# The Anti-plague System in the Newly Independent States, 1992 and Onwards: Assessing Proliferation Risks and Potential for Enhanced Public Health in Central Asia and the Caucasus

by

Sonia Ben Ouagrham-Gormley
Alexander Melikishvili
Raymond A. Zilinskas

James Martin Center for Nonproliferation Studies
Monterey Institute of International Studies
Monterey, California, U.S.A.

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## Executive Summary

This report focuses on the status of the anti-plague (AP) system in ten republics of the former Soviet Union (FSU). Although the circumstances described in this report relate mainly to the period 1992 – 2004, many of the systems and their facilities that we describe experience the same difficulties in 2007. However, some significant changes have taken place since 2004 at AP facilities located in countries that have become the beneficiaries of assistance programs such as the U.S.-funded Cooperative Threat Reduction (CTR) Program. These changes – and sometimes the lack thereof – will be the subject of a future publication.

After the Soviet Union's dissolution in December 1991, the centralized Moscow-controlled state AP system disintegrated into smaller national systems within the Newly Independent States (NIS). During the 1990s, national AP facilities had to contend for their survival on many fronts. From the administrative point of view, AP facilities had to counter attempts by national authorities to merge the AP system with the Sanitary Epidemiological System (SES)—a Soviet-era organization responsible for many traditional public health functions such as water and food sanitation and vaccine campaigns, but one without adequate expertise in dealing with highly dangerous diseases. In effect, if these attempts had succeeded, the AP systems would have been placed under the authority of the SES, thus threatening their survival and retention of unique expertise. The battle was most pronounced in Kazakhstan and Uzbekistan—inheritors of the largest number of AP facilities from the Soviet Union. The struggle ended in the late 1990s when an outbreak of human plague occurred in Kazakhstan, convincing most national governments of the importance of maintaining the AP systems as independent organizations. The exception was Moldova, where the AP system was entirely dismantled.

Only in Georgia was the AP system safe from the pressure to reorganize. The Georgian government chose to place the AP system at the center of its national public health system and transferred several other public health organizations with a wide array of functions and responsibilities under its authority. However, these circumstances generated a different set of challenges, as this report shows.

The economic crisis that followed the Soviet Union's dissolution also threatened the survival of the AP systems in the NIS. Most AP facilities experienced an average 50 percent decrease in their budgets and a loss of personnel that reached a staggering 80 percent in some cases. Although most of the AP institutes and stations established during Soviet times were still operational in 2004, they were in various states of disrepair and insolvency. As a result, their scientific activity and output were low, hovering between 20 and 50 percent of what it was during the Soviet era.

The combination of these circumstances adversely affected the security and safety of the AP facilities and severely curtailed their ability to perform disease surveillance, research, and training. With insufficient funds to maintain infrastructures, most of the facilities visited by the James Martin Center for Nonproliferation (CNS) staff during 2002-2004 had deteriorated and physical security features were absent or in poor condition. Alarm systems installed in Soviet times were out of order in most cases. Perimeter walls or fences surrounding AP facilities were often broken or badly damaged, leaving them vulnerable to unauthorized intruders. Physical security features at laboratory buildings and pathogen collection rooms were woefully inadequate—often consisting only of ordinary padlocks and wax seals, which would not prevent a potential intrusion. To make matters worse, personnel background checks, which were customary in Soviet times, were no longer conducted due to a lack of financial, administrative, and technical means.

Safety conditions were in a similar poor state. After 1992, funds allocated by national authorities were insufficient to replace obsolete equipment or to purchase the basic material to conduct laboratory work, such as agar, substrates, and glassware. AP scientists worked with highly dangerous pathogens without basic biosafety equipment, such as glove boxes and filtered ventilation systems. In addition, many AP facilities were, and still are today, located in residential areas or city centers, thus creating the potential for an outbreak in the civilian population caused by pathogens escaping from a laboratory or culture collection as a result of an accident or deliberate act.

Disease surveillance programs were also in disarray. With obsolete equipment, sharply reduced funding, and a lack of qualified personnel, disease surveillance activities had on average decreased 60 percent since Soviet times. AP personnel generally concentrated their efforts and meager resources on heavily populated areas, leaving more isolated areas unvisited by surveillance teams. Some areas had not been surveyed since the Soviet Union's dissolution. When teams were sent out in the field, the length of disease surveillance campaigns was decreased from the usual two to three months per year in Soviet times, to one or two weeks. In addition, AP personnel concentrated their surveillance efforts on a smaller number of diseases than previously, generally only plague and cholera.

These circumstances generated three types of proliferation risks with varying degrees of gravity: risks pertaining to the diversion of pathogens, brain drain, and transfers of equipment.

One of the most serious threats was the possibility that insiders or outsiders would purloin pathogens housed at AP facilities. Most AP institutes and regional stations possessed unique collections of pathogenic bacterial, fungal, and viral strains collected over many years during the Soviet era and, to a lesser extent, after their home nations became independent. Some of these pathogens had characteristics—virulence and antibiotic resistance—that made them ideal raw material for states or terrorist groups seeking to acquire biological weapons. Considering the lack of physical security and the openness of AP facilities' territories, the risk of unauthorized access to pathogens was high.

An equally important proliferation threat was brain drain. Although few non-Russian AP facilities were directly involved in the Soviet biological warfare (BW) program, they retained two categories of personnel that posed proliferation threats: personnel who worked on projects sponsored by the Soviet BW program, and personnel who have gained experience from working with pathogens of BW relevance. Indeed, many AP staff members, including scientists and technicians, were highly educated in the biological and epidemiological characteristics of some of the world's deadliest pathogens. They were also accustomed to working with low-tech equipment and under harsh field conditions—two characteristics that appeal to states or terrorist groups intent on secretly acquiring and operating a BW program. AP personnel were poorly paid, with average salaries lower than the national or regional average. In addition, several AP facilities were, and still are today, located on or near illicit trafficking routes for drugs and weapons and areas where various terrorist groups operate. These circumstances dramatically increase the risks that personnel might be co-opted by criminal or terrorist groups.

The possibility that equipment and supplies, meager as they were, might be stolen and used by criminals or terrorists could not be ignored. However, taking into consideration that most of the laboratory equipment in use at AP facilities was obsolete and in bad repair, the proliferation threat posed by diverted equipment was not significant. In addition, due to the shortage of laboratory equipment in AP facilities, any theft would have been immediately discovered and the likely thief identified.

As this report recounts, AP systems in the NIS clearly posed numerous proliferation risks. Simultaneously, however, these systems also hold the key to raising the level of public health in the NIS, including Russia. AP institutes and stations possess unique expertise that today is in short supply throughout the world, and some of it may be so specialized as to be nonexistent elsewhere. With international assistance, this expertise could be put to work once again to protect Europe's southeastern flank from imported infectious diseases. In addition, AP facilities house collections of bacterial, fungal, and viral pathogens that could be utilized by teams of FSU and Western scientists for basic research and development of anti-microbial drugs and vaccines. A side benefit of such collaborative research is that adequately funded AP specialists would be less susceptible to recruitment by proliferating states and terrorist groups than poorly paid specialists. Potentially, the AP institutes could be highly beneficial to their national populations, offer valuable know-how for the control of infectious diseases elsewhere in the world, and for maintaining culture collections of interest to both science and industry. Although the United States has spearheaded an effort under the CTR Program to improve the security of biological research facilities and improve disease surveillance in Central Asia and the Caucasus, the level of engagement of AP facilities in this program was minimal in 2004 and is still wanting today. It is worthwhile noting that other than the United States, western countries, most notably European countries, have so far not involved themselves in assisting AP systems in the NIS. (The reasons behind the suboptimal circumstances of AP facilities, together with an evaluation of international assistance programs supporting the AP system, were the subject of an article written by Sonia Ben Ouagrham-Gormley, published in 2006;[1] found in Annex 1 of this report.)

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Sonia Ben Ouagrham-Gormley
Alexander Melikishvili
Raymond A. Zilinskas

## Introduction

This is the second report on the history of the former Soviet Union's (FSU) anti-plague (AP) system written by Sonia Ben Ouagrham-Gormley, Alexander Melikishvili, and Raymond A. Zilinskas. The first report was published in five discrete but contiguous articles in the February 2006 issue of *Critical Reviews in Microbiology*,[2] and on the James Martin Center for Nonproliferation Studies (CNS) website.[3] In the first report, the authors concentrated on the Soviet AP system as it existed and operated until the Soviet Union's dissolution in December 1991. In this second report, the authors explore the AP system's recent history, spanning from 1992 to 2004. Although the authors completed their field research on the AP system in 2004, more recent information from outside sources has been included selectively in some chapters as appropriate.

Based on information derived from site visits, interviews of AP personnel, and reports commissioned from AP facilities in the NIS, this report concentrates on clarifying the post-Soviet status of AP or public health systems in ten countries: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Tajikistan, Ukraine, and Uzbekistan. The authors describe the structural changes in national AP systems that occurred between 1992 and 2004, AP facilities' work programs and staffing patterns, the security of their microbial and viral culture collections, the proliferation threat stemming from these facilities, and the conditions under which AP personnel monitor naturally occurring foci of dangerous diseases.

Belarus presents a special case because it does not have an AP system, nor did it ever have one. However, when we started this project, we were unaware that Belarus had no AP system, so one of us visited the country and, as with other countries, met with government public health officials and scientists working for its premier microbiological research institute. After having invested much work into investigating the Belarus public health status and proliferation potential, and having found information of pertinence to our study, we decided to include a chapter on this country.

This report describes and analyzes both the proliferation potential and the public health impacts of the AP systems in the ten countries listed above. Each country is covered in its own chapter, and each of the ten chapters outlines the history of the nation's AP system and describes the public health activities of the nation's AP system; international activities that involve the nation's AP system; and the proliferation potential of the nation's AP system.

It is important to note that the situation of some AP facilities has dramatically changed since 2004, due to security and safety improvements conducted under the auspices of U.S.-funded nonproliferation programs such as the CTR Program; particularly significant developments in this regard have taken place in Kazakhstan, Uzbekistan, and Georgia. These programs and today's situation of the AP system will be the subject of a future report.

# Chapter I: The Anti-plague System of Armenia

## 1. History of Armenia's Anti-plague System

The Armenian AP system was established in 1942, when the Soviet MOH transformed a tularemia station, which had existed under the auspices of the municipal disinfection station in Armenia's capital Yerevan, into the Armenian AP station. At the time the main impetus for opening an AP station in Armenia was the proximity of natural plague foci on the territories of neighboring Azerbaijan, Iran, and Turkey (as is noted below, natural plague foci were first discovered in Armenia in 1958). With a staff of only 14 employees, the Armenian AP station was unable to carry out the sanitary and prophylactic anti-epidemiological measures against especially dangerous infectious diseases over the entire territory of the republic. Consequently, in 1944 the Soviet MOH established the first field AP station in Leninakan (now Gyumri). In 1953, the Soviet MOH opened a second field AP station in Kapan to monitor the regions adjacent to the border with Azerbaijan, due to the existence of natural plague foci in Azerbaijan (near Mehmed-Beyliy, Akara, and Gadrut).[4] And in 1972, the Soviet MOH opened its third field AP station in the settlement of Martuni on the southern coast of Lake Sevan for the purpose of full-scale epizootiologic monitoring and implementation of necessary prophylactic anti-epidemiological measures on the territories of the districts contiguous to the Lake Sevan.[5]

As with other Soviet AP stations, the Armenian AP station was subordinate to the Main Directorate of Quarantine Infections of the Soviet MOH. Throughout the Soviet period the Stavropol Scientific-Research AP Institute of the Caucasus and Transcaucasus (now Stavropol Scientific-Research AP Institute) oversaw the activities of the Armenian AP station, conducted research on its premises, and provided consultative-methodological guidance to its personnel and administration. After the Soviet Union's dissolution in December 1991, the Armenian AP station came under the jurisdiction of the Armenian Ministry of Health (MOH) and in 1993 it was renamed the Center of Prophylaxis of Especially Dangerous Infections (CPEDI).

## 2. Current Organizational Structure of the Armenian Anti-plague System

As of March 2004, the Armenian AP system was comprised of the CPEDI, three field AP stations in Gyumri, Kapan, and Martuni, and seven seasonal AP laboratories in Aparan, Ararat, Jermuk, Sevan, Sisian, Stepanavan, and T'alin.[6] Figure 1 shows the organizational chart of the Armenian AP system. The Armenian AP system had 240 employees, including 26 physicians, 10 zoologists, and the balance comprised of auxiliary personnel (laboratory technicians, disinfectors, sanitary workers, drivers, guards, etc.).[7] Figure 2 shows the changes in personnel and funding of the Armenian AP system for the period from 1995 to 2002.

**Figure 1. Organizational Structure of Armenia's AP System**

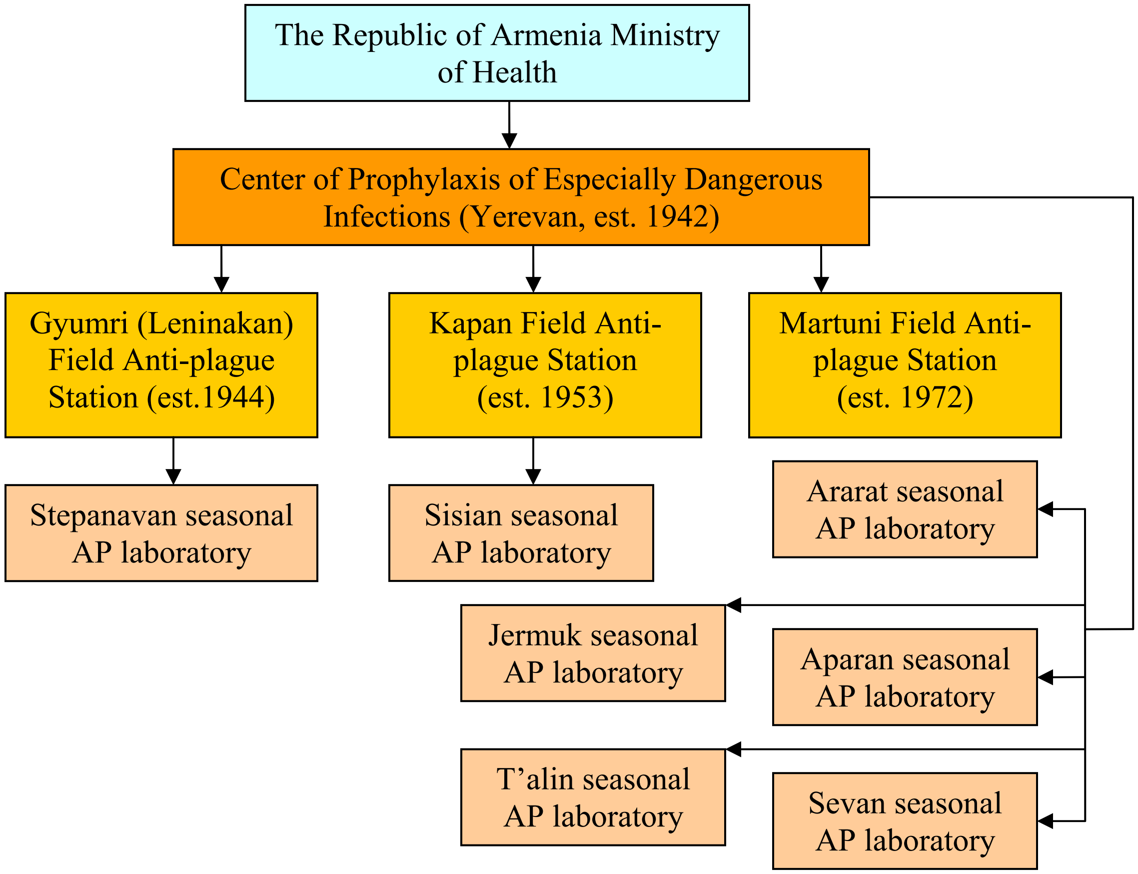



**Figure 2: Personnel and Funding of Armenia's AP System (1995-2002)**[8]

| **Year** | **1995** | **2000** | **2002** |
|---|---|---|---|
| **Total personnel** | 297 | 253 | 240 |
| **Doctors** | 42 | 36 | 35 |
| **Zoologists** | 33 | 26 | 25 |
| **Laboratory technicians** | 53 | 46 | 45 |
| **Disinfectors** | 50 | 40 | 34 |
| **Total funds allocated in millions of Armenian Drams or AMD ($ equivalent)**[9] | 27 AMD ($66,502) | 69.2 AMD ($128,259) | 69.7 AMD ($121,566) |

## 3. Public Health Activities of the Armenian Anti-plague System

The overall public health functions carried out by the Armenian AP system since 1992 have remained the same as during the Soviet period. Thus, its main objective is to protect the population of Armenia from group I-II infectious diseases[10] (plague, anthrax, tularemia, cholera and brucellosis), by monitoring epizootic activities in the natural foci of especially dangerous infectious diseases and implementing appropriate anti-epidemiological measures. Plague surveillance and control include the following activities:

- The epizootic monitoring of the territory with the purpose of timely identification of epizootics of plague (as well as other naturally occurring infectious diseases) and the prevention of its spread to the population;
- The epidemiological monitoring of regions endemic for plague;
- Prophylactic measures (extermination, disinfection, vaccination, and educational outreach addressing sanitary and hygienic issues in the population);
- The training of the medical personnel in public health organizations for clinical monitoring, diagnostics, and prophylaxis of plague (and other especially dangerous infectious diseases); and
- The examination of patterns of natural occurrence of plague (and other infectious diseases).[11]

Other public health activities performed by the Armenian AP system include:

- Prophylaxis of other especially dangerous (tularemia, anthrax, and brucellosis) and naturally occurring infectious diseases (yersiniosis, leptospirosis, and erysipeloid);
- Vaccination of the population against especially dangerous infectious diseases—particularly in the areas frequently affected by outbreaks of such diseases and people who might be exposed to them due to their professional occupations;
- Sanitary protection of the Armenian territory from imported diseases;
- Implementation of quarantine measures as necessary to stop the spread of quarantined diseases;
- Epidemiological readiness of public health institutions with regard to the especially dangerous infections;[12]
- Implementation of laboratory and field experiments for scientific purposes.

The most important Armenian AP facility, CPEDI, is comprised of a laboratory for diagnostics of prionic diseases, a bacteriological laboratory, and a zooparasitological laboratory. The CPEDI's public health mandate also incorporates monitoring and control of cholera, including the following related activities:

- The bacteriological study of water samples (open water sources, sewage, tap water) to identify and isolate strains of *Vibrio cholerae* in order to prevent their spread to the population;
- The monitoring of patients exhibiting symptoms of acute intestinal diseases;

- The training of SES personnel stations and public health organizations in laboratory diagnostics of cholera;
- The training of medical personnel in clinical monitoring, diagnostics, treatment, and prophylaxis of cholera; and
- The identification and verification of strains of *V. cholerae* recovered by SES stations and public health organizations.[13]

The CPEDI also has a specialized anti-epidemiological brigade responsible for rapidly responding to epidemiological emergencies. However, in March 2004, it was not fully equipped, casting doubts about its readiness level.

CPEDI's 2004 budget was equivalent to approximately $270,000, of which $158,000 was earmarked for employee salaries, while the rest was supposed to cover all other expenditures, including implementation of sanitary-prophylactic measures, acquisition of diagnostic materials, laboratory equipment, and other necessary items and activities.[14]

*Epizootic and Epidemiological Monitoring of Natural Foci of Plague*

Armenia's territory hosts natural foci of plague, tularemia, anthrax, yersiniosis, leptospirosis, and erysipeloid. There are two natural plague foci in Armenia—the Transcaucasus Mountainous and Trans-Arax foci. The Transcaucasus Mountainous focus was discovered by Armenian AP specialists in 1958, when they isolated the first culture of *Yersinia pestis* from the flea species *Ctenophthalmus teres* collected from the burrows of common voles in the vicinity of Zugaykhpyur village (close to Gyumri city, Gukasyan district, northwestern part of Armenia) at the foot of the Kechut (Javakheti) Mountain Ridge.[15] The Transcaucasus Mountainous plague focus is located in the mountains of the Armenian Plateau and Lesser Caucasus at elevations of 1,600 to 3,200 meters above the sea level. It is further divided into three plague meso-foci—Gyumri, Zangezur-Karabakh, and Trans-Sevan. Armenian AP specialists discovered the natural plague foci in the Zangezur-Karabakh and Trans-Sevan regions in 1962. The main host in these foci for *Y. pestis* is the common vole, while the vectors are particular varieties of fleas that reside on voles— *Callopsylla caspia* and *Nosopsyllus consimilis*. The Trans-Arax natural plague focus was identified and mapped in 1972. The main host here is Vinogradov's jird (*Meriones vinogradovi*), a gerbil-like animal whose ectoparasites *Nosopsyllus iranus* and *Xenopsylla conformis* are vectors. The fauna of plague vectors responsible for transmission of this deadly disease in Armenia is very diverse—comprised of 63 species of fleas, 31 species of gamasid ticks, and 40 species of argas and ixod ticks.[16]

According to CPEDI, approximately 24,000 sq. km of Armenia's territory (29,800 sq. km), or 80 percent of the country, is endemic for plague.[17] The fact that Armenia is a very mountainous country with more than 90 percent of its territory located at over 1,000 meters above sea level further complicates epidemiological monitoring.

Each of the main structural units of the Armenian AP system is responsible for the epidemiological health of a particular part of the country.[18] Thus, the Gyumri field AP station monitors the epidemiological situation in the provinces of Shirak and Lorri, which encompass ten former districts of northwestern Armenia—Akhuryan, Ani, Artik, Amasiy, Ashots, Gugar, Tashir, Stepanavan, Spitak, and Alaverdi. The Kapan field AP station services the territory of Syunik province (formerly the Sisian, Goris, Kapan, and

Megrin districts). The Martuni field AP station is responsible for the epidemiological health of residents of the Gegharkunik province (formerly four regions near Lake Sevan—Gavar, Martuni, Vardenis, and Krasnoselsk). The territory of the remaining six provinces (Aragatsotn, Ararat, Armavir, Kotayk, Tavush, and Vayots' Dzor) and the federal municipality of the capital Yerevan are monitored by the CPEDI.[19]

Armenia's natural plague foci are characterized by relatively high levels of epizootic activity. From 1968 to 1991, plague epizootics of varying intensity were recorded annually in Armenia, although the highest levels were recorded in 1973-1974, 1977-1978, 1980-1981, and 1987.[20] Starting in 1976, Armenian AP specialists began using serological methods for plague diagnostics in the natural foci. From 1992 to 2002, localized plague epizootics were recorded in the Zangezur-Karabakh region and during 1995-1996 and 2001-2002 in the Gyumri region. The CPEDI established that the *Y. pestis* strains that circulate in the natural plague foci in Armenia are characterized by selective virulence when tested on laboratory animals (for instance, cultures are virulent for white mice, but less virulent for guinea pigs). It must be also noted that the *Y. pestis* strains isolated from the Persian jirds (*Meriones persicus*) in the Trans-Arax focus are characterized by higher virulence than those that are isolated from voles in the Transcaucasus Mountainous focus.[21] The CPEDI regularly notifies the AP Center of the Russian MOH about any discovered epizootics of plague and quantities of isolated *Y. pestis* and *V. cholerae* strains. In exchange it receives information on the epidemiological situation in the rest of the Commonwealth of Independent States (CIS).

*Monitoring of Other Especially Dangerous Infectious Diseases*

**Tularemia:** Armenian AP specialists first reported a tularemia epizootic in the fall of 1949 when they isolated the *Francisella tularensis* strains from a wood mouse, a black rat, and ticks. However, the main host is the common vole, and sometimes the water vole, while the main vectors are ixod and gamasid ticks. In the 1950s, tularemia outbreaks of varying intensity were reported along the 230 km-long border with Turkey both among people and rodents. In 1954, a tularemia outbreak was recorded among workers of the meat packing plant in Gyumri. Reportedly, 165 workers were infected by contaminated mutton meat that had been imported from Turkey. Tularemia occurs naturally throughout nearly the entire territory of Armenia.[22]

**Anthrax:** Anthrax is endemic throughout Armenia. During 1990-2002, with the exception of 1994, 1996, and 1997, sporadic cases of anthrax were recorded. In 1999 and 2001 the Armavir and Artik districts suffered outbreaks of the disease. CPEDI's records indicate that anthrax is contracted in Armenia on a seasonal basis—from June to October—which corresponds to the period when cattle are sent to the fields for annual grazing. In fact, more than 80 percent of recorded anthrax cases occur during this period. Anthrax is a profession-specific disease in Armenia as it is prevalent among cattle breeders (usually age 30 and over). Anthrax epizootics among cattle occur annually.

**Cholera:** One of the main measures of epidemiological monitoring for cholera is the bacteriological control over open-water sources, as well as timely identification of patients exhibiting symptoms of acute intestinal diseases. For decades Armenian AP personnel have been collecting water samples from special control points located along main waterways, including the Arax River, Lake Sevan, irrigation canals, ponds, and public pools. The *V. cholerae* El Tor strain was first isolated in Armenia in 1971 from the Arax River. In 1988, a cholera outbreak occurred in the village of Zartonk, Amavir district, in the southwestern part of Armenia. About 200 patients were affected; of them, 42 were carriers of *V. cholerae*.[23] The diagnosis was confirmed by the laboratory of the Armenian AP station in Yerevan. After the outbreak's etiology was established by the Armenian AP station, subsequent examinations of patients took place at the bacteriological laboratories of SES stations and infectious disease hospitals under the direct supervision of AP specialists.[24] The prompt anti-epidemiological measures carried out by the AP specialists contained the outbreak. However, during 1999-2002, the CPEDI and its branches continued to isolate *V. cholerae* strains from open-water sources.

**Leptospirosis and Erysipeloid**: Gyumri field AP station workers discovered the first natural occurrence of erysipeloid in Armenia in 1957 in the Gukasyan district. At various times since, people infected with this disease were identified among the workers of the Gyumri meatpacking plant and the population of the Gyumri district in general.

Natural leptospirosis foci have been found among rodent populations in 29 districts of Armenia. Nine species of rodents are considered carriers of its causative pathogen, *Leptospira* species, in Armenia. The highest percentage of infections is observed among the grey rat, Asia Minor ground squirrels, and common voles. Among people, leptospirosis was first recorded in the Aykadzor village in 1948. Subsequent sporadic and group outbreaks were recorded in Armavir district in 1963, 1971, and 1974 in the Shamshadin district. During 1986-2002, 95 persons were diagnosed with leptospirosis in Armenia.

*Decline in Epizootic Surveillance and Epidemiological Monitoring of Natural Plague Foci*

After Armenia's independence, the financial situation of the AP system deteriorated dramatically. Fund allocations from the state budget were reduced substantially and as a result, epizootiologic monitoring and other sanitary and prophylactic activities were reduced by 60 to 90 percent. As of March 2004, the CPEDI and its subordinate field AP stations could monitor only about 30 to 40 percent of the territory endemic for plague.[25] Compared to the Soviet period, epidemiological monitoring is carried out on a much smaller scale and for shorter periods of time, which does not allow the CPEDI to discern the complete picture of the epizootiologic and epidemiological situation in Armenia. As depicted in Map 1, both Gyumri and Kapan field AP stations have their own seasonal laboratories in Stepanavan and Sisian, while CPEDI uses the rest of the seasonal laboratories for its epidemiological monitoring. The CPEDI and its subordinate field AP stations dispatched epidemiological and zoological teams for a total of only 50 days during June – September 2004. During this period, the zoological teams deliver collected field material (rodents) to the seasonal laboratories on a daily basis. Due to the shortage of funds and vaccines, the CPEDI can no longer vaccinate residents of areas frequently affected by epizootics of plague and tularemia, which could create significant epidemiological complications in case of outbreak.

In addition some areas, such as the Nagorny-Karabakh enclave, are virtually unmonitored. Prior to the war between Azerbaijan and Armenia over the Armenian-populated enclave of Nagorny-Karabakh, the Azerbaijani AP system controlled the field AP station in the settlement of Gadrut located in the enclave. After the end of the war in 1994, CPEDI formally assumed epidemiological control of the unrecognized Nagorny-Karabakh Republic, where plague is endemic to the entire territory. However, in practice, neither the Armenian nor the Azerbaijani AP systems have performed any epidemiological monitoring in the Nagorny-Karabakh enclave since 1993. The CPEDI receives no information on the epizootic or epidemiological situation from the Nagorny-Karabakh Republic, while the Gadrut field AP station seems to have been lost in a no-man's land, being part of neither the Armenian nor the Azerbaijani AP systems. As of October 2005, the Gadrut field AP station was still open, although its operation remains doubtful: it was not staffed with qualified specialists and the chief doctor of the local SES station served as its director.[26]

The lack of funding and appropriate personnel also affects the monitoring of other dangerous diseases. For instance, in Soviet times, beginning in 1965, the population in areas affected by tularemia was vaccinated en masse with live tularemia vaccine every five years.[27] However, the cutoff of state funding following the Soviet Union's dissolution ended this practice and as a result the residents of those regions have not been vaccinated against tularemia for more than 15 years. Similarly, cattle breeders in regions endemic for anthrax are no longer vaccinated against the disease due to the lack of funds. The absence of special burial sites in villages for animals that died from anthrax complicates the epidemiological situation further. All of this, according to CPEDI's specialists, makes Armenia's current epizootic and epidemiological situation dangerously unpredictable.

