Executive Summary

The DoD Global Emerging Infections System (DoD-GEIS) was established in 1997 in response to Presidential Decision Directive NSTC-7 on emerging infections. The directive expanded the mission of the DoD "to include support of global surveillance, training, research, and response to emerging infections disease threats." Core FY00 funding to implement the directive was $7.1 million, which was leveraged in many cases through additional support from the DoD regional unified commands and other federal agencies including the Centers for Disease Control and Prevention (CDC).

DoD-GEIS activities occur in three primary settings: the Military Health System (MHS), the five DoD overseas medical research units, and various training, leadership, and capacity building partnerships with regional CINC and other governmental and international agencies. Presidential Decision Directive NSTC-7 calls for implementing actions in several areas relevant to DoD-GEIS.

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

Within the MHS, DoD-GEIS has focused most of its resources on facilitating general military public health laboratory system improvements, on establishing laboratory-based surveillance for respiratory diseases and antibiotic resistance, and on fielding a nearly real-time prototype syndromic surveillance system in the National Capital Region for emerging infections including those caused by bioterrorism. A high point was DoD-GEIS sponsorship in May 2000 of a 3-day meeting entitled "Conference and Workshop on Syndromic and Other Surveillance Methods for Emerging Infections, Including Bioterrorism." This was the first interagency meeting focused on these innovative, non-traditional methods for public health surveillance. About 60 carefully selected invitees from the U.S. and U.K. military, other federal, state, and local agencies, and academia met to share their work on the feasibility and utility of health indicator surveillance and to develop a consensus concerning how best to design the necessary complementary systems to meet various scenarios.

The DoD influenza surveillance program made a particularly important contribution in FY00 in that one of its viral isolates from Panama was chosen by the U.S. FDA and the WHO to be one of three strains included in the more than 60 million doses of influenza vaccine distributed to Americans in 2000. In addition, the program's findings had a key influence on one of the other strains chosen and provided supporting evidence for selection of the third component. DoD-GEIS also coordinated the DoD response to the outbreak of West Nile fever on the East Coast.

Internationally, DoD-GEIS, largely through the overseas laboratories, conducted substantial collaborations with institutions in 38 countries around the world. Work focused on surveillance for drug-resistant malaria, antibiotic-resistant enteric organisms, influenza, and unexplained febrile illness. Findings from surveillance sponsored by DoD-GEIS have already led to changes in therapeutic policies and practices in several areas of the world. Some of these changes that pertain to malaria and leptospirosis are probably saving lives.

The overseas laboratories, with CINC support, have been providing training opportunities for local scientists and public health technicians and have been providing key regional leadership. For example, Pacific Command funded a meeting cosponsored by NAMRU-2 and the Indonesia Ministry of Health and Social Welfare entitled "Regional Action Conference for Surveillance and Response to Infectious Disease Outbreaks in Southeast Asia." Held on Bali in September 2000, this conference, which was part of an initiative sponsored by the United States under the Asia-Pacific Economic Cooperation, brought together more than 320 officials from 16 countries for the purpose of producing a consensus framework for action. Several public health surveillance and electronic network capability building projects in the Caribbean and Peru were also conducted by DoD-GEIS with CINC, CDC, and WHO support.
Although the primary DoD-GEIS mandate is not research, DoD-GEIS has been in the position to facilitate the research agendas of the Military Infectious Disease Research Program and other partners. In many cases this facilitation is from the added value of a steady stream of surveillance specimens for use in the evaluation of diagnostics. In other cases, surveillance data, such as those for anti-malaria drug resistance, help guide product development programs.

DoD-GEIS has also focused on developing new tools specifically for surveillance. These tools include a joint DoD-GEIS/NASA project in which satellite remote sensing data are used to prepare monthly predictive maps for the emergence of Rift Valley fever outbreaks in Africa. These are published on the DoD-GEIS website under “Key Programs/ Climate and Disease.”

In summary, DoD-GEIS is making considerable progress in improving military health care system capabilities that are essential to meet the special requirements of service families. However, the documented impacts protect not only the force and other beneficiaries but also help preserve the health of the general U.S. population. Beyond health benefits, the activities of DoD-GEIS directly and indirectly enhance national security through reducing regional threats to economic stability and peace.

DoD-GEIS engagement activities have been of significant value to the U.S. diplomatic community and the unified commands.

Having completed 2 full years of its 5-year strategic plan, DoD-GEIS has embarked on an external review by the Institute of Medicine of the National Academy of Sciences. The purpose of this undertaking is to ensure that the current program and direction are giving key stakeholders the best value possible and that appropriate opportunities for future growth are thoughtfully considered. This review, which began in spring 2000, will be completed in the summer of 2001. It is already apparent that DoD-GEIS is achieving the goals and objectives called for in the NSTC-7 directive.

The mandate for DoD-GEIS is found in the 1996 Presidential Decision Directive NSTC-7 on emerging infectious diseases, which states 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.”

Eight implementing actions were directed that were to be coordinated, where relevant, with Presidential Decision Directive 39 on U.S. policy on counterterrorism.

The NSTC-7 directive also states 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.”

The second primary setting for DoD-GEIS work is collaborative international surveillance and response managed on a regional basis through the five DoD tropical overseas medical research units in Peru.
The DoD-GEIS program at USAMRIID continued to enhance surveillance capabilities by producing, testing, and stockpiling critical diagnostic reagents to support global emerging infections surveillance and outbreak investigation. In FY00 immediate requirements included production, testing, and stockpiling of reagents for Hantaviruses, tick-borne encephalitis viruses, dengue/Venezuelan equine encephalomyelitis/West Nile and St. Louis encephalitis viruses, Crimean-Congo hemorrhagic fever virus, anthrax, brucellosis, tularemia, Sindbis virus, Semliki Forest virus, Marburg virus, etc. These reagents were widely distributed within DoD and to civilian collaborators.

Some of the most unique assets within the DoD-GEIS network are the laboratory resources of the U.S. Army Research Institute of Infectious Diseases (USAMRIID). DoD-GEIS supports the critical need for USAMRIID to maintain a broad, operationally oriented DoD reference capability for the isolation and identification of unusual etiologic agents and the diagnosis of infectious diseases requiring high levels of containment.

Training of DoD and civilian personnel remained a focus at USAMRIID. A major effort to produce non-cross reactive diagnostics for West Nile was undertaken. The DoD-GEIS program at USAMRIID performed approximately 2,000 assays for many organizations. The field investigations focused on Ebola in the Ivory Coast, anthrax in Minnesota and North Dakota, and the West Nile outbreak on the East Coast. As part of DoD surveillance for West Nile, USAMRIID tested 18 human sera specimens from DoD facilities and participated in an avian serosurvey in New York State.

Effective surveillance and response to emerging infections can only be conducted if an underlying infrastructure is in place. Laboratory assets are a prerequisite for this work. The DoD has a wealth of standard and relatively unique laboratory capabilities that can contribute to meeting the challenge of emerging infections. However, they are disbursed among many organizations and are not functionally coordinated to provide the desirable level of access.

In September 1999 DoD-GEIS held a 3-day “Military Public Health Laboratory Symposium and Workshop” to assess DoD public health laboratory services and laboratory-based surveillance. In July 2000 the proceedings of this symposium and workshop were published as a 75-page special supplement to Military Medicine containing 18 peer-reviewed papers by leading military and civilian authorities. The recommendations of this symposium and workshop were reviewed by the Armed Forces Epidemiology Board in February 2000 and received a strong written endorsement.

