The importance of militaries from developing countries in global infectious disease surveillance

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Abstract

Military forces from developing countries have become increasingly important as facilitators of their government's foreign policy, taking part in peacekeeping operations, military exercises and humanitarian relief missions. Deployment of these forces presents both challenges and opportunities for infectious disease surveillance and control. Troop movements may cause or extend epidemics by introducing novel agents to susceptible populations. Conversely, military units with disease surveillance and response capabilities can extend those capabilities to civilian populations not served by civilian public health programmes, such as those in remote or post-disaster settings. In Peru and Thailand, military health organizations in partnership with the military of the United States use their laboratory, epidemiological, communications and logistical resources to support civilian ministry of health efforts. As their role in international affairs expands, surveillance capabilities of militaries from developing countries should be enhanced, perhaps through partnerships with militaries from high-income countries. Military-to-military and military-to-civilian partnerships, with the support of national and international civilian health organizations, could also greatly strengthen global infectious disease surveillance, particularly in remote and post-disaster areas where military forces are present.

Militaries maintain public health programmes to monitor, prevent and treat infections that could reduce the operational effectiveness of their forces. To advance mission objectives or broader national goals, military forces may extend their public health capabilities to civilian populations not adequately served by civilian public health programmes – for example, groups experiencing humanitarian emergencies or people in remote areas beyond the reach of ministries of health. However, the mobility that facilitates such operations can also allow military forces to carry infectious agents to susceptible civilian populations.[1]

In many developing countries (that is, low- or middle-

income economies as classified by the World Bank)[2] the pursuit of foreign policy goals may involve use of military forces to participate in peacekeeping operations, military exercises and humanitarian relief missions, or to carry out more traditional military tasks such as the securing of borders.

Here, we consider the growing importance of developing country militaries in global affairs, and the threats and opportunities this growth presents for infectious disease surveillance and control in civilian populations. We use examples from Peru and Thailand to show how militaries in developing countries can strengthen surveillance programmes run by ministries of heath.

Militaries in developing countries: new and traditional missions

During the 1990s, military forces in developing countries comprised an increasing proportion of the global total military as the United States and other high-income countries made significant reductions in force size.[3] According to one set of troop strength estimates, militaries in developing countries currently comprise 17 of the 25 largest active duty forces worldwide, with a combined total of 10.5 million of the 14.3 million personnel in these 25 forces.[4]

Currently, military forces from developing countries are deployed to participate in many multinational operations (Box 1). Increasing engagement abroad is evident in UN peacekeeping operations. Between 2001 and 2006, the number of high-income countries contributing military forces to UN peacekeeping operations decreased slightly from 24 to 23, and the number of military personnel contributed by high-income countries fell from about 8000 to 2000. During the same period, the number of developing countries contributing military forces increased from 53 to 73, and the number of personnel contributed nearly tripled, from about 22,000 to about 63,000.[5]

Developing countries also supply forces to non-UN multinational missions. The African Union Mission in Sudan draws its approximately 7000 military personnel from Chad, Egypt, Gabon, the Gambia, Kenya, Nigeria, Rwanda, Senegal, South Africa and Zambia.[6] The Multinational Force and Observers in the Sinai Peninsula includes about 800 military personnel from Colombia, Fiji and Uruguay, in addition to contingents from Canada, European countries, New Zealand and the United States.[7] As of January 2007, stability operations in Iraq included forces from 22 developing countries.[8]

Military personnel from developing countries are frequent participants in multinational military exercises to improve collaboration and practice tactical plans with allies. For example, military forces and observers from 18 countries, including several in central and south America, exercise plans every year for defending the Panama Canal.[9]

Following the 11 September 2001 terror attacks, the United States military established the Combined Joint Task Force – Horn of Africa in Djibouti to assist countries in eastern African in combating terrorism. In a recent exercise led by Combined Joint Task Force - Horn of Africa, military forces from Kenya, Uganda, the United Republic of Tanzania and the United States practiced a coordinated response to humanitarian emergencies.[10]