The deterioration of the overall epidemiological situation in the country is further evidenced by the fact that other zoonotic infections, which previously had not been recorded in Armenia, have been reported as of late. According to the medical statistics released by the Armenian MOH in January-October 2006, there were five cases of leptospirosis, one case of intestinal typhoid, two cases of paratyphoid fever, and twelve cases of tularemia. Also in the aforementioned period there was a growth in the number of acute infectious diseases such as brucellosis, syphilis, and sarcoptic mange. The cases of acute intestinal disease increased by 660 in 2006 compared to 2005. The number of patients with intestinal problems was 4,698, including 876 with bacterial dysentery.[28] In 2004, according to the information submitted by Armenia to the Coordinating Council on Problems of Sanitary Defense of Territories of the CIS Member-States of the Council on Cooperation in the Field of Public Health of the CIS Member-States, in the third and fourth quarters there were 107 cases of brucellosis, 23 cases of malaria, 402 cases of tuberculosis (TB), and 8 cases of meningococcal infection.[29] In addition, the Russian AP Center received information that in 2004 plague epizootics were recorded in the natural plague foci located in Gyumri (Ani and Ashtarak districts) and the Zangezur-Karabakh region (Kapan and Sishan districts).[30]

**Map 1: Locations of Armenian Anti-plague Facilities**

## 4. International Activities Involving the Armenian Anti-plague System

When CNS staff visited Armenia in 2004, no significant international activities involving AP facilities were underway and none was in the planning stage.

## 5. Analysis of the Armenian Anti-plague System's Weaknesses and Proliferation Potential

Before the Soviet Union's dissolution, the Armenian AP system performed another important function in the public health area; it offered training sessions on pathogen identification to workers employed by hospitals, clinics, SES, and other public health institutions. As of March 2004, the CPEDI was no longer able to offer such courses due to the absence of diagnostic materials such as reagents for immunofluorescence assays and enzyme-linked immunosorbent assays (ELISA). The CPEDI staff was able to perform pathogen identifications only by the classical methods of gram staining, culturing, and antibody titre analysis, which are not suitable for instructional purposes at this level as they are basic microbiology and are time-consuming.

Armenian MOH officials appear to pay very little attention to the problems accumulated in the AP system, possibly because they do not understand the importance of the AP system.[31] This leads to a combination of factors that cause a steady decline of cadres at the CPEDI. First among these factors is the low level of salaries offered by the CPEDI. According to the CPEDI director, the Armenian AP system experiences acute shortages of specialists because it cannot offer competitive salaries. As of March 2004, the average monthly salary of an experienced AP specialist was the equivalent of $90; the starting salary of a physician with no experience was $60; while the average salary for auxiliary personnel was estimated to be $40.[32] As a result, the majority of CPEDI specialists are forced to seek supplemental income by working at local hospitals or teaching at medical schools in order to support their families.

Many of the CPEDI's personnel have not received proper professional training since the breakup of the USSR. Prior to 1992, staff physicians, zoologists, and laboratory technicians had to attend specialization training in especially dangerous infectious diseases at Soviet AP institutes in Stavropol, Saratov, Rostov, Irkutsk, or Almaty. As of 2003, about 80 percent of Armenia's AP physicians had not received proper specialized training, while those who had received such training in Soviet times, had not had the opportunity to refresh their skills since the Armenian National Institute of Health does not offer courses on especially dangerous infectious diseases.[33] The fact that qualified old cadres are retiring also contributes to the overall decrease in professionalism in the Armenian AP system. Already there are no employees with higher scientific degrees at the CPEDI.

Armenian AP specialists work under very difficult conditions. All laboratory equipment at the CPEDI and its branches was manufactured in the 1960s or 1970s and is therefore obsolete and in dire need of replacement or upgrading. The antiquated equipment increases the risk of laboratory accidents involving pathogens of dangerous infectious diseases occurring, which poses a major health hazard to not only employees of the AP system but also to the population living near the laboratory facilities, especially in the event of an accidental release of pathogens. The likelihood of the aforementioned accident occurring is increased at the CPEDI since there is no ventilation system in the laboratory building. Furthermore, the CPEDI and its branches are not heated in winter when temperatures sometimes drop to below minus 20 degrees Centigrade. In 2004, AP facilities had no hot water in the AP facilities and they experienced frequent power outages. In addition, some of the AP facilities, (including the seasonal AP laboratories in Stepanavan, Sisian, and the field AP station in Martuni) have been occupied by Armenian refugees from Nagorny-Karabakh. In March 2004, there were still refugees in these facilities. At the Kapan field AP station the situation was different. The Armenian police department and the local branch of the Ministry of National Security occupied most of the building, forcing AP personnel to work on the top or fourth floor.[34] While on the one hand, the presence of law enforcement authorities in AP buildings may prevent potential security breaches, on the other hand, working with dangerous pathogens requires strict adherence to biosafety rules, which implies that the premises should not be shared with other organizations.

In our view, the implementation of the following recommendations would significantly improve the effectiveness of disease surveillance by the Armenian AP system and considerably reduce the proliferation threat:

- Improve the physical protection of CPEDI's pathogen collection (the range of measures can vary from the most expensive, such as setting up a CCTV surveillance system, to the least costly, such as installing iron doors and combination locks);
- Institute a background check procedure for newly hired employees at the CPEDI and throughout the Armenian AP system;
- Computerize the CPEDI and field AP stations and link them into an integrated information exchange system;
- Sponsor biosafety/biosecurity training of select CPEDI personnel at Russian and/or Kazakh AP institutes;
- Install modern laboratory equipment at the CPEDI and field AP stations in phases to gradually replace old equipment; and
- Establish a nucleic acid-based laboratory for the diagnosis of plague, tularemia, cholera, and other especially dangerous infectious diseases.

Even partial implementation of the aforementioned recommendations would lead to an increased level of biosecurity. Further, it is likely that the focusing of international attention on the CPEDI and its affiliated branches would prompt the Armenian government to give a higher priority to this indispensable public health service.

## Chapter II: The Anti-plague System of Azerbaijan

### 1. History of Azerbaijan's Anti-plague System

In 1932, a plague outbreak occurred in central Azerbaijan that lasted approximately 43 days and claimed the lives of 35 residents in Gadrut city and the surrounding villages of Bulutan (Buruktan), Melik Zhanly, Shagakh, and Agulu, all located in a region that is currently on the territory of the secessionist Armenian-populated Nagorny-Karabakh enclave. The outbreak prompted Soviet authorities to establish a permanent AP system in the Azerbaijan SSR.[35] After the Gadrut plague outbreak was mitigated, the Council of People's Commissars (*Sovet Narodnykh Komissarov*) of Azerbaijan issued a resolution creating a specialized AP system in the republic, headquartered at the Republic Institute of Microbiology in Baku, the capital of Azerbaijan. During 1931-1935, seven AP observation outposts were established in districts bordering Iran, including in the cities of Astara, Lenkoran (Lenkaran), Bilasuvar, Karadonly, Gadrut, Khudafirin, and Julfa (Culfa). The establishment of these outposts was motivated by the perception that plague had entered Azerbaijan from Iran. In 1934, the Council of People's Commissars decided to transform the AP department of the Republic Institute of Microbiology into an independent institution named the Central AP Station of Azerbaijan and to relocate it to the Zykh village on the outskirts of Baku.[36] In 1963, the Central AP Station was relocated to a newly built compound in Baku. Throughout the Soviet period, the Azerbaijani AP system reported to the Main Directorate of Quarantine Diseases of the Soviet MOH, while its scientific curator was the Stavropol Scientific-Research AP Institute of the Caucasus and Transcaucasus (now the Stavropol Scientific-Research AP Institute).[37] In 1956, due to the increase in its monitoring and research activities, the Central AP Station of Azerbaijan was granted the status of institute. Even though the official title of the organization did not change throughout the Soviet period, twenty AP specialists earned their degrees in medical science at the Central AP Station of Azerbaijan. During 1956-1957, Azerbaijan's AP system expanded as new field AP stations were opened in Khachmaz (Xacmaz) (northeast), Mingechaur (Mingacevir) (central northwest), and Shamkir (Samkir) (west) in order to extend the epidemiological monitoring of territories endemic for plague and other dangerous infectious diseases. Subsequently, one more field AP station was built in Imishly (Imisli) (south central). Later, the AP observation outposts in Lenkoran (a major port city on the Caspian Sea coastline in the southern part of the country), Julfa (located in the Nakhichevan Autonomous Republic, an Azeri-populated landlocked exclave separated from Azerbaijan by the swath of Armenian territory), and Gadrut were enlarged to field AP stations.[38]

The Azerbaijani AP system also included a Railway AP Station (RAPS), which was established in 1951 in response to a plague outbreak that had occurred in 1949 on land controlled by the Azerbaijani railway system. Throughout the Soviet era the RAPS operated independently from the rest of the Azerbaijani AP system and reported to the Soviet Ministry of Communications, while its scientific curator was the Irkutsk Scientific-Research AP Institute. The main function of RAPS was to monitor land areas within 20 km of railroad tracks. In Azerbaijan, the length of railroad tracks was over 2,000 km (including 1,700 km that pass through areas endemic for plague). In its heyday, the RAPS had fifty-six employees, including eleven physicians. The RAPS would send two epidemiological teams to monitor epizootics in the two natural plague foci along the railway tracks for the duration of six to seven months.[39]

## 2. Organizational Structure of Azerbaijan's Anti-plague System

After the Soviet Union's dissolution, the Azerbaijani AP system was reorganized and as of 2004, it was comprised of nine facilities. These include the S. Imamaliyev Republic AP Station (formerly Central AP Station of Azerbaijan); six field AP stations in Imishly, Julfa, Khachmaz, Lenkoran, Mingechaur, and Shamkir; and two seasonal AP laboratories in Tyrkyany (Apsheron Peninsula) and Jeiran (Agstafa district, close to the border with Georgia). Figure 3 presents the current organizational structure of the Azerbaijani AP system.

Due to the hostilities between Azerbaijan and Armenia, which broke out over the predominantly Armenian enclave of Nagorny-Karabakh in late 1991, the Azerbaijani government lost control over the enclave, which included the Gadrut field AP station, to the separatist forces of the self-proclaimed Nagorny-Karabakh Republic (NKR). Currently, neither the Azerbaijani nor the Armenian governments have de facto jurisdiction over the Gadrut field AP station.[40]

In 1993, the RAPS came under the authority of the Ministry of Communications of Azerbaijan. As of March 2004, RAPS employed thirty-seven people, including six physicians. However, RAPS can be considered defunct as an AP organization since it survived only by fulfilling commercial laboratory analyses orders for AIDS and cholera.[41]

Over the years, the Republic AP Station was accorded an increasingly important role in Azerbaijan's health care system as it absorbed structural elements of other organizations along with their personnel. In 1992, the Republic AP Station assumed epidemiological control responsibilities of the Republic SES with regard to all quarantine and especially dangerous infectious diseases other than plague, including tularemia, anthrax, brucellosis, and rabies. In addition, the Azerbaijani AP system was charged with administering epidemiological measures to prevent importation of hemorrhagic and yellow fevers. In 1998, the Republic AP Station incorporated the laboratory components of the SES system specializing in general bacteriology, immunology, and study of viruses. As of 2004, the organizational structure of the Republic AP Station consisted of three main units: the Laboratory Department, the Epidemiological Department, and the Zooparasitological Department.

Laboratory Department:

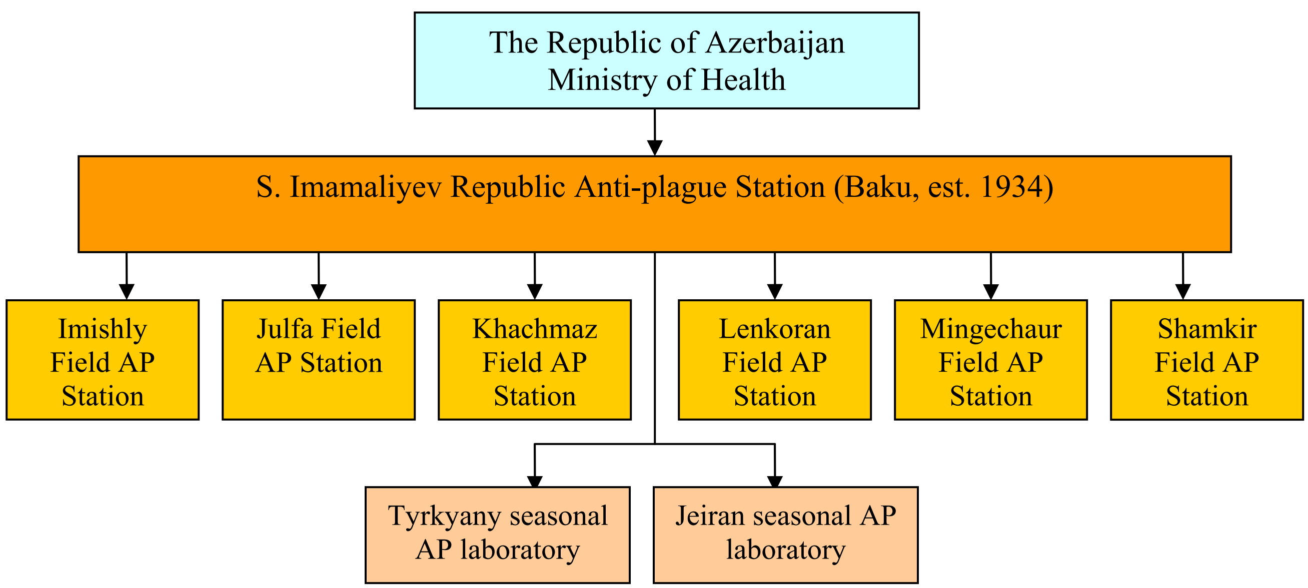
- Laboratory of Plague and Tularemia Diagnostics
- Cholera Laboratory
- Laboratory of Zoonotic Infectious Diseases (including anthrax and brucellosis)
- Laboratory of General Bacteriology
- Laboratory of Microbiological Anthropology
- Laboratory of Immunology
- Laboratory of Viruses
- Experimental Laboratory

Zooparasitological Department:

- Division of the Fight Against Hosts and Vectors of Plague and Tularemia
- Vivarium

As of March 2004, the Azerbaijani AP system had 357 employees, including 123 physicians, 116 laboratory technicians and disinfectors, and 118 auxiliary personnel. With regard to personnel turnover, there have been no noticeable decreases since 1992. It is worth noting, however, that due to practices that are common in former Soviet states, assessing the total number of employees is not an easy task. Indeed, facility managers customarily inflate the number of staff members in order to provide existing staff with sufficient funding. More precisely, the same employee might be occupying several positions simultaneously to receive additional monthly income. The average monthly salary of an AP specialist was the equivalent of $50-60 in March 2004, while the starting salary for a physician with no experience was about $36, laboratory technicians earned $20, and junior medical personnel earned $15.[42] The low salary levels explain why the Azerbaijani AP system has been experiencing difficulties in attracting young physicians. In 2004, for instance, the Republic AP Station requested that the MOH of Azerbaijan provide it with fourteen physicians—two for the Republic AP Station and the rest for the field AP stations. It is not clear if this request was ever satisfied. The administration of the Republic AP Station admits that the difficult working conditions at the field AP stations make it impossible to attract qualified physicians to work there. As a result, most of the field AP stations are severely understaffed with regard to physicians.

**Figure 3. Organizational Structure of Azerbaijan's Anti-plague System**



## 3. Public Health Activities of Azerbaijan's Anti-plague System

*Epidemiological Monitoring of Natural Foci of Plague and Other Diseases*

Azerbaijani AP specialists estimate that plague is endemic to 30,000 sq. km (or approximately 35 percent) of Azerbaijan's 86,500 sq. km territory. The Azerbaijani AP system discovered the first natural plague focus in Azerbaijan in 1953. There are now three known natural plague foci in Azerbaijan—the Transcaucasian Foothill-Plain, the Transcaucasian Mountainous, and Nakhichevan foci. The largest and the most epidemiologically active is the Foothill-Plain focus, extending from the Apsheron Peninsula to the border with Georgia. The Transcaucasian Mountainous focus covers the mountainous central parts of Azerbaijan, which are currently occupied by NKR separatists. The Nakhichevan focus is located on the territory of the Azeri-populated Nakhichevan Autonomous Republic along the Aras River, which marks the border with Iran. The main natural host for *Y. pestis* in the plains of Azerbaijan is the red-tailed gerbil.[43] Scientists have found that the *Y. pestis* strains isolated in the Transcaucasian Foothill-Plain focus are more virulent than those that are isolated in the Transcaucasian Mountainous focus.

The last plague epizootic was recorded in the Transcaucasian Foothill-Plain focus in 1985-1987. Since then, the epizootic situation has remained by and large stable. However, since 2001, there has been a noticeable increase in the rodent population on the territory of the focus (in certain areas up to 100-150 rodents per hectare), which might lead to a quick spread of plague infection, if an epizootic outbreak does occur.[44] In Soviet times, the Central AP Station used to dispatch four epidemiological teams annually to study natural plague foci. Two were sent to the Foothill-Plain focus in spring and fall, one to the Transcaucasian Mountainous focus, and one either to the natural plague foci adjacent to the field AP station in Lenkoran or Khachmaz.

After the breakup of the Soviet Union, the Azerbaijani AP system significantly reduced epidemiological monitoring of the natural plague foci due to the lack of government funding. According to the management of the Republic AP Station, as of March 2004, the Azerbaijani AP system managed to carry out epizootic surveillance of only between 20 and 30 percent of the territory endemic for plague.[45] The last time the Republic AP Station dispatched a fully equipped epidemiological team to study natural plague foci was in 1997. As of 2004, the Republic AP Station dispatched only zoological teams.[46] These teams collect rodents in the field and bring them back for examination by AP specialists, either at the Republic AP Station in Baku or the field AP stations. In the meantime, the seasonal AP laboratories have fallen into disrepair and can no longer be used.

The Central AP Station of Azerbaijan became responsible for the prophylactic measures against cholera after an epidemic struck the Autonomous Republic of Karakalpakstan in Uzbekistan in 1965. Thus, since 1970 this task has become integral to the overall mission of the Azerbaijani AP service. In May 2004, the Azerbaijani AP system was planning to conduct a comprehensive bacteriological study of sewage waters across the country to detect the presence of *V. cholerae* bacteria. For this purpose, the collection of water samples from 600 control points was planned during May-November.[47] Whenever the regional and district SES stations recover *V. cholerae*, they forward them to the Republic AP Station for confirmation and strain identification.

*Commercial Contracts*

In 2003, limited epizootiological monitoring was made possible by a contract signed between British Petroleum (BP) and the Azerbaijani AP system. BP is a major stakeholder in the Baku-Tbilisi-Ceyhan (BTC) pipeline, which crosses Azerbaijan from east to west. BP sponsored an epizootic study of the natural plague foci located along the BTC oil export pipeline. The length of the Azerbaijani sector of the BTC pipeline is 442 km and its route lies across the Transcaucasian Foothill-Plain natural plague focus. In addition, there are also areas that are endemic for anthrax located along the route of the BTC pipeline. Under the BP-sponsored epizootiological study of natural plague foci, the Republic AP Station and its subordinated field AP stations carried out epizootic monitoring of 12,000 sq. km of territory for fifty days. Under the terms of the agreement with BP, the Azerbaijani AP system received a new UAZ all-terrain vehicle and enough funding to pay each of the six-member epidemiological team $10 per diem, which was in addition to their regular salaries. In the course of the field work, the Azerbaijani AP specialists examined more than 1,495 rodents and 8,376 fleas, but did not recover any *Y. pestis* microbes.[48] It is noteworthy that at BP's request , the 2003 epizootiological monitoring was documented in a film showing every stage of the epizootic study—from collection of natural plague hosts in the field to their laboratory examination at the AP facilities. In 2005, the Republic AP Station signed an agreement with BP, providing for regular epizootiological monitoring of natural plague foci located along the BTC pipeline.[49]

The Republic AP Station was able to slightly improve its financial standing through other commercial activities. For instance, the Laboratory of Zoonotic Infectious Diseases and Laboratory of General Bacteriology earns steady revenue by fulfilling commercial orders to perform standard sanitary-epidemiological analyses on food samples to detect bacteria commonly found in food products, such as *Brucella* species, *Salmonella* species, and *Escherichia coli*. For carrying out various orders for the Republic SES, the Republic AP Station receives diagnostic reagents, which are essential for any laboratory activities and a benefit to all structural components of the Azerbaijani AP system.

*Vaccination and Outreach*

The Azerbaijani AP system carries out limited vaccination of certain groups of people who are at an increased risk of contracting dangerous infectious diseases due to their professional occupations or place of residence. The Republic AP Station is also actively engaged in educational outreach activities. It offers training on prophylaxis of especially dangerous infectious diseases to border guards, customs officials, and representatives of different airlines and commercial maritime transportation agencies.[50] The Medical Institute of Azerbaijan periodically offers courses on especially dangerous infectious diseases, which are taught at the Republic AP Station. Such courses have been offered on three occasions since 1991.

## 4. International Activities That Involve the Azerbaijani Anti-plague System

The Republic AP Station is sporadically engaged in cooperation with international health organizations. As of March 2004, for instance, the Laboratory of Immunology was working under a United Nation's program aimed at assessing population's immunity against various commonly spread infectious diseases. It bears noting that the Laboratory of Immunology has acquired the status of national reference laboratory. Some limited equipment upgrades at the Republic AP Station were the result of assistance programs from the World Health Organization (WHO). In 2003 the World Bank sponsored a seminar on especially dangerous infectious diseases, organized by the Republic AP Station.[51]

In June 2005, the Azerbaijan Cabinet of Ministers and the U.S. Department of Defense signed the framework biological threat reduction agreement under the CTR Program, which will support projects to affect significant improvements of physical security at Azerbaijan's central pathogen collection and the enhancement of biosecurity and biosafety with regard to the pathogens causing dangerous infectious diseases in general.[52] In particular, the U.S. will provide funds to implement physical security upgrades of Azerbaijan's pathogen collection and to prevent pathogen theft that could lead to bioterrorism. In exchange for the assistance, Azerbaijan agreed to provide cultures of pathogens that cause especially dangerous infectious diseases to the U.S.[53] Under the provisions of the agreement, the U.S. and Azerbaijani sides also plan to develop modern diagnostic and detection equipment for the early detection of outbreaks of dangerous diseases. In addition, the Azerbaijani scientists will receive training at U.S. laboratories.[54]

An agreement for the transfer of pathogens from Azerbaijan to the U.S. was concluded in the course of an official visit by U.S. Senators Richard Lugar and Barack Obama on August 31, 2005.[55] As a result, on September 2, 2005, 124 samples of 62 strains of *Y. pestis*, *B. anthracis*, *V. cholerae,* and other dangerous infectious disease agents were transported by U.S. military aircraft from Baku to the U.S. Armed Forces Institute of Pathology in Washington, D.C. The strains had been collected over many years from a variety of environmental, human, and animal sources in Azerbaijan. In accordance with the U.S.-Azerbaijani biological threat reduction agreement, the American and Azerbaijani researchers will jointly study the transferred strains.

### 5. Analysis of the Azerbaijani Anti-plague System's Weaknesses and Proliferation Potential

Although built in 1963, as were most of the AP facilities in Azerbaijan, the Republic AP Station has been repeatedly renovated by its employees since the appointment of the new director in 1997. The ventilation system is in order and the perimeter fence was rebuilt around the station with funds from the neighboring private clinic and spa. The Republic AP Station has central heating and it is also supplied with hot water year round.

Conditions at the field AP stations, on the other hand, are truly appalling. They experience electricity shortages on a regular basis, and none of them is equipped with back-up generators. The building of the Lenkoran field AP station, constructed in 1908, was in such bad shape that its wooden floor collapsed during the CNS staff visit to the facility in March 2004.[56] The premises of Imishly, Mingechaur and Lenkoran field AP stations are illegally occupied by Azeri refugees from Nagorny-Karabakh, who live in the isolation wards, vivariums, and other buildings.

There have been no major equipment upgrades in the Azerbaijani AP system since 1992, so most of the existing laboratory equipment is obsolete and in constant need of repair. The continued use of the antiquated laboratory equipment increases the chances of accidents involving pathogens of dangerous infectious diseases, which could create a public health hazard in the event of an accidental release into environment.

As far as we have been able to discern, there were no BW-related activities in Azerbaijan, so there is no expertise in the country of proliferation concern.

Based on the preceding discussion, the implementation of the following recommendations would significantly improve the effectiveness of disease surveillance by the Azerbaijani AP system and considerably reduce risks to biosafety:

- Improve physical protection of the pathogen collection at the Republic AP Station;
- Renovate dilapidating field AP stations and remove squatters from those field AP stations that are currently illegally occupied;
- Provide funds for biosafety/biosecurity training of select Azerbaijani AP cadres at the Almaty AP institute or other appropriate foreign institutions;
- Provide modern laboratory equipment to the Republic AP Station and field AP stations.

# Chapter III: The Public Health System of Belarus

## 1. History of Belarus' Public Health System[57]

Belarus is located in the center of Europe, has a land area of 208,000 $km^2$, and a population of about 10 million. The country is divided into six *oblasts*, which are subdivided into *rayons*. Minsk, the capital city with a population of approximately 1.7 million, is an independent administrative unit.

Unlike the other countries addressed in this report, Belarus has never possessed an AP system or housed any AP facilities. The reason is very simple; there have never been any natural plague foci within Belarusian territory. Hence, the public health system in Belarus, both during the Soviet era and in its current manifestation, is comprised of the SES, supported by the Belarus Research Institute of Epidemiology and Microbiology (NIIEM). In this section, we describe the public health system as it first began functioning during the tsarist times, was expanded during the Soviet era, and as it continues in independent Belarus.

*Tsarist Era*

A public sanitary system in Belarus stems from the 1870s when permanent sanitary commissions were established in several provinces and districts. This system grew over the next 20 years, encompassing several major cities. In addition, as explained in our earlier report,[58] the tsarist government was developing sanitary regulations and surveillance throughout the empire during this time, including Belarus.

Due to a rise in the incidence of venereal diseases in Minsk especially, the city government set up the Municipal Sanitary Committee in 1891. Other cities followed this example, and similar committees were set up in Vitsyebesk and Homyel in 1897, Hrodna in 1904, and Mahilyow in 1909. On the provincial level, the Medical Statistics Office headed by a sanitary physician was opened in Minsk in 1899 and its responsibilities included monitoring compliance with sanitary regulations and bringing enforcement actions against violators. In somewhat parallel developments, three sanitary stations began their operations during the first decade of the 20th century. Called Pasteur stations, two were established in 1910 in Orsha and Mahilyow, and the third in Minsk in 1911.

This system existed until the Bolsheviks took power in 1917. In general, this system was deemed primitive and under-financed, and its various components worked in an uncoordinated way. As such, it probably had a very small effect on the level of public health in Belarus.

*Soviet Era*

In September 1922, the SES was established in the Soviet Union. It was the result of the Russian Socialist Federation of Soviet Republic's Council of People's Commissars' decree "On Sanitary Agencies of the Republic," which defined the government's role in protecting public health in the USSR. Among the decree's provisions, it defined the duties, rights, and responsibilities of sanitary physicians, and determined the structure of the SES. Soon after, in October 1922, a sanitary-epidemiological station was set up in the BSSR—the Fifth Anniversary of the October Revolution Station. This development was promoted by Dr. K.Yu. Kononovich, then director of the Sanitary-Epidemiological Department of the Homyel *oblast* Department of

Public Health. He acted to combine sanitary and anti-epidemic work, which had previously been divided among several agencies, within one agency. This new agency worked to improve occupational and community health, fight infectious diseases, and teach and train sanitarians and other types of public health officials.[59] Kononovich's concept soon was accepted throughout the USSR and, as a result, a network of sanitary-epidemiological stations formed the backbone of the Soviet SES. Between 1922 and Germany's attack in 1941, the Belarus SES grew substantially; it came to include 147 SES stations, 57 anti-malaria stations, and 8 training institutions and employed over 200 physicians and 1,300 other medical personnel.