In concert with the recommendations of the September 1999 symposium and workshop, joint planning with the Armed Forces Institute of Pathology is proceeding towards ensuring that DoD health care improves for both patient care and public health purposes. It is expected that a staffed memorandum of understanding and a standing formalizing this action will accommodate a DoD laboratory-based surveillance system.

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DoD joins growing global effort to track antibiotic resistance in Neisseria gonorrhoeae

In April 2000 the Hawaii Department of Health issued an alert advising that fluoroquinolones no longer be used to treat gonorrhea. Resistance in Neisseria gonorrhoeae had increased in Hawaii from 3.4% of isolates in 1997 to 9.5% in 1999. N. gonorrhoeae largely reaches Hawaii from the western Pacific, where fluoroquinolone resistance is established. Data indicate that resistance is becoming endemic in Hawaii.

Although military cases accounted for 33% (166/507) of all cases of gonorrhea reported in Hawaii during 1998, resistance data to date have come entirely from civilian clinical laboratories because the local military lab uses a non-culture based nucleic acid test for routine diagnosis of gonorrhea. With Hawaii serving the military as a principal gateway to the western Pacific, characterization of resistance within the military community is essential.

Gonorrhea remains a significant sexually transmitted disease around the world. In the United States and specifically in the DoD, it is the second most frequently reported communicable disease. Although gonorrhea rates in the United States have decreased almost every year since 1970, the case rate in 1998 was 1.32/1000 (185,642 cases), an 8.9% increase over the preceding year. On a global scale, the case rate in 1999 was estimated to be 30.3/1000 (62 million cases), about half of these were in the western Pacific and Southeast Asia, where the DoD has a stable presence.

Effective gonorrhea control is a public health priority. Evolving gonococcal resistance to antibiotics is driving the need for surveillance of antibiotic susceptibilities. The CDC started the gonococcal isolate surveillance project (GISP) in 1987 to monitor resistance in N. gonorrhoeae in the United States. Countries are engaged in surveillance of gonorrhea, and WHO sponsors the gonococcal antimicrobial surveillance program (GASP) to encourage coordination of surveillance activities. For example, a long-term continuous surveillance in 19 countries of the western Pacific has tracked significant resistance in N. gonorrhoeae to the quinolones and penicillins since 1992. Currently the WHO and CDC are working to increase collaboration among countries to standardize and share surveillance data and to identify additional areas to study.

The DoD is concerned with the potential military impact of the growing global threat of resistance in N. gonorrhoeae. Military personnel and their families are stationed in areas, such as Hawaii and the western Pacific, where fluoroquinolone-resistant gonorrhoes continues to develop and establish. They are stationed in or deployed in Europe, Africa, and South America where little information is available about gonorrhea susceptibility. The mobility of military personnel and their families through areas with resistance places them at risk of transmitting resistant disease to regions with little or no resistance, such as the United States.

DoD-GEIS is committed to working with the CDC, WHC, and other countries on the globalization of surveillance for N. gonorrhoeae resistance and is establishing a GISP to interface with the CDC project. By focusing on military populations in areas with known or suspected resistance in the civilian sector or areas where data in the civilian sector are lacking, DoD-GEIS can then determine if military resistance patterns reflect those seen in the civilian sector and recommend treatment for military populations. Priority sites include military treatment facilities in Hawaii, Korea, and Japan, where fluoroquinolone resistance is a concern among civilians in Hawaii, and is known of resistance patterns in civilians and in highly mobile military personnel in the United States. To date, Tripler Army Medical Center in Hawaii has formally established a GISP site, and military treatment facilities in Japan and Korea are considering participation as sentinel sites.

DoD-GEIS is exploring the feasibility of surveillance of military personnel during deployments to areas of high or unknown resistance and partnership with foreign ministries of health to establish surveillance of civilian sex workers in areas holding military personnel during such deployments.

Previously isolated from military specimens were identified. These genotypes will undergo molecular sequencing to better understand the nature of the genetic changes and any implications of these changes on future adenovirus vaccine development.

Another respiratory disease tracked by the DoD-GEIS NHR program was invasive Staphylococcus pneumoniae. Clinical laboratories at seven U.S. military medical centers forwarded invasive S. pneumoniae isolates to NHR to be tested for antibiotic resistance, and subtyped. Of 231 isolates collected between August 1997 and September 2000, full or partial penicillin resistance was found in 77 (33.3%). Resistance to three or more antibiotics was noted in 54 (23.4%) of the isolates. An NHR surveillance program at the U.S. Naval Academy in Annapolis, Maryland, also produced important findings for stimulating approaches to prevention. Of 85 midshipmen evaluated for acute respiratory disease, S. pneumoniae was found in 7.3% Mycoplasma pneumoniae in 33.3% Chlamydia pneumoniae in 52.6%. adenovirus in 1.2%. and influenza in 14.2%.

NHR C also established active surveillance programs for Bordetella pertussis at four military recruit training centers in light of the recognition that this infection is on the rise in adolescents and adults within confined populations. Preliminary results indicate that pertussis is present at DoD training centers. To evaluate whether respiratory syncytial virus is also an emerging pathogen in military camps, a joint protocol was developed and approved in FY 00 to conduct respiratory syncytial virus surveillance at Fort Benning and at the Royal Navy recruit camp in the United Kingdom. Specimen collection is planned for October 2000 through April 2001.

The presence of a state-of-the-art public health laboratory for respiratory diseases at NHR C results in a steady stream of specimens that can be used to evaluate new, rapid diagnostic tools that may be of use in military settings, especially for the rapid characterization of outbreaks. During FY 00 NHR C evaluated a rapid diagnostic test for adenovirus against standard culture. The adenovirus assay had a sensitivity of 65% a specificity of 60% and a positive predictive value of 92%. Rap tests for influenza were tested at three training centers. Final results are pending.

In addition to the evaluating the military, unique respiratory laboratory infrastructure at NHR C funded by DoD-GEIS also allows NHR C to undertake respiratory disease clinical trials at a relatively small marginal cost. In FY 00 these trials included a clinical trial at the underwriter demili-
The IERA lab is an active collaborator with the WHO influenza reference laboratory at the CDC and is a regular presenter at the annual meeting of the Food and Drug Administration during which components of the next influenza vaccine are chosen. In FY 00 the DoD-GEIS IERA lab provided pivotal information with respect to two of the three components in the vaccine designed for the 2000-2001 influenza season. In one case the identification of a specimen provided by the Navy medical research detachment in Lima, Peru, as A/New Caledonia/20/99-like was the first confirmation that this virus was present in Latin America. This observation prompted the Food and Drug Administration and WHO to include it in both the Northern and Southern Hemisphere 2000-2003 vaccines. Even more significant, IERA’s global reach has resulted in the acquisition of a specimen from an outbreak in Panama in July 1999. This specimen ultimately became the seed virus for the A/Panama 2007/31N2 component that was used in the 2000-2003 influenza vaccine given to both military and civilian populations throughout the United States and elsewhere in the world.

Adenovirus-Associated Febrile Respiratory Illness
An Army, Navy, Marine Corps, Coast Guard, and Air Force Problem

Air Force Outbreak. In November 1999 Air Force recruits experienced the onset of the first documented outbreak of febrile respiratory illness attributable to adenovirus (type 4) at Lackland AFB in Texas. Lackland AFB is the only basic (initial entry) training center for the Air Force. Personnel from the DoD-GEIS Air Force hub (IERA, Brooks AFB, Texas) conducted an outbreak assessment to identify possible non vaccine control measures. Significant findings follow:

- Prevalence of adenovirus carriage in asymptomatic trainees exceeding 16%
- Poor indoor air quality in classrooms
- Inadequate air quality in sleeping areas
- Febrile respiratory illness hospitalization rate of up to 14% in some cohorts
- Average oral temperature of 102.3ºF in hospitalized trainees.