Disaster relief missions also draw on military forces from developing countries. These forces made a significant contribution to the multinational response to the December 2004 Indian Ocean earthquake and tsunami. Militaries from Bangladesh, India, Indonesia, Malaysia, Pakistan, Sri Lanka and Thailand, among others, contributed medical, logistical and engineering personnel, as well as aeroplanes, helicopters and ships.[11]

Military deployments and transnational epidemics

Increasing deployment of militaries from developing countries could help spread infections across borders. Historians believe that forces from the United States were instrumental in the rapid spread of the 1918–1919 influenza pandemic during World War I.[12] Crowded berthing and training environments probably facilitated transmission among troops, while troop movements within the United States and to Europe introduced the virus to new populations. Recently, influenza outbreaks on United States Navy ships following port calls (despite high crew vaccination rates) have raised the possibility of port-to-port spread.[13] Military forces also have carried adenoviruses[14] and Mycobacterium tuberculosis[15] between populations.

Transmission of vector-borne diseases between military and civilian populations can occur when infected troops travel to areas with competent vectors. A large malaria outbreak occurred in California in 1952 when a soldier

United Nations peacekeeping operations (current)

- United Nations Organization Mission in the Democratic Republic of the Congo; 18 473 military personnel.
- United Nations Mission in Liberia; 15 638 military personnel.
- 14 other current operations.

Other multinational peacekeeping or security operations (current)

- African Union Mission in Sudan; 7000 military personnel.
- Multinational Force and Observers, Sinai Peninsula; 1500 military personnel.
- Operation Iraqi Freedom and Operation Enduring Freedom.

Joint military exercises with the United States

- Panamax 2006: 18 countries; Panama Canal defence.
- Cobra Gold, 2006, with Indonesia, Japan, Singapore, Thailand; various scenarios.
- Natural Fire, 2006, with Kenya, Uganda, the United Republic of Tanzania; humanitarian response coordination.

Humanitarian relief operation

- Indian Ocean tsunami response, 2004–05; militaries from about 20 countries.

Box 1. Types and recent examples of multinational military operations with significant participation by developing countries

Department of affected naval base	Disease or syndrome
Iquitos (north east, in Amazon jungle region)	P. vivax malaria, dengue fever, diarrhoeal disease
Tumbes (north)	Dengue fever, diarrhoeal disease
Piura (north)	Diarrhoeal disease
Lima (west)	Cyclospora cayetanensis (multiple outbreaks), diarrhoeal disease (multiple outbreaks)
Ica (south west)	Diarrhoeal disease

Table 1: Selected infectious disease outbreaks in Peruvian naval forces detected by Alerta, 2004–2005

infected with Plasmodium vivax malaria during service in the Korean War camped, while parasitaemic, in a popular park.[16] A rapid public health response may have prevented local dengue transmission when infected Australian soldiers returned from service in East Timor.[17] Local transmission was theoretically possible following return of Soviet forces infected with P. vivax from Afghanistan,[18] and of United States forces infected with dengue from Haiti[19] and Somalia.[20]

Deployed forces may encounter antimicrobial-resistant pathogens that are not common in their home countries. For example, in 1997 Minnesota National Guardsmen returned from training in Greece with ciprofloxacinresistant Campylobacter jejuni diarrhoea.[21] Nosocomial transmission of drug-resistant Acinetobacter baumannii, which has caused wound infection and colonization in United States forces serving in Afghanistan, Iraq and Kuwait[22] occurred in at least one United States military hospital.[23]

Multinational military operations pose an additional risk of deployment facilitated spread, since forces may have different exposure histories, and screening and vaccination requirements.[24] To reduce the risk of introducing human immunodeficiency virus (HIV) into host country populations, the UN requires that countries offer uniformed peacekeepers voluntary pre-deployment HIV testing and counselling.[25] There are few data to make a causal link between multinational peacekeeping operations and local outbreaks.