In great part due to the work of SES, the level of public health in the BSSR increased substantially as a result of the near elimination of diseases such as typhus, gastro-intestinal infections, childhood infections, malaria, and other common diseases of the time. Almost all of these advances were lost during the German occupation as the SES was destroyed. As a result there was a resurgence of infectious diseases in the BSSR, including typhoid, dysentery, malaria, and spotted fever (typhus). In the immediate post-war period, the Soviet health system took great effort to eradicate infectious diseases by emphasizing "sanitary protection." This included such actions as vaccine campaigns, improving water supplies and waste disposal, and rebuilding the SES.

Despite the efforts of SES, there were thousands of cases of typhus, poliomyelitis, diphtheria, and other infectious diseases in the 1950s in the BSSR. The awful public health situation stimulated the Soviet MOH to undertake a large public health program in the BSSR, which included ordering the SES to set up infectious disease offices throughout the republic that operated large vaccination campaigns. This worked well; typhus, diphtheria, and poliomyelitis were largely eliminated by 1963. Between 1963 and 1986, the level of public health continued to rise in the BSSR and the republic became one of the healthiest of the Soviet republics when measured by public health indexes such as infant mortality rates, longevity, and others.

The Chernobyl nuclear power plant disaster in April 1986 struck the BSSR especially hard. The plant's plume released radioactive material equal to that which would have resulted from the explosion of 150 atomic bombs the size of the one dropped on Hiroshima. Though the plant was located in Ukraine, the winds blew in the direction of the BSSR after the explosion. As a result, 70 percent of all radioactive fallout fell on BSSR territory, heavily contaminating one-fifth of it into a zone of radioactivity. This zone's population at that time was approximately 2.5 million people and these inhabitants were the most heavily affected. However, much of the remaining Belarusian territory was also exposed to radiation to a lesser or greater degree. Chernobyl has resulted in a drastic decrease in the level of overall health in the BSSR as the incidence of cancers, genetic mutations, leukemia, and other chronic diseases, has markedly increased. For example, the incidence of thyroid cancer in the decade that followed the Chernobyl disaster increased by over 80 times.[60]

One effect of the Chernobyl accident was to stimulate some developments at the local level. The BSSR SES was provided with the resources needed to set up a new network of radiometry laboratories and to found new research institutes including the Radiation Medicine Research Institute, Belarus Center for Medical Technologies, Department of Radiation Medicine and Ecology at the Minsk Medical Institute, and the Division of Medical Consequences of the Chernobyl Disaster within the BSSR MOH.

*Post-Soviet Era*

The Republic of Belarus' (hereafter Belarus) economy suffered immensely after the Soviet Union's dissolution since most of the heavy industries that were the base for its prosperity went bankrupt. The substantial fall in Belarus' GDP has had many negative consequences on its health system and the public health of the population. Nevertheless, almost alone among the NIS, Belarus maintains a Soviet-style centrally planned economy, including providing universal free health care to its population.

All current public health-related activities in Belarus stem from the law "On the Sanitary-Epidemiological Well-Being of the People." The Supreme Council approved the law on November 23, 1993.[61] Briefly, this law seeks to provide Belarusians with optimum conditions for healthy living, but with a clear emphasis on disease prevention. It includes guidelines that govern the operations of public health agencies, other governmental agencies, and both public and private enterprises. The law specifies penalties for individuals and businesses that violate its provisions, and contains other regulations such as hygienic standards.

As a result of a growing understanding of newly discovered enforcement issues, the need for modern sanitary-epidemiological measures, and the need to coordinate public health laws and regulations of Belarus with other CIS members, the 1993 law was considerably revised on August 10, 2000, becoming the Council of Minister's Decree No. 1236, "On Confirming the Statute of the Government Sanitary Surveillance in the Republic of Belarus." Since then, over 100 regulations have been enacted by legislature or government agencies to implement the law's provisions. Among them are provisions that make public health duties, including disease surveillance, environmental monitoring, and certain preventive programs the responsibility of SES. The SES facilities are distributed in line with *rayon* and *oblast* divisions but report directly to the Belarus MOH.[62] In addition, government agencies other than the Belarus MOH have their own SES facilities. These include power companies, the Administration of Affairs of the President of the Republic of Belarus, and Belarus Railroad; each headed by persons with the rank of Deputy Chief Sanitary Physician.

Currently, Belarus' SES has a simple vertical organizational structure. The SES is part of the Belarus MOH,[63] and is headed by a Deputy Minister of Health who also holds the title of Chief State Sanitary Physician. The Deputy Chief State Sanitary Physician heads the Republic Center for Hygiene and Epidemiology in Minsk. The republic's sanitary-epidemiological facilities located in *oblasts*, some district seats, and major cities report to the Center for Hygiene and Epidemiology. The Belarus SES works very closely with Belarus' most important biomedical research institute, the Belarus Research Institute of Epidemiology and Microbiology (Russian acronym NIIEM).

## 2. Activities of Belarus' Public Health System

The development of a new, modern SES commenced with the adoption of the law "On Sanitary-Epidemiological Well-Being of the People," mentioned above, and its revision in 2000. With a clear emphasis on disease prevention, this law sets requirements for public health agencies, government administrative agencies, and businesses to provide Belarus' residents with the optimum conditions for living and for maintaining and improving their health. The law provides penalties for damages to citizens' health due to violations of health laws, health norms and regulations, and hygienic standards.

The Belarus' SES vertical organizational structure in theory allows it to react quickly to emerging situations and undertake broad-scale sanitary and anti-epidemic measures. The SES is headed by the Chief State Sanitary Physician, who as Deputy Minister of Health directs the ministry's Sanitary-Epidemiological Administration. The Deputy Chief State Sanitary Physician heads the Republic's Center for Hygiene and Epidemiology.

The regions, major cities, and district seats have regional, municipal, and district Hygiene and Epidemiology Centers. Each district hygiene and epidemiology center has a sanitary-hygiene department, an epidemiology department, and a bacteriology laboratory that performs some virology (serology) work. The regional and municipal centers have a high-risk infection department and bacteriology, virology, and parasitological laboratories.

The country's SES comprises 154 sanitary-epidemiological agencies employing over 1,700 physicians, over 600 specialists with advanced non-medical degrees, and about 6,000 mid-level medical personnel. The sanitary service agencies under the Ministry of Internal Affairs, the Ministry of Defense, Belarus Railroad, and the Committee for State Security employ over 220 physicians and over 400 mid-level medical personnel.[64] The Belarus SES is responsible for the:

- collection of vital and health statistics;
- surveillance of infectious diseases and the forecasting and management of epidemics;
- management and delivery of immunization and vaccination programs;
- monitoring of environmental hazards and radiation levels; and
- supervision and enforcement of laws on sanitary conditions, including water supplies, food production, sewage disposal, and environmental pollution.[65]

The SES works closely with related scientific institutions, which, despite the difficult economic situation, have been able to provide most of the ever-increasing scientific support needed by the operational agencies. The two scientific institutions most involved in this work are the NIIEM (see above) and the S.M. Vyshelessky Belarus Research Institute of Experimental Veterinary Medicine (which is not discussed in this report due to our emphasis on human diseases).

The official registry of Belarus has five classes of endemic diseases: (1) the "most widespread infectious diseases" have annual morbidity rate of greater than 1,000 cases per 100,000 population and includes enterobiasis, influenza, and acute respiratory infections; (2) the "widespread infectious diseases" have annual morbidity rates of 100–1,000 cases per 100,000 population and include parotitis, trichuriasis, gonorrhea, epiclesis, scabies, rubella, ascariasis, and chicken pox; (3) the "frequent infectious diseases" have annual morbidity rates of 10–100 cases per 100,000 population and include dysentery, viral hepatitis A and B, measles, epidermophytosis, scarlet fever, TB, salmonellosis, microsporia, other acute intestinal infections other than dysentery and salmonellosis, and syphilis; (4) the "uncommon infectious diseases" have annual morbidity rates of 1–10 cases per 100,000 population and include trichinosis, intestinal yersiniosis, diphtheria, viral hepatitis C, meningococcal infection, herpes infection, yersiniosis, pertussis, rotaviral gastroenteritis, and infectious mononucleosis; and (5) the "rare infectious diseases" have annual morbidity rates of fewer than 1 case per 100,000 population and this heterogeneous group of 20 diseases includes, for example, typhoid fever, tick-borne encephalitis, Lyme disease, tetanus, and rabies.[66]

While a rare disease, anthrax continues to be a public health threat to Belarus. At one time, anthrax was widespread. For example, there were 3,424 anthrax cases recorded in 1901 and 6,107 cases during the period 1906–1913. Over 500 natural anthrax foci have been identified in the republic, but this does not reflect the actual situation as demonstrated by the fact that 98.8 percent of the animal anthrax cases occurred outside of the identified anthrax foci.[67] Human anthrax morbidity has been sporadic during the last 25 years. Cases typically occurred in newly identified areas due to the delayed diagnosis of animal infections. Most infections have occurred at random with no connection to occupational exposure. The cutaneous form of anthrax is predominant, presenting as a mild or moderately severe illness. No cases were recorded between 1982 and 1994, but in 1995, three persons were infected with cutaneous anthrax while slaughtering privately owned cattle.

Another rare but problematic disease in Belarus is leptospirosis. Soils, geography, the abundance of wet biotopes, the mammal fauna, and intensive livestock production are favorable factors for the existence of natural and man-made foci of this infection. Natural foci encompass the basins of the Western Dvina, Neman, Dnieper, and Pripyat rivers. The greatest activity is found in the Hrodna, Mahilyow, and Homyel regions, which contain about 70 percent of the animal disease foci. The main reservoirs of infection are various species of small mouse-like rodents that inhabit wet areas. Human cases of the disease have been recorded since 1947. The greatest morbidity rates were recorded in the early and mid 1960s, and ranged from 1.8 to 9.1 per 100,000 population. In the 1970s, the leptospirosis epidemic situation was considered to be quiet (no more than three cases recorded a year), which led to a lessening of epidemiological and clinical watchfulness, cutbacks in laboratory diagnosis, and the relaxation of preventive measures. However, the existence of a multitude of natural leptospirosis foci presents a constant potential danger of the disease in humans and farm animals.[68]

Tularemia is yet another threatening natural focal disease in Belarus. The typical natural tularemia foci in Belarus are located in the floodplain-swamps or near floodplain-swamp-lakes. There is a variety of natural tularemia foci due to the ecological and geographical differences between zones ranging from the southern boundary of the taiga in the north to the northern boundary of the forested steppe in the southeast. Hence in the western and parts of the northern and eastern zones of the republic, the foci are small and relatively inactive. In the south and southeast (the Belarus Polesye Lowland), the foci occupy broad areas of swampy floodplains and interfluves, and have been active over many years of observation. Tularemia is enzootic in 58 of Belarus' 118 rural districts.[69]

Tularemia morbidity in Belarus has been recorded since 1943. There have been frequent epidemic increases in morbidity to as high as 7.2 per 100,000 inhabitants (1963). These occur when various factors coincide, such as epizootics among water rats, massive flights of blood-sucking dipterans, and intensive farm work by people with no immunity. Due to a broad campaign of human immunization against tularemia (2–2.5 million people were vaccinated in the last five years, primarily in rural areas), morbidity decreased to

0.01–0.02 per 100,000 inhabitants and became sporadic. No tularemia was recorded in the republic from 1986 through 2002.[70] However, as with anthrax and leptospirosis, due to the natural tularemia foci in Belarus, a serious outbreak of tularemia could occur at any time.

Rabies is a constant threat to Belarus' population. Persistent natural rabies foci cover up to 30 percent of the land area (mainly in the north and northeast of the country) and rabies has been recorded among animals in 107 of the republic's 117 administrative districts. The morbidity rate of rabies among wild carnivores is very high, accounting for over 50 percent of recorded cases of animal rabies. Of wild animals, over 80 percent of rabies cases occur in red foxes. Recent studies indicate that the rabies epizootic situation among domestic and wild animals is not improving. In 1999, there were 125 identified risk locations for rabies and 136 cases recorded in animals, of which 73 were wild animals.[71] Despite large-scale efforts to control rabies, its morbidity rate among wild animals is not decreasing. Consequently, nearly the entire country of Belarus is at risk for contracting rabies.

In view of NIIEM's importance with respect to public health in Belarus, a detailed description of it follows. NIIEM's basis was laid when the Minsk Pasteur Station (established 1911) and the Provincial Department of Health Central Chemistry and Bacteriology Laboratory (established in 1920) were combined to form the Belarus Pasteur Institute of the BSSR People's Commissariat of Health in 1924 and housed at the Belarus State University. Its main work at that time was focused on smallpox, TB, rabies, diphtheria, and pertussis. In 1931, it was renamed the Belarus Institute of Epidemiology and Microbiology of the BSSR People's Commissariat of Health and its scope of responsibilities was widened, to include investigations of typhoid fever, dysentery, measles, tetanus, and rhinoscleroma (a chronic disease of the upper airways caused by a bacterial pathogen).

After being totally destroyed during World War II, the rebuilding of NIIEM started in 1944 and was largely completed over the next few years. With the addition of new facilities, the institute gained capabilities to study viruses, including those that cause encephalitis, influenza, poliomyelitis, and hepatitis. In addition, its facilities for developing and manufacturing diagnostic preparations, vaccines, serums, antitoxins, and gamma globulin were expanded. By the mid 1970s, the institute had become the center for epidemiology, microbiology, and hygiene research and methodology in Belarus, being a leader in developments in a number of areas. Its directions and workload remained approximately the same after Belarus became independent in August 1991.

In 2005, NIIEM had six science departments; the Department of Microbiology and Immunology, the Department of Epidemiology and Immunoprophylaxis of Infectious Diseases, the Department of Biotechnology and High-Risk Infections, the Department of Ecology and Epidemiology of Natural Focal and Uncontrollable Anthroponotic Viral Infections,[72] the Department of Clinical Virology, and Department of Scientific and Medical Information. The four main departments are discussed below.

*Department of Microbiology and Immunology*

The major research topics of this department, which was established in 1998, include the principles, propagation mechanisms, and variability of pathogenic microorganisms in the environment and the human population; mechanisms of acquiring resistance to drugs (antibiotics) and antiseptics in hospital settings; and the morphological and functional properties of immunocompetent cells. The department consists of three laboratories, as follows:

- The Laboratory of Clinical and Experimental Microbiology develops modern microbiology laboratory technologies and test systems for the diagnosis, treatment, and prevention of bacterial infections of concern. Research is conducted on pathogen biology and the pathogenesis of nosocomial and other bacterial and viral infections of particular concern to Belarus.
- The Biochemistry Laboratory conducts research on proteins and enzymes, particularly on the structural and functional properties, activity regulation mechanisms, principles of biosynthesis, and role in cell metabolic processes. Scientific approaches are being developed for designing new therapeutic and diagnostic preparations by microbial synthesis, as well as preparations for correcting metabolic disorders that accompany enzymopathies.
- The Interferon and Immunocorrection Group works on the development and clinical implementation of methods of stimulating interferon formation and methods of immunocorrection. New interferon inducers are tested on volunteers and in clinical settings.

*Department of Epidemiology and Immunoprophylaxis of Infectious Diseases*

The department's major research interests are to improve epidemiological surveillance of infectious diseases and develop and implement methods and means for diagnosing, preventing, and treating these diseases. The department now has four laboratories and two special groups:

- The Laboratory of Influenza and Influenza-Like Diseases serves as the National Center for Influenza and Acute Respiratory Diseases. Its major areas of activity are to study the epidemic process and develop anti-epidemic measures against influenza and acute respiratory diseases; prepare analytical overviews and predictions for the Republic MOH; study the effectiveness of vaccinations and chemoprophylaxis against influenza; develop recommendations; develop and improve methods of isolating, indicating, and identifying acute respiratory disease pathogens; develop and implement diagnostic preparations; and collaborate on science and methodology with the Republic Center for Hygiene and Epidemiology and with WHO centers and National Centers for Influenza and Acute Respiratory Diseases.
- The Immunoprophylaxis Laboratory is a WHO-affiliated National Reference Center for Poliomyelitis. Its responsibilities are to study the epidemiology of controllable infections, particularly poliomyelitis and diphtheria; develop and implement epidemiological surveillance programs for these diseases; study various population groups for humeral and cell immunity against controllable infection pathogens; conduct molecular epidemiological monitoring for polioviruses and corynebacteria circulating in the republic; study the mutagenic and recombinant variability of vaccine polioviruses; and prepare materials for international certification of the eradication of poliomyelitis from the republic.
- The Laboratory for Diagnosis of Combined Bacterial-Viral Infections and for Biological Monitoring studies the epidemiology and pathogenesis of chlamydial-

viral infections; develops methods of diagnosing and treating combined bacterial-viral infections; and is responsible for the quality control of indigenously produced and imported immunobiological drugs.

- The Viral Hepatitis Laboratory's main work relates to viral hepatitis and rotavirus infections. It is Belarus' lead institute for carrying out two republic-wide programs; to develop measures for lowering viral hepatitis morbidity and a program against intestinal infections. To do this, it develops and improves methods of isolating, indicating, and identifying the pathogens of viral hepatitis and viral diarrhea; monitors the presence of these pathogens in the environment; and develops, manufactures, and implements diagnostic, therapeutic, and preventive preparations for this group of infections.
- The Epidemic Analysis and Epidemic Process Prediction Group carries out systems evaluation of sanitary, hygienic, epidemiological, clinical, environmental, and other parameters affecting the state of public health.
- The Epidemiological Surveillance Group for Parasitic Diseases carries out epidemiological surveillance for parasitic diseases and develops effective methods for exterminating parasitic worms in the environment, taking into account spontaneous soil-cleaning processes, the influence of climatic conditions, and industrial pollution.
- The Department of Biotechnology and High-Risk Infections conducts research pertaining to immunobiological and molecular biological diagnostic preparations for high-risk viral pathogens; clarifies the molecular mechanisms of pathogenicity of high-risk infections; performs molecular-epidemiological analysis of extraordinary infections; and develops drugs against certain infectious viral diseases.
- The Laboratory of Biotechnology and Immunodiagnostics of High-Risk Infections studies the antigen spectrum of viral, bacterial, and other infection pathogens and the mechanisms for the circulation of genetic structures in natural focal viral infection pathogens. It also is responsible for developing tests to diagnose high-risk viral infections (such as Lassa, Marburg, and Ebola hemorrhagic fevers), as well as lymphocytic choriomeningitis, tick-borne encephalitis, HIV, measles, diphtheria, hemorrhagic fever with renal syndrome, and hepatitis C.
- The Laboratory of Genetic Engineering Research Methods conducts molecular-biological analysis (genotyping) of poliomyelitis viruses circulating in the republic. Research is also being conducted to develop recombinant plasmids with inserted DNA copies of the genomes of high-risk pathogenic viruses.
- The Chemotherapy Laboratory uses viral infection models to investigate new and existing drugs, including official ones, in order to identify synthetic substances with antiviral properties. The mechanisms of development of drug-resistance in viruses are studied, as well as ways of overcoming such resistances. Researchers also study the etiology and clinical aspects of Lyme disease in Belarus.
- The Science-Production Laboratory studies leptospirosis and its role in infection pathology, develops methods and preparations for diagnosing this infection in Belarus, and carries out experimental production of test systems developed in this country.

*Department of Ecology and Epidemiology of Natural Focal and Uncontrollable Anthroponotic Viral Infections*

This department's major areas of activity are to develop and introduce modern methods of monitoring natural focal and uncontrollable anthroponotic viral infections; to study the mechanisms and principles of the vector, water, and food routes of transmission of natural focal and enteroviral infections in humans; to perform exploratory methodological, functional, and organizational development work related to testing and obtaining new viral inhibitors, including substances and preparations that prevent viral replication in the cells and body of hosts, or that neutralize the infectiveness of viruses in the environment; and to develop anti-epidemic and therapeutic measures for preventing outbreaks and epidemics of disease in Belarus. The department has four laboratories:

- The Sanitary Virology Laboratory conducts research on the biological properties of human pathogenic viruses circulating in the environment. New methods of detecting viruses in water and food products are developed. Molecular-epidemiological methods are used to study the geno- and serotypes of enteroviruses circulating in Belarus. Criteria are developed for virological assessment of drinking water quality to ensure human health safety. Experiments are conducted to investigate the influence of radiation factors on the biological properties of viruses in order to predict the course of epidemic situations in radiation-contaminated areas. One area of applied research is the development and experimental production of test systems for diagnosing human enterovirus infections and detecting these pathogens in water.
- The Laboratory of Ecology and Epidemiology of Arbovirus Infections performs research to identify, study, and map natural arbovirus disease foci. The biological and serological properties of isolated viruses are studied and the role of these viruses in human pathology is determined. Researchers study the ecology of natural focal infection pathogens that are "new" to Belarus. Diagnostic preparations are developed for rapid indication and identification of isolated arbovirus strains.
- The Laboratory for Prevention and Treatment of Group II Viral Infections develops scientific approaches, methods, and means for emergency prevention and treatment of such group II viral infections as the viral encephalitides (rabies, tick-borne, and West Nile) and hepatitis C. Current applied research relates to the development of practical active chemotherapeutic antiviral preparations that will afford a high index of protection for suppressing pathogenic agents during the early stages of infection (the incubation period).
- The Laboratory for Preclinical Study of Inhibitor Specific Activity studies the antiviral properties of new synthetic and natural substances and drugs and is building a databank of research findings. The laboratory investigates the action of antiviral preparations and develops ways of overcoming the resistance of viral infection pathogens to them. It also conducts epidemiological monitoring for resistance of viral infection pathogens to disinfectants used in Belarus.

*Department of Clinical Virology*

The department's major areas of research are: laboratory diagnosis and investigation of the pathogenesis, clinical signs, and course of the viral infections that are most common and of greatest significance to public health; developing modern methods and means of etiological and differential diagnosis, therapy, and prevention of persistent viral and bacterial infections (HIV infection and AIDS; various forms of herpes and cytomegalovirus infections; Epstein-Barr virus, varicella-zoster virus, adenovirus, hepatitis B and C, chlamydia, and other infections), including congenital infections and infections in newborns; and monitoring the incidence of HIV infection in Belarus using methods of molecular epidemiology and molecular virology. The department has three laboratories.

- The Laboratory for Diagnosis of HIV and Accompanying Infections diagnoses the most common viral and bacterial infections using modern virological, serological, and molecular-biological methods; monitors the incidence of HIV infection in Belarus; conducts sero-, geno-, and phenotyping studies of HIV; and studies the pathogenesis of HIV and herpes viruses.
- The Clinical Division of Neuroinfections studies aspects of the clinical and laboratory diagnosis of infectious diseases affecting the nervous systems of children and adults, develops criteria for diagnosing these diseases, studies pathogenic mechanisms, and compares the effectiveness of therapeutic methods. Division staff members regularly work with colleagues at virology and immunology laboratories on problems of tick-borne, herpes, and prion infections. The division also is a collaborator in the WHO program to eradicate poliomyelitis. The division serves as the Republic's Center for Chronic Viral Infections, which provides consultants on practical health care.
- The HIV Laboratory conducts research to find HIV-inhibiting compounds, develops test systems for diagnosing HIV, and sets up experimental production of test systems developed in the country. The laboratory assists health-care agencies in the republic and provides therapy for people infected with HIV.

The construction of a group I level pathogen facility in Smolevichi, which was begun before the dissolution of the USSR, has been on hold since 1992 due to a lack of funding.

In 2004, the NIIEM employed approximately 240 persons. Of these, 95 were scientists, including 5 professors, 14 doctors of science, and 38 candidates of science. Further, its scientists included 2 academicians, 1 corresponding member of the Belarus National Academy of Sciences, and 7 members of the New York Academy of Sciences.

In general, scientists in Belarus are significantly underpaid compared to other professions. At NIIEM, a senior scientist earns the equivalent of about $100 per month. Scientists may supplement their salaries through income from the sale of items such as biological preparations, but this possibility is afforded to only a small number of scientific workers. By far the main provider of funding to the NIIEM is the Belarus MOH.

During 2004-2005, the institute moved from its old location in central Minsk to a suburb. CNS staff was unable to visit the new facility so thus are not in a position to describe it. We have received information to the effect that although the institute will have completely new laboratories, the building was not designed for use as a biological research institute and therefore must undergo substantial alterations. Further, the institute's vivarium is not in good shape because it does not have sufficient funding to adequately house the number of animals it contains. Reportedly the institute is setting up a National Culture Collection of Viruses and Other Microorganisms, but it is unclear how this project has progressed.

### 3. International Activities That Involve the Belarus Public Health System

The NIIEM receives some funding to support its research from foreign sources. Thus, some of its scientists have been able to have projects funded by the International Science and Technology Center (ISTC), Inco Copernicus (an EU assistance program), the Pasteur Institute in France, certain German institutes, the Chernobyl investigation on effects of radiation on immunological systems, and the WHO programs on influenza and poliomyelitis. However, in general Belarus is not in a good position to ask for, or receive, international assistance due to the repressive policies of its President, Mr. A. Lukashenko.

It is worth noting that in 2005 the Belarus Minister of Health, Dr. L.A. Postoyalko, signed a collaborative agreement with the WHO Regional Office for Europe that includes provisions for "Achieving measles and rubella elimination through strengthened immunization services with high quality and safe immunization delivery systems" and "Strengthening surveillance for effective monitoring of immunization systems and assessment of disease burden related to vaccine preventable diseases."[73] As of this writing, the budget for the agreement had not been specified, nor whether the WHO will fund it.

### 4. Analysis of the Belarus Public Health System's Weaknesses and Proliferation Potential

During the Soviet era there was an excellent system for training highly skilled personnel. Specialists in high-risk infection departments of sanitary-epidemiological stations took a 3–6 month specialization course at Soviet AP institutes in Stavropol and Rostov-on-Don, with refresher courses every 3–5 years thereafter. Bacteriologists, virologists, parasitologists, and other specialists at SES stations took specialization training and continuing education in the corresponding departments of various continuing education institutes for physicians. Scientists at NIIEM were trained mainly in specific graduate programs at the D.I. Ivanovsky Institute of Virology in Moscow.

After the Soviet Union's dissolution, high-risk infection specialists for the centers for hygiene and epidemiology have been trained mainly at workplaces in the Republic Center for Hygiene and Epidemiology and in departments of the Belarus Medical Academy of Postgraduate Education. As a result, the quality of practical training for specialists has diminished. In recent years, NIIEM has started graduate programs in specialties such as microbiology, virology, and infectious diseases, but it is impossible at this time for an outsider to assess their quality. The institute has a special council for the defense of doctoral and candidate dissertations. NIIEM and the Republic Center for Hygiene and Epidemiology organize and conduct various seminars, conferences (including international ones), and symposiums for continuing education for specialists. In addition, many staff members receive practical training in the United States, Germany, France, and elsewhere. Of course, some highly qualified specialists do not return to Belarus after training, but instead chose to remain abroad.

The Soviet-style anti-epidemic protection system still exists in Belarus is its public health sector. The system is based on the preparation for and responding to natural disease outbreaks. It is therefore not adequately trained or equipped to respond to a bioterrorism event. The problem is not just insufficient funding and not enough highly qualified specialists, but also is one of biomedical scientists being entirely ignorant of such a threat. Obviously, the new conditions require a review of biological weapons defense within the framework of national security, which is something that is beginning to be realized in Belarus.[74]

In conclusion, as outsiders we find it very difficult to determine whether or not the public health system in Belarus, whose main component is SES, is an effective one in meeting the challenges posed by infectious diseases. In general, infectious diseases are not a large problem in Belarus, being responsible for less than 1 percent of all deaths in the country.[75] However, it is difficult to determine if this low mortality rate is due to the Belarus possessing a climate that is not conducive to infectious diseases, its population in general is a healthy one, or the SES is working effectively. We know that the SES has been effective in meeting the goals of immunization programs achieving, for example, 96 percent coverage against measles by 1994.[76] This seems to indicate good coverage throughout the nation, but does not tell us anything about the SES's ability to quickly detect and monitor infectious diseases, especially those that might suddenly appear as a result of importation or emergence. From our survey of diseases afflicting the republic it appears as its potable water delivery system and, probably, waste disposal systems are in very bad shape. This means that the possibility of serious water-borne infectious disease outbreaks such as cholera, dysentery, typhoid fever and other salmonellosis, and others occurring is high. Many Belarusians worry about their country's porous borders, which allow for the ready cross-transport of Asians, Africans, and Eastern Europeans to destinations in wealthy northern European countries, some of who may carry nasty pathogens that could be contracted by Belarusians. It is probable that if faced with a major outbreak of an unfamiliar infectious disease, the poorly equipped SES would not be up to adequately dealing with the challenge.