IERA assisted the staff of the Wilford Hall Medical Center at Lackland AFB in a study of clinical cases. Symptoms reported by more than 200 hospitalized recruits follow:

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Recruits reporting symptom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sore throat</td>
<td>193 (85.4)</td>
</tr>
<tr>
<td>Headache</td>
<td>162 (71.7)</td>
</tr>
<tr>
<td>Cough</td>
<td>159 (70.4)</td>
</tr>
<tr>
<td>Chills</td>
<td>144 (63.7)</td>
</tr>
<tr>
<td>Myalgia</td>
<td>132 (58.4)</td>
</tr>
<tr>
<td>Malaise</td>
<td>122 (54.0)</td>
</tr>
<tr>
<td>Rhinorrhea</td>
<td>110 (48.7)</td>
</tr>
</tbody>
</table>

Almost 13% needed a chest x-ray. One-fourth of these had radiographic evidence of pulmonary involvement. Forty percent of the hospitalized recruits had some degree of dehydration.

This outbreak followed the loss of the sole source for adenovirus vaccines for types 4 and 7. The Air Force stopped using these vaccines in 1987, whereas the Army and Navy continued until supplies were exhausted in the late 1990s. A hypothesis for initiation of the outbreak is that the agent was introduced by a member of another service who came to train at Lackland AFB after completing basic training at an installation experiencing an outbreak of adenovirus-associated febrile respiratory illness.

Outbreak Continues in All Services. Adenovirus associated febrile respiratory illness continues to appear in training populations in the Army, Navy Marine Corps, and Coast Guard. The DoD-GEIS Navy hub (Center for Deployment Health Research, NHRC, San Diego) tested 4,527 throat swabs from June 1998 to October 2000. Nearly 60% were positive for adenovirus.

Mortality Surveillance

Mortality surveillance was another critical DoD deficiency that DoD-GEIS worked to resolve in FY 00. The particular interest of DoD-GEIS is to rapidly identify deaths of unknown but probably infectious etiology in otherwise healthy individuals and to take timely and appropriate steps to identify the agent or agents. With DoD-GEIS funding the basic elements for gathering data were established in the Armed Forces Medical Examiner’s Office and described in an article in Military Medicine Vol. 165, Suppl. 2:057, 2000. The speed of reporting and response mechanisms must be improved to identify potential emerging infectious diseases in time to launch an appropriate response. In joint collaboration with the Armed Forces Institute of Pathology and the Army Center for Health Promotion and Preventive Medicine (CHPPM), DoD-GEIS is working to refine and institutionalize a mortality surveillance methodology that will meet the needs of all stakeholders. A formal memorandum of understanding outlining expectations and sources of support is pending. It is expected that institutionalizing near real-time DoD mortality surveillance will pay dividends far beyond emerging infections surveillance.

Surveillance and Response for Sexually Transmitted Diseases and Antibiotic Resistance

The public health response to antibiotic resistance and sexually transmitted diseases in DoD was another DoD-GEIS focus. Based on previous success at Fort Bragg with geographic information system approaches to sexually transmitted disease tracking, a similar effort, under DoD-GEIS sponsorship, is planned at Fort Lewis. The hope is that the methodology used to track sexually transmitted diseases with geographic information systems can be expanded to track other syndromes, such as those that may be associated with bioterrorism.

As was the case with NHRC, the robust platform supported by DoD-GEIS at IERA and the steady flow of surveillance specimens allow the cost-effective evaluation of diagnostics. IERA collaborates with USAMRIID in the evaluation of primer and probe sets for rapid PCR identification. Influenza primers for three key influenza subtypes (H3, H1, and B) have been developed and appear to be highly specific, non-cross-reactive, and able to detect viruses at very low copy number (i.e., directly from throat swabs).

IERA can also evaluate influenza vaccine effectiveness in military personnel. This was begun in January 2000 through a case-control study in which culture-confirmed cases in the IERA surveillance database were compared with four controls each. Case and control immunization status was verified by reference to Military Immunization Tracking System data, and viral sequences of strains from “breakthrough” cases were compared with the sequence of vaccine strains. Final results are pending.
During FY00 the DoD-GEIS central hub also coordinated with the CDC to add additional DoD sites to the CDC gonococcal isolate surveillance project. The first site was Tripler Army Medical Center in Hawaii because of a recent increase in resistant gonococcal organisms in Hawaii. Specialized gonococcal antibiogram surveillance programs are also needed because nucleic acid testing has replaced the traditional culture methods at most military installations. Without such surveillance, treatment protocols used by DoD providers may not reflect local epidemiologic patterns of resistance.

In addition to gonococcal drug-resistance surveillance, DoD-GEIS also established a Cooperative Research and Development Agreement with MRL, Inc. during FY00. MRL’s automated approaches will be used for broader antibiogram surveillance in several DoD health care facilities. It is anticipated that during FY00, Tripler Army Medical Center and Keesler AFB will be added to Wilford Hall in using the MRL program for antibiogram surveillance.

The attention of DoD-GEIS to the broader issue of antibiotic resistance surveillance was also reflected in its active participation throughout the year in the federal task force on antibiotic resistance. A federal action plan was staffed, published, and finalized for publication. However, this action plan highlights specific roles for the DoD as a large federal provider of health care.

In July 1999 the CDC became aware of an outbreak of influenza-like illness in Panama and contacted the DoD-GEIS central hub. At that time, the CDC had no isolates of the suspected influenza virus available for analysis. Through coordination by the DoD-GEIS Air Force hub at Brooks AFB, personnel at Howard AFB in Panama (now closed) collected and shipped 27 throat cultures to the Brooks AFB virology laboratory. Within only 2 weeks of the original call, influenza A had been isolated, antigenically subtyped, and sent to CDC for further studies. In addition, molecular sequencing was accomplished on a subset of these samples. Testing at the CDC indicated these viruses were antigenically similar to an H3N2 variant already identified from Moscow. This virus was not growing well in tissue culture, so the original specimen from the Panama outbreak (A/Panama 2007/H3N2) became the seed virus for the H3N2 component of the 2000-2001 vaccine used throughout the United States.

The Brooks AFB lab also contributed to the selection of the H3N1 vaccine component of the 2000-2001 vaccine. During the 1998-1999 flu season a variant H1N1 virus was recovered from samples collected in Lima, Peru, by the DoD-GEIS program at the NMRCD laboratory in Lima. These samples were then forwarded to Brooks AFB. The variant, not previously seen in Latin America, was identical to the H3N1 virus identified in New Caledonia in the South Pacific. Finding this variant in Peru supported the decision to change the H1N1 component for the 2000-2001 vaccine.

The influenza B component of the 2000-2001 vaccine remained unchanged, and DoD-GEIS influenced that decision. All type B isolates from the DoD surveillance program were the same as the previously isolated vaccine strain. This was true of isolates from other contributing laboratories. The confidence in a “no change” decision is increased when the body of evidence is both global and consistent.

Health Indicator Surveillance

Emerging infections, including bioterrorism, must be recognized as promptly as possible. A consensus has emerged that health indicator surveillance, including surveillance for syndromes in addition to laboratory-confirmed diagnoses, may help detect problems that surface in an ominous manner. The DoD-GEIS central hub recognized the great need for developing and evaluating methodologies for health indicator surveillance, took a major leadership role in this area.