Military surveillance contributions to civilian health authorities

In humanitarian emergencies, well-equipped militaries may use their logistical, communication, organizational, epidemiological and mobile laboratory resources to establish surveillance for populations vulnerable to epidemics.[26,27]

Following the Indian Ocean tsunami in 2004, a United States Department of Defense overseas laboratory, United States Naval Medical Research Unit-2 (NAMRU-2, in Jakarta), established a field laboratory in the heavily affected Indonesian city of Banda Aceh with the Indonesian government and WHO.[28] The laboratory provided reference services that confirmed some epidemics, thus facilitating timely intervention for some outbreaks and allaying concerns about other infectious diseases. After several months, NAMRU-2 turned the laboratory over to the Indonesian government who continued to use the facility.

Some militaries that maintain advanced laboratory and epidemiological capabilities to protect the health of their forces share these assets with civilian health organizatio respond to epidemics.[29] For example, German and U States military medical organizations are partners in Global Outbreak Alert and Response Network, a WHO technical collaboration of institutions and networks pool human and technical resources for the r identification, confirmation and response to outbreak international importance. Three United States Depart of Defense overseas laboratories – NAMRU-2, the N Medical Research Unit-3 (NAMRU-3, in Cairo) and Armed Forces Research Institute of Medical Scie (AFRIMS, in Bangkok) – are WHO Collaborating Cer and frequently assist ministries of health and WHO in surveillance of and response to epidemics.

Developing country militaries might not pos sophisticated public health capabilities, but if they main awareness for unusual disease occurrences, they provide valuable early warning for epidemics of gl importance. Within some developing countries, milit already support civilian health authorities by provi health services for civilians in remote areas and repo military surveillance data to the ministry of health. W forces collaborate with civilians to conduct military civilian infectious disease surveillance, these partners enable compliance with the International He Regulations (2005),[30] which require that WHO be ra notified of infections that may constitute a public he emergency of international concern – irrespective of whe the infections are in civilian of military populations.

Later in this paper, we describe surveillance syst operated by developing country militaries that, in var ways, support epidemic preparedness of the ministr health in the host country. These systems are collabor efforts of the host country military and the United S Department of Defense through its overseas laborato long-standing facilities that conduct research on infec diseases of bilateral importance.[31] As part of the U States Department of Defense – Global Emer Infections Surveillance and Response System, establi by Presidential directive in 1997 to confront eme infections as a national security threat,[32] they also dev regional capacity to detect and respond to epidem Two of the five United States Department of Def overseas laboratories are hosted by foreign militaries Peruvian Navy hosts the United States Naval Me Research Center Detachment (NMRCD), establishe 1983; and the Royal Thai Army (RTA) hosts AFR established in 1961.

Peru

Peru has a population of over 27 million people living in tropical, sub-tropical and temperate regions. The Peruvian military comprises the Army, Navy, Air Force and National Police and includes more than 200,000 personnel. The Navy maintains dozens of training facilities, ports and other bases across the country – from modern facilities in the capital city Lima to remote bases in border areas. Crowded living conditions and difficulties in maintaining hygiene (with which most militaries must contend) contribute to outbreaks of respiratory and diarrhoeal diseases among Navy personnel. In tropical areas, Navy units are at risk of malaria, yellow fever, dengue and other vector-borne diseases. Outbreaks of infectious disease have had a significant effect on the Peruvian Navy's ability to carry out missions.

In Peru, as in many countries, the military complies with disease reporting policies established by civilian health authorities. The Peruvian Ministry of Health has identified 45 nationally reportable infectious and non-infectious diseases. The Navy monitors these diseases in its active duty personnel (about 25,000 people) and their family members (about 100,000), and reports surveillance data to the Ministry of Health. With many units in remote locations, the Navy provides the Peruvian Ministry of Health with information on disease burden and outbreaks in areas where there is little civilian public health infrastructure.