The main biological weapons proliferation threat presented by Belarus is related to the National Culture Collection of Viruses and Other Microorganisms at the NIIEM. During Soviet times, NIIEM was an open institute although it did have closed laboratories that performed work for "Problem 5," the code name for the Soviet biological weapons defense project.[77] Of greater importance, however, is that NIIEM provided highly dangerous viral pathogens to the offensive Soviet biological weapons program, including the Ebola and Marburg viral strains that were weaponized at Vector in Koltsovo. To this day, NIIEM's culture collection houses many of the world's most dangerous group I and II pathogens, but in facilities that foreign experts have deemed as unsatisfactory, from both the biosafety and biosecurity viewpoints. Regarding the biosafety issue, the facilities housing highly dangerous pathogens and the laboratories where work with these microorganisms are performed are inadequate, so the probability that workers could be exposed to organisms or that organisms could escape the facility's confines is unacceptably high.

Of more pertinence to this report is the biosecurity problem. Within the MOH there is the Committee for Control over Compliance with the Requirements of Biological Safety and Anti-Epidemic Conditions that oversees biosecurity regulations aimed at preventing unauthorized access to culture collections and facilities where investigations are carried out. However, there are questions whether enforcement of these regulations is strong. The regulations do not include mechanisms for control over potentially dangerous scientific technologies or how results from research may be applied. Recognizing the weaknesses of the current system, in March 2006, the Committee established an ad hoc group to: (1) analyze existing international codes and different professional regulations; and (2) identify criteria for risk assessment of research projects and on the basis of that analysis, develop a national code of conduct for the life sciences recommendations for setting up institutional controlling bodies to oversee dual-use biological research.[78] We do not know the results of these initiatives, but they appear to be on the right track to correct some of the deficiencies in the Belarus' biosecurity.

Yet, concerns remain among both biosafety and biosecurity experts about NIIEM's culture collection of highly dangerous pathogens, with the main issue being whether Belarus has the capability of adequately securing these pathogens and preventing unauthorized access to them. The prevalent opinion among foreign experts is that Belarus does not have these capabilities. This being the case, suggestions has been made for the international community to make political overtures to the Belarus government to secure its permission to move the most dangerous pathogens from the NIIEM culture collection to a safe site in another country, possibly Sweden. At the time of this writing, there has been no apparent movement on this proposal.

# Chapter IV: The Anti-plague System of Georgia

## 1. History of the Georgian Anti-plague System

The first officially documented mention of a plague outbreak in Georgia was in 1836, when the deadly disease struck the port city of Batumi on the Black Sea coast. Consequently plague outbreaks of varying intensity were recorded in Batumi in 1901, 1910, and 1920. The reason for the repeated occurrences of plague was believed to be the poor sanitary conditions prevalent in the city. The fact that the initial cases of plague were always discovered in proximity to the port facilities led Soviet epidemiologists to conclude that the plague was brought to Georgia by foreign naval vessels from Turkey and other Middle Eastern countries where unsatisfactory epidemiological conditions prevailed. Thus, in 1927, by decision of the People's Commissariat of Public Health (Russian acronym *Narkomzdrav*) of the Georgian Soviet Socialist Republic a specialized AP laboratory was set up at the Batumi port to carry out the quarantine monitoring of the ships coming from countries considered as risks with regard to plague. In 1934, the Batumi port AP laboratory joined the centralized AP system of the USSR as a department of especially dangerous infections.[79]

In 1933, on the initiative of Professor G. Eliava, the Transcaucasian AP Center was created in Tbilisi under the Institute of Bacteriology. In 1937, the Transcaucasian AP Center became an independent organization and was renamed the Tbilisi AP monitoring station. The main function of this newly formed organization was to carry out epidemiological monitoring of the Tbilisi municipality and surrounding districts. In 1939, under the leadership of N. Abashidze, the functions of the Tbilisi AP monitoring station expanded as Georgian AP specialists began to study epidemiological outbreaks of unknown etiology and the epizootic monitoring of areas adjacent to the Turkish border. Due to the discovery of plague epizootics among Libyan jirds (*Meriones libycus erythrourus*) living on the Apsheron Peninsula in Azerbaijan in 1953, the Georgian AP system organized and dispatched the first epidemiological team to look for a natural plague focus in Eastern Georgia on the then administrative border with Azerbaijan. In 1956, the continuous plague epizootics in neighboring Armenia and Azerbaijan prompted the reorganization of the Tbilisi AP monitoring station into the Georgian Republic AP Station. In 1958, by the decision of the Soviet MOH, the Batumi port AP laboratory was upgraded into a field AP station and placed under administrative control of the Georgian Republic AP Station in Tbilisi. In 1979, another field AP station was established in Tsitelitskaro (now Dedoplistskaro) to conduct epidemiological monitoring of eastern Georgia. Hence, on the eve of the Soviet Union's dissolution, the Georgian AP system consisted of the Georgian Republic AP Station in Tbilisi, two field AP stations in Batumi and Tsitelitskaro, and four seasonal AP laboratories in Aspindza, Dmanisi, Jandara, and Ninotsminda.[80]

## 2. Organizational Structure of Georgian Anti-plague System

After Georgia achieved independence in 1991, the Georgian AP system became subordinate to the Georgian MOH. In 1992, by order of the MOH (now the Ministry of Health, Labor and Social Affairs), the Department of Especially Dangerous Infections of the Republic Sanitary-Epidemiological Station was transferred to the Georgian Republic AP Station. Similarly, the epidemiological divisions of hospital and intestinal infections of the Scientific-Research Institute of Medical Parasitology and Tropical Medicine were also transferred to the Georgian Republic AP Station, which was renamed the Scientific-Practical Center of Especially Dangerous Infections.[81]

As a result of the restructuring, in August 1996, all remaining epidemiological functions, including immunization, and the corresponding staff, were transferred from the Republic SES to the Scientific-Practical Center of Especially Dangerous Infections by order of the Georgian Ministry of Health, Labor and Social Affairs. The Scientific-Practical Center of Especially Dangerous Infections was renamed the National Center for Disease Control (NCDC), reflecting the fact that it consolidated the entire spectrum of epidemiological functions. By Presidential Order No. 55 "On the Establishment of the Legal Entity of Public Law–National Institute of Health and the Legal Entity of Public Law–L. Sakvarelidze National Center for Disease Control and Medical Statistics" dated February 21, 2003, the Center of Medical Statistics, which previously existed within the structure of the Georgian Ministry of Health, Labor and Social Affairs, merged with the NCDC. The NCDC was renamed again acquiring its current title—L. Sakvarelidze National Center for Disease Control and Medical Statistics (NCDCMS). Moreover, the aforementioned presidential order changed the legal status of the NCDCMS from a subject of private law, which it had acquired during the 1995-1996 reform of the healthcare system, to a subject of public law.[82] This change indicated that the NCDCMS regained its status as a state-funded institution with substantial autonomy.[83]

As of 2004, the organizational structure of the Georgian AP system, as is illustrated in Figure 4, consisted of the NCDCMS in Tbilisi, a field AP station in Batumi, and two seasonal AP laboratories in Aspindza and Ninotsminda. The Georgian AP had 220 employees, including 200 at NCDCMS, and 20 at the Batumi field AP station. The NCDCMS staff included 74 physicians, 26 other specialists (biologists, zoologists, parasitologists, etc.), 27 laboratory technicians, and 10 guards. Comparatively, in 1993 there were 313 employees in the Georgian AP system. In terms of the distribution of scientific degrees, the AP system had 2 doctors of medical sciences, 1 doctor of biological sciences, and 25 candidates of medical and biological sciences.[84] The organizational structure of the NCDCMS consisted of the following units:

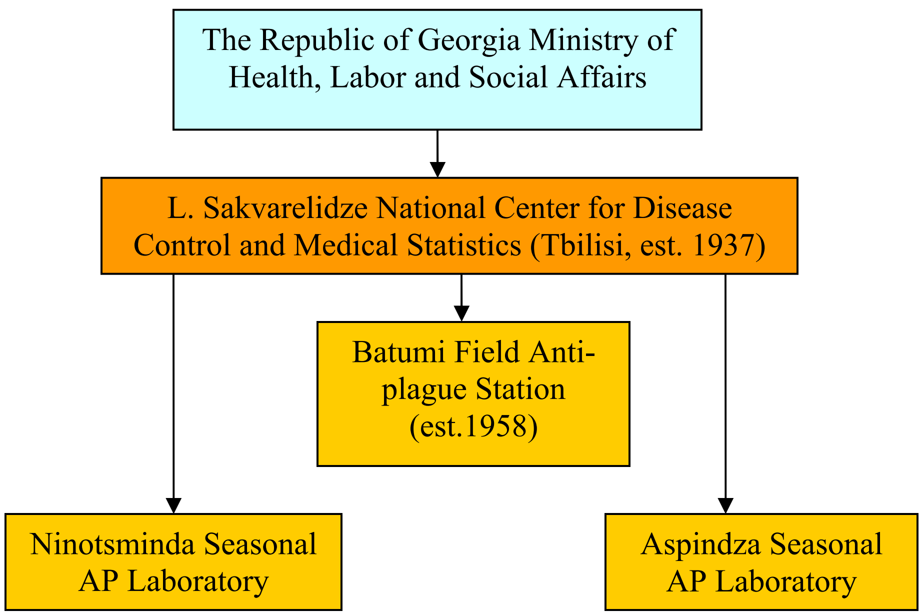
- Office of the Director of the NCDCMS
- Departments:
  - International Cooperation and Threat Reduction
  - Immunization and Logistics
  - Field Epidemiology
  - Surveillance of Vaccine-Preventable Diseases
  - Surveillance and Analysis
  - Health Promotion and Epidemiology of Chronic Diseases
  - Parasitic Diseases
  - Information Resources and Epidemiological Bulletin
  - Hospital Infections
  - Medical Entomology and Zoology
  - Organizational-Methodological
  - Information Technologies

Laboratories:

- Plague and Especially Dangerous Infectious Diseases
- Zoonotic and Anaerobic Diseases
- Cholera and Diarrheal Diseases
- Poliomyelitis and Enteroviral Diseases
- Viral and Rickettsial Diseases
- Molecular Epidemiology
- Cell Culture
- Respiratory Diseases

- Museum of Live Microorganisms (Georgian National Pathogen Collection)
- Georgian National Vaccine Fund
- Nutrient Media Production and Sterilization Facility
- Training Center
- Vivarium.[85]

**Figure 4. Organizational Structure of the Georgian Anti-plague System**




In 2003, the NCDCMS offered very low pay to its employees, which made it difficult for it to retain qualified cadres and recruit new specialists. For example, physicians earned 90 Georgian Laris (GEL), the equivalent of $45 a month, heads of laboratories and departments earned 140 GEL ($70) a month, and the auxiliary personnel only 60 GEL ($30) a month. In addition, there were recurrent problems with delayed payment of salaries due to state budget shortages. At the time of the CNS staff visit in May 2003, for instance, the NCDCMS staff salary was six months in arrears. However, a substantial number of NCDCMS personnel survived by being able to access funds from international scientific grants (see below).[86]

**3. Public Health Activities of the Georgian Anti-plague System**

The nationwide public healthcare reform and ensuing restructuring broadened the public health functions carried out by the Georgian AP system. While in the past the primary area of responsibility was circumscribed to the prophylaxis and control over especially dangerous infectious diseases, including plague, anthrax, tularemia, and cholera, now the NCDCMS is responsible for implementing epidemiological measures against the wide array of diseases deemed significant from the public healthcare point of view, including diphtheria, malaria, and poliomyelitis, as well as intestinal, respiratory, and hospital infections. The NCDCMS serves as the national clearinghouse for epidemiological data because the existing public health regulations require all public healthcare organizations and institutions in Georgia to submit reports of occurrences of infectious diseases to the NCDCMS. These reports must be submitted on a regular and timely basis and include monthly accounts of sanitary conditions. In turn, the NCDCMS collates and analyzes the data and produces the epidemiological bulletins, which show the dynamics of different diseases and include epidemiologic forecasts of future developments. Another new function of the NCDCMS is the management of the nationwide immunization programs. The NCDCMS also carries out large-scale epidemiological studies of infectious and non-infectious diseases in the population. The NCDCMS is actively engaged in educational outreach efforts aimed at improving the overall level of public health by raising public awareness with regard to harmful effects of drug use, unprotected sex, smoking, and alcoholism.[87]

As of May 2003, the Department of Public Health of the Georgian Ministry of Health, Labor and Social Affairs, financed and coordinated fourteen state prophylactic programs, including four that were managed and implemented by the NCDCMS. The state prophylactic programs in the areas of epidemiological monitoring, control, and prophylaxis of infectious diseases and promotion of healthy lifestyle are the priorities of the NCDCMS. Hence, the NCDCMS is responsible for the implementation of the following four state prophylactic programs:

*Program of Epidemiological Monitoring and Control of Especially Dangerous Infections and Coordination of Prophylaxis of Other Contagious Diseases*

This program is aimed at preventing the spread of infectious diseases. The objectives of the program include: (1) strengthening the system of epidemiological monitoring and early warning; (2) establishing the etiology of outbreaks and their control; (3) creating national reference laboratories with external quality control; (4) implementing standard definitions for cases of infectious diseases; and (5) rendering methodological and practical assistance to public healthcare institutions and organizations. The program is responsible for the following measures: (1) epizootiological and epidemiological monitoring of natural foci of plague and tularemia and discovering the natural circulation of other especially dangerous infections; (2) constant monitoring of the epidemiological situation and illness rates, epidemiological analysis and forecasting, and publication of a monthly epidemiological bulletin; (3) supporting the operations of the reference laboratories; (4) maintaining the national collection of microorganisms; (5) monitoring resistance to antibiotics; and (6) the monitoring of hospital infections.[88]

Since Soviet times, there has been a decline in epizootic surveillance and epidemiological monitoring of natural plague foci. There are two natural plague foci in Georgia—the Transcaucasian Plain-Foothill and South Caucasus Mountainous. Their combined area occupies about 10 percent of Georgia's territory. The main natural plague host in the Transcaucasian Plain-Foothill focus is the Libyan jird, while the main plague vectors are its fleas (most commonly *Xenopsylla conformis*, *Ceratophyllus laeviceps*, *Rhadinopsyla ukrainica,* and *Stenoponia tripectinata*). In the South Caucasus Mountainous plague focus the main natural plague host is the common vole (*Microtus arvalis*), and its ectoparasites (*Ceratophyllus caspius* and *Ctenophtalmus teres*) are the main vectors. The Transcaucasian Plain-Foothill focus incorporates parts of the Dedoplistskaro, Signakhi, Gardabani, and Marneuli districts, while the South Caucasus Mountainous focus encompasses the Javakheti Plateau, Ninotsminda, Dmanisi, Akhalkalaki, and parts of Tsalka districts. Both foci are located in the southern part of Georgia, the latter larger (5,000 sq. km) than the former (2,100 sq. km).[89]

At its apex in Soviet times, the Georgian AP system dispatched fully equipped epidemiological teams to monitor the natural foci of plague and tularemia from the seasonal AP laboratories for up to two months during the epizootically active seasons. At that time, epidemiological teams consisted of laboratory and field groups. The field group was comprised of a zoologist, a parasitologist, an exterminator, and seasonal workers. Its primary objectives included studying the epizootic factors (distribution of the rodent population on the territory of the focus, its composition, etc.), collecting field samples of plague hosts and vectors, and delivering them to the seasonal AP laboratory. The laboratory group, comprised of a physician-bacteriologist and laboratory assistants, carried out complex laboratory analysis of the collected field materials.[90]

After the Soviet Union's dissolution, the considerable decrease in state funding forced the NCDCMS to cut back on epidemiological monitoring. Severe financial crises led to the closure of the Dedoplistskaro field AP station in accordance with a MOH order on April 1, 1999. The NCDCMS transferred the Jandara seasonal AP laboratory to the Georgian border guards for temporary use, while the Dmanisi seasonal AP laboratory ceased to function.[91] As a result, as of May 2003, apart from the NCDCMS, only the Batumi field AP station and two seasonal AP laboratories in Ninotsminda and Aspindza continued to operate. Here it should be noted that staff of the NCDCMS admitted that squatters occupy both seasonal AP laboratories, which allegedly does not interfere with seasonal field studies. The local public prosecutor lives at the Ninotsminda seasonal AP laboratory, while a police officer and his family occupies the building of the Aspindza seasonal AP laboratory.[92]

Compared to the Soviet period, the NCDCMS had to scale down the scope of epidemiological monitoring. The NCDCMS dispatches an epidemiological team to study plague and tularemia foci in Southern Georgia (Ninotsminda district primarily) and a zoological-entomological team to study rodent reservoirs in Eastern Georgia (Dedoplistskaro and Gardabani districts), whereas the Batumi field AP station studies plague and tularemia foci in Western Georgia and in the Aspindza, Akhaltsikhe, and Adigeni districts. In 2003, for instance, the NCDCMS and Batumi field AP station sent two epidemiological teams to the South Caucasus Mountainous plague focus—to Ninotsminda and Aspindza districts respectively—to monitor the populations of hosts and vectors for up to one month. The NCDCMS also dispatched specialists to study natural tularemia foci for 5-10 days. Nonetheless, the NCDCMS administration admits that the limited scope of the epidemiological monitoring of natural foci of especially dangerous infections may result in an undetected epizootic, which may, in turn, lead to an outbreak especially in densely populated areas. Due to the shortage of relevant vaccines, the NCDCMS can no longer conduct limited vaccinations of groups of people who are at greater risk of contracting especially dangerous infectious diseases due to their professional occupation or place of residence. Consequently, the risk of an outbreak becomes even more likely.[93]

During 2003-2006, the construction of the Baku-Tbilisi-Ceyhan (BTC) main oil export pipeline allowed the Georgian and Azerbaijani AP systems to carry out short-term commercial epizootiological surveys of areas along the pipeline route. The NCDCMS and S. Imamaliyev Republic AP Station (Baku, Azerbaijan) received contract work from the main BTC stockholder, BP.

*Immunization Program*

In the early 1990s, vaccination rates plummeted in Georgia due to the fact the Russia stopped supplying vaccines and there were no alternative vaccine suppliers. Only with substantial international humanitarian assistance from the U.S. Agency for International Development (USAID) and United Nations International Children's Emergency Fund (UNICEF) was the prior level of routine vaccinations restored nationwide. As the organization responsible for managing the national immunization programs, the NCDCMS houses the Georgian National Vaccine Fund, built with financial assistance from UNICEF. All vaccines necessary for the implementation of the national immunization calendar are stored at the Vaccine Fund. The NCDCMS receives vaccines free of charge as part of the humanitarian assistance program of UNICEF and the Global Alliance for Vaccines and Immunization (GAVI). In order to successfully implement the national immunization campaigns, the NCDCMS maintains contractual relationships with about 700 immunization providers across Georgia. The NCDCMS pays each immunization provider to vaccinate residents in its respective locale. As of May 2003, due to delays in the transfer of state funds from the Department of Public Health of the Georgian Ministry of Health, Labor and Social Affairs, the NCDCMS owed 900,000 GEL (approximately $450,000) to local immunization providers for already performed vaccinations.[94] In order to broaden the immunization of children, the NCDCMS organized special mobile brigades in seven regions of Georgia. These mobile brigades perform prophylactic vaccinations in the remote mountainous areas, where the medical service infrastructure is virtually absent.[95]

*Program on Control and Prophylaxis of Malaria*

The socio-economic developments of recent years, including the influx of internally displaced persons from the conflict in Abkhazia, the rise in poverty and unemployment rates, and accompanying increase in population migration negatively affected the epidemiological situation with regard to malaria. The steady increase in malaria cases is bolstered by transmission of this disease from abroad. For example, during 1970-1995 there were 147 recorded cases of malaria in Georgia; these originated from 24 foreign countries (13 from Africa and 9 from Asia). It must be noted that 68.6 percent of the population of Georgia resides on the territory, where the likelihood of malaria outbreak is high. The main vectors are mosquitoes belonging to the *Anopheles* species. The epidemiologically active season lasts 150 days. The anti-epidemiological measures carried out by the NCDCMS under the aegis of the state anti-malarial campaign include timely detection of cases and their intensive treatment, seasonal and inter-seasonal chemical prophylaxis of mosquito reservoirs. The NCDCMS Department of Parasitic Diseases is responsible for carrying out the state anti-malarial campaign. The employees of the Department of Parasitic Diseases actively collaborate with the WHO Regional Office for Europe within the context of the Roll Back Malaria program to educate the Georgian parasitologists, entomologists, and epidemiologists about best practices with regard to eliminating malaria in Georgia.[96]

*Healthy Lifestyle Program*

In 1998, the working group entitled "Public Health Support and Prophylaxis of Non-Infectious Diseases" was organized by the NCDCMS to pursue the following objectives: (1) creation of a basis for the system of epidemiological monitoring of non-infectious diseases; (2) implementation of measures to control diseases that have a negative impact on social health; (3) anti-tobacco campaigns; (4) prophylaxis of heart disease, AIDS, alcoholism, and drug use; (5) prevention of traumatic injuries; and (6) family planning. For the most part, the objectives entail thorough studies of the status of population's health in general. With this purpose the NCDCMS began intensive international cooperation with the U.S. Centers for Disease Control and Prevention (CDC), WHO, and UNICEF. The cooperation with CDC has been particularly useful as the NCDCMS employees learned modern methods of epidemiological studies. With financial support from the United Nations Population Fund (UNFPA), UNICEF, USAID, the United Nations High Commissioner for Refugees (UNHCR) and CDC, the NCDCMS carried out reproductive health surveys of Georgian women in 2000 and 2005. During 2000-2001 with funds from the USAID and Save the Children (Georgia Field Office), the NCDCMS conducted the study of the nutritional status of children under five in six of Georgia's regions. Finally, NCDCMS developed close relationships with the American International Health Alliance (AIHA) in the area of programs aimed at promoting healthy lifestyles.[97]

**4. International Activities That Involve the Georgian Anti-plague System**

In September 1995, USAID together with the Georgian Ministry of Health, Labor and Social Affairs unveiled the "Project for Development of Public Healthcare Sector." The CDC and the Agency for Healthcare Research and Quality (both of which are parts of the U.S. Department of Health and Human Services) implemented the project. One of the main elements of the project was the radical reform of the state SES and the creation of the two departments within the Ministry of Health, Labor and Social Affairs —the Department of Public Health and the Department of Sanitary Monitoring (now Department of Sanitary Inspection). The latter controls compliance with state sanitary-hygienic norms and regulations. The main functions of the former are as follows: (1) epidemiological monitoring of infectious and non-infectious diseases and control (organization and implementation of relevant measures) of socially important diseases, as well as monitoring, analysis and forecast of the epidemiological situation; (2) implementation of prophylactic measures; and (3) promotion of a healthy lifestyle. In addition, the legal status of all public health organizations and institutions in Georgia, including that of the Scientific-Practical Center of Especially Dangerous Infections, changed when the NCDCMS became subject of private law, which implied that they were financially independent entities, cutoff from state budget financing. In other words, the Georgian government provides targeted funds to public health organizations to implement only specific state healthcare programs and therefore the relationships between the public health organizations and the Ministry of Health, Labor and Social Affairs are based on contractual agreements.[98]

The watershed event that enabled the NCDCMS to begin building contacts with the international scientific community was the International Training and Research in Emerging Infectious Diseases (ITREID) program administered jointly by the John E. Fogarty International Center for Advanced Study in Health Sciences and the National Institute of Allergy and Infectious Diseases (NIAID) of the National Institutes of Health (NIH). Through the ITREID program, the NCDCMS was paired with a U.S. partner organization, the University of Maryland at Baltimore, and this led to collaborative research projects that spanned 1997-2002. This fruitful collaboration allowed the NCDCMS employees to acquire new skills and to adopt modern methods of molecular epidemiology in daily work.

Another substantial source of assistance in terms of training and limited equipment upgrades has been the AIHA. In 2001 a training center was built with AIHA funds at the NCDCMS that can accommodate 40 people in its main classroom. The training center is well suited for seminars and briefings as it is equipped with computers, projectors, and even equipment for simultaneous interpretation. The establishment of working relationships with the WHO led to contacts with the WHO Collaborative Centre for Virus Reference and Research in Lyon, France. As a result of the participation of the employees from the NCDCMS Laboratory of Poliomyelitis and Enteroviral Diseases in the WHO laboratory network on poliomyelitis and diphtheria, NCDCMS received five Class II biosafety cabinets. In fact, the combination of foreign assistance from different sources led to the creation of the Laboratory of Molecular Epidemiology, which is staffed by specialists who underwent training at U.S. universities at various times. Finally, the NCDCMS won five research grants from the Biotechnology Engagement Program (BTEP) of the U.S. Department of Health and Human Services, which put it in touch with the ISTC, Lawrence Livermore National Laboratory, Walter Reed Army Institute of Research and other leading scientific centers of the world. All of the above collaborations contributed to the limited equipment upgrades, improved quality control in the daily laboratory work, and augmented the NCDCMS' capacity to detect and react to an infectious outbreak in a timely and efficient manner.[99]

### 5. Analysis of the Georgia's Anti-plague System's Weaknesses and Proliferation Potential

Since the time of the CNS visit in May 2003, significant physical security upgrades of the NCDCMS building and the complete refurbishment of the Batumi field AP station have been introduced under the auspices of Threat Agent Detection and Response (TADR) project as part of the CTR Program, which is administered by the U.S. Defense Threat Reduction Agency (DTRA). These physical security upgrades have largely addressed the majority of proliferation concerns, which the CNS staff noted during the visit to the NCDCMS and Batumi field AP station in May 2003. In particular, iron doors equipped with digital punch-in locks and magnetic card readers were installed at all laboratories throughout the NCDCMS, including the Museum of Live Microorganisms.[100] With support from the TADR project, the epidemiological laboratories at the NCDCMS were outfitted with state-of-the-art laboratory equipment, which fully meets international biosecurity, biosafety and environmental protection standards.

In the context of the TADR project, the NCDCMS houses an Epidemiological Monitoring Station (EMS) of the second level in the TADR project hierarchy. As envisioned by the TADR project, the EMS at the NCDCMS will rapidly diagnose any given dangerous infectious disease and provide data and pathogen strains to the Central Reference Laboratory, which is currently under construction in Alekseyevka on the outskirts of Tbilisi.[101] The TADR project in Georgia is in its final stages of completion as three out of four of its elements are already operational. These are the second level EMS stations in Tbilisi (on the NCDCMS premises), Kutaisi, and Batumi (on the premises of the Batumi field AP station). The construction of the aforementioned Central Reference Laboratory in the Alekseyevka suburb of Tbilisi will be complete in 2009.[102] In addition, according to different estimates, the U.S. government intends to spend somewhere between $65 to $150 million in the next five to six years on building, equipping and maintaining these facilities in Georgia.[103]

However, until the Central Reference Laboratory becomes operational, the Museum of Live Microorganisms remains on the top floor of the seven-story NCDCMS building, which poses certain public health risks considering that Georgia is in a seismically active region, where devastating earthquakes occur with some regularity. Thus, the collapse of the NCDCMS building in case of an earthquake of considerable proportions may result in the accidental release of dangerous infectious diseases with grave consequences for the adjacent residential neighborhood.

With the exception of several incidents of petty theft of scrap metal from the territory of the Batumi field AP station prior to 2003, and the unsuccessful theft of the laboratory equipment from the EMS station compound in Kutaisi in December 2005, thus far there have been no proliferation-significant episodes involving the Georgian AP system.[104] With regard to the Kutaisi incident, it should be noted that at the time of the theft the EMS station was under construction and the aforementioned laboratory equipment was still in containers stored at the site for subsequent installation. According to the NCDCMS administration representative, the local law enforcement operatives quickly identified the culprits and the stolen laboratory equipment was returned intact to the EMS station compound.[105]

As was already mentioned in the first report on the AP system, the Georgian Republic AP Station, the Soviet predecessor of the NCDCMS, was included in the Soviet Union’s 1987 CBM declaration primarily due to the fact that it had been involved in the special scientific efforts focused on developing means against viral pathogens, which were originally intended to prevent possible acts of bioterrorism during the 1980 Moscow Olympics.[106] This implies that a certain proportion of the Georgian AP workforce may have retained BW-related expertise from the Soviet times when it was trained at the AP institutes in Russia or was engaged in the Problem 5 research projects. The CNS staff was unable to determine the precise number of people who may possess such knowledge in the Georgian AP system, but it is safe to assume that their number is dramatically shrinking as majority are nearing retirement age. In addition, it is difficult, if not impossible, to assess the proliferation potential of each individual without conducting extensive person-to-person interviews and/or distributing relevant questionnaires to elicit the required feedback. Moreover, after retirement the personal ties with the former employer are often severed, which further complicates the tracking of individual scientists. If the problem of residual Soviet-era BW expertise among some of the former Georgian AP employees is considered in the context of porous borders, uncontrolled territories (Abkhazia and South Ossetia), organized crime and corruption, then the possibility of illicit transfer of BW knowledge to rogue states or international terrorist organizations certainly cannot be ruled out. Nonetheless, it is important to bear in mind that, as indicated by the recent admission of Vice Admiral Robert Murrett, director of the National Geospatial Intelligence Agency, monitoring people with BW expertise represents a formidable challenge requiring vigorous information sharing and coordination of activities among multiple intelligence agencies.[107] If this is true for such powerful country as the U.S., then what degree of attention to this complex subject can be realistically expected from the Georgian government that is preoccupied with meeting basic economic development priorities and restoring territorial integrity of the country?