Focusing on the critical National Capital Region, the central hub continued developing the Electronic Surveillance System for the Early Notification of Community-based Epidemics (ESSENCE) as a tool for the daily monitoring of mortality at more than 300 DoD primary care clinics. ESSENCE is based on ambulatory data routinely documented by DoD health care providers. During FY00 major progress was made in developing mathematical methods for using historical data to set adjusted norms against which to compare current data and in developing improved methods for displaying daily analyses. A key contribution to the development of ESSENCE has been the geographic information system contributions from the Army CHPPM. Realizing that a system with optimal sensitivity to detect events in the National Capital Region must be supplemented by non-DoD information sources, extensive and ongoing collaborations were pursued with other local entities including local universities and the Washington Metropolitan Council of Government’s subcommittee on public health.

Health indicator surveillance is an innovative, ambitious, epidemiologically complex, and rather untested approach to public health surveillance. Recognizing that there is little precedent to consult for guidance and that many entities were independently trying to advance the relevant science, DoD-GEIS sponsored the “Conference and Workshop on Syndromic and Other Surveillance Methods for Emerging Infections, Including Bioterrorism” in May 2000. About 60 carefully selected invitees who represented a wide range of institutions and specialties with an interest in health indicator surveillance came to this 3-day meeting. The meeting provided the first-ever forum to share work on the feasibility and utility of health indicator surveillance and to develop a consensus on a general approach to designing and implementing an effective, efficient, and integrated “system of systems” methodology, primarily for the homeland scenario. Proceedings of the conference and workshop are being prepared for publication.

In addition to these health indicator activities, the Navy Environmental Health Center used DoD-GEIS funds to improve syndromic and other surveillance capabilities for its shipboard deployed forces. The Navy Environmental Health Center and the Space and Naval Warfare Systems Command (SPAWAR) merged the desktop Shipboard Nontactical ADP Automated Medical Systems (SAMS) with the Naval Disease Reporting System. Specifically the medical event report, disease monitoring and battle injury report, vaccine adverse event report, and tuberculosis screening modules were incorporated into SAMS. This integration extends to the shipboard setting an integrated surveillance and clinical data collection function similar to the same program that is deployed to all other medical settings within the Navy and Marine Corps. R Rheese to the fleet is expected in early FY00. Additional testing, refinement, and training will follow. The expectation is that for the first time the Navy Environmental Health Center will have direct and smooth acquisition of shipboard surveillance data.

During FY00 the DoD-GEIS-Air Force element also implemented a record validation program for reportable communicable diseases, designed a layout for web-based interactive surveillance reports using geographic information system utilities, and converted influenza reporting from routine to urgent.

DoD Surveillance Contributes Three Ways to 2000-2001 Influenza Vaccine

Three components of the 2000-2001 influenza vaccine were influenced by information gleaned through surveillance sponsored by DoD-GEIS. The DoD global influenza surveillance network comprises 19 sentinel sites and 49 ad hoc collection sites that every year provide data to the Food and Drug Administration and WHO for determination of the annual influenza vaccine.

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Streptococcus Pneumoniae: An Emerging Pathogen of Military Importance

Problem:
1. Streptococcus pneumoniae causes an estimated 500,000 cases of pneumonia, 3,000 cases of meningitis, 50,000 cases of bacteremia, and 7,000,000 cases of otitis media annually in the United States.
2. Resistance in S. pneumoniae to antibiotics has risen dramatically.
3. S. pneumoniae has been responsible for outbreaks of pneumonia in military members.

Response: Through DoD-GEIS funding and competitive grants, the DoD-GEIS Navy hub (Center for Deployment Health Research, NHRC, San Diego) has acquired the following unique capabilities to support surveillance, outbreak investigations, and special studies:

- Culture and sensitivity testing
- Pneumolysin testing by PCR/enzyme immunoassay
- Serotyping
- DNA fingerprinting

The NHRC respiratory disease laboratory accomplished the following in FY00.

1. Continued surveillance of invasive isolates from military medical centers that began in 1997. Of 231 isolates tested since 1997, 33.3% had full or partial resistance to penicillin, and 23.4% showed resistance to three or more antibiotics.
2. Initiation of an effectiveness trial of the 23-valent pneumococcal vaccine in 191,800 basic trainees at four different training sites with collaboration from military and civilian academic institutions.
3. Confirmation of S. pneumoniae as the etiologic agent for an outbreak of pneumonia that developed in about 5% of a large Marine training unit at Camp Pendleton in late 2000. The outbreak investigation was completed through collaboration with the Navel Medical Center and Naval Environmental and Preventive Medicine Unit Number 5 in San Diego.

West Nile Fever

The emergence of an Israeli strain of West Nile fever along the East Coast of the United States and its rapid spread from upper New England and New York to North Carolina illustrates the need for emerging infections systems to be able to recognize and respond to the unexpected. Although the surveillance and response to West Nile are primarily a civilian problem, DoD also participates at the state level, the extensive presence of DoD surveillance in the affected area required coordinated DoD participation.

The DoD-GEIS central hub was asked to coordinate the reporting of DoD, civilian, and mosquito surveillance data and to represent DoD in weekly conference calls with the CDC and state West Nile coordinators. Extensive mosquito surveillance was conducted by CHPPM along the East Coast. Of 2,805 mosquito pools collected, one positive Culex pipiens mosquito pool was found in Fort Hamilton, New York. The Walter Reed Health Arm Medical Center’s human surveillance in the northeastern United States detected no human cases.

The North Atlantic Regional Veterinary Command coordinated bird testing, which confirmed four positive birds at West Point and one at Fort Hamilton. The Air Force also reported extensive mosquito trapping data. It is anticipated that in FY01, an even more robust DoD surveillance will be required because it is thought that West Nile will spread more extensively throughout the southeastern United States.

Malaria and Other Public Health Threats in the Republic of Korea

In consideration of the large U.S. troop presence in South Korea, the ongoing threat of malaria, Japanese encephalitis, and Hantavirus in that country and the historic impact of these and other agents on morbidity and mortality, DoD-GEIS has focused on supporting improved field nonhuman surveillance capabilities in the 18th Medical Command. The recent reemergence of malaria in South Korea and ongoing morbidity in both Koreans and U.S. troops provide particular motivation for this support.

With support from the Army component of AFRIMS in Thailand, more than 25,000 trapped Anopheles mosquitoes are being tested by enzyme-linked immunosorbent assay to enable production of malaria risk maps. New methods of mosquito surveillance were also compared and evaluated. A comprehensive mosquito surveillance program using geographic information systems, satellite imagery, and travel collections was also supported at several key installations and this has allowed a better appreciation of potential abortion sites under DoD control.

Many other sites are on nearby private lands though which makes complete control more difficult. To better understand the use of anti-malaria personal protection measures by soldiers, another element during calendar year 2000 was to survey troops through a questionnaire.

Preliminary data are consistent with past information that the current system of education in the use of these effective means of protection is ineffective. Japanese encephalitis is another concern for U.S. forces, although the widespread use of immunization in the Korean population tends to reduce the risk in host nationals. During FY00 mosquito surveillance for Japanese encephalitis in collaboration with USAMRIID identified seven arboviruses. Final results are pending. Rodent-borne disease surveillance has also been initiated. Early results from surveys near one training site indicated the presence of rodents infected with both Hantavirus and scrub typhus. Work is ongoing.
Conference to Integrate Surveillance Systems Breaks New Ground

Over the last 30 years considerable morbidity and mortality have resulted from disease outbreaks that probably could have been detected and responded to more promptly. Detection mechanisms for emerging infections, which tend to be inherently challenging to identify, are not sufficiently flexible when the condition is not reportable or diagnosable with readily available laboratory methods. Improving public health capabilities to handle disease emergencies, including those from bioterrorism, necessitates the consideration of how surveillance systems can be made more timely, flexible, and sensitive without compromising quality.

