudspeth MK, Poddar SK. Surveillance for Emerging Respiratory Threats among US Military Populations. Military Public Health Laboratory Symposium, Armed Forces Institute of Pathology, Washington DC, 21-22 September 1999.

Gray GC, Hochwalt JM. Accreditation of a Medical Research Laboratory. Military Public Health Laboratory Symposium, Armed Forces Institute of Pathology, Washington DC, 21-22 September 1999.

Gray GC, Hudspeth MK, Hawksworth AW, Hollingshead SK. Antibiotic Resistance and emm-Gene Typing of Group A Streptococci from Military Trainees. 39th Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, 26-29 September 1999 (abstract 1215).

Hawksworth AW, Goswamie PIR, Malasig MD, Gray GC, Schnurr DP, Adenovirus Surveillance Group. Adenovirus Infections among Vaccinated and Non-Vaccinated US Military Trainees. 39th Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, 26-29 September 1999 (abstract 683).

Hawksworth AW, Malasig MD, Gray GC. Surveillance for Febrile Respiratory Illness among U.S. Military Trainees. 5th Annual Recruit Healthcare Symposium, Beaufort, South Carolina, 28-30 April 1999.

Howell MR, McKee KT, Quinn TC, Gaydos JC, Gaydos CA. Point-of-Entry *Chlamydia trachomatis* (CT) Screening in Young Female Soldiers: Who Derives the Benefit? International Society for Sexually Transmitted Diseases Research, Denver, 11-14 July 1999 (poster).

Kelley PW. International Partnerships in Disease Surveillance and Outbreak Investigation. Third Meeting of the Pan American Health Organization Task Force on Emerging and Reemerging Infectious Diseases, Mexico City, 16 November 1998.

Kelley PW. International Partnerships in Disease Surveillance and Outbreak Investigation. French Military Tropical Medicine Institute, Marseilles, 6 January 1999.

Kelley PW. DoD Global Emerging Infections Surveillance and Response: An Information Briefing for World Health Organization Emerging Infections Program Staff, Geneva, 7 January 1999.

Kelley PW. DoD Global Emerging Infections Surveillance and Response: An Information Briefing for the European Command Surgeon's Staff. Stuttgart, Germany. 8 January 1999.

Kelley PW. The Role(s) of Military Medicine in Emerging Infections: Force Protection and Preventive Defense. Royal Dutch Navy Emerging Infections Symposium, University of Amsterdam, 12 January 1999.

Kelley PW. Emerging Infections Surveillance and Response in the DoD. Institute of Medicine, Washington DC, 14 January 1999.

Kelley PW. Emerging Infections. Holy Cross High School, Bethesda, Maryland, 5 February 1999.

Kelley PW. Emerging Infections as a National Security Issue. Industrial College of the Armed Forces, Washington DC, 11 February 1999.

Kelley PW. Emerging Infections Surveillance and Response in the DoD. Johns Hopkins Tropical Medicine Dinner Club, Baltimore, 24 February 1999.

Kelley PW. Emerging Infections Surveillance and Response in the DoD. Society of Armed Forces Medical Laboratory Scientists Annual Meeting, Washington DC, 28 February 1999.

Kelley PW. Emerging Infections as a Global Security Issue. Asia-Pacific Military Medicine Meeting, Bangkok, Thailand, 9 March 1999.

Kelley PW. Ethical Considerations in Clinical Trials in the Third World. Catholic University Department of Philosophy Seminar, Washington DC, 19 March 1999.

Kelley PW. Emerging Infections Surveillance and Response in the DoD. Briefing to Latin American Bureau, State Department, Washington DC. 26 March 1999 (briefing).

Kelley PW. Emerging Infections Surveillance and Response in the DoD. Morgan State University, Baltimore, 5 April 1999.

Kelley PW. Establishing Global Information Management Networks for Surveillance and Response to Emerging Infectious Diseases. Second Meeting to Establish a Network of Laboratories for Surveillance of Emerging Infectious Diseases in the Amazon Region, Tarapoto, Peru, 15 April 1999.

Kelley PW. Emerging Infections Surveillance and Response in the DoD. A Briefing to the Armed Forces Institute of Pathology Commander and Infectious Disease Staff, Washington DC, 27 April 1999.

Kelley PW. Building Laboratory Surveillance Networks. Pan American Health Organization Workshop on Laboratory Improvement, Washington DC, 29 April 1999.

Kelley PW. Training to Establish International Networks in Disease Surveillance and Outbreak Investigation. Fogarty International Center, National Institutes of Health. Bethesda, Maryland. 30 April 1999.

Kelley PW, Davis SR. DoD-GEIS Plans for Addressing Antibiotic Resistance. Public Health Service Antibiotic Resistance Task Force Meeting, Washington DC, 20 May 1999.

Kelley PW. Emerging Infections Surveillance and Response in the DoD. Uniformed Services University of the Health Sciences MPH Students. Bethesda, Maryland. 2 June 1999.