# Chapter V: The Anti-plague System of Kazakhstan

## 1. History of the Kazakh Anti-plague System

In the desert and steppes of Kazakhstan, plague cases most frequently occur in late summer and early fall. Transmission of *Y. pestis* usually is through wild rodent fleas, which bite humans who come near the burrow entrances of rodent colonies. Large outbreaks of plague also have been associated with the slaughtering and cooking of plague-stricken camels. In rarer instances, human plague has resulted from direct contact with rodents and hunted prey. Plague outbreaks recur in the same areas, but unpredictably. Some natural plague foci may present annual outbreaks for decades at a time, and then remain dormant for a few years, only to suddenly and unexpectedly reemerge. Kazakh scientists have not yet determined the factors that allow *Y. pestis* to survive in the environment, making predictions about when such pathogens may reactivate in natural foci problematical.

To deal with the regular outbreaks of plague in Kazakhstan, Soviet authorities created several AP stations, one of which—the Almaty AP station[108]—grew to become one of the Soviet Union's six main AP institutes. After the Soviet Union's dissolution, Kazakhstan's inherited AP facilities were reorganized along with the public health system. Today, the Kazakh AP system is the largest of the national AP systems in the Central Asian region and among the NIS. In 2004, the system consisted of one institute, 10 regional stations, 18 field stations, and 46 seasonal laboratories. The Almaty AP institute, now called the M. Aikimbaev Kazakh Scientific Center for Quarantine and Zoonotic Diseases (KSCQZD), has the widest range of activities of any of the AP organizations in the region. These range from disease monitoring and supervision of regional stations and research on and production of biomedicines, to training. Regional AP stations conduct disease monitoring on specific territories assigned to them, and a few of them also conduct research and training activities. The field stations, on the other hand, only monitor the territory assigned to them.

Since independence most of the Kazakh AP facilities have experienced serious financial difficulties, which have made them unable to retain or attract qualified personnel or to purchase the materials and equipment required to conduct epidemiological monitoring and microbiological research activities. This, in turn, has adversely affected their ability to maintain internal security and biosafety regimes and to perform disease monitoring activities.

*Pre-1992 History*

The Soviet MOH established Kazakhstan's leading AP facility, the Almaty AP station, in 1934.[109] The AP station was created on the foundation of the former AP laboratory of the Kazakh Sanitary Bacteriological Institute. It had a staff of 14, and reported to the Saratov AP Institute (Mikrob) in Russia. The AP stations' mandate was to take preventive measures against human plague, respond to plague outbreaks, and study the causes of plague among humans and rodents, all based on an antiepidemic plan approved by the Soviet MOH and Mikrob. To support the station's field work, AP posts were established in various areas of the country. Between 1934 and 1948, the station's staff increased from 14 to 134.

In 1945, the natural plague foci of Central Asia, especially in Kazakhstan, suddenly became more active and generated numerous epidemics. A large epidemic occurred along the northern coast of the Aral Sea at the same time as an outbreak in the Atyrau Region, both located in southwest Kazakhstan. These were followed in 1946 by epidemics in the western regions of Kazakhstan. A serious epidemic of pneumonic plague in the Almaty area began in late 1947 and was suppressed in early 1948. Several months later, plague broke out again in various regions of Kazakhstan and other Central Asian republics.

As a result of these outbreaks, in 1949 the Soviet MOH decided to transform the Almaty AP station into an AP institute, named the Central Asian Anti-plague Research Institute, to develop techniques for eliminating natural plague foci. In addition to supervising the work of the other Central Asian AP stations, the newly established institute was to become a central research, production, training, and outreach organization. The institute's main tasks included:[110]

- conducting research on the prevention and suppression of plague and other high-risk diseases such as tularemia and brucellosis;
- suppressing outbreaks of plague and other high-risk diseases and studying their epidemiology;
- producing specific bacterial preparations (vaccines, test kits);
- training AP staff and developing methodological instructions, programs, textbooks, and exhibits for university courses on high-risk diseases;
- providing scientific support for field work;
- publishing research, instruction manuals, handbooks, and public-health outreach materials; and
- organizing meetings and conferences, and supervising public-health outreach work.

In 1949, the institute had a staff of 194, including 30 scientists. As its activities increased, its staff grew to 400 employees by 1979. The latter number included 121 scientists, of whom 65 were Ph.D. candidates and seven held Ph.D.s in medical-related sciences. The institute directed the activities of the 17 stations reporting to various government agencies as follows:

- 10 AP stations reported to the MOH Second Directorate[111] (Aral Sea, Atyrau, Qyzylorda, Taldyqorghan, Mangghystau, Oral, Shymkent, Tajik, Uzbek, and Karakalpak);
- four AP stations reported to the Ministry of Railways (Almaty, Atyrau, Qasaly, and Kazalinsk), and the Central Asia station located in Tashkent, Uzbekistan); and
- three AP stations reported to the MOH Third Directorate[112] (Medical Sanitation Unit 104 located in Aqtau, the Aqsuyek station, and the Uchquduq station).

During the 1970s, the institute also trained physicians and biologists from Burma, Indonesia, Vietnam, and Mongolia, who came on WHO scholarships to study epidemiological monitoring methods for plague and cholera. More significantly during that period, the institute also became engaged in the Soviet biological weapons defense program, codenamed "Problem 5."[113] Under Problem 5, a small team of the institute's researchers conducted research on the immunogenicity, reactivity, and safety of vaccine strains of *Y. pestis* and *Brucella suis*.

*Post-Independence History*

After independence, the Kazakh AP system was reorganized. In 1992, by decree of the Kazakh Ministry of Public Health,[114] the Central Asian Anti-plague Research Institute was renamed "Anti-plague Research Institute of the Republic of Kazakhstan." Nine years later, on May 2, 2001, the institute was given its present name—"M. Aikimbaev Kazakh Science Center for Quarantine and Zoonotic Diseases (KSCQZD)" in honor of its first director.[115] The institute became the central AP facility of Kazakhstan in charge of overseeing the work of the country's AP stations.

In the mid-1990s, the Kazakh MOH started reorganizing the public health sector and decreasing its personnel, including in the AP system. The AP stations that were under the Ministry of Railways in Soviet times were closed, as well as some of those that once reported to the Soviet MOH Third Directorate.[116] Because of the lack of serious outbreaks during the period, Ministry officials briefly entertained the idea of merging the AP system with the Kazakh SES. In effect, this would have placed the AP system under the authority of the SES, which at that time enjoyed a closer relationship with the Kazakh MOH. The AP system resisted the move, explaining that SES personnel were neither certified nor experienced in conducting work with dangerous diseases. The dispute was settled in 1999, when an outbreak of human plague occurred in the northern regions of Kazakhstan, resulting in nine cases of plague, of which two were fatal (see Map 2). Another outbreak occurred in 2001 in the same region, further convincing MOH officials of the importance of the AP system's independence.

Other structural changes took place between 1994 and 2004, which resulted in the closure of several former AP stations and the opening of new ones. These changes were instituted to adjust to the fluctuations in the activity level of natural foci: new stations were created where the natural foci activity level increased, and existing stations were downgraded or closed where activity levels decreased. As a result, the Kazakh AP system grew to include 10 regional AP stations, 18 field stations, and 46 seasonal laboratories.

The relationship between AP stations and KSCQZD also evolved over time. Until 1994, AP stations were subordinate to KSCQZD, which reported to the Kazakh MOH. In 1994, KSCQZD changed its status and became a "state-treasury" institute ("государственно-казенное" in Russian) while AP stations remained state organizations. This change had two important consequences. First, AP stations were no longer subordinate to KSCQZD, but instead reported directly to the Department for Quarantine and Highly Infectious Diseases under the Kazakh MOH Committee for State Sanitary-Epidemiological Monitoring, from which they receive funding. Although AP stations submitted their work plans to the KSCQZD for review, KSCQZD's role was reduced to providing consultative-methodological assistance to the stations; the Deputy Minister of Health approved each AP station's work plan.

Second, with its new status, KSCQZD acquired relative financial independence from the MOH. From then on the institute was allowed to conduct commercial activities —for instance the sale of vaccines and other medical products—and use the profits for its own needs.[117]

**Map 2. Plague Outbreaks in Kazakhstan, 1999 – 2001**


KSCQZD's management also changed after Kazakhstan's independence. In 1995, after eight years of serving as its director, Professor V.M. Stepanov resigned and later joined the Sanitary Epidemiological Station in Almaty. He was replaced by Doctor of Medical Sciences V.P. Dobrin, who served three years, before resigning in 1998 to move to Russia. He was succeeded by Dr. Bakyt Atshabar, who was appointed director by the Ministry of Public Health, Education, and Sports (Order No. 61 of 21 December 1998) and directs the institute to this day.

The AP system's organizational changes together with the financial crisis that Kazakhstan endured in the early 1990s caused a sharp decrease in funding for the AP system. This in turn led to cuts in salaries and pay delays, sometimes exceeding six months.[118] With the simultaneous streamlining of the medical service in general and the AP system in particular, staffing levels in the AP system started to decrease as early as 1992. By 2004, the number of Kazakh AP system staff had dropped by 80 percent. The decrease came in waves, however, and was unequal among facilities.

The AP system's staff decreased from 2,173 persons in 1991 to 1,526 by the end of 2000. Among the staff, the number of scientific personnel (physicians, biologists, and laboratory technicians) decreased from 641 people in 1995 to 420 in 2000, a drop of 34.5 percent. In individual facilities, the drop in personnel could exceed 50 percent. For instance, personnel at the AP institute of Almaty dropped from 440 in 1991 to 120 by the year 2000, a 70 percent decrease. The composition of scientific staff at the institute also changed dramatically: of the 93 scientists employed at the institute in 1991, only 50 remained by the year 2000, with only 30 of them possessing an advanced scientific degree. Some of the specialists returned to Russia or retired, while others took higher paying jobs in other medical institutions or privately owned companies.

The personnel situation stabilized in 2001 as funding improved in the aftermath of the 1999 and 2001 plague outbreaks. As a result, salaries increased and were paid on time. Newly hired specialists at AP stations were also offered a hazard premium of 40 percent over the base salary, and a 10 percent annual salary increase. These measures increased the average AP specialist's salary from 8,000 Tenge (about $60) to 12,000 Tenge (about $90) with the 40 percent hazard premium. After 10 years of experience, the average salary increases to between 16,000 and 18,000 Tenge/month (between $130 and $140).

Despite these improvements, monthly salaries at AP facilities were still very low compared to the national average salary and much lower than the salaries paid in industry. In 2004, the national average monthly salary was 28,270 Tenge (about $217);[119] while in businesses engaged in research and development, monthly salaries averaged 52,000 Tenge ($400), and in the oil and gas industry they were more than 63,000 Tenge (about $480).[120]

As of 2004, the AP system employed 420 people, an 80 percent drop from the 2,173 people employed in 1991. Of the total staff, 16.9 percent had higher education degrees (248). These specialists included physicians (59.3 percent) and biologists (40.7 percent). Of the 248 degreed specialists, 17 had advanced degrees: two had PhDs in science, and 15 were Ph.D. candidates in science. In addition, 172 specialists with secondary medical education were employed at AP stations, representing 39.7 percent of the total staff.

Financial and organizational turmoil exacted an uneven toll on AP facilities. For instance, personnel at the AP facility located in Aktau by the Caspian Sea dropped from 198 people in 1992 to 88 in 1998, a 55 percent drop in six years, reflecting the average decrease across the AP system. However, the drop in experienced personnel was more dramatic. Many of the station's scientists returned to Russia, immigrated to foreign countries (most often to Germany), while others left the system and severed contact with their former colleagues. As a result, in 2002 the station had only five experienced scientists left on its staff.

The booming economic activity in the Aktau region, caused by the development of the oil and gas industry, surprisingly had two negative impacts on the Aktau station. First, because of the higher salaries offered in the oil and gas industry, the AP station experienced severe difficulties in hiring new staff to replace departed scientists. As salaries in the region increased, with a regional average of 35,000 Tenge (about $240) per month, the AP station's highest salary was less than half the regional average, at 12,000 Tenge per month ($82). This is hardly enough to live on in a region where a booming economy has also caused local prices to soar. In ten years, between 1992 and 2002, the station was able to hire only two physicians. As a result, most of its personnel are near or past retirement age, working sometimes until the age of 70.

The second negative impact caused by the growth of the oil and gas industry is the increased need for epidemiological surveillance. Oil and gas rigs and their personnel are now located in previously uninhabited areas. Since they drill in areas located on active plague foci, oil and gas personnel disrupt the natural habitat of *Y. pestis* hosts (rodents) and vectors (fleas) thereby increasing worker susceptibility to disease. To prevent this, the Aktau AP station conducts disease surveillance campaigns and preventive measures in the new areas in addition to the previously inhabited areas that it protected. The region is also endemic for Crimean-Congo Hemorrhagic Fever (CCHF), which increases the need for surveillance in areas where the oil and gas industry is operating. In other words, at a time when its scientific and support staff was shrinking and aging, the Aktau AP station faced an increase in demand for its services.

In contrast, the Atyrau AP station, which monitors a territory as large as the Aktau station's (165,000 square kilometers), employed 279 people in 2002.[121] Between 1992 and 2002, personnel at Atyrau AP station increased by 10 percent, and in 2003, 302 people were employed at the station.[122] In spite of the fact that the Atyrau station also faced financial difficulties, it has been able to weather the crisis better than the Aktau station.

Simply put, personal connections or the proximity of the station to the seat of power determines the level of a station's funding. Since funding for each station is allocated directly by the MOH, stations located close to government centers in Almaty (former capital) and Astana (new capital), where the MOH is located, have generally been more successful in obtaining funding than those located in more distant regions. In addition, personal connections between station directors and MOH officials improve funding allocations. In 2004, the Aktau station had no personal connections with government officials and its location – three time zones away from Almaty and Astana - provided the facility's management with only limited opportunities to confer with MOH officials. Even though the Atyrau station is equally far removed from power centers, its personal connections with MOH officials explain its more advantageous funding circumstances.[123]

Inequality in the distribution of funds among AP facilities was further deepened by a budgetary practice called "Centralized Distribution" that allowed MOH officials to distribute discretionary funds to select AP facilities. These funds supplement a facility's formal budget.[124] Here, too, AP facilities with connections in the MOH were more likely to garner larger budgets, irrespective of the comparative need.

AP facilities were and probably still are today entirely dependent on government funding for support. As state-owned institutions, they are to this day not allowed to receive funding from other sources. As a result, the stations located in areas with a booming economy or industry (such as the oil and gas industry) cannot charge private companies for disease surveillance work performed in areas of industrial activity.

In addition, AP facility budgets are not fungible. Line items have to be used for stipulated purposes, and cannot be reallocated to other expenses as the need arises. This lack of budgetary flexibility not only prevents AP facilities from adjusting to a sudden rise in activity at specific natural disease foci, for instance by redistributing funds to cover the cost of more intensive epidemiological work, but sometimes it is also an additional reason for decreased funding. Indeed, during their annual review of AP station budget expenses, MOH officials tend to eliminate or reduce unused or little used line items in the following year's budget. Personal connections and proximity to government centers allow some AP station directors to prevent this from happening, while those without connections are left helpless. AP directors often complain of a lack of understanding by MOH officials of the cyclical character of certain diseases such as plague, which led them to confuse the absence of outbreaks with the disappearance of the diseases from those areas. The financial consequences of these cutbacks are significant.

## 2. Public Health Activities of the Kazakh Anti-plague System

*Disease Surveillance: Theory and Practice*

Plague is enzootic in nearly 40 percent of Kazakhstan's territory, which is also endemic for anthrax, CCHF, and tularemia. In addition, new plague foci have been discovered in recent years.

Instructions for epidemiological surveillance of natural plague foci in Kazakhstan were prepared by leading specialists at KSCQZD and approved by the MOH. These instructions are binding for all AP institutions in Kazakhstan. The instructions state that the key element of epidemiological surveillance is to monitor and detect epizootics before they affect human health. Therefore, AP personnel are responsible for:

- detecting plague epizootics in a timely manner, determining their intensity and boundaries, and identifying the risk of epidemic;
- identifying potential movements of epizootics and predicting when they may occur;
- determining the location, occupation, and travel routes of the human population; and
- determining the nature and scope of preventive measures against possible outbreaks.

Each station's management determines the station's work plan annually. The plans are sent to KSCQZD for review and comment. The intensity of and methods used for surveillance work in each disease focus are determined based on previous outbreak data, as well as on a multiyear analysis of the epizootic situation in individual foci. As a result, the surveillance programs differ for each focus and for each facility.

If the monitoring process suggests that a natural focus has become active, AP specialists institute the following control measures. AP personnel set up a mobile laboratory or open an existing seasonal laboratory and then collect rodents and other animals, as appropriate. The collected field material is then checked for ectoparasites. AP specialists also extract samples of blood and organ tissue for serological testing for antibodies to disease agents. The collected ectoparasites are then processed and cultured for *Y. pestis,* or other bacteria or viruses as applicable, at the field laboratory. If negative, the sampling continues for the predetermined length of the expedition. If positive, the samples are transported to the parent AP station for confirmation and further analysis. In addition, the area of the natural focus is treated with rodenticides and/or insecticides. If villages are located nearby, AP personnel will apply rodenticide in powder form around a perimeter located 0.5 km from the inhabited area, including in holes where the rodents live. AP staff may also decide to conduct village-wide immunizations of the inhabitants and public outreach work on plague prevention.

When an AP field team recovers a pathogenic strain during its investigations, it creates a "strain passport," which is a document containing the following information: the strain/serotype number, date of isolation, date when the host was caught, date of inoculation into media, method of isolation, growth in liquid medium, and reaction to glycerin. Whenever possible, additional tests are conducted at the field/regional station, such as the phage test.[125] The results of these tests are added to the strain passport. The strains identified by the AP stations are then sent to KSCQZD, which confirms the strain type and conducts further analysis to identify the characteristics of the strains. After completion of the confirmatory analysis at the institute, regional stations are allowed to keep non-virulent strains in their collection. Virulent strains can be stored only at KSCQZD's culture collection, and regional AP stations must destroy all original or duplicate samples they might possess. All destructions and transfers are documented at the AP stations, with copies sent to KSCQZD.

The general health-care system serves as an adjunct to the AP system, by routinely monitoring people living in or traveling through plague and other enzootic areas. In areas where health services are sparse, a network of sanitary specialists with special training in the clinical aspects and prevention of plague are responsible for alerting medical authorities if a case arises. Additionally, veterinarians are trained to differentiate plague symptoms in camels which are the most common domestic animal carrying the disease. In many rural areas of Kazakhstan, most notably in Western Kazakhstan, humans become infected when they slaughter sick animals for their meat and/or hide.[126]

In practice, however, due to the financial constraints noted previously, most AP facilities have decreased their disease surveillance activities, and the control measures listed above might not be applied or may only be partially applied. In fact, all Kazakh AP stations visited by CNS staff had, on an average, decreased their monitoring activities by 60 percent since independence due to a simultaneous lack of funding, equipment, and qualified staff (see Table 4). Monitoring campaigns were shortened from two or three months during the Soviet era, to two to four weeks as of 2004 as a result of a lack of reliable transportation at AP facilities. Often old military trucks made in the 1960s and 1970s were the only means of transport. Due to lack of maintenance and repair since independence, many of these trucks were out of service at the time of the CNS site visit, decreasing the mobility of AP teams. This is in sharp contrast with Soviet times, when AP personnel had small aircraft at their disposal that took them where they were needed to be. The aircraft also re-supplied field teams, allowing for extended monitoring campaigns. Due to their decreased mobility, most AP facilities can now monitor only a third to one half of the territory falling under their responsibility.

Taking into consideration that most of the natural plague foci in Kazakhstan are active, this situation created a risk that a potential epizootic outbreak could remain undetected until it affected nearby communities. This became more probable with the development of the petroleum and natural gas sectors because areas that once were uninhabited are increasingly becoming populated due to growing economic development. In addition, due to the lack of monitoring, AP scientists and epidemiologists can no longer thoroughly investigate the cyclical characteristics of natural plague foci.

As of 2004, most of the AP stations had also decreased their analytical activities for financial reasons. In theory, regional AP stations should have been sufficiently equipped and supplied to correctly characterize the properties of strains isolated by field stations. In reality, regional AP stations conducted only preliminary testing of isolated strains, and then transferred the strains to KSCQZD for complete analysis. In addition, due to financial constraints, most AP stations have either cut back or entirely stopped their research activities.

Financial constraints also hampered the regular transfer of isolated strains. In Soviet times, each AP station had extensive culture collections of pathogens, because as new strains were isolated and identified they were stored at the station that discovered them. As a result, pathogen culture collections at AP stations tended to grow annually as the stations' field teams recovered an increasing number of bacterial strains. After independence, the Kazakh government adopted new regulations to centralize pathogen storage at KSCQZD.[127] In theory, all pathogen transfers from regional stations to KSCQZD should be performed through a courier service of the Kazakh post office called "*Spetspochta*" (special postal delivery service). *Spetspochta* provides armed guards to safeguard cultures during transport and, in theory, the state budget covers payment for this service. The transfers of strains from field AP stations to regional AP stations typically take place at the end of each monitoring campaign, while transfers from regional AP stations to KSCQZD usually occur on a semi-annual basis.

In reality, however, very few facilities could transfer their isolated strains to KSCQZD as often as they should, and in general they did not use *Spetspochta*. For cost reasons, facilities with tight budgets tended to postpone transfers of strains, particularly those stations located thousands of miles away from KSCQZD. In general, the transfers of strains were accomplished by having a trustworthy person hand carry them and travel by car, train, or aircraft, depending on the distance that separates the station from KSCQZD.

Outreach activities, such as informing the local population, local physicians, and veterinarians, also were discontinued due to a lack of funding and personnel. As of 2004, only KSCQZD maintained a wide range of activities, including disease surveillance, production, and training.

## KSCQZD's Activities

As noted previously, because of its unique legal status, KSCQZD is the only AP facility in Kazakhstan that has been able to maintain a relatively healthy financial situation. As a result the institute has also been able to sustain its disease monitoring, research, production, and training activities.

### *Disease Surveillance*

In terms of disease surveillance, KSCQZD's main responsibility is to supervise the work of its regional stations and provide them with appropriate methodological guidance. KSCQZD's scientists also regularly participate in disease surveillance campaigns organized by regional stations.

### *Research*

One of the areas that remains KSCQZD's virtually exclusive domain is research. The center's main area of research concerns the study of the epizootic process in different types of natural plague foci. The institute also conducts research on priority problems in microbiology, epidemiology, prevention, clinical practices, and therapy for plague, cholera, tularemia, brucellosis, and other quarantine and zoonotic infections. In 1998, KSCQZD also instituted methods for the molecular study and identification of suspected bioterrorism materials. Equipment for this purpose was installed at the Zoonotic Disease Department.

Since 2002, KSCQZD administers Kazakhstan's national collection of microorganisms and is the national repository for high-risk pathogens. The institute's collection of live cultures contains over 2,000 strains of microorganisms[128] collected during both Soviet and recent times.

*Production*

Since Soviet times, KSCQZD has produced various biological products for diagnostic and prophylaxis of highly dangerous diseases, including plague vaccines and diagnostics, and cholera diagnostics.[129] During the Soviet period, these products were distributed to 260 facilities across the USSR. For example, about 40 facilities belonging to the ministries of health, defense, and other agencies used diagnostics based on monoclonal antibodies produced at KSCQZD.[130] In addition, the institute's products were exported to 20 countries, including countries in Asia (Burma and Vietnam), Africa (Guinea and Zaire), Latin America (Brazil), and Eastern Europe (Bulgaria and Hungary).[131]

In 2004, the institute produced 30 types of biological products that were exported to various NIS, including diagnostics for plague, cholera, tularemia, brucellosis, and other infectious diseases. KSCQZD's production component includes a nutrient media laboratory and a laboratory of experimental animals. In 2004, the nutrient media laboratory produced 90 types of media, including those required for the culturing and conservation of pathogens such as *Y. pestis*, *V. cholerae*, *B. suis*, *Francisella tularensis*, and other disease agents.[132]

*Training*

In Soviet times, the Almaty AP institute was one of the AP system's central training centers for plague specialists. Since its foundation in 1950, the institute's training department has trained over 3,000 physicians, zoologists, and biologists from Russia, Ukraine, Byelorussia, Moldova, Georgia, Azerbaijan, Armenia, Uzbekistan, Kyrgyzstan, and Kazakhstan, as well as from the Soviet MOD. Those attending became specialists in high-risk infections. Starting in 1970, the institute also provided training in high-risk infections to specialists from Vietnam, Mongolia, Burma, China, Cuba, and Laos. In 1989, the institute offered a specialization course for physicians, and in 1994 a similar course was developed for biologists.[133] Later, a comparable course was developed for laboratory technicians as well.

After the Soviet Union's dissolution, the number of trainees decreased due to financial difficulties besetting Kazakhstan and neighboring Central Asian states. The condition of KSCQZD's training equipment and materials also deteriorated. In spite of these difficulties, training activities have been maintained.[134] In 2004, the training department had a classroom of laboratory counters with glass protection windows for 30 students, enabling individual bacteriological research on many of the most dangerous disease pathogens. The institute also used one biosafety level II cabinet located in the molecular laboratory for student demonstrations. After independence, the KSCQZD also started organizing seminars for physicians and laboratory employees of the Kazakh SES.

As of 1999, 2,500 SES physicians and laboratory employees had been trained at the institute.[135]

### 3. Analysis of the Kazakh Anti-plague System's Weaknesses and Proliferation Potential

The main proliferation threats identified in Kazakhstan include the risks of pathogen theft or diversion, brain drain, and threats associated with unauthorized transfer or theft of laboratory equipment.

*Risks of Pathogen Diversion*

The risk of theft of dangerous material from AP facilities was in 2004 one of the highest proliferation threat posed by the AP system. It stemmed from the absence of appropriate physical security measures at AP facilities, the weak chain of material custody and the lack of background checks for new personnel.

<u>Poor physical security measures</u>

As of 2004, apart from KSCQZD, most Kazakh AP facilities had little or no biosafety equipment and only modest to negligible physical security.

In 2000–2001, a number of security upgrades were introduced at KSCQZD under the CTR Program, and have been reinforced since then. The outer perimeter of the Center was reinforced with a new concrete fence topped with razor wire, a new guard station and metal gates. To improve visibility, trees and bushes were removed, and several obsolete buildings were torn down. In addition, outdoor light poles as well as façade lighting were installed. Workrooms containing dangerous pathogens are now protected 24 hours a day by trained and armed guards. Each laboratory has metal doors with combination locks that prevent unauthorized access. The windows and air conditioners were protected with metal grids, and the windows and doors equipped with electrical alarm systems connected to a central control post at the guard station.

Most of the other AP facilities however remained largely accessible to outsiders. For instance, during our visit to one station, we witnessed local inhabitants entering the grounds of a regional station through a hole in the fence to take a short cut to the city. The local population also used the station's grounds as pasture for sheep and goats, and occasionally cut trees located on the station's grounds for firewood.

Most stations were guarded by unarmed pensioners, and had no check points, pass system, or alarm system.[136] Some stations presented additional threats due to their location in the midst of residential areas, increasing the risk of dangerous consequences from a laboratory accident.