Motivated in part by the possibility of bioterrorist activities, many agencies and municipalities have recently explored novel and innovative approaches to surveillance. Although some have been implemented and many are being considered, lessons learned have not been widely disseminated. These include surveillance of Emergency Medical System calls, over the counter pharmaceutical sales volumes, and clinical laboratory assay requests. To avoid costly mistakes and to foster efficient progress, DoD-GEIS sponsored the “Conference and Workshop on Syndromic and Other Surveillance Methods for Emerging Infections, Including Bioterrorism” in May 2000 in Gaithersburg, Maryland.

About 60 carefully selected invitees from federal, state, and local government agencies, the U.K. Ministry of Defence, and various academic and corporate entities with experience, expertise, or an interest in syndromic surveillance attended. The conference and workshop had two fundamental goals.

The first goal was to demonstrate the feasibility and utility of current and emerging surveillance methods for rapidly detecting and confirming disease outbreaks. This goal was unique because although virtually all forums on bioterrorism defense have recommended improvements in public health surveillance, no formal interagency meeting had ever been convened to discuss the special methodological approaches required.

The second goal was to bring together developers, managers, and users to reach consensus on a general approach to designing and implementing effective, efficient, and integrated surveillance systems. The conference and workshop helped create a necessary professional network dedicated to advancing these new public health methodologies.

The resulting recommendations are being prepared for submission to a major peer-reviewed journal. In addition, the recommendations are being shared with many organizations — government, academic, professional associations and commercial — that can and should be key in the rapid detection and confirmation of emerging outbreaks.

As noted under “Respiratory Disease Surveillance and Capacity Building,” surveillance by NMRCD in partnership with the IERA influenza laboratory had a worldwide impact by identifying isolates that contributed to decisions for the 2000-2001 influenza vaccine. The isolation of the New Caledonia H1N1 influenza A virus supported the conclusion that this new virus was spreading geographically. NMRCD conducts surveillance of respiratory agents at eight sites three in Ecuador, four in Peru, and one in Argentina. In FY00, 225 isolates were studied. Influenza A and B viruses were isolated from Ecuador and coastal Peru, although it appeared that overall there was a decrease in influenza activity in FY00. A significant incidence of enteroviruses as a cause of illness among children in Buenos Aires was another important observation.

Surveillance for antimalarial drug resistance involved partners in Peru, Bolivia, and Suriname and was conducted largely under the supervision of a CDC officer assigned to NMRCD. Surveillance in the Amazon basin, the second most drug-resistant area of the world, is a serious challenge. To ensure true capacity building, a major focus of DoD-GEIS is training of host country staff to conduct this surveillance using standardized WHO/PAHO 14- or 28-day in vivo drug protocols in vitro parallel testing is also performed when possible. Results indicate widespread, intense resistance of Plasmodium falciparum to chloroquine but not to sulfadoxine-pyrimethamine on the north coast of Peru. In the Amazon basin, resistance to both chloroquine and sulfadoxine-pyrimethamine is noted in the central Amazon region and along the northern and eastern borders with Colombia and Brazil. Resistance to chloroquine but not to sulfadoxine-pyrimethamine is noted in the western Amazon. The combinations of sulfadoxine-pyrimethamine plus artesunate and mefloquine plus artesunate proved more than 99% efficacious on the north coast and in the Amazon region, respectively. As a result of this work, Peru now has better and more up-to-date information on antimalarial drug resistance than any other country in the Americas.

These and other surveillance studies funded by DoD-GEIS prompted a decision to change treatment policy in early 1999 to quinine plus tetracycline in the Peruvian Amazon. Additional changes are expected in FY00 based on evaluations of combination therapy. Training of malaria control staff from Bolivia and Suriname, which was funded by USAID and PAHO as part of DoD-GEIS FY00 testing in Peru, has given Bolivia and Suriname the capacity to do work with only minimal technical support from NMRCD.

Surveillance for antibiotic-resistant enteric organisms was conducted largely under the supervision of a CDC officer assigned to NMRCD. Surveillance in the Amazon basin, the second most drug-resistant area of the world, is a serious challenge. Surveillance for antibiotic-resistant enteric organisms generated 671 specimens from eight sites in Peru and Bolivia. Substantial progress was also made in enabling the Peru Ministry of Health to establish a network of 14 regional reference labs to perform surveillance of this type. Results indicated continuing high levels of resistance in both Peru and Bolivia. For example, 62.5% of Campylobacter were resistant to ciprofloxacin, although only 1.4% appeared resistant to azithromycin. More than 60% of Shigella and Salmonella, and Campylobacter were resistant to trimethoprim-sulfamethoxazole. Fewer than...
West Nile Virus Spreads Along East Coast of United States

In the summer of 1999, an outbreak of fatal encephalitis occurred in the greater New York City area. Ultimately, 55 cases and seven deaths were attributed to the West Nile virus. This outbreak is the first known occurrence of West Nile virus in the western hemisphere.

West Nile virus, which has caused disease outbreaks in Mediterranean countries, Europe, Africa, and central and western Asia, is transmitted by mosquitoes and culex birds as its primary reservoir. The presence of viral RNA in over-wintering mosquitoes in New York City and the possibility that migrating birds could reintroduce the virus to the United States prompted federal and state health officials to prepare response plans in case the virus reappeared. Surveillance for the reemergence of the virus in mosquitoes and birds as well as humans in 2000 was a key component.

With DoD-GEOI coordination, commanders and medical personnel at DoD installations along the eastern seaboard were educated about the risk of disease caused by West Nile virus. Clinical, entomological, preventative, and laboratory information was prepared and distributed. The capability to test mosquitoes for the presence of the virus was developed by the Entomological Sciences Division at CHPPM in Fort Meade, Maryland. CHPPM also assisted in many installations with trapping and testing the insects and identifying and controlling mosquito breeding sites. Testing for potential human cases was offered at USAMRId, to which all installations were encouraged to send any suspect specimens for analysis.

The 2000 season revealed not only a return but an apparently greater spread of West Nile. It was isolated from mosquitoes, birds, horses, and a range of other mammals between New Hampshire and North Carolina. However, despite the increase in the geographic range, fewer human cases were reported: 14 from New York, six from New Jersey, and one from Connecticut. There were two deaths.

CHPPM tested 2,805 pools of mosquitoes. Only one pool containing three Culex mosquitoes, collected at Fort Hamilton in New York on 23 August, tested positive for West Nile virus. The pools submitted for West Nile virus testing this year contained 22,678 female mosquitoes collected from 17 Army and three Air Force installations in the North Atlantic region.

Five dead birds from DoD installations submitted for West Nile virus testing at the U.S. Geological Survey laboratory in Madison, Wisconsin, were positive. Four of the positive dead birds (one house sparrow, two cedar waxwings, and one hummingbird) were collected at West Point, New York, and the fifth positive dead bird (a crow) was collected at Fort Hamilton. USAMRlD tested 18 military beneficiaries for the presence of West Nile virus and all were negative. Military surveillance data were collected and consolidated by DoD-GEOI before being transmitted to the CDC’s national tracking system each week.

This year NAMRU-2 expanded its portfolio of core and innovative new surveillance and capacity building efforts. One critical regional gap filled by NAMRU-2 is the establishment of ongoing influenza surveillance in Indonesia. During FY00, 730 specimens were collected, and 41 were positive for influenza A by either isolation or PCR. By hemagglutination inhibition, the strains were closely related to the H3N2 Sydney strain. Another new program headed by a CDC officer on loan to NAMRU-2 is sentinel surveillance for hemorrhagic fevers in Southeast Asia. During FY00 three sites were brought on line in Cambodia, and specimens from 164 patients have been obtained. Most (106) cases had dengue hemorrhagic fever. Others had leptospirosis (19) or scrub typhus (3). Personnel trained as part of this effort included nine laboratory members from the National Institute of Public Health and the Royal Cambodian Army.