Kelley PW. Leptospirosis. DoD Tropical Medicine Course. Uniformed Services University of the Health Sciences. Bethesda, Maryland. 27 July 1999.

Kelley PW. Emerging Infections Surveillance and Response in the DoD. CDC Meeting of Public Health and National Security Officials on Bioterrorism, Atlanta, 6 August 1999.

Kelley PW. DoD-GEIS: An Overview of Selected Program Elements. Army Force Protection Conference, Atlanta, 26 August 1999.

Kelley PW. Leptospirosis. Southern Command Emerging Infections Conference, Miami, 16 September 1999.

Kelley PW. Emerging Infections as a Global Security Issue. Southern Command Emerging Infections Conference, Miami, 16 September 1999.

Kelley PW. Public Health Laboratories: Challenges for the 21st Century. Military Public Health Symposium, Armed Forces Institute of Pathology, Washington DC, 22 September 1999.

Kelley PW. DoD-GEIS: An Overview of Selected Program Elements. European Command Bioterrorism Response Planning Conference, Catania, Italy, 25 September 1999.

Linthicum KJ. Global Emerging Infections Surveillance and Response System. 65th Annual International Meeting of the American Mosquito Control Association, St. Louis, Missouri, 21-24 February 1999.

Linthicum KJ. Southern Oscillation Index, Sea Surface Temperature, and Satellite Vegetation Index Indicators to Forecast Rift Valley Fever Epizootics/Epidemics in Kenya. 37th Goddard Memorial Symposium, Greenbelt, Maryland, 17-18 March 1999.

Linthicum KJ. Emerging Infectious Diseases. 34th Annual Meeting of the Ohio Mosquito Control Association, Mansfield, Ohio, October 1999 (keynote address).

Linthicum KJ. Drug Resistant Scrub Typhus in Northern Thailand. 1999 Annual Meeting of the Entomological Society of America, Atlanta, 12-16 December 1999.

Linthicum KJ, Anyamba A, Tucker CJ, Kelley PW, Myers MF, Peters CJ. Climate and Satellite Indicators to Forecast Rift Valley Fever Epidemics in Kenya. International Congress on Ecosystem Health, Sacramento, California, August 1999.

Linthicum KJ, Anyamba A, Tucker CJ, Kelley PW, Myers M, Peters CJ. El Niño/Southern Oscillation, Pacific and Indian Ocean Sea Surface Temperature and Satellite Indicators to Forecast Rift Valley Fever Epidemics in East Africa. 48th Annual Meeting of the American Society of Tropical Medicine and Hygiene, Washington DC, 29 November- 2 December 1999.

Linthicum KJ, Anyamba A, Tucker CJ, Kelley PW, Myers MF, Peters CJ, Wilson ML. Climate and Satellite Indicators to Forecast Rift Valley Fever Epidemics in Kenya. GEOMED'99: Second International Workshop on Geomedical Systems, Paris, 22-23 November 1999.

Linthicum KJ, Kelley PW, Anyamba A, Tucker CJ, Myers M. 1999. Southern Oscillation Index Data Can Be Used to Predict a Mosquito-Borne Disease in East Africa. 65th Annual International Meeting of the American Mosquito Control Association, St. Louis, Missouri, 21-24 February 1999.

Linthicum KL, Sattabongkot J, Tanskul P, Rossi C. Prevalence of Hantavirus Antibody in Rodents and Humans in Northern Thailand. 47th Annual Meeting of the American Society of Tropical Medicine and Hygiene, San Juan, Puerto Rico, 18-22 October 1998.

Linthicum KJ, Sattabongkot J, Tanskul P, Rossi C. Prevalence of Hantavirus Antibody in Rodents and Humans in Northern Thailand. 9th Annual Asia-Pacific Military Medicine Conference, Bangkok, Thailand, 7-12 March 1999.

McKee KT, Jenkins PR, Shields TM, Zenilman JM, Gurri-Glass GE. Application of a Geographic Information System (GIS) to Tracking and Control of a Diarrheal Disease Outbreak. 37th Annual Meeting of the Infectious Diseases Society of America, Philadelphia, 18-21 November 1999 (abstract 585).

McNeill KM, Benton FR, Montieth SC, Tuchscherer MA, Gaydos JC. Epidemic Spread of Adenovirus Type-4, an Emerging Virus Causing Acute Respiratory Disease, between US Army Installations. Prevention 99, Washington DC, 20 March 1999 (slide session).

Pavlin JA. Epidemiology of Bioterrorism. National Symposium on Medical and Public Health Response to Bioterrorism, Washington DC, February 1999.

Pavlin JA, Gambel J, Canas L, Kelley PW. Department of Defense Global Emerging Infections System (DoD-GEIS) and International Influenza Surveillance. 9th Annual Asia-Pacific Military Medicine Conference, Bangkok, Thailand, March 1999.