Stations' directors were aware of these vulnerabilities and some took steps to improve security. For instance at one facility, the management fitted iron bars over windows, covered the doors with metal sheets, placed safes inside the laboratory to store cultures, and set up an alarm system with multiple sensors on walls, windows, and doors. The station's management also organized security training for personnel, reminding them of the sensitive nature of their work. The employees were warned against discussing the specific content of their work with outsiders. Although several directors told CNS staff that intruders have penetrated their facility's grounds on several occasions, they added that the perpetrators only intended to steal coal or scrap metal stored outside the buildings. As of 2005, no attempt had been made to break into the buildings.[137]

Weak Material Chain of Custody

None of the AP stations visited by CNS staff had a reliable communication system to communicate with either the field teams during monitoring campaigns or with the scientists in charge of transferring pathogens to KSCQZD. The most common communication tool used in the AP system was a radio system with very limited range that many still use today. With such equipment, personnel performing work in the field are often out of reach for several days, increasing the risk that in case of an incident or accident during the isolation or transport of pathogens, the chain of custody might be broken voluntarily or involuntarily.

No Personnel Background Checks

In theory, specialists who work with group I–II pathogens must have higher or secondary medical, biological, or veterinary education and must complete a mandatory professional specialization course. Personnel working with material infected or suspected of being infected with group I–II pathogens must not be contraindicated physically (defects of the hand or impaired spatial vision), psychologically, or immunologically (congenital immunodeficiencies, hypersensitivity to antibiotics). New hires must pass a preliminary medical examination by several physicians (a general practitioner, neurologist, ophthalmologist, dermatologist, surgeon and, as appropriate, gynecologist), as well as undergo laboratory analyses and clinical studies. Letters of recommendation and personnel files from previous employers or schools are also requested. New hires have a probationary period of two months, during which they are introduced to working with group III and IV pathogens.

In reality, however, most facilities to this day do not conduct any background checks. In some cases, good health and appropriate degrees are the only criteria for hiring new staff. In addition, the AP system has traditionally favored employing members of the same family. During Soviet times, this helped reinforce loyalty to the AP institutes and stations. Today, this characteristic continues to help support loyalty in time of crisis and transition. However, it also increases the risk of an insider threat, as members of one family may avoid reporting on each other in case of wrongdoing or could even collude to remove strains or allow unauthorized access to the station. Considering this, the two-man rule applicable to laboratory work with dangerous pathogens has little effect. In the absence of appropriate security systems and with no background check for newly hired employees, the insider threat was and remains very high today.

*Risk of Brain Drain*

Some Kazakh AP personnel have worked directly on Problem 5 projects and others were trained or spent part of their careers in Russian AP facilities, which concentrated most of the BW-related work conducted in the Soviet AP system. Because of this, they could have BW-related knowledge that poses a direct proliferation threat. The risk of brain drain is increased by the low salaries at AP facilities, and the fact that several facilities are located on drug and arms trafficking routes crossing Kazakhstan and going north to Russia, and south towards Iran and Turkey through Uzbekistan.

It is important to note however, that because the Soviet BW research program was compartmentalized, the proliferation potential of each person may vary considerably. Unfortunately, due to the lack of historical data—AP facilities tend to not keep personnel records—it is difficult to identify the personnel with specific BW knowledge, which makes the development of brain drain prevention programs a daunting task.

*Risk of Transfer of Dual-use Equipment*

Most of the equipment (thermostats, autoclaves, etc.) used at Kazakh AP facilities during CNS staff visits dated back to the 1970s and 1980s. Because the equipment was outdated and unreliable it did not present a substantial proliferation concern. Even though terrorist or criminal groups might have found it useful to steal some items required to grow and propagate small quantities of classical pathogens suitable for contaminating food and beverages, any theft or transfer of laboratory equipment by insiders would have been immediately obvious given the shortage or total lack of replacement funds.

## Chapter VI: The Anti-plague System of Kyrgyzstan

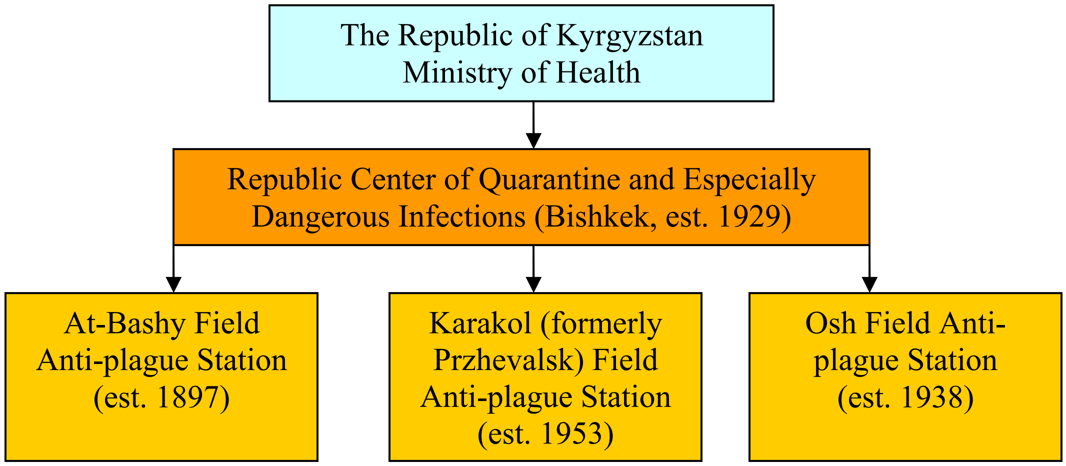
### 1. History of the Kyrgyz Anti-plague System

Plague outbreaks in neighboring China, Iran, and Afghanistan were the main reason why Tsarist authorities opened eight medical observation outposts along the Semirechenskaya *oblast*-China border in 1897. At the time the Semirechenskaya *oblast* incorporated the entire territory of present-day Kyrgyzstan and it was administered by the Central Asian general-governorship directly appointed by and accountable to the Tsar. The first medical observation outpost was established in the settlement of At-Bashy (Naryn province of Kyrgyzstan) on February 6, 1897.[138] However, the deterioration of the epidemiological situation continued, with plague outbreaks in the mountainous Tyan Shan region of Kyrgyzstan occurring in 1907, 1908, 1910, and 1913. After the Bolshevik Revolution of 1917 and the overthrow of the Tsarist government, Kyrgyzstan's Soviet authorities responded to a plague outbreak in the village of Bashkaindy in 1928 by establishing an AP laboratory in Frunze, Kyrgyzstan's capital, in 1929. The nascent Kyrgyz AP system expanded in the 1930s and thus was able to provide epidemiological monitoring to the rest of the country. AP laboratories were set up in Przhevalsk (northeastern Kyrgyzstan), Osh (southern Kyrgyzstan), and At-Bashy (in the north).[139] In 1939, the AP laboratory in Frunze was upgraded to an AP station and the three AP laboratories were placed under its administrative control. In 1943, the At-Bashy AP laboratory was reorganized into a field AP station, followed by similar reorganizations of AP facilities in Przhevalsk and Osh in 1947. Throughout the Soviet period, the official title of the AP station in Frunze was the Central AP Station or Republic AP Station. In Soviet times, the Central AP Station was directly subordinate to the Main Directorate of Quarantine Infections of the Soviet MOH. Until 1949, the Russian Scientific-Research AP Institute "Microbe" (in Saratov, Russia) oversaw the activities of the Central AP Station in Kyrgyzstan. From 1949 until 1991, the Scientific-Research AP Institute of Central Asia (now A.M. Aikimbayev Kazakh Center for Quarantine and Zoonotic Diseases in Almaty, Kazakhstan) provided methodological and scientific guidance and oversaw epidemiological activities carried out by the Kyrgyz AP system.[140] In April 2001, the Central AP Station was renamed the Republic Center of Quarantine and Especially Dangerous Infections (RCQEDI). It is subordinate to the Kyrgyz MOH.

### 2. Public Health Activities of the Kyrgyz Anti-plague System

As of May 2003, the Kyrgyz AP system was comprised of the RCQEDI in the capital Bishkek and field AP stations in At-Bashy, Karakol, and Osh[141] (see Figure 7). The Kyrgyz AP system employed 156 persons in 2003, including 23 physicians, 8 zoologists, 42 laboratory technicians, and 61 auxiliary personnel (disinfectors, sanitary workers, drivers, guards, etc.). The RCQEDI was comprised of a Plague Laboratory, a Bacteriological Laboratory, a Cholera Laboratory, a Laboratory of Arboviruses, a Zoological-Parasitological Department, and a Vivarium. RCQEDI's public health activities included epidemiological monitoring of natural plague foci, as well as sites where other highly dangerous diseases occurred.

**Figure 7. Organizational Structure of the Kyrgyz Anti-plague System**




As of 2003, natural plague foci covered 16 percent of Kyrgyzstan's territory (188,500 sq. km). As a result of systematic epizootic studies of the environment from 1939 to 1955, the Kyrgyz AP service discovered and mapped the boundaries of two natural plague foci—Tyan Shan and Alay. The Tyan Shan natural plague focus is the largest, covering 12,000 sq. km located in the northern part of the country. The Alay natural plague focus covers 3,500 sq. km in southern Kyrgyzstan. In 1974, The Kyrgyz AP system discovered a third focus – Talas, in western Kyrgyzstan. The Talas focus is about the same size as the Alay focus. There are two main natural plague hosts in Kyrgyzstan—the grey marmot in the north (Tyan Shan focus) and red marmot in the south (Talas and Alay foci). In Soviet times the Kyrgyz AP system carried out massive vector elimination campaigns during which epidemiological teams sprayed large quantities of DDT pesticide into rodent burrows. These measures reduced the ectoparasite population of rodents, thus epizootic activity declined by 50-100 percent over a territory of 10,000 sq. km. The *Y. pestis* strains isolated in Kyrgyzstan were sent to the Scientific-Research AP Institute of Central Asia in Almaty, Kazakhstan, for further research and scientific studies.[142]

The last plague outbreak in Kyrgyzstan was in 1942 on the territory of the Tyan Shan focus and involved the Aq-Bulan and Qayrma villages in Issyk Kul *oblast*. According to the RCQEDI administration, as of May 2003, the last time *Y. pestis* was recovered in Kyrgyzstan was in 1998.

During the Soviet era, the Central AP Station and its subordinated field AP stations dispatched 12-15 epidemiological teams to monitor the natural plague foci annually. After independence, due to the cutoff of state funding, the Kyrgyz AP system could deploy only 2-3 epidemiological teams for 20-25 days annually. During July-August 2002, the RCQEDI sent two epidemiological teams; their responsibility was to survey 2,500-3,000 sq. km of territory where the natural plague hosts were the most active. However, this still does not yield enough epizootic data to construct an accurate picture of the epidemiological situation within a given focus. With its meager budget (for 2002, it was 3,164,000 Kyrgyz Soms [KGS] or approximately $70,000), the RCQEDI could not afford to send employees to check on the work conditions at the sanitary-quarantine checkpoints located in the vicinity of the ports of entry on the border with China, even though sanitary protection of the state borders from import of especially dangerous infectious diseases to this date remains one of its primary functions. The RCQEDI management admitted to CNS staff that the aforementioned sanitary-quarantine checkpoints were old and very poorly equipped mobile trailers.[143]

The Kyrgyz AP system took over epidemiological control of cholera in Kyrgyzstan after a cholera epidemic struck the Autonomous Republic of Karakalpakstan in Uzbekistan in 1965. In Soviet times, the Central AP Station used to send *V. cholerae* strains to the Scientific-Research AP Institute in Rostov, Russia. After independence, whenever regional or district-level bacteriological laboratories of the SES isolate strains of *V. cholerae*, these strains are sent to the RCQEDI for further analysis and confirmation.

In 1984, the Kyrgyz AP system was given responsibility for controlling anthrax. Since then, AP specialists have found 1,235 sites from which anthrax bacteria are recoverable. Before the USSR's dissolution, the Central AP Station sent whatever *Bacillus anthracis* strains it recovered to the Irkutsk Scientific-Research AP Institute in Russia for analysis. After 1992, the cutbacks in government funding have forced the Kyrgyz AP system to reduce the epidemiological monitoring of these anthrax bacteria containing sites. Nevertheless, between 1992 and 2003, 1,235 soil samples were tested for anthrax bacteria; of these, 647 were positive. Of the sites from which these came, 498 were covered with concrete slabs and 368 were fenced off to prevent farm animals from grazing in fields containing contaminated soil. The geographic distribution of anthrax-containing sites is skewed towards the northern provinces of Chuy (485 sites) and Issyk Kul (124 sites). Preoccupation with zoonotic diseases such as anthrax contributed to the development of good working relations between the Kyrgyz AP system and the Kyrgyz veterinary system. With regard to anthrax, the epidemiological situation is tense in the southern provinces of Kyrgyzstan, where there has been a steady rise in human cases, mostly attributed to the improper slaughter of infected cattle.[144] It bears noting that after the 2001 U.S. anthrax letter scare, the RCQEDI administration decided to destroy the strains of *B. anthracis* it had in its culture collection.[145]

Apart from plague, anthrax, and cholera, the public health mandate of the RCQEDI includes brucellosis, TB, tick-borne encephalitis, rabies, rickettsial diseases, tropical fevers, spotted typhoid, leptospirosis, yersiniosis, and ornitosis. However, the expansion of RCQEDI's responsibilities was not matched with a corresponding increase in state funding, leaving the organization struggling harder than ever with the problem of limited resources and increased responsibilities.[146]

The chronic lack of state funding had resulted in cutbacks on performing routine building maintenance and as a result the infrastructure was crumbling. This was evidenced by leaking water pipes on the center's first floor. The majority of the laboratory equipment used by the Kyrgyz AP system is antiquated, increasing the likelihood of accidents that could pose a major public health hazard if not quickly contained. While RCQEDI staff appears to follow Soviet-era instructions with regard to its work with pathogens of especially dangerous infectious diseases, the biosafety level nevertheless is low due to the bad state of the infrastructure. Further, the accounting of pathogens was carried out on paper logs, which could be easily forged, tampered with or even destroyed. In Soviet times, Kyrgyz AP specialists underwent rigorous specialization training at the Rostov Scientific-Research AP Institute. After independence, such training is no longer available and, therefore, the overall level of professionalism among the Kyrgyz AP personnel has sharply decreased. As the RCQEDI director told CNS staff, there is a dire need for reinstituting educational exchange programs that would allow him to send young Kyrgyz AP specialists for professional training to AP institutes in Kazakhstan or Russia.[147]

### 3. International Activities that Involve the Kyrgyz Anti-plague System

The Kyrgyz AP system in 2003 was completely funded by the MOH and, as far as we were able to discern, received no outside assistance of any substance. RCQEDI's director mentioned that some years previously, they had received assistance during a cholera outbreak from Doctors Without Borders, but this seemed to be limited to re-hydration solutions and antibiotics. As of this writing, Kyrgyzstan has not signed a bilateral agreement with the U.S. so it therefore remains outside the CTR Program.

### 4. Analysis of the Kyrgyz Anti-plague System's Weaknesses and Proliferation Potential

There is no sign of any Kyrgyz AP facility having taken part in the Soviet BW program. This being the case, the main proliferation threats emanating from the Kyrgyz AP system are related to the physical protection of pathogens during their transport from remote field AP stations to the RCQEDI and their subsequent storage at the RCQEDI's Museum of Live Cultures. In 2003, pathogens collected in the field were transported by any available means to Bishkek, including unguarded personal automobiles and motorcycles. The physical security of the building housing the RCQEDI was obviously inadequate, with broken fences and poorly trained part-time guards.

## Chapter VII: The Anti-plague System of Moldova and Its Successor Establishment

### 1. History of the Moldovan Anti-plague System and Its Successor

The Republic of Moldova (hereafter Moldova) is a land-locked country in South-eastern Europe, bordering Ukraine in the east and Romania in the west. It covers 33,843 sq. km, 80 percent of which is arable land, crops, and pasture. Moldova has 4.3 million inhabitants, 752,000 living in Chisinau, the capital city. The country is the most densely populated of the NIS, with a population density of 124 people per sq. km. Approximately 54 percent of the population lives in rural areas with agricultural and food processing activities dominating the economy. Between 1993 and 1999, Moldova's GDP decreased by about 60 percent. In 2000, per capita GDP was $353.50. Wages are often paid substantially in arrears. More than 90 percent of the population in 2001 lived on less than an equivalent of $1.00 per day. Moldova has had uninterrupted negative net migration since 1982, with the population shrinking at a rate of -0.32 percent per year, mostly due to emigration. The country's administrative units consist of 32 *raions* (*raioane*), 3 municipalities (*municipiul*), 1 autonomous territorial unit (*unitatea teritoriala autonoma*), and 1 territorial unit (*unitatea teritoriala*).

There are four epizootic regions in Moldova. In the north, there is the Faleshti-Glodeni region; in the center, the Codru region; in the south, the Vulcaneshti and Cahul region; and in the east (the Transnistrian region), the Curciurgan region. However, as with Ukraine, Moldova has no natural plague focus.

The Moldova AP Station was established in Chisinau in 1972.[148] The direct reason for the establishment of the station was in response to two severe outbreaks of cholera that occurred in 1970 and 1971 in Moldova. In addition to cholera, the station was given responsibility for studying tularemia and anthrax, both which exist in natural foci in Moldova. It reported to the Scientific Research AP Institute at Rostov-on-Don.

In the 1980s, the AP Station employed 81 persons, including 14 doctors and 28 lab technicians, with the remainder being auxiliary personnel. In addition, the Station had a field staff of 2 zoologists, 2 lab technicians, 1 doctor, and 2 assistants. At that time, the Station was well supported so it possessed all that was needed to perform adequate field studies—equipment, supplies, and enough people. The Station then possessed eight vehicles, including 4-wheel drive trucks, for use on field expeditions. The Station sent field expeditions to each of the four epizootic regions on an annual basis to monitor disease activity. Samples collected from rodents and the environment were frozen and sent for analysis to the Station in Chisinau. All cultures of anthrax, cholera, and tularemia bacteria recovered by the Station were sent to the Rostov AP Institute for confirmation. In addition, specialists from Rostov came to Chisinau twice a year for consultations. Moldovan AP Station workers also were dispatched every year to the Aralsk region in Kazakhstan because there was a need for more experts to perform field studies than were available at the Alma-Ata Central Asian AP Institute.

At the end of 1991, the AP Station stopped receiving funding from the Soviet MOH and, equally disastrous, it received no funding from the newly established republic. Therefore, the Station could no longer be sustained and it was closed down in early 1992. Its specialists were sent to work at the Moldovan SES's station in Chisinau and its culture collections of bacterial strains that cause cholera, tularemia, anthrax, and yersiniosis were destroyed. Only a few cultures of *Yersinia pseudotuberculosis,* and *Y. enterocolitica* were saved for use in serological studies. What used to be the AP Station's laboratory became a SES HIV/AIDS laboratory.

In 1992, the republic's government established the National Scientific Practical Center of Epidemiology and Hygiene, where the AP specialists relocated. The center was renamed the National Scientific Practical Center of Preventive Medicine in 1994. It reported to the Chief Sanitary Doctor of the State who, in turn, reported to the vice-minister in charge of sanitary-epidemiological issues at the Moldovan MOH. The National Scientific Practical Center of Preventive Medicine had a General Epidemiological Center and the Virology Section. The General Epidemiology Center has a Section of Conventional and Extremely Dangerous Diseases that, in effect, took over the functions of the former AP station. In 2004, its main functions related to performing epidemiological surveillance of dangerous diseases caused by bacteria, the most important being those that cause anthrax, leptospirosis, tularemia, brucellosis, cholera, and other waterborne diseases. The Section had a laboratory where work was carried out on group II pathogens; if a suspected group I pathogen was recovered somewhere in Moldova, it was immediately destroyed or dispatched to the M.P. Chumakov Institute of Poliomyelitis and Viral Encephalitis in Moscow with which it retains good relations. The Section's laboratory housed a small culture collection that includes strains of *Bacillus anthracis*, *Francisella tularensis*, *Leptospira* species, *V. cholerae*, and *Y. enterocolitica*.

In 2004, 12 SES field stations reported to the General Epidemiological Center. Each field station has two general sections. The first section conducted epidemiological studies in its area of responsibility. The second section consisted of four laboratories for conducting studies in hygiene, food sanitation, water sanitation, and environment. Each field station covered a specific region of Moldova. In Soviet times each of the republic's 32 *raions* had a field station, but since 1991 there were insufficient financial or human resources to support such a widespread network.

The Section of Conventional and Extremely Dangerous Diseases had several research goals. For example, its scientists were performing studies on the epidemiological characteristics of epizootic diseases; studies on natural foci of yersiniosis; studies on pathogens that cause conventional diseases in children; and studies on the sensitivity to various antibiotics of pathogens causing gastro-intestinal diseases in Moldova. The results from these studies are used by the MOH to develop methodological instructions on how to prevent and treat these diseases in Moldova. The Section currently has 12 doctors, 24 lab technicians, and 4 auxiliary personnel.

Like the salaries of other professionals employed by the government, the salary levels for scientists are very low in Moldova. A center director earns about 1260 lei per month ($90), a senior doctor at the General Epidemiology Center earns 300 – 400 lei per month ($ 22-29); a junior doctor about 250 lei ($18); and a lab technician about 180 lei ($13).[149] However, the Center has so many vacant positions that the remaining staff receives an additional 50 percent added to their base salaries. Those staff members who are recognized as possessing superior capability, which is decided by a special committee, receive an additional 100 lei per month. It usually takes 15 years on the job before this honor is granted. In winter, the Center itself needs to pay for its heat and other utilities so it secures this funding by dunning its staff's salaries. To visualize how low these salaries are, the minimum estimated living costs for family of four in Chisinau is about 1200 lei ($85) and to live normally, more than 2000 lei ($142).

The National Scientific Practical Center of Preventive Medicine's Virology Center was established in 1995. It used to be located in the Center's headquarters, but in 2000 moved to a separate building that has better security and whose research "boxes"[150] were better suited for viral work. The Center currently consists of four laboratories: the Laboratory of Viral Hepatitis; the Laboratory of Diagnostic Poliomyelitis and Enterovirus Infections; the Laboratory of Infectious Respiratory Viral Diseases (including SARS); and the Scientific-Practical Laboratory, which concentrates on herpetic diseases, especially Herpes zoster and Herpes simplex. For extremely dangerous viral infections, like rabies, specimens are sent to the Center for Extremely Dangerous Infections for study. In case the Virus Center needs to turn to a reference laboratory for assistance with an especially difficult diagnosis, its main contact is the M.P. Chumakov Institute of Poliomyelitis and Viral Encephalitis in Moscow.[151] The Center's scientists have had a close working relationship with the Institute since 1966.

The Virology Center employs 30 persons, including 12 doctors and 14 lab technicians. Its funding comes from the MOH through the economic section at the National Scientific Practical Center of Preventive Medicine. The Virology Center never receives enough money for equipment and supplies. Its staff is also poorly paid, receiving the same rates as those described above.

**2. Public Health Activities in Moldova**

Several decades of progress in reducing the incidence of communicable diseases during the Soviet era were reversed for a number of illnesses in the years following independence. Increasing poverty, weakened prevention and control programs in the early period after independence, and increasing international travel of the population were the most likely causes for the worsening of public health. The health sector budget dropped dramatically both in terms of the percentage of GDP allocated to health and in actual health expenditure per capita. The severe lack of funding for the health sector combined with an emphasis on tertiary care and continued use of non-standard and more costly treatment protocols for some conditions (for example TB, child birth, and mental illness) has threatened the provision of the most basic health services, including vaccination, for the Moldovan population. The national vaccination service almost stopped altogether between the years 1990 and 1993 due to a lack of resources. Physical deterioration of facilities and equipment and a lack of basic drugs and contraceptive devices are a reality for many medical centers and research institutions.

In 1995, Moldova experienced a public health crisis. More than half of its population was not receiving health care, morbidity rates from infectious diseases had almost doubled, and sexually transmitted diseases were becoming epidemic, as was TB. Alcohol-related diseases were at an all time high level. The international community came to recognize Moldova's dire situation, so assistance started to arrive from the WHO, international and bi-national aid agencies, and nongovernmental organizations. Also, the Moldovan government took substantial steps to reform health care delivery and disease prevention programs. As a result, life expectancy has increased, maternal and infant mortality rates have declined, and the incidence of syphilis and TB has decreased. Nevertheless, a 2003 World Bank study found that "Moldova faces a dual, evolving epidemiological profile with the presence of diseases typical of developing countries (infectious and parasitic diseases) as well as a high rate of diseases typical of developed countries (cancer, accidents and cardiovascular diseases).[152] However, despite the large, and growing, burden of the second category of non-communicable diseases (which account for approximately 87 percent of all deaths in Moldova), the focus of Moldovan public health remains much as it did in Soviet times, when the emphasis of the SES was on control of communicable disease and environmental health (which account for less than 2 percent of all deaths).[153]

Moldova, like a number of neighboring countries, suffered a major diphtheria outbreak between 1994 and 1996; more than 700 people were infected during that time. A large-scale cholera outbreak also occurred in 1995. Sexually transmitted infections have sharply increased since independence, with syphilis showing one of the largest increases. In a ten-year period, sexually transmitted infections have risen by a factor of nearly thirty. Moldova has relatively few HIV/AIDS cases, with the majority being drug users. However, other estimates suggest that the country has a much higher incidence. Moldova had very high rates of viral hepatitis in the past, but the incidence has been declining since 1999. Nonetheless, Moldova's current rate of hepatitis B is seven times the EU average, mostly due to unsafe injection practices.

TB has emerged as another major communicable disease problem in Moldova, particularly among the prison population. Although coverage with the BCG vaccine is high among the Moldovan population, the incidence of TB has been rising since 1990. For example, in 1998, 65.6 cases per 100,000 people were recorded. The TB rate in prisons is much higher; in some Moldovan prisons, up to 85 percent of inmates have TB.[154] Currently, HIV/AIDS, TB, and sexually transmitted diseases are Moldova's most urgent public health problems.[155]

The MOH has overall responsibility for health care, including setting guidelines and monitoring nationwide health services. National programs administered by the ministry include the national immunization and TB control program and the national-level "republican" hospitals and research institutions (including the National Scientific Practical Center of Preventive Medicine). The MOH has departments that cover health service personnel planning, pharmaceutical regulation, mother and child health, health reform issues, medical technology, family planning, and other areas. State level research and hospital institutes, such as the Republican Institute for Mother and Child Health, and the Cardiology and Oncology Institutes, which are found mainly in Chisinau, are funded directly by the MOH and cover both service and research. The new regional health administrations report to ministry headquarters. However, the so-called Transdniestrian MOH is effectively responsible for the funding and management of the health services in its region.

The National Scientific Practical Center of Preventive Medicine was established in 1999 as part of the restructuring of the SES. It had regional offices in each of the nine new *judets* (counties) that were established in 1998 (but were replaced in 2003 by 32 *raions*). It establishes standards and guidelines for environmental health, communicable diseases, occupational health and other areas. The center focuses on communicable disease control and environmental health issues. The center was formerly the national center of the SES and, to a large extent, carries out generally the same sanitary and epidemiological activities as it did previously. The establishment of *raions*-level public health departments is planned within the next two to three years, which would bring together the center's work and is carried out through the Regional Health Administrations. The management of the national immunization program forms a key part of communicable disease activities. National TB control efforts are also being expanded and updated to be in line with international guidelines. However, prisons, where TB is concentrated, do not fall under the center's mandate. Other key programs include prevention of viral hepatitis, diarrheal diseases and cholera, anti-rabies programs and iodine deficiency disorders prevention. In Moldova, environmental health issues are of great importance due to fears that large tracts of agricultural land were heavily contaminated during Soviet times by large-scale and indiscriminate use of pesticides and artificial fertilizers. Ironically, in early 2006, Russia's Chief Sanitary Inspector, Gennadiy Onischenko, claimed that unacceptably high levels of heavy metals and pesticides had been detected in Moldovan wines and banned their import.

**3. Current International Activities that Involve Moldova's Public Health System**

The WHO has a large assistance program for Moldova to improve its public health and health provision systems. The WHO Country Office for Moldova was established in Chisinau in 1994. WHO's main assistance up to 2005 was in the following areas:[156]

- reproductive health and maternal and child health;
- control and prevention of non-communicable diseases and impact assessment of water safety;
- certification of the country as polio free;
- creation of a national list of essential drugs;
- creation of a national health information system and training of decision-makers to use data; and
- TB and HIV/AIDS.

For 2006–2007, the main planned joint activities are in the areas of:

- policy recommendations on health financing reforms;
- a performance assessment for the health system;
- human resources planning;
- the Making Pregnancy Safer initiative, linked to the national reproductive health strategy;
- to strengthen the national system for reporting and surveillance of HIV/AIDS, and improvement of prevention and care of HIV/AIDS;
- to strengthen the use of Directly Observed Therapy Short course (DOTS) for TB control;
- to address non-communicable diseases: tobacco control, cervical cancer screening, suicide prevention, violence and injury prevention, involvement of primary health care in treating the most common conditions;
- to provide for safe drinking-water;
- to strengthen the country's capacity to respond to health crises; and

- to insure blood safety.