The NAMRU-2 Early Warning Outbreak Recognition System (EWORS) is a computer-based sentinel syndromic surveillance system designed to provide early warning of possible outbreak conditions. EWORS grew to involve eight sites throughout Indonesia plus three more in Cambodia. Five of these were new for FY00. A palm pilot version is being explored in a memorandum of understanding with the Singapore Ministry of Defence for use in refugee situations. EWORS was responsible for the recognition of cholera and dengue outbreaks in Indonesia. To provide an appropriate response to these warnings, NAMRU-2 also continued to teach its intensive 10-day outbreak investigation course to public health professionals. To date, eight of these courses have been conducted in Indonesia, Cambodia, and Laos. NAMRU-2 used its outbreak response skills while assisting with outbreaks in Indonesia (malaria, hepatitis, and dengue), Laos (pertussis), and Cambodia (typhoid, cholera, and malaria).

Preemptive Nipah virus surveillance indicated no evidence of Nipah virus in those Indonesian areas closest to Malaysia. These findings contributed to the lifting of importation restrictions on Indonesian pork products by the rest of the region.

With CINCPAC funds NAMRU-2 sponsored the "Regional Action Conference for Surveillance and Response to Infectious Disease Outbreaks in Southeast Asia" in APEC, CDC, and other bodies co-sponsored this conference held September 2000 on Bali. More than 120 participants from 16 countries attended and produced a framework on which to build future initiatives.
base regional surveillance and response efforts. As a first step in implementing this framework, NAMRU-2 has partnered with the Singapore Quarantine and Epidemiology Department, Ministry of the Environment, to establish a regional website to share emerging infections information across international borders.

As with NMRCD, DoD-GEIS has a major investment with NAMRU-2 in surveillance for *in vivo* antimalaria drug resistance. Therapeutic response to chloroquine or Fansidar® was tracked in 161 patients in central Java. Another 120 patients were followed in South Sumatra. The Central Java follow-ups were ongoing as of FY 2000 closed. In the South Sumatra surveillance, NAMRU-2 found the first demonstration of clinical resistance to chloroquine by *P. falciparum* anywhere in the world and the first demonstration of resistance to chloroquine by *P. vivax* on the main island of Sumatra. This information benefits the Indonesian malaria control program and travelers to these regions. A 5-day training and certification course in malaria microscopic diagnosis was given to 65 students in five locations in Indonesia.

Naval Medical Research Unit Number 3 (NAMRU-3) - Cairo, Egypt

As the largest DoD overseas laboratory, NAMRU-3 fielded a particularly robust DoD-GEIS program in FY00. In addition, the benefit of having a CDC officer on a long-term assignment to DoD-GEIS at NAMRU-3 was a tremendous asset. Reflecting local needs, surveillance for meningitis and encephalitis is a primary focus of the DoD-GEIS NAMRU-3 program. In FY00, 1,473 cases of acute febrile illness were studied in FY00. A bacterial pathogen was diagnosed in 27% of cases. *Salmonella typhi* (12%) and *Salmonella paratyphi* (14%). Serologic studies are underway to explore these cases further.
reaction. Brucellosis was diagnosed by culture or serology in 155 (15%). Multidrug resistance among S. typhi was shown to have dropped at Abbassia Fever Hospital from about 60% in 1990 to <20% in 1998. Other fever cases were attributed to Rift Valley fever and sandfly fever (Sicilian).

Surveillance and associated training were also conducted at multiple sentinel sites for pathogens associated with severe diarrheas in Egypt. More than 500 children were systematically sampled and diagnosed with Shigella, Campylobacter, or ETEC. Additional studies for other bacteria, viruses, and parasites are underway on stored samples from these cases. Antibiotic resistance was common; however, ciprofloxacin was effective against all Shigella strains. Erythromycin was effective against all Campylobacter strains. Additional village-based surveillance was performed for diarrheas cases identified through more than 1,500 home visits per month. ETEC was the most common pathogen followed by Campylobacter. Shigella was uncommon. Again, high degrees of resistance were found. Campylobacter now routinely demonstrates resistance to quinolones.

During FY 00 surveillance was also begun for multidrug-resistant tuberculosis using specimens from 13 chest and fever hospitals. CDC has been providing laboratory support. Results and analysis were pending at the conclusion of FY 00.

NAMRU-3 also conducted influenza surveillance in Egypt and Syria. Inclusion of Djibouti was delayed until early FY 01 because it was necessary to arrange a source of liquid nitrogen and other logistics. In Syria 96 cases were studied, yielding 10 cases of H3N2 influenza A, 16 cases of influenza B, and four enteroviruses. In Egypt, 2,850 clinical samples were evaluated. Over 40% of the isolates were influenza with about half influenza A and half influenza B.

The largest programme was the febrile illness surveillance program in Nepal. About 137 in vitro plague cases were reported from the surrounding mountainous area. Leptospirosis affected 17.0% of the adults presenting with fever, the second most common diagnosis after malaria (21%). Leptospirosis was responsible for 60% of the revits (most were not treated with antibiotics initially), 15% of the hospitalizations, and two of the three deaths. A seasonality was not noted.

Human granulocytic ehrlichiosis was also noted (6% prevalence among symptomatic persons). Monocytic ehrlichiosis was found too. Rickettsial disease was diagnosed. More detailed analyses are in progress. These findings have had an immediate local impact on medical practice, especially with respect to prompt institution of potentially lifesaving treatment for leprosy. Collaborators in this surveillance included the Harvard School of Public Health and the Uniformed Services University of the Health Sciences.

The AFRIMS febrile illness surveillance program in Nepal has also collaborated by supplying technology transfer and training to establish diagnostic capabilities at the Vector-borne Disease Research and Training Center in Hetauda, Nepal. AFRIMS continues to provide confirmatory diagnostics and a quality assurance function for Hetauda. Through the AFRIMS field station in Nepal, fever surveillance is focused on three hospitals in Kathmandu. More than 90 samples were screened for dengue and Japanese encephalitis, of which 33 were positive for Japanese encephalitis. The AFRIMS hospital-based febrile disease surveillance in Kathmandu identified patients who presented with one of several syndromes. A total of 683 cases were assessed serologically: 23 cases of leptospirosis and nine cases of scrub typhus were confirmed. No cases appeared to have an acute spotted-fever infection by serology.

Influenza surveillance was another focus with 39 specimens sent to the Air Force IERA influenza lab from suspect cases at the U.S. embassy in Bangkok, at the hospital in Sangkhlaburi, and at the CIWEC Clinic in Kathmandu. All isolates were either A/Sydney/H3N2 or B/Beijing.

A unique opportunity available to AFRIMS through its core DoD-GEIS program is a zoonotic disease surveillance module. An AFRIMS team worked with veterinarians and technicians from the Ministry of Agriculture to collect specimens from domestic and wild animals in Sangkhlaburi, from the hospital in Sangkhlaburi, and at the CIWEC Clinic in Kathmandu. All isolates were either A/Sydney/H3N2 or B/Beijing.

AFRIMS, the Army's largest overseas medical research unit, conducted the full range of core DoD-GEIS surveillance activities in its region during FY 00. Surveillance for antimicrobial resistance patterns was conducted in six different populations of U.S. soldiers during Operation Cobra Gold, adult travelers presenting to a clinic in Nepal, children younger than age 5 at a hospital in northeastern Thailand near Laos, children younger than age 5 at a hospital in southern Thailand, children younger than age 5 in a village in central Vietnam, and children under age 12 at two hospitals in the Bangkok area. In all, 2,571 human cases and 488 human controls were studied.