Peruski LF, David JC, Wierzba TF, El-Yazeed RA, Rao M, Morsy BA, Clemens JD, Savarino SJ. Shigella Infections in Abu Homos, Egypt: Strain Characterization and Implications for Control. International Conference on Environmental Management, Health, and Sustainable Development, Alexandria, Egypt, 1999.

Peruski L Jr, Wierzba TF, El-Ghorab NM, Shaheen HI, Khalil SB, El-Yazeed RA, Clemens JD, Svennerholm AM, Savarino SJ. Enterotoxigenic *Escherichia coli* strains from Diarrheic Egyptian Children Are Phenotypically Diverse Pathogens. American Society for Microbiology 99th General Meeting, Chicago, May 30 – June 3, 1999

Rompalo A, Gaydos C, Crotchfelt K, Madico G, Daniels R. Shah K, Gaydos J, McKee K. Evaluation of a Novel Approach to the Diagnosis of Genital Infections in Female Soldiers. International Society for Sexually Transmitted Diseases Research, Denver, 11-14 July 1999 (poster).

Rongnoparut P, Linthicum KJ. Population Genetic Structure of *Anopheles maculatus*, a Malaria Vector in Thailand. 47th Annual Meeting of the American Society of Tropical Medicine and Hygiene, San Juan, Puerto Rico, 18-22 October 1998.

Ryan MAK, Gray GC, Malasig MD, Hudspeth MK, Poddar SK, Hawksworth AW. The Naval Health Research Center Respiratory Disease Reference Laboratory. Military Public Health Laboratory Symposium, Armed Forces Institute of Pathology, Washington DC, 21-22 September 1999.

Shaheen HI, Lowe B, David JC, Kodani N, Khalil SB, El-Ghorab NM, Kamal KA, Steffen R, Peruski LF Jr. Characterization of Enterotoxigenic *Escherichia coli* Strains from Diarrheagenic European Travelers to Kenya. American Society for Microbiology 99th General Meeting, Chicago, May 30 – June 3, 1999.

Thompson D, et al. Early Influenza Antigenic Shift Detection Using an Enhanced Laboratory Based Sentinel Surveillance System. American Society of Tropical Medicine and Hygiene Annual Meeting, Washington DC, December 1999.

Trent L. Merging Laboratory and Morbidity Data in Surveillance. Military Public Health Laboratory Symposium, Armed Forces Institute of Pathology, Washington DC, 21 September 1999.

Zenilman JM, Glass G, Shields T, Jenkins P, McKee K. Development of a Prototype Geographic Information System for Infectious Disease Surveillance in a Defined Community. Prevention 99, 18-21 March 1999, Washington DC (abstract IT700).

Book Chapters

Gaydos CA, Gaydos JC. Adenovirus vaccine. In *Vaccines*, edited by Plotkin SA, Mortimer EA. Philadelphia: Saunders, 1999, pp 609-628.

McKee KT Jr, Gaydos JC. Sexually transmitted diseases in the US military. In STD – A Clinical and Public Health Approach, edited by Zenilman J. Saunders Company, Philadelphia, PA, in press.

Sharp TW, Luz GA, Gaydos JC. Military support of relief: a cautionary review. *In Humanitarian Crises: The Medical and Public Health Response*, edited by Leaning J, Briggs SM, Chen LC. Cambridge MA: Harvard University Press, 1999, pp 273-291.

U.S. Department of Defense
Global Emerging Infections Surveillance and Response System
Walter Reed Army Institute of Research
503 Robert Grant Avenue
Silver Spring, MD 20910-7500
www.geis.ha.osd.mil

Acronyms

AFB	Air Force Base
AFRIMS	Armed Forces Research Institute of Medical Sciences (Thailand)
CDC	Centers for Disease Control and Prevention
CHCS	Composite Health Care System
CINC	Commander-in-Chief
CISET	Committee on International Science, Engineering & Technology
CY	Calendar Year
DoD	Department of Defense
ELISA	Enzyme Linked Immunosorbent Assay
ESSENCE	Electronic Surveillance System for Early Notification of Community-based Epidemics
EWORS	Early Warning Outbreak Recognition System
FY	Fiscal Year
GEIS	Global Emerging Infections Surveillance and Response System
IERA	Institute for Environment, Safety and Occupational Health Risk Analysis
MHS	Military Health System
MIDRP	Military Infectious Disease Research Program
NAMRU-2	Naval Medical Research Unit-2 (Indonesia)
NAMRU-3	Naval Medical Research Unit-3 (Egypt)
NASA	National Aeronautics and Space Administration
NHRC	Naval Health Research Center
NMRCD	Naval Medical Research Center Detachment (Peru)
PHLIS	Public Health Laboratory Information System
SOUTHCOM	Southern Command
STDPC	Sexually Transmitted Disease Prevention Committee
USAMRIID	U.S. Army Medical Research Institute of Infectious Disease
USAMRU-B	U.S. Army Research Unit-Brazil
USAMRU-K	U.S. Army Research Unit-Kenya
WHO	World Health Organization