There are other assistance programs similar to the one provided by the WHO that are operated by national agencies, such as the USAID and its European counterparts, but it is beyond the scope of this study to describe them. As far as international or bilateral agreements between Moldovan research institutions and foreign counterparts, in 2004 none could be identified. However, on December 7, 2004, Moldova joined the Science and Technology Center in Ukraine (STCU), thus becoming the STCU's fifth and newest recipient state. The STCU's Governing Board meeting notes from November 16, 2006, state that Moldovan scientists submitted 11 project proposals, and one had been funded.[157] However, no information was available about either the nature of proposed projects or the project proposal that was accepted.

**4. Analysis of the Moldovan Public Health System's Weaknesses and Proliferation Potential**

We are not in a position to analyze Moldova's public health system because unfortunately we do not have the information required for an evaluation. While some of the reports referenced in this study make a passing note of the Moldovan public health system, none provide any clues as to its effectiveness. Further, when one of the authors visited Moldova in May 2003,[158] he could not collect trustworthy information about the system at that time. He did receive anecdotal information during conversations with scientists at the National Scientific Practical Center of Preventive Medicine that public health was sadly under funded and therefore had lost most of its doctoral-level professionals to internal and external brain drain. Many professionals reportedly emigrated, especially to Russia, but there was no way to verify this information. Persons interviewed shared derisive comments over the government's plan to establish SES stations in each of the 32 *raions*, the situation in Soviet times. They alleged that there was neither funding for building nor equipping the new stations, nor to hire personnel to staff them. If the statements from Moldovan scientists are to be believed, the current Moldovan public health system is in very bad shape and barely survives on funding from foreign sources.

No Moldovan biological facility took part in the Soviet BW program and available evidence indicates that no Moldovan scientists ever worked on Soviet biological weapons issues. It is the opinion of the authors that Moldova does not pose a direct biological weapons threat. However, it is possible that an insider could steal pathogenic bacterial strains from the Section of Conventional and Extremely Dangerous Diseases laboratory's culture collection and supply them to unauthorized entities. This possibility increases over time, as newly hired staff's level of capabilities is limited due to the low wages offered. Due to the Section laboratory's location, it would be difficult for an unauthorized person to enter the premises.

# Chapter VIII: The Anti-plague System of Tajikistan

### 1. History of the Tajik Anti-plague System

By the early 1950s, Soviet epidemiologists performing a retroactive study determined that a plague epidemic that struck the villages of Marzich and Anzob in the Aini district of Tajikistan in 1898 rather than having been imported actually was of local origin. This determination was further supported by the fact that landscape and ecological conditions of the Pamir Mountains are conducive for natural circulation of plague among hosts and vectors. The Soviet MOH resolved to study the possibility of the existence of natural plague foci on the territory of Tajikistan. For this purpose, the Tajik AP Station was established in Tajikistan's capital Dushanbe in 1955.[159]

Throughout the Soviet period, the Tajik AP station was subordinate to the Soviet MOH, while the Scientific-Research AP Institute of Central Asia in Almaty, Kazakhstan (now A.M. Aikimbayev Kazakh Center for Quarantine and Zoonotic Diseases) oversaw its epidemiological activities and provided methodological guidance. In the 1980s, there were 90 employees at the Tajik AP station, including 13 physicians, 7 zoologists, 2 parasitologists, while the rest were represented by the auxiliary personnel (laboratory technicians, disinfectors, sanitary workers, drivers, guards, and the like). The Tajik AP station dispatched between four and six epidemiological teams annually to carry out epizootic monitoring. In terms of organizational structure, the Tajik AP station was comprised of laboratories for plague and cholera, a zoological department, and a vivarium. It had armed guards with direct phone lines to a local police unit. The guards protected the Tajik AP station's compound on a 24-hour schedule. The Tajik AP station was relatively well financed by the Soviet MOH according to historical annual budget figures. In 1970, the budget was 209,700 rubles (the Soviet ruble then was roughly equivalent to the U.S. dollar). In 1973, the budget was 261,300 rubles, and in 1986, it was 375,000 rubles.[160]

As a result of purposeful and systematic studies, Tajik AP scientists discovered the Gissar Mountainous natural plague focus in 1970. The first strain of *Y. pestis* was isolated in Tajikistan in 1970 as well. It was found that the strains of *Y. pestis* isolated in the Gissar focus had slightly different characteristics than strains found elsewhere, so Tajik AP specialists named them *Y. pestis Gissarica*. The main natural plague host in the Gissar focus is the juniper vole (*Microtus juldaschi*). The Tajik AP service also discovered and mapped potential plague foci, where plague epizootics occurred periodically in the rodent reservoirs but no strains of *Y. pestis* were isolated. The regions identified were in the Jirhital district (on the border with Kyrgyzstan), Kusmangir region adjacent to the Karadum Desert (on the border with Afghanistan), and Istravshon district (on the border with Uzbekistan).[161]

After the Soviet Union's dissolution, Tajikistan suffered a severe economic downturn. As the Tajik AP system came under the jurisdiction of the cash-strapped Tajik MOH, it was deprived of almost all funding. But the breaking point occurred when the Tajik Civil War (1992-1997) broke out. The Tajik AP station happened to be located along one of the many frontlines between the Islamic militants from the United Tajik Opposition (UTO) and the pro-government secular armed forces of the Tajik military. There were frequent incursions of UTO militants onto the premises of the Tajik AP station, invariably accompanied by looting and destruction of property. The UTO militants were, however, not interested in laboratory equipment or pathogens. Instead they expropriated vehicles and stole refrigerators, air conditioning units, gas heaters, and auto parts. Soon after the outset of hostilities in 1992, the Tajik AP station's workers decided to destroy the station's cell culture collection in order to prevent the pathogens it contained from falling into the wrong hands. This was done by opening the vials containing the pathogens and submerging them in a large bucket containing Lysol disinfectant liquid. Documentation of the destruction was sent to the Tajik MOH and copies were stored at the Tajik AP station.

In 1992, Tajik militants overpowered the station's guards and then physically abused the then Tajik AP station's director, Dr. Kazimir Derlyadko. He fled to Russia soon afterwards, as did the majority of the Slavic (Russian and Ukrainian) staff members. As the non-Tajik staff members constituted the core of the Tajik AP station's expertise, this loss of staff largely destroyed the functionality of the Tajik AP station; only a small and primitive cholera laboratory continued to operate.[162]

**2. Public Health Activities of Tajikistan's Anti-plague System**

When the CNS staff visited the Tajik AP station in May 2003, it had the opportunity to interview a veteran AP worker, and the last remaining member of the Soviet-era core staff of the Tajik AP station, Dr. V.S. Maiboroda. According to Dr. Maiboroda, during the Tajik Civil War the deterioration of security situation outside Dushanbe made it impossible to carry out regular epidemiological monitoring of natural plague foci or undertake other field investigations. When in 1997 the Tajik AP station dispatched an epidemiological team for one month, the team members encountered different groups of militants, who expropriated the team's camping gear and gasoline. In 2000 and 2002, under his personal initiative, Dr. Maiboroda, accompanied by two assistants traveled to the Gissar focus to conduct at least a partial epizootic reconnaissance by determining the approximate population of rodents. The duration of these missions was limited to ten days.[163]

In May 2003, the only functional unit of the Tajik AP station was the cholera laboratory. Cholera is a substantial problem in Tajik areas adjoining Afghanistan, where there are large numbers of refugees. The cholera laboratory sporadically carried out bacteriological tests of water samples for the presence of the strains of *V. cholerae*. The Tajik MOH provides meager funds for this water monitoring.

The Tajik AP station's annual budget in 2003 was 10,582 Tajik somoni (TJS), which was roughly equivalent to $3,425. Of this, more than half was used to pay the salaries of 63 employees. As is practiced elsewhere in the former Soviet republics, the administration of the Tajik AP station deliberately inflated the station's staff level with "dead souls" in order to receive more state funds. Thus, while officially the station had 63 employees, in actuality there were 35 (and many of these were hardly ever seen). The monthly salaries were extremely low; for example, the station's director's salary was 34 TJS ($12) per month, while a physician with 13 years of professional experience received 19.8 TJS (less than $7). With these low salaries, it was close to impossible for the station to attract qualified cadres. In order to offer additional incentives, Dr. Maiboroda promised the new hires (who were mostly from rural provinces) living quarters on the station's compound. However, after working for about a year many quit, but continued to occupy the quarters they had been provided without fear of being evicted. Some of the former employees even managed to illegally privatize their accommodations. As a result, squatters appropriated many of the station's living quarters.[164]

**3. International Activities that Involve Tajikistan's Anti-plague System**

Although certain national and international aid organizations are active in Tajikistan, including the USAID and the CDC, the Tajik AP system was not benefiting from this assistance as of late 2004.

**4. Analysis of the Tajik Anti-plague System's Weaknesses and Proliferation Potential**

The Tajik AP system in 2003 had only one function, to perform minimal cholera surveillance. It is deficient in all aspects; leadership, human resources, facilities, equipment, and supplies. In view of these vast problems, a detailed analysis of the system is pointless.

The existence of the Gissar natural plague focus should prompt the Tajik government to attempt to revive the Tajik AP station and system. From this point of view, the appointment of a young former SES physician in April 2003 as the director of the station served as the promising sign. However, he faces enormous challenges, the chief one among them was the chronic shortage of funds coupled with the apparent indifference of Tajik MOH officials.[165]

As far as our investigation could determine, no Tajik institution or scientist was involved in the offensive Soviet BW program. Therefore, there is no proliferation threat of biological weapons know-how from Tajikistan. The Tajik AP station, having destroyed its culture collection, poses no threat with regard to potential proliferation of pathogens. Its equipment has been thoroughly looted, so there is no threat from availability of dual-use equipment.

# Chapter IX: The Anti-plague System of Ukraine

## 1. History of Ukraine's Anti-plague System

Unlike other nations covered in this report (with the exception of Belarus and Moldova), Ukraine has no natural plague focus. The republic nevertheless needed to establish an AP system because throughout history its ports have been important passageways for the movement of plague from the Far and Near East to Russia and Europe. In particular, through the centuries ships carrying rodents infected with plague have arrived at Black Sea ports, particularly Odessa, Mykolayiv, and Kherson. The ships offloaded cargo along with plague-infected rodents and the people who then were instrumental in spreading the disease northward. That fact that such incidents occurred many times in the past is evidenced by the presence of eight separate cemeteries in Odessa that only contain graves of plague victims, representing the eight plague pandemics that occurred during 1793 – 1910. So, while the Ukraine AP system is small in size compared to other NIS, with just two facilities, it has a long history and remains important to Ukraine's public health today.

The main mission of the Ukrainian AP system since its establishment has been to interdict plague originating from foreign ports and preventing it from becoming established in Ukraine and spreading elsewhere. Therefore the two Ukrainian AP facilities responsible for fulfilling this mission are located in strategically important cities, namely Odessa and Simferopol.

*Odessa*

Due to the importance of Odessa as a transit point for plague, possibly the first plague epidemic control facility in the world was established in the city in 1886 by the renown Ukrainian scientists I.I. Mechnikov, M.F. Hamaley, and Y.Y. Bordakh, and named the Odessa Bacteriological Station.[166] After having gone through several name changes, in 1965 it was renamed the I.I. Mechnikov Odessa Scientific and Research Institute of Viral Diseases and Epidemiology.

In a parallel development, the Odessa Port AP Laboratory was founded within the Odessa harbor by epidemiologist M.A. Minchin in 1937. This was apparently done after the League of Nations requested the Soviet government to establish a plague laboratory because of fears of plague being imported into Europe through the Odessa harbor. This laboratory was renamed the Odessa AP Station in 1970 and, in 1997, after Ukraine's independence, was reorganized into the State AP Station of Ukraine.

The latest AP system-related development, in 1999, was that the I.I. Mechnikov Odessa Scientific and Research Institute of Viral Diseases and Epidemiology and the State AP Station of Ukraine were merged and the resulting institution was named the I.I. Mechnikov Ukrainian Scientific-Research Anti-plague Institute (hereafter Mechnikov AP Institute).[167] It is located on Tserkovna Street in Odessa city, a few miles east of a famous landmark, the Potemkinsky Stairs.[168]

Going back to Soviet times, lacking natural plague foci, plague bacteria can be found only at Ukrainian seaports in infected rodents or their ectoparasites. Therefore the most important, and dangerous, task for the Odessa AP Station throughout the Soviet era was to catch rats and mice on ships and around the harbor and culture them and their ectoparasites for pathogens. In addition to plague bacteria, over the years the station has recovered bacteria from rodents that cause cholera, tularemia, leptospirosis, and brucellosis. Beyond Odessa, the station was responsible for monitoring the situation related to plague, cholera, anthrax, tularemia, and leptospirosis in the western and northwestern parts of the USSR, although its activities were mainly undertaken in Ukraine and Moldova. Its major responsibilities were to eliminate these diseases as much as possible and to train local health officials on how to handle and test dangerous pathogens. The station worked under the Rostov AP Institute, and reported to the Ukrainian SSR MOH, which in turn reported to the Soviet MOH.

Before 1985, all of the Odessa station's work was secret, meaning that it had no contacts with any institute outside the Rostov AP Institute and other Soviet AP facilities. The station's scientists were not allowed to publish in the open literature, although some of its staff members published articles in parochial publications, such as those published by Mikrob and the Almaty AP institute. When reporting on its work, Odessa scientists had to use code words for diseases; for example, "Form 10" represented plague. With the institution of *glasnost* soon after Mikhail S. Gorbachev was elected as the General Secretary of the Communist Party Central Committee in March 1985, some of the Odessa AP station's work became public knowledge, but some remained secret. For example, the station was not allowed to reveal the number of victims of cholera, plague, tularemia, and other disease outbreaks to anyone outside the Rostov AP Institute and MOH. The first foreign visitor to the Odessa AP station, from Bulgaria, was received in 1986, but visitors from the West were not allowed until two Israeli scientists came as part of a team from the WHO in 1991. The first U.S. citizen to visit the station did so in 2000.

In the 1980s, the station employed between 120 and 130 staff members on an average, including 30 doctoral-level scientists. Usually, it would dispatch five or six field expeditions per year. Field teams could be as small as three persons or, if there was an active epidemic, up to 40-50 persons. When necessary, the Ukrainian MOH augmented teams with experts from other institutes. Teams were routinely sent to study natural foci of tularemia, cholera, CCHF, and others. For example, there were 24 *oblasts* in Ukraine and the Crimea that possess natural tularemia foci. Periodically, tularemia becomes a serious problem and large-scale outbreaks occur. For example, during 1946-1948, there were two large-scale tularemia outbreaks in the Odessa region. The reasons appears to have stemmed from the recently concluded World War II; due to a shortage of farm workers harvests lay abandoned in the fields, allowing for a tremendous increase in the rodent population that carried tularemia bacteria. Eventually, approximately 50,000 people became ill with tularemia. Although sporadic cases of tularemia occur with some frequency, since the 1940s outbreaks, Ukraine has not suffered any large-scale tularemia epidemics.

The Odessa AP Station was well supported in Soviet times so it could do all the work that it was assigned. This situation continued for the first year of Ukrainian independence, roughly through 1992. At that time, a doctoral-level scientist earned about 500 rubles per month, while a regular scientist was paid about 300 rubles per month. In addition, AP workers were paid extra bonuses when they worked with dangerous pathogens. This was a time when a person living in Odessa paid 10-12 rubles per month for a nice apartment and 20 kopeks (100 kopeks per ruble) per liter of gasoline. In general, in Soviet times scientists were considered members of a highly honored profession and were compensated accordingly.

Since the end of 1992 and beginning of 1993, the station's financial situation became dire because it did not receive funding on a regular basis from the government. Payments of salaries often were delayed and their amounts were substantially less than in Soviet times. In addition, the price of everything rose rapidly, which made it almost impossible for the station to continue doing serious work. There were several years when no field expeditions were sent out or, if one was sent out, its membership was small and remained in the field for no longer than a few days. It has only been in the last couple of years that the station's situation has improved somewhat so that it can at least perform its most important functions. Hence it has had an important role in efforts to control and eliminate cholera in recent times. Although cholera is not endemic to Ukraine, it is often imported; for example, in recent times Ukraine experienced cholera outbreaks in 1991, 1994, and 1995.

The Mechnikov AP Institute, established in 1999,[169] has slowly grown. In 2004, it employed 208-210 persons, including 43 doctors and 10 laboratory assistants who perform scientific research in the first two departments, while 30 doctors and 25 assistants work in the third and fourth departments.

Salaries at the time of the CNS staff's visit for institute workers remain much lower than in Soviet times. For example, in 2004 a deputy director was paid 600 hryvnias (HR) (about $113) per month. A regular scientist received about 400 HR ($75) per month and a new scientist about 250 HR ($47) per month. For comparison, a family needed about 2,500 HR ($472) per month to live decently in Odessa. Of this amount, a worker pays between 80 and 150 HR ($15-28) per month for a reasonably comfortable apartment, although apartment rents continue to climb.

The new institute's organizational structure and responsibilities were as follows. In 2004, the institute's director was Dr. Yurii Boschenko. Under the director, there were three deputy directors. The first was in charge of the administration and accounting, while the other two have scientific responsibilities. The first, Dr. Lev Y. Mogilevsky, was in charge of the Department of Especially Dangerous Bacteria and Virus Research, encompassing all work dealing with Groups I and II bacterial and viral pathogens. The second deputy director of science was in charge of the Department of Prophylaxis of Plague and Other Especially Dangerous Infections, a practical department that performs fundamental research on vaccinations, diagnostics, and the like. In 2004, Dr. George Stepanovich Skriptenko was the deputy director.

The Department of Especially Dangerous Bacteria and Virus Research had the following laboratories:[170]

- Laboratory of epidemiology
- Laboratory of especially dangerous bacterial natural infections
- Laboratory of especially dangerous virus infections
- Laboratory of the ecology of especially dangerous strains
- Laboratory of ecology of carriers and vectors of especially dangerous strains
- Laboratory of slow infections (prions) and AIDS

In general, the Department of Especially Dangerous Bacteria and Virus Research concentrated on performing research to clarify the evolution and development of natural foci of tularemia, leptospiroses, psittacosis, cholera and other vibrios, and arboviruses. In recent years, it developed a particular interest in arboviruses related to birds—such as CCHF virus and West Nile fever virus—because southern Ukraine is a major transit point for birds migrating from Africa to Europe and some are carriers of these viruses. However, until 2004, this department had never studied the CCHF virus directly.

The Department of Prophylaxis of Plague and Other Especially Dangerous Infections has the following laboratories:

- Laboratory of cytopathology and morphology
- Laboratory of genetics and selection of especially dangerous bacteria and viruses
- Laboratory of chemical therapy and immunological preparations

The Department of Prophylaxis of Plague and Other Especially Dangerous Infections' main objectives were to improve vaccines against tularemia and rabies. In addition, the institute had two specialized departments. The Department of Licensing performed research on inventions that result from the institute's work, to determine whether any of it can be patented. If it is determined that a patent is advisable, the department was in charge of filing patent applications. The Department of Organization of Prophylaxis of Plague and Other Infections was responsible for providing expert assistance to the SES regional stations. It had four small laboratories: the Epidemic oversight center, the Bacteriology laboratory, the Virology laboratory, and the Laboratory of carriers and vectors. This department did only practical work, such as identifying microorganisms and helping diagnose diseases.

The institute had a fairly sizeable collection of pathogens, although its administration claimed to never have had, nor have now,[171] any cultures of group I pathogens.[172] Whenever institute scientists work on a group I pathogen, it is destroyed after this work is completed. Further, the institute tries to limit its collection of non-group I pathogens, keeping only reference and atypical strains.

In 2004, the state of the institute's biosecurity was of questionable efficiency. As for physical security, the institute was better guarded than most AP facilities that CNS staff has visited, but not as well as it should be. The wall and fence surrounding the institute could be improved and more surveillance cameras would enhance biosecurity. In 2004, there was no particular threat to the institute from outsiders. There was no terrorist activity in the area. Although Odessa is the home to many criminal enterprises, some of who have international reach, to date none had bothered the institute. As far as the institute security staff was aware, there had been no unauthorized attempt to enter the institute.

*Simferopol*

The second AP facility in Ukraine is the Crimea AP Station,[173] was founded in 1971 in response to cholera pandemic that originated from Alexandria, Egypt, but that came to affect southern Ukraine. Odessa was especially hard hit, suffering approximately 125 victims, but cholera also spread throughout the Crimean peninsula.[174] The station's original mission was to provide advice, develop standard procedures, and carry out specialized work on cholera. Its first director was Galina Fedorovna Mitsevich, who previously had been the director of the Crimea Region Sanitary Epidemiological Station. The Crimean AP Station was built at Maryino, a suburb of Simferopol, where it remains today. Simferopol is located in approximately the middle of the Crimean peninsula, about 250 kilometers southeast of Odessa. The Crimean AP Station is comprised of a one-story stone building, an infectious material facility, and other working areas.

By 1976, the station's responsibilities went far beyond cholera in the Crimean peninsula; it was responsible for disease monitoring in eight regions of eastern Ukraine, as well as the seaports of Berdyansk, Mariupol, and Kherson. A new branch of preventive medicine at that time was border sanitation, which involves preventing the importation and spread of quarantine diseases from abroad. This work included developing plans for epidemiological surveillance and helping medical institutions prepare for epidemics. This type of work soon became the station's major occupation. By the 1980s, the station had begun monitoring the natural foci of diseases such as tularemia, anthrax, leptospiroses, brucellosis, and yersiniosis. In 1986, the station opened a virology laboratory to study tick-borne encephalitis, CCHF, hemorrhagic fever with renal syndrome, and West Nile fever. In this work, the station collaborated with specialists from many cities in Russia, including Nizhny Novgorod, Kaliningrad, Lipetsk, Murmansk, Rostov-on-Don, Chita, Krasnodar, and Elista, as well as cities in former Soviet republics that now are independent states, including Baku in Azerbaijan; Yerevan and Spitak in Armenia; Tbilisi in Georgia; Almaty, Aralsk, and Kyzyl-Orda in Kazakhstan; Tashkent, Andizhan, and Termez in Uzbekistan; Minsk in Belarus; Vilnius in Lithuania; and Riga in Latvia.

It is claimed that research at the Crimean AP Station led to a number of discoveries, including the identification of five phages that analyze non-01 serogroup cholera vibrios; the first isolation in Crimea from humans and the environment of halophilic and other rare vibrio species, *Yersinia enterocolitica*, and pseudotuberculosis pathogens. In addition, the station's investigators are said to have discovered and mapped natural foci of tularemia, leptospiroses, intestinal yersiniosis, tick-borne encephalitis, CCHF, and hemorrhagic fever with renal syndrome. The station's members have reportedly presented over 300 reports to international, all-union, and republic congresses, symposia, and conferences; published over 230 scientific papers in various journals; and defended 1 doctoral dissertation and 4 candidate dissertations.

In 1991, the Crimean AP Station became a part of the Ukraine MOH. However, as a result of serious economic difficulties in Ukraine, the station was downsized. Most important, the virology laboratory was closed and some experienced senior staff departed. In 1997, Aleksandr B. Khaitovich, Doctor of Medical Sciences and Professor at the Crimea State Medical University, was appointed head of the station and began working to reestablish its reputation in Ukraine (Khaitovich was still the station's head as of December 2004).[175]

In 2001, the station celebrated its 30th anniversary. Attending the ceremonies were the Chairman of the Presidium of the Supreme Council of Crimea Autonomous Republic, representatives of Ukraine's President in the Crimea Autonomous Republic, representatives of the Ukraine and Crimea Ministries of Health, the Chief State Sanitary Physician of Crimea, and directors of various government agencies. The program honored important achievements made by the station. Twenty staff members received recognition and awards from the Supreme Assembly of Crimea Autonomous Republic, the Council of Ministers of Crimea Autonomous Republic, and the Ukraine and Crimea Ministries of Health.

The Crimean AP Station currently provides health-care institutions with advisory, methodological, and practical assistance concerning border controls, prevention, and control of quarantine and other high-risk infectious diseases. Furthermore, it appears that the Crimean AP Station simultaneously serves as the Republic AP Station for the Autonomous Republic of Crimea.[176]

**2. Public Health Activities of the Ukrainian Anti-plague System**

As in other NIS countries, the state SES has the main responsibility for promoting and sustaining public health, including controlling communicable diseases and assuring environmental protection. Ukraine's AP system appears to have a very small role in public health as demonstrated by the fact that it is not even mentioned in a report published by the WHO Regional Office for Europe, which probably provides the most thorough and current overview of Ukraine's health system.[177]

The SES's main responsibilities are epidemiological surveillance, investigations of infectious disease outbreaks, monitoring food and water supplies, and identifying environmental hazards. In 2000 the SES was comprised of 778 stations and 28 disinfecting stations. At that time it employed approximately 65,000 persons, including about 11,000 medical doctors and 27,000 mid-level health workers. Its budget was part of the national budget administered through the MOH.[178]

Most of the epidemiological studies of the most dangerous infections found in the Ukraine are performed by the SES.[179] There are 30 laboratories at regional SES centers that perform initial investigations of disease outbreaks. The Central Sanitary-Epidemic Station of the Ukrainian MOH in Kiev is responsible for quality control at the regional SES laboratories, investigating errors and mistakes at regional SES laboratories, and assessing the performance of regional SES laboratories. It also provides training to the staff of regional SES laboratories on how to handle and transport samples containing dangerous organisms. It serves as a reference laboratory for all Ukrainian clinical laboratories.

In terms of the public health activities of Ukraine's AP system, there is no available information on the public health activities of the Crimean AP Station. According to the available information on the Mechnikov AP Institute's public health activities, it is probably low. The problem is lack of money; the institute's total budget in 2002 was only 1.2 million HR ($226,000). This sum appears to be sufficient to allow the institute to operate at a low level of activity, but is not enough to purchase new equipment or sufficient supplies. As far as our observations could discern, the station's ability to perform field studies is extremely limited. Our estimate is that many of the functions that were responsibilities of the AP system in Soviet times have been taken over by the SES since Ukraine's independence.

As mentioned previously, Ukraine has no natural plague foci. However, the country has problems with other dangerous diseases including anthrax, listeriosis, tularemia, brucellosis, cholera, rabies, and rickettsiosis. Further, Ukraine has some "polyinfectious" natural disease sites—sites where several types of infection exist at the same time—for example, tularemia and listeriosis. It experiences several cases of human anthrax per year and isolates of *B. anthracis* can be readily recovered from several environmental sites. Ukraine occasionally has had some cases of brucellosis, but they always were imported, usually from Turkey and Italy. Rabies, which is mainly carried by red foxes, is a continuous problem for Ukraine (as well as neighboring Germany and Poland), so AP researchers monitor the main natural reservoirs of this virus.

Waterborne infections have historically presented pressing and difficult problems to Ukraine. Of highest importance has been cholera, although typhoid fever, shigellosis, and hepatitis A and E have also been problematic.[180] In recent times, Ukraine experienced a serious cholera outbreak in 1991, caused by the contamination of the Dunay River, which originates in Rumania. The largest cholera outbreak since the 1920s, was in 1994, affecting over 2,500 persons. Contaminated waters of the river South Bug were responsible for the 1994 epidemic, with the contamination having originated in Dagestan. This outbreak continued in 1995. During 1997-2002, approximately 3,000 persons contracted hepatitis A by drinking contaminated water. Contaminated waters from shaft wells and reservoirs still remained a large problem for public health in Ukraine the time of this report. In general, cholera is most prevalent during June-September; during these months all regional SES stations have to report on local cholera status every two weeks. If any cholera isolates are recovered, the facts about them are supposed to be posted on the World Wide Web.

Ukraine has a national system of epidemiological surveillance that appears comprehensive and well organized, comprised of "…sanitary-epidemiological stations, anti-plague institutions, and scientific and research institutions of epidemiological specializations." In addition, there supposedly are "…91 sanitary units [that] act in international airports, sea and river harbors, highways and railroad stations."[181] However, according to interviews, in general the Ukrainian public health system is neither well run, nor efficient, nor comprehensive. This is mostly due to it being considerably under-funded. As an AP scientist confided, "we usually learn of disease outbreaks elsewhere in Ukraine from newspapers or television, and then in the most sensationalist and unreliable terms."[182] The questioning of other scientists throughout Ukraine elicited similar comments, to the effect that there is no central system of conveying epidemiological information of importance to public health workers and the ability of both SES and AP facilities to undertake epidemiological investigations is very low or non-existent.