Among the nonimmune U.S. soldiers on Cobra Gold, nearly 70% of the diarrheas was caused by Campylobacter. Among Campylobacter isolates, resistance to nalidixic acid ranged from 90% for C. coli to 8% in the central Vietnamese village.

Among S. typhi isolates, most samples were from the Bangkok area. In all, 2,571 human cases and 488 human controls were studied. The most common pathogen followed by Campylobacter. Shigella was uncommon. Again, high degrees of resistance were found. Campylobacter now routinely demonstrates resistance to quinolones.

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DoD Helps WHO Respond to Rift Valley Fever Outbreak in Yemen

On 21 September 2000, the Navy’s research laboratory in Cairo (NAMRU-3) received an urgent request for assistance from WHO. Four days earlier health and agricultural officials in Yemen had received reports of Rift Valley fever in the El Zuhrah district of the Hodeidah governorate in Yemen. These reports followed by one week a confirmed outbreak of the disease in neighboring Saudi Arabia.

Through DoD-GEIS funding, NAMRU-3, which was approved just last year as a WHO Collaborating Centre, helped WHO respond to disease outbreaks in the Middle East. NAMRU-3 quickly assembled an investigative team that reached Yemen on 25 September and arrived in the outbreak area the next day. The team consisted of experts from the lab’s virology, vector biology, and disease surveillance programs and three members of the Egyptian Field Epidemiology Training Program.

The first task was to confirm the cause of the outbreak, and on 28 September the team made a serologic diagnosis of Rift Valley fever in the affected region. For nearly 2 months the team continued to assist Yemeni health and agricultural authorities by conducting epidemiologic and serologic surveys to characterize the evolution and extent of the outbreak and to help evaluate disease and vector control measures.

In the midst of this assistance, on 12 October, a terrorist bomb blew a hole in the hull of the USS Cole during refueling at Aden, Yemen, about 200 miles southeast of Hodeidah. Although the attack was feared as serious, it maintained its schedule of grueling 18-hour days. As an indication of the humanitarian role of the military that DoD-GEIS fosters, a team member noted that they never felt threatened, saying, “We did not experience any anti-American sentiment. It was well-known that we were associated with the U.S. military - however, the work was perceived as a public health/humanitarian assistance response.”

In addition to on-site assistance, DoD-GEIS supplied Rift Valley fever vaccine for investigators through USAMRID. Through its partnership with NASA, the DoD-GEIS central hub provided satellite imagery to the NAMRU-3 team to better understand possible predictive environmental correlates.

Rift Valley fever is a mosquito-borne zoonotic viral disease predominantly causing abortion and deaths of young animals (e.g., sheep and goats). Epizootic and epidemic transmission is associated with periodic heavy rainfall. Human infection is usually not apparent or is associated with a brief self-limited febrile illness. However, complications such as retinitis, hemorrhagic fever, or encephalitis can occur. Transmission is primarily by contact with infected animal bodily fluids and mosquito bites. Person-to-person transmission has not been reported.

From 7 August to 7 November, 1,087 suspected human cases were identified in Yemen, including 121 deaths. Most cases were associated with contact with infected animals.

NAMRU-3 also provided technical assistance to the Saudi Arabia Ministry of Health to evaluate their response to the epidemic. The epidemics in Saudi Arabia and Yemen were the first known outbreaks of Rift Valley fever outside East Africa.

In the new facility, 83 specimens from multiple sites in Kenya were evaluated. The mean chloroquine IC50 values were 3.3 times higher than the standard chloroquine-resistant strain (W2). The mean mefloquine IC50 was 2.6 times lower than D6, the mefloquine-resistant clone, and comparable with the mefloquine-susceptible W2 strain. The mean IC50 values for quinine were 3.2 times higher than the quinine-sensitive D6 strain. Overall, 94.4% of isolates were resistant to quinine, and 83% were resistant to chloroquine, although mefloquine resistance was only 9.6%. No resistance to halofantrine was documented. PCR methods to check for drug-resistant genes are also being explored.

USAMRU-K worked to strengthen and derive additional benefit from the recently rejuvenated yellow fever network for Kenya, which is operated by the WHO reference center for hemorraghic viruses that is co-located at the Kenya Medical Research Institute with USAMRU-K. The network consists of 24 clinics distributed widely in Kenya. In partnership with CDC, USAMRU-K provided two technicians to the WHO reference lab and supported the supply and travel budget. More than 1,200 blood specimens were screened during FY00 along with nearly 6,000 arthropod specimens. Screening by DNA or RNA amplification was performed for flavivirus, alphavirus, bunyavirus. This project confirmed dengue type II in Kilifi District Hospital on the coast of the Indian Ocean, the first clinical case in Kenya. It confirmed dengue type II in Machakos and Marsabit, the first cases in Kenya. Resistance to three or more antibiotics was found in 76% of Shigella; 67% of enterohemorrhagic E. coli were resistant to multiple drugs.

President Decision Directive NSTC-7 calls for the establishment of regional hubs linked by modern communications. Reliable communications are not easy in East Africa. In the spirit of the directive and reflecting USAMRU-K’s shared vision with many key emerging infections partners at the Kenya Medical Research Institute (CD/C, WHO Viral Research Centre, Japanese International Cooperation Agency, and Welcomer Oxford), USAMRU-K erected avSAT satellite dish and hired a full-time Internet supervisor/webmaster. The efficiency of scientific and public health communications has consequently been greatly improved for these agencies.

Studies on enteric illness antibiotic sensitivity were undertaken by USAMRU-K in collaboration with the African Medical and Research Foundation, the hub of a large regional network of hospitals and clinics. To support expansion of the work, USAMRU-K has expanded its enteric capabilities with an agreement with the Center for Microbiological Research. Enterics surveillance in FY00 centered at Entebbe in Uganda. The Tanzanian border; Mekelik, north of Nairobi; and Marsabit. Surveillance and capacity building for Rift Valley fever conducted by the DoD-GEIS central hub, has identified 370 human cases of Rift Valley fever and 121 deaths. Most cases were associated with contact with infected animals.

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

DoD-GEIS is primarily organized and funded as a public health surveillance and capacity building program. Most emerging infections research conducted by the DoD is managed and funded separately by the Military Infectious Disease Research Program (MDR). Nevertheless, DoD-GEIS has been in the position to facilitate the research agenda of MDR and other partners. In many cases this stems from the added value of using
surveillance specimens for additional research purposes such as the evaluation of new diagnostics. As noted under “Respiratory Disease Surveillance and Capacity Building,” DoD-GEIS assets have leveraged diagnostics development both domestically and internationally. The DoD-GEIS surveillance program is well positioned to recognize research questions that must be answered pertaining to the epidemiology and control of emerging agents. Sharing of infrastructure (e.g., the VSAT satellite at USAMRU-K) and various fixed costs at the overseas labs has augmented the output of both the MIDRP and DoD-GEIS programs at those institutions.

An operationally oriented research area of DoD-GEIS has been the development of new tools specifically for surveillance. For example, ESSENCE, the GEIS syndromic surveillance program for emerging infections including bioterrorism, is geared to test and evaluate new and innovative approaches to conducting surveillance.

Another unique operationally oriented research area of DoD-GEIS has been the application of satellite remote sensing to predict the occurrence of Rift Valley fever in East Africa. As one product of an interagency agreement between DoD-GEIS and NASA’s Goddard Space Flight Center, a monthly Rift Valley fever prediction map for Africa is made and posted on the DoD-GEIS website (www.geis.ha.osd.mil/riftvalleyfever/index.htm).