Before 2002, however, the Peruvian Navy relied on a paper-based reporting system that did not facilitate rapid detection and control of infectious disease outbreaks, especially in remote locations. Mailed reports could take weeks to reach Lima from the border areas, by which time outbreaks often were well advanced or over. After several unexpected deaths – probably the result of infectious diseases – in units in the Amazon jungle region drew attention to surveillance deficiencies, the Peruvian Navy and NMRCD developed Alerta, an electronic disease surveillance system that at modest cost has transformed public health surveillance and response in the Peruvian Navy.

Alerta allows reporting and tabulation of the nationally reportable diseases, as well as others important in military populations, such as influenza-like illness and training injuries. Units report to the surveillance hub at NMRCD by Internet, telephone or radio-relay. The Navy has assigned an officer to the hub to facilitate communication with surveillance sites. Alerta covers over 95% of Navy forces and family members in all Navy regions. The system has identified 31 disease outbreaks (some of which are shown in Table 1), including Peru's first confirmed cyclosporiasis epidemic,[34] and has frequently allowed rapid epidemiologic investigation and control to take place.

Another collaborative surveillance activity of NMRCD and the Peruvian military is focused on peacekeepers. Since June 2005, Peru has deployed groups of about 200 troops for six month tours with the UN Stabilization Mission in Haiti (MINUSTAH).

To assess the risk of infectious disease exposure in Haiti and importation back to Peru, the Ministry of Defense and NMRCD developed a serological surveillance programme. With funding from the United States Military HIV Programme, the Ministry of Defense collects serum from peacekeepers before and after deployment, which NMRCD tests for exposure to HIV, hepatitis B and hepatitis C viruses, human T-cell lymphotropic virus 1 and 2, syphilis, dengue and malaria. Each peacekeeper also completes a questionnaire on insect, animal and sexual contacts while deployed.

As with Alerta, the military uses this programme primarily to monitor infectious disease risks in its forces. But through data sharing with the Peruvian Ministry of Health, civilian authorities will be made aware of infectious diseases imported by returning forces that could be transmitted to civilian populations in Peru.

Thailand

During the late 1980s, Thailand experienced a sharp rise in HIV prevalence.[35] The Thai government launched a countrywide HIV/AIDS education campaign and made condoms available to commercial sex workers and their clients, since commercial sex was considered a major route of HIV transmission.[36] The Thai Ministry of Public Health initiated HIV surveillance in sentinel populations, including commercial sex workers and intravenous drug users, to track the epidemic and assess the effectiveness of control measures in high-risk groups. In 1989, the RTA initiated HIV screening for all incoming recruits, who were conscripted by lottery from every district in Thailand (50 000–60,000 men aged between 18 and 22 years annually, with exemptions given to certain groups;[36] currently, the RTA does not use conscription). With technical assistance from the United States Army Component of AFRIMS, the RTA also gathers socio-demographic information from recruits when they are admitted to the RTA.

By allowing the Thai Government to monitor the HIV epidemic in a large, national sample of young men, the RTA HIV screening programme has proven a useful complement to the Ministry of Public Health HIV surveillance programmes. The Ministry of Public Health and RTA staff, often in collaboration with university researchers, used the RTA HIV surveillance database to assess the national effect of government control measures in young men,[36,37] identify areas of Thailand with high HIV incidence,[38,39] define risk factors for HIV infection,[40,41] and describe the natural history of HIV infection.[42] To support future epidemiological studies of other infectious diseases, scientists from the RTA and United States Army maintain a repository for serum that is left after HIV testing at the RTA Institute of Pathology.

Another collaboration between the RTA and United States Army addresses a similar challenge to the one facing the Peruvian Navy – conducting timely infectious disease surveillance in remote areas. Many RTA personnel are assigned to areas near borders with Cambodia, the Lao People's Democratic Republic and Myanmar where they deter and defend against external and internal security threats. Public health resources and communications are limited in these places, making timely epidemic detection and control in RTA forces difficult. In border areas

inaccessible to the Ministry of Public Health, the RTA provides public health services for both civilian and military populations.