It bears noting that one a governmental level, the Soviet era biosafety/biosecurity procedures were starting to be replaced in 2004 as the Ukrainian government was developing its own procedures under the direction of the Chief State Sanitary Doctor.[183] The government was following the WHO biosafety guidelines in this endeavor. The first Ukrainian protocol for biosafety procedures was to come into effect in early 2005; they deal with methods for working with group I and II pathogens. The second protocol was to be completed in late 2005; it deals with preparing for and responding to the importation of especially dangerous infections. We do not know if either protocol has actually been completed and adopted by the Ukrainian legislature.

### 3. International Activities That Involve the Ukrainian Anti-plague System

Before 2004, the Mechnikov AP Institute received no support from either international or other foreign sources. It had no sources of funding from outside sources at all; for example, it does not rent out space or perform contract research for private parties. Although we are not certain about the funding situation at the Crimean AP Station, as far as the authors are aware no Westerner has ever visited it. It therefore is unlikely that it has any support from international sources.

Perhaps the Mechnikov AP Institute's first involvement with foreign collaborators was in regards to the wetlands restoration projects during 1999-2003 that were supported by the EECNET Action Fund (EAF), whose main sponsors are Dutch agencies and nongovernmental organizations. These projects probably only paid for direct expenses incurred by institute researchers.

Theoretically, any Ukrainian biomedical institution that once had connections to the Soviet BW program could get projects funded by the STCU if they were deemed scientifically valuable. For the first time, researchers from the Mechnikov AP Institute (with collaborators from the I.I. Mechnikov Odessa National University and A.V. Bogatsky Physico-Chemical Institute in Odessa) developed a proposal called the "Elaboration of a system for drug-design and selection of effective anti-herpetic preparations using modern computer technologies," that was funded by the STCU in 2004 for the amount of $183,320. The Mechnikov AP Institute was awarded a second STCU project in December 2005, receiving almost $200,000 for a project on tularemia control, and a third in 2006, again for about $200,000, which involves nanotechnology and vaccine development. It can be expected that as its staff learns how to write proposals, the Institute will become more successful in having its proposals accepted by the STCU.

In September 2005, the Mechnikov AP Institute entered into collaboration with the U.S. Naval Medical Research Unit 3, based in Cairo, Egypt, to sample wild birds for avian influenza. By early 2006, more than 2,000 birds had been sampled.[184] This collaboration continues at the time of this writing, but how it is funded, or the amount of funding, has not been published.

Another promising development for Ukrainian biological sciences in general was that on August 29, 2005, Ukraine and the U.S. signed the Nunn-Lugar Biological Agreement (CTR Program). Under this agreement, the U.S. promises to assist Ukraine to:

- Upgrade the security for pathogens currently stored at various health laboratories throughout Ukraine;
- Significantly reduce the time required to accurately diagnose disease outbreaks in Ukraine and assess whether they are natural or the result of a terrorist act; and
- Allow for cooperation in developing better diagnostic tools and treatments to protect both U.S. and Ukrainian populations against infectious diseases. This includes leveraging U.S. laboratory capabilities to improve detection of endemic diseases in Ukraine.[185]

It is unclear how much funding this agreement will bring to Ukrainian biological sciences. At the time of the agreement, $15 million was promised the Ukrainians. However, this amount has been increased by over 100 percent by 2007, and may be further enlarged. Our estimate is that the Mechnikov AP institute and the Lviv Scientific and Research Institute of Epidemiology and Hygiene of the MOH[186] will receive the lion's share of this new funding.

## 4. Analysis of the Ukrainian Anti-plague System's Weaknesses and Proliferation Potential

There was no Soviet offensive BW facility in Ukraine, but the Lviv Scientific and Research Institute of Epidemiology and Hygiene was an important Problem 5 institution whose work program was classified. No foreigner was allowed to enter its premises until 2002. Since it did not belong to the Soviet AP system, it will not be discussed here further except to state that since it performed strictly defensive R&D, the proliferation threat it poses is probable low.

As for the Mechnikov AP Institute, its management claimed in 2003 that it knew nothing about either the Soviet offensive or defensive BW program. We question the second since it was in effect a closed facility until the late 1980s and worked on highly dangerous Group II pathogens and, probably, at least at time on some Group I pathogens since at least 1965. It would make sense if at least one of its laboratories worked on Problem 5 projects. Yet, as far as the authors can discern, the institute has a good safety record.

As for biosecurity, the Mechnikov AP institute is fairly well guarded and is surrounded by a high wall. It would be difficult for outsider to gain unauthorized access to its laboratories. Nevertheless, the possibility that insiders could supply pathogens from the institute's culture collection to unauthorized persons is a distinct possibility. In addition, it is equipped with some better than adequate equipment and associated supplies. For these reasons, the Mechnikov AP Institute does pose a not inconsiderable proliferation threat.

Since Ukraine henceforth will benefit from the CTR Program, we expect that the biosecurity aspects of the Mechnikov AP institute will substantially improve by 2009. Already plans are being developed for rebuilding its BL3 laboratory so that is will meet WHO standards for such a facility. When this and other biosecurity measures have been instituted, they will serve to substantially decrease whatever proliferation threat the institute now poses.

As for the Crimean AP Station, the authors have no way to assess its proliferation potential or whether it presents any biosafety or biosecurity threats.

# Chapter X: The Anti-plague System of Uzbekistan

## 1. History of the Uzbek Anti-plague System

In Soviet times, the Uzbek AP system was comprised of four main facilities and four field stations reporting to various government agencies. Two regional AP stations (the first, "Uzbek," located in Tashkent and the second located at Karakalpak) reported to the Soviet MOH's Second Directorate.[187] The Uzbek and Karakalpak regional AP stations had two AP field stations each, in Bukhara and Zarafshan, and Takhtakupir and Turktul, respectively. One railroad AP station reported to the Ministry of Railways (Tashkent). The railroad station was created in 1950, and was responsible for monitoring the land within 5 meters of railroad tracks in Uzbekistan. Its laboratories, mounted on railroad cars, traveled across the country and took samples from land on both sides of the tracks. One AP station, at Uchkuduk, serviced the Nawoiy Mining and Metallurgical Combine (NMMC) and reported to the Soviet MOH's Third Directorate.[188] Among these facilities, only the Uzbek and Karakalpak AP stations were associated with the Almaty AP institute in Kazakhstan, which provided methodological guidance to the stations and reviewed their work plans.

As in Kazakhstan, most of the AP stations were set up in response to plague outbreaks in specific areas. For instance, the Karakalpak station was founded on November 9, 1949, in the aftermath of plague outbreaks in Nukus city during 1947-1948. Similarly, as a result of two human plague outbreaks in Uchkuduk and Tamdy settlements, the Zarafshan AP station was founded on August 11, 1982, as a field station subordinate to the Uzbek regional station.

Unlike Kazakhstan, which inherited a rather coherent AP system after the break-up of the Soviet Union, Uzbekistan acquired a rather disparate set of facilities. Whereas in Kazakhstan most AP facilities were already under the authority of the Almaty AP institute in Soviet times, the Uzbek AP facilities had no unifying component. To foster some cohesion in its national AP system, the Uzbek government decided to establish the Center for Prophylaxis of Quarantine and High-Risk Infections (CPQHRI) in 1999.[189] CPQHRI was put in charge of all AP stations located in Uzbekistan. The new organization was established at the former Uzbek AP station in Tashkent and became the de facto coordinating AP facility of Uzbekistan. The Karakalpak station was given the status of a CPQHRI branch, and the other stations were subordinate to them. In 2004, the Uzbek AP system was comprised of 12 facilities: the CPQHRI, the CPQHRI branch in Karakalpak, one regional AP station, six field stations, and three seasonal laboratories.

In 2002, CPQHRI employed 741 people (station staff included).[190] Today, it reports to the Chief State Sanitary Physician and the MOH Department of Sanitary-Epidemiological Monitoring. The CPQHRI and its Karakalpak branch receive funds from the MOH and then distribute them to the subordinate AP organizations.

As lead agency, the CPQHRI manages, coordinates, plans, and supervises the activities of all AP facilities in Uzbekistan. The only exception is the state-owned NMMC's AP station, which functions independently and is subordinated to the management of the NMMC.

In 2004, CPQHRI was comprised of 8 laboratories, including:

- Laboratory of the National Collection of Group I-II Pathogenic Bacteria;
- Plague Epidemiology and Bacteriology Laboratory; Cholera Epidemiology and Bacteriology Laboratory;
- High-Risk Viral Fevers Laboratory;
- Zooparasitology Laboratory;
- Department of Organization and Methodology;
- Department of Culture Media Production; and
- Laboratory Animal Vivarium.

CPQHRI also created a training center to train personnel from the Uzbek AP system who dealt with diseases from group I and II and the SES, who dealt with all group II diseases except plague (see Table 2). Training sessions lasted six weeks and there were 200 to 300 trainees per year.

The Karakalpak branch functioned, and still does today, as a regional AP station having as primary areas of responsibility disease surveillance and epizootic monitoring of natural plague foci in the territory of the Autonomous Republic of Karakalpakstan. The field AP stations, on the other hand, are responsible for disease surveillance and epizootic monitoring of smaller geographic areas.

**2. Consequences of the Financial Crisis**

Uzbekistan suffered severely from the post-Soviet economic downturn. The crisis was more serious in Uzbekistan than in Kazakhstan due to its higher poverty level. Unlike Kazakhstan with its sizeable deposits of petroleum and natural gas, Uzbekistan's economy is based on traditional agriculture, mainly cotton, vegetables, and fruit. As a result of Uzbekistan's penurious state, the AP system in Uzbekistan has been seriously underfunded and since 1992 has operated with a significant deficit.

Although some Uzbek AP facilities lost personnel after the break-up of the Soviet Union, the Uzbek AP system has not endured waves of massive departures as in Kazakhstan. One of the reasons for this is that in Soviet times, the Uzbek AP system employed very few ethnic Russians, who in other FSU republics were the first to depart starting in 1992. Some Uzbek facilities actually have more employees today than in 1992. This is an artificial increase, however. In order to obtain more funding from the government, facility directors inflate the number of employees they need. They then use these funds to increase the salaries of existing employees, who end up performing the work of two people.[191]

In 2004, one of the major problems experienced by the Uzbek AP system in general was an inability to retain qualified personnel and to hire new qualified employees. This situation arose largely due to the low level of the compensation offered for labor-intensive and dangerous work. In 2003, salaries ranged from the equivalent of $25-$35 a month for an AP scientist with experience.[192] As in other NIS, salary payments were often delayed.

Since the break-up of the Soviet Union, all Uzbek AP facilities have suffered a shortage of equipment and material to conduct research and disease surveillance work. Laboratory equipment was obsolete and facilities needed major renovations and upgrades. The Uzbek AP system also experienced an acute shortage of bacteriological diagnostic products, culture media, vaccines, reagents, instruments, special clothing, and laboratory equipment and ware. Research work with dangerous pathogens was conducted in laboratories deprived of adequate ventilation systems, so AP staff worked in laboratories with open widows, especially in the summer.

The field bases and laboratories located in desert plague foci that were used for field work also needed major renovations and equipment upgrades. In addition, expedition vehicles were often inoperable due to lack of repairs, spare parts, fuel, and lubricants.

After 1992, due to the lack of personnel, equipment, and funding, AP facilities have been unable to send their field teams to distant areas and in regions that are difficult to access, resulting in a decrease in monitoring activities by 70 to 80 percent.

During the Soviet era, difficult to reach natural foci could be accessed with all-terrain vehicles, including AL-3 bacteriology laboratory trucks, with which the Uzbek AP system was equipped.[193] In addition, funding was available to lease airplanes and helicopters for work in deserts and mountainous areas that were not accessible by land vehicles. This is no longer possible, so some inaccessible natural foci have not been surveyed for 12 years. For example, as of 2004, the natural foci in these mountainous regions were last monitored in 1989.

Due to the lack of funds, the AP system has cut field staff to a minimum, further disrupting epidemiological surveillance. Thus, only natural plague and cholera foci have been monitored since 1993. Further, in 2004, the Uzbek AP system monitored only 20 to 30 percent of the country's natural plague foci, primarily those located near borders with other countries.[194]

The situation was even more severe on the territory supervised by the Karakalpak Branch. The station's monitoring territory has increased by about 60,000 sq. km due to Aral Sea desiccation. The Amu Darya and the Syr Darya are the two main rivers that supply the Aral Sea, and they have been used since Soviet times to irrigate cotton fields. Over the years, the water lost due to being diverted from the rivers has led to much of the Aral Sea having dried up. One result has been that Vozrozhdeniye Island, once the site of the major Soviet biological weapons field test facility, connected to mainland in 2004, allowing rodents and insects endemic to the island to migrate to the mainland and, in the process, possibly bring with them new strains of pathogens. AP scientists fear that the island still harbors residues from the many BW-related field tests that were carried out during 1937-1991, which may increase the Aral region's population's exposure to dangerous disease agents. As disease surveillance data is confidential in Uzbekistan, it is not possible to determine whether this has occurred.

### 3. Monitoring of Natural Plague Foci and Other Diseases in Uzbekistan

The natural plague foci in Uzbekistan occupy almost 517,998 sq. km. This vast expanse is also endemic for such diseases as anthrax, tularemia, brucellosis, and cholera.

*Natural Plague Foci*

There are three main natural plague foci in Uzbekistan: one desert natural focus (400,000 sq. km), and two mountainous natural foci (100,000 sq. km collectively).[195] The desert natural focus borders Kazakhstan, Tajikistan, Afghanistan, and Turkmenistan. It includes two sub-foci; the Ustyurt (80,000 sq. km) and Kyzylkum (320,000 sq. km) autonomous foci. (Natural foci are called autonomous when no pathogen exchange occurs between them and other foci.) The Ustyurt and Kyzylkum foci are separated by the Amu-Darya River, which stops the circulation of plague hosts (great gerbils), and consequently the vectors. This natural barrier facilitates prophylaxis measures and makes them more effective.[196] The mountainous natural plague foci spread into Kyrgyzstan and Tajikistan. In both of these mountainous natural plague foci the main host is the marmot.

According to the director of CPQHRI, two new natural plague foci, at Aralkum and Khorezm, have been discovered since the break up of the Soviet Union. The new Aralkum natural focus—based on the presence of new strains—is located on the former Vozrozhdeniye Island and covers a territory of 42,000 sq. km. When the rodents from the mainland start inhabiting the former island's territory, it will be officially recognized as a new natural focus.

The Khorezm natural focus is located on the left bank of the Amu-Darya River and borders Turkmenistan. The Khorezm natural focus is considered to be new because it: (1) has a unique host (the meridional gerbil); and (2) is separated from other existing natural foci by a natural border (the Amu-Darya River). In the past the main host in this area was the great gerbil. However, several years ago floods killed large numbers of great gerbils, and as a result, the vectors switched to a new host—the meridional gerbil.

*Other Natural Foci*

In addition to plague, there are other natural disease foci in Uzbekistan, including diseases caused by bacteria (cholera; tularemia, anthrax, glanders, and melioidosis), viruses (yellow fever and several other types of highly dangerous viral fevers), and parasites (cutaneous acute necrotizing leishmaniosis).[197]

*Monitoring of natural plague foci*

As of 2004, monitoring campaigns were typically organized in the spring and fall, with each lasting six weeks. As a rule, epidemiological teams were sent to locations where pathogens had been isolated the previous year. Epidemiological teams usually comprised 7-8 people, including one physician, one biologist, one parasitologist/zoologist, and auxiliary personnel who delivered field samples to the regional or AP field station.

Once on site, members of the epidemiological teams, especially zoologists, studied the rodent population and took samples from rodents, such as blood and ectoparasites, for analysis. The team's physicians conducted a preliminary bacteriology and serology analysis of the samples at the seasonal laboratory. All samples were later transferred to the field/regional AP stations for further analysis.[198] This work was performed to detect plague epizootics among wild rodents, determine the intensity of epizootics, and assess their epidemic threat. Epidemiological teams also identified the major risk factors for human infection and the groups, places, and times associated with these risks.

The AP system and the veterinary network also collaborated in the surveillance of camel herds in epizootic areas. In theory, camels could not be slaughtered without a veterinary certificate and all camel carcasses had to be tested for plague bacteria.[199] In practice however, farmers and other people living in rural areas rarely call a veterinarian before slaughtering sick animals. This habit regularly generates cases of human plague.

In the event of epizootics near populated areas, “buffer zones” were established in the vicinity of the areas by exterminating wild rodents and their ectoparasites, killing rodents and insects inhabiting residential and commercial buildings, and providing plague vaccinations to exposed populations as needed. The AP system also conducted outreach work among residents of enzootic areas to provide information on the prevention and quarantine of high-risk infections.

### 4. Analysis of the Uzbek Anti-plague System’s Weaknesses and Proliferation Potential

After the September 11, 2001 terrorist attacks in the United States, CPQHRI’s director decided to move the Center’s collection of pathogens from the first floor to the second floor and have it guarded by facility employees at night. Containing over 1,000 strains of pathogens causing quarantine and high-risk infections, the facility housing the collection had an alarm system. However, the facility director did not consider it an adequate security measure.

Under the auspices of the CTR Program, additional security features were introduced in 2003. The laboratory housing the National Collection of Pathogens was equipped with special refrigerators with lockable doors. In addition, the entrance to the pathogen collection was secured with a new iron door equipped with a security eyehole, a combination lock, and an iron grid.[200]

To decrease the risks associated with the existence of multiple collections of pathogens, CPQHRI’s director initiated an effort to transfer pathogen cultures housed at other Uzbek sites to the CPQHRI. Now, pathogens may be stored on a permanent basis only at the National Collection of Pathogens, which is located at the CPQHRI. The rest of the AP facilities are permitted to store cultures of pathogens only temporarily.

Despite the consolidation of pathogen collections, the process of transferring pathogen from regional and field AP stations to the National Collection of Pathogens posed security concerns in 2004. According to internal regulations on pathogen transportation, newly isolated pathogens are to be sent to CPQHRI at the end of each monitoring campaign. In practice, however, due to personnel, fuel, and transportation shortages, the transfer of pathogens often was delayed and cultures were stored at field stations where they could not be adequately protected.

As in other NIS, the absence of an adequate communication system between the CPQHRI and the teams transporting the pathogens also represented an area of concern. In addition, due to temperatures that may exceed 100 degrees F in the summer, and to the absence of refrigeration equipment, transfers of pathogens usually were conducted at night, which provides concealment for anyone intent on stealing cultures.[201]

Apart from CPQHRI, none of the other Uzbek facilities had an alarm system; the doors and windows were not protected—except for decorative iron grids; most facilities have no trained guards or were guarded by pensioners. Perimeter walls, when they existed, were low enough to allow intruders to scale them. Pathogens were stored in small kitchen refrigerators protected only by a wax seal. Material accounting was accomplished on paper logs that often lay on laboratory tables, accessible to anyone. As a result of these shortcomings, Uzbek AP facilities were extremely vulnerable to intrusion and theft of pathogens by insiders.

In 2004, the biosafety situation at the Uzbek AP facilities was more than challenging. In addition to the fact that none of the facilities had adequate biosafety equipment to conduct laboratory work with dangerous diseases, specific infrastructure deficiencies created additional problems. One facility for instance had no system for collecting and treating liquid wastes. Some had incinerators to burn solid biohazard waste and dead animals, but they were not located in the laboratories. As a result laboratory staff had to carry infected material across the grounds of the facilities to the incinerators, thus creating a risk that accidentally released microorganisms would infect employees, and also a greater likelihood of infectious material being stolen. At facilities, which did not have incinerators, solid biohazard wastes and animal carcasses were buried in pits covered with wooden lids, with no provision for physical security.

The electrical and ventilation systems at AP facilities were and in some cases still are today obsolete and unreliable. The windows, which often do not have screens, were kept open most of the year in order to ventilate the laboratories. This not only allowed insects into the buildings, but also made it impossible to achieve the proper level of bio-safety in the laboratories. Given that some facilities were and still are located in residential areas, this shortcoming creates additional risks for infecting local populations.

The AP system also faced a shortage of individual protective equipment. For instance, because of a lack of latex gloves, personnel used rubber gloves, which did not provide enough tactile sensitivity for handling hazardous materials in the laboratory, where precision and caution is essential. The AP suits were over 12 years old, which is far beyond their expected life. In addition, because of the lack of showers or showers in working order, laboratory personnel had no opportunity to shower after leaving infected rooms, thus creating another opportunity for contamination.

Based on the information that we have gathered, none of the Uzbek AP facilities were directly involved in the Soviet BW program. Although, some staff members worked closely with Soviet-era Russian AP scientists, the risks of brain drain are probably small; they, however, should not be overlooked.

The highest proliferation threat from Uzbek AP facilities in 2004 was the risk of pathogen diversion because of the absence or weakness of existing security systems. There were also concerns about the security of pathogens transfers. After they were isolated, pathogens were transported over long distances in remote and isolated areas, where an attack on the vehicle carrying live cultures could have remained unnoticed by law enforcement authorities for some time. In addition, AP employees responsible for pathogen transfers did not have appropriate communication equipment to inform the CPQHRI or law enforcement agencies in case of trouble.

The system of pathogen accounting in use in the Uzbek AP system as of 2004 further facilitated possible diversion. Accounting was based on paper logs that were subject to forgeries. Although the Soviet standard operating procedures that were still in use in Uzbekistan after 1992 imposed a two-man rule during laboratory work (usually a physician and a laboratory assistant), including in cases of pathogen destruction, it is not clear whether AP facilities actually verified the destruction of pathogens by performing periodic inventory of all pathogens.

**Photo 1: Anti-plague Suit**

**Annex 1: *Arms Control Today* Article**

***Arms Control Today*** **March 2006**

# Plagued by Errors: New Approach Needed to Tackle Proliferation Threats from Anti-Plague System

Sonia Ben Ouagrham-Gormley

The former Soviet anti-plague system stands today as a little-known but profoundly important proliferation challenge facing the international community. The Soviet Union managed this unique system, consisting of more than 80 facilities, to control deadly endemic diseases and to prevent the spread of exotic pathogens. Until recently, however, the anti-plague system's other role—contributing to the Soviet biological weapons program—has been overlooked.

Today, the anti-plague system retains the raw material and knowledge highly sought after by bioterrorists. What's more, more than a decade of fragmentation has resulted in lax security, severely underpaid staff, and virtually no accounting system for highly lethal strains of viruses and bacteria. While international donors have taken some steps to contain the system's physical security threats, existing and prospective nonproliferation efforts are not substantial enough and somewhat off the mark. Such efforts will not be truly effective until they rein force the important public health benefits these facilities offer.

**Historical Roots**

Created by the tsars in the 1890s to respond to numerous outbreaks of plague, the anti-plague system, then composed of 11 laboratories, experienced a dramatic expansion under Soviet rule. By the late 1970s, the system was composed of 87 facilities engaged in disease surveillance, research, production and testing of vaccines and laboratory equipment, and training of civilian and military personnel. The system employed a staff of 14,000, including 7,000 scientists whose expertise broadened beyond plague to other endemic zoonotic[1] diseases, such as anthrax, brucellosis, tularemia, and Crimean-Congo hemorrhagic fever. Most importantly, the anti-plague system stretched beyond Russian borders into Central Asia, the Caucasus, Ukraine , and Moldova, with facilities strategically located in 11 republics.

In the early 1960s, the system, until then primarily engaged in defending the country against endemic and exotic diseases, experienced a profound turning point: it was enlisted to support the Soviet biological weapons program. Initially, anti-plague facilities contributed to the defensive biological weapons program by providing the military with samples of dangerous pathogens, conducting research, training military scientists, and producing vaccines for mobilization purposes. Rapid response teams were also created at anti-plague facilities and were trained to deploy rapidly to an outbreak location in order to determine whether the disease occurred naturally or was the result of a biological attack. In the 1970s, the anti-plague system's involvement in the Soviet biological weapons program went a step further, when selected facilities started contributing to the offensive biological weapons program. This also led to the system's rapid militarization, with military officers appointed to head key anti-plague facilities.

Three degrees of involvement in the Soviet biological weapons program existed within the anti-plague system. The first, and probably the largest, consisted of a "blind" contribution, where scientists' research was used for the biological weapons program unbeknownst to the researchers. This happened through military monitoring of the work of anti- plague facilities. This process was facilitated by the centralization of research and disease surveillance findings in a central database, and the review of their research findings at two anti-plague institutes in Saratov and Rostov headed by military officers.

The second level of involvement consisted of small teams of researchers working on secret programs in various anti-plague facilities, with only the research team leaders aware of the work's purpose.

A third type of research, concentrated at major anti-plague institutes such as at Saratov, Rostov, and Volgograd, consisted of a more active role in the offensive and defensive programs.

In spite of their biological weapons work, anti-plague facilities preserved their original public health mission of protecting against endemic and imported dangerous diseases. Even at sites that were actively involved in the biological weapons program, civilian and biological weapons work was conducted in parallel but separately. In most cases, biological weapons activities did not adversely affect public health activities.[2]

**Post-Soviet Fragmentation**

On the eve of the Soviet Union's dis solution, the anti-plague system had 89 facilities, including six central institutes, 29 regional anti-plague stations, and 53 field stations located in 11 republics of the former Soviet Union. The system employed about 10,000 personnel, including 2,000 scientists. After the Soviet Union's dissolution, anti-plague facilities were reorganized as independent national networks in each newly independent state, with one facility taking the role of the new network's center.[3

Yet, the anti-plague system lost its organizational cohesion. Soon after 1992, most ethnic-Russian personnel working at anti-plague facilities in non-Russian former Soviet republics returned to Russia to work at Russian anti-plague facilities or other research institutes. The loss of personnel continued steadily as economic circumstances worsened in the newly independent states.

To make matters worse, conflicts arose in several of these states over the control of the anti-plague system. Some officials favored preserving anti-plague facilities because of their unique experience and knowledge while others sought to integrate anti-plague facilities into the Sanitary Epidemiological System (SES), a network of facilities with more traditional public health responsibilities such as vaccination and sanitation. These conflicts subsided after a 1999 plague outbreak in Kazakhstan made clear the value of the anti-plague facilities. Plans to integrate the anti-plague and SES systems were shelved.

Nevertheless, this tumultuous period exacerbated the anti-plague facilities' already precarious financial situation. On average, they lost about 50 percent of their budgets and 40 percent of their staff. The scientists that remained received low salaries and irregular payments, which in 2004 ranged from $20 to $100 per month for senior scientists with 25-30 years of experience. With salaries often lower than the regional average, anti-plague facilities have been unable to replace lost personnel with a new generation of specialists.

**Proliferation Threats**

The resulting proliferation danger is palpable. Foremost is the high risk of brain drain. Considering the undocumented outflow of personnel that began soon after 1992, it is quite possible that some leakage has already occurred. According to anti-plague system directors and veterans, most of the "lost" personnel were technicians and support staff. Fortunately, facilities have generally been able to preserve their scientific personnel, many of whom have passed retirement age. Nonetheless, even personnel still employed by the anti-plague facilities may continue to pose a proliferation threat. These include scientists and technicians with biological weapons knowledge, as well as other scientific personnel who may not have, at least knowingly, worked on the biological weapons program but who possess experience and knowledge of biological weapons relevance. More particularly, anti-plague scientists are accustomed to working with low-technology equipment and are trained to isolate pathogens in harsh field conditions, often finding their way to natural foci of dangerous diseases just using their memory. These qualities would be of great interest to criminal or terrorist groups who wish to preserve the secrecy of their activities.

The Soviet Union's dissolution also gravely affected the implementation of security measures at anti-plague facilities. In Soviet times, the sophistication of the anti-plague facilities' security systems depended on their degree of involvement in the biological weapons program. The systems ranged from on-site KGB officers, Ministry of Interior troops guarding facility perimeters, and fences topped with barbed wire to police communication lines and alarm systems with motion detectors on doors and windows, particularly in the pathogen collection rooms.

There were also strict regulations on the storage and transportation of dangerous pathogens. For instance, pathogens were either transported by a special service with armed guards or transferred by at least two members of the scientific staff by car, train, or plane. Strict safety regulations were also imposed for laboratory work with dangerous pathogens. Even though the governments of the newly independent states adopted Soviet-era regulations on safety and security, funding and personnel shortfalls severely affected their implementation. The security systems have collapsed in most facilities. Ministry of Interior and police protection are no longer available; barbed wire on fences are often stolen and sold as scrap metal; alarm systems no longer work due to frequent power cuts and lack of maintenance; and fences have collapsed due to lack of repairs, leaving the territory of these facilities essentially open to intruders.

The low level of physical security together with an inadequate accounting system also put at risk anti-plague facilities' collections of pathogens. These constitute a unique historical database of hundreds of strains from various regions of the former Soviet