When Rift Valley fever broke out in 2000 in Saudi Arabia and Yemen, appropriate remote sensing data were made available to the field investigators from the MIDRP to assist in determining whether predictive models could be extended to that area. Similar work was also conducted to develop methods to predict dengue hemorrhagic fever in Southeast Asia and Filovirus infections in Africa.

Behavioral issues, although not a major emphasis of DoD-GEIS, have received attention in various contexts such as the knowledge, attitudes, and behaviors surveys of U.S. soldiers in Korea concerning their use of the DoD personal protection system for the prevention of malaria transmitting mosquitoes.

Virtually all elements of DoD-GEIS are involved with training DoD personnel, collaborating foreign scientists, and public health workers. Many training efforts are formal courses such as the outbreak investigation course taught by NAMRU-2 in Laos in FY 00. Other efforts include more informal yet still substantive training of laboratory and other collaborators at hospitals, clinics, and other sites that serve the regional DoD-GEIS networks.

In addition the CINC’s support humanitarian assistance projects such as the efforts funded by Southern Command that are directed toward building electronic laboratory-based emerging infections networks in the Caribbean and in Peru. For example, under these Southern Command projects during FY 00 DoD-GEIS and its partner, the Caribbean Epidemiology Centre, trained more than 60 public health professionals in the Bahamas, Guyana, St. Kitts, Grenada, and Peru in the use of computers for public health surveillance.

Perhaps the most significant for the DoD is the DoD-GEIS oversees medical research laboratory orientation training program. Arguably the greatest challenge to DoD in addressing the problem of emerging infectious diseases is maintaining a cadre of well-trained and enthusiastic uniformed professionals able to work both CONUS and OCONUS on these challenges. Economic opportunities and retirements have taken their toll on the pool of military tropical disease experts. The overseas lab orientation training program is targeted toward recruiting young military personnel from various relevant disciplines to a career involving international infectious diseases surveillance, prevention, and research. This year 15 candidates were competitively selected for a mentored field experience at one of the five DoD overseas labs. The training spanned from about 6 weeks at the laboratory and its field sites. Initial feedback has been excellent, and early indications are that some of these trainers are heading toward careers in this arena.

Another major venue for outreach was the “Second International Conference on Emerging Disease” organized by the CDC with financial assistance from many groups including DoD-GEIS.

Although controlling the migration of infected travelers is primarily the responsibility of the Quarantine Division of the CDC, the cooperation of DoD is essential, especially in light of the rapid movement of large numbers of DoD personnel in and out of the country. Fortunately, during FY 00 large exposure prone deployments were not as significant as in recent years. However, lines of communication must be regularly exercised and expanded to ensure improvement. Internal to DoD-GEIS, hopes to more effectively disseminate travel-related health information through the proactive use of “push” technologies on its website. In addition, during FY 00 DoD-GEIS participated in the organizing meeting of the WHO Global Outbreak and Alert Response Network and continues to share information, as appropriate, with DoD health authorities.

DoD-GEIS has been a leader in helping other nations move emerging infections higher on their agendas. A particularly vivid example is the leadership of NAMRU-2 in organizing a 1-week conference on Bali in September to establish a Southeast Asian emerging infections network. Attendees included representatives of WHO, 16 countries of the region, and the international banking community. DoD-GEIS was the only WHO collaborating center in developing the network, and it was on the agenda of the WHO Global Outbreak and Alert Response Network.

During the year NAMRU-3 was formally approved as a WHO Collaborating Centre for Emerging Infections and in that capacity led the WHO response to the outbreak of Rift Valley fever in Yemen.

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“3. Expand formal training and outreach to health care providers.”

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

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

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

“5. Make information about all international travelers with communicable diseases more accessible to domestic health authorities.”
DoD-GEIS participated in the PAHO Emerging Infections Task Force Meeting. DoD-GEIS also arranged using funding from the Southern Command Humanitarian Assistance Program for a four-person team, led by the U.S. Army Health Facilities Planning Agency, to perform a 1-week on-site consultation in Trinidad to help PAHO’s Caribbean Epidemiology Centre plan major infectious disease laboratory renovation.

DoD-GEIS has established itself as a key international asset for dealing with the full range of emerging infections problems. It continues to execute its domestic and international programs in accordance with the 5-year strategic plan approved and published in 1998. To ensure that its programs are scientifically sound, fiscally reasonable, and responsive to the needs of the taxpayer and to the nation’s service members, DoD-GEIS contracted with the Institute of Medicine of the National Academy of Sciences in FY00 to have a committee of eight internationally recognized public health experts perform a thorough review of all aspects of the program. This review, which includes site visits to each overseas lab and various CONUS elements, was begun in April 2000 and will be completed in late FY01. It is expected that the committee’s recommendations will help refine DoD-GEIS plans, although emphasis is expected to still include improving MHS surveillance and response capabilities, addressing product availability issues, developing needed human resources, and using the DoD overseas lab as a robust forward-deployed platform from which to conduct emerging infectious disease work in the interest of U.S. national security. DoD-GEIS expects to continue to play to the historic strength of the overseas laboratories in the areas of field epidemiology, malaria, enteric diseases, viral diseases, entomology, and veterinary science. A strong continuing effort to leverage DoD capabilities through the training of collaborators will also remain a focus along with assisting other federal agencies, providing international leadership in scientific, public health, and diplomatic settings.

The Future

Deployed U.S. troops can find themselves dogging through rice paddies in Southeast Asia, sleeping on the African savanna, or training in South American jungles. While these environments challenge the armed forces, they also nurture emerging infectious diseases. To combat these unique threats, the Army and Navy operate five tropical research and surveillance centers in Egypt, Indonesia, Kenya, Peru, and Thailand. All are staffed with active-duty and U.S. civilian scientists along with local researchers and support personnel. Maintaining a cadre of skilled scientists who seek the challenges and opportunity to work at the overseas labs is essential to their continued success.

For the past 2 years DoD has sponsored short training rotations at the labs for early and mid-career scientists who are interested in assignment at one of the facilities. Many want first-hand knowledge of the programs and the local living and working conditions before committing to a career in military tropical medicine research. The first trainee was selected in late 1999, and by the end of FY00 15 individuals had spent an average of 39 days at the DoD overseas labs. Five more were selected for training in early 2001. Trainees have come from Uniformed Services University of the Health Sciences, residency training programs, and fellowships.

DoD-GEIS Trains Scientists for the Future

Major Michael Lewis was a preventive medicine resident at WRAIR in 1999 when he was awarded a 3-week rotation to study febrile illness in Nepal under the mentorship of an established AFRIMS scientist in Bangkok. Lewis is now assigned to the AFRIMS lab.

"Although I had a pretty good idea that I wanted to go to Thailand," says Lewis, "having the opportunity to spend time on the ground, seeing the quality of the work, the outstanding quality of the people, and the overall enthusiasm of everyone I met, solidified my decision." Lewis also had a 2-year-old and an infant and says, "Having the opportunity to check out the family situation was probably the biggest thing...in giving my family the comfort to pick up and move."

After rotation surveys consistently commend the projects and mentors at the labs. So far, Thailand has been the most popular training site, but opportunities are plentiful at all labs both for training and assignment. The training program offers career choices that young physicians and scientists may not otherwise consider because many have limited knowledge of the depth and breadth of the DoD research and development program. Exposure to the overseas labs can be a powerful and unique enticement for individuals to pursue a career in tropical infectious diseases. Information about the program, including eligibility requirements and application guidelines, is available on the DoD-GEIS website.
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