RTA and United States Army collaborators developed the unit-based surveillance system in 2002 to improve surveillance along the Thai-Cambodian and Thai-Lao People's Democratic Republic borders. The system allows data to be collected by RTA soldiers who do not have medical training (since few RTA medical officers serve in such areas), with analysis and interpretation carried out in Bangkok. Participating military units collect syndromic information daily on local populations and report the data to higher headquarters by radio or fax (syndromes under surveillance include constitutional, respiratory and gastrointestinal). At headquarters, data are recorded into a Microsoft Access-based program and transmitted through an internet-based system to the AFRIMS main frame at least twice a week. If analysts at AFRIMS identify a possible outbreak, medical authorities from the Ministry of Public Health and the RTA are notified and they may initiate control measures.

Building on the partnership that created the unit-based surveillance system, the RTA and United States Army medical personnel are currently refining the system for surveillance of influenza-like illness and initiating laboratory-based influenza surveillance at remote RTA facilities that serve civilian and military populations.

Discussion

Military-to-military partnerships, in which militaries with advanced public health capabilities commit to helping other militaries develop laboratory and epidemiologic capacity, are one way of improving surveillance in developing country militaries. There are other successful military-to-military partnerships besides the ones presented here. For example, the French Forces Institute of Tropical Medicine (IMTSSA), a WHO Collaborating Centre, partnered with the Vietnamese Army Health Corps to control malaria in Viet Nam.[43] The French military also supported the Gabonese military and Global Outbreak Alert and Response Network partners in responding to an Ebola epidemic in 2001.[44]

As the global involvement of military forces from developing countries rises, the importance of effective surveillance in these populations increases – not only for the protection of military units but also for civilians. Higherincome countries, and their militaries with advanced epidemiologic and laboratory resources, should seek opportunities to partner with militaries from developing countries to improve surveillance capabilities. Militaries of all countries should seek civilian-military partnerships when located in domestic or foreign areas where their surveillance capabilities could improve the local civilian public health infrastructure. These collaborations could provide mutual benefit, alerting each population to infectious disease risks in both groups and providing early warning of epidemics with potential global significance.

Neutral international health organizations, such as WHO, can facilitate partnerships between military organizations through leadership that remains independent of the interests of any one country. Both military and civilian health agencies may be reluctant to fully engage in health partnerships with militaries without the broad legitimacy that such organizations can provide.

In the United States military experience with influenza surveillance, close relations with WHO have facilitated international partnerships. The United States Department of Defense – Global Emerging Infections Surveillance and Response System coordinates global influenza surveillance for the United States military through the Military Health System and the Department of Defense overseas laboratories, which conduct influenza surveillance with many partner countries and contribute to the WHO Global Influenza Surveillance network. Assuring potential partners that surveillance will support WHO efforts has been especially important in certain regions. For example, NAMRU-3, a WHO regional reference laboratory for influenza, has helped countries throughout the Middle East and north Africa to develop national influenza laboratories.

In 2003, the Russian Academy of Medical Sciences, WHO, the North Atlantic Treaty Organization, and the United States Department of Defense – Global Emerging Infections Surveillance and Response System hosted civilian and military public health leaders from 18 countries in St Petersburg, the Russian Federation, to discuss ways of enhancing influenza pandemic preparedness through civilian–military cooperation.[45] Participants established lasting collaborations with groups in their home and other countries, and agreed that WHO leadership and continued work was needed to bridge gaps between civilian and military efforts. In the future, multilateral civilian–military public health forums involving international organizations and developing and high-income countries could establish and sustain partnerships to address those gaps.

Finally, there is a need for critical examination of the expanding role of militaries in post-disaster assistance, global infectious disease surveillance and other activities that extend military public health capabilities to civilian populations in need. Research should draw on lessons learned from recent[46] and ongoing missions to identify appropriate applications and methods of civilian–military public health cooperation. ❑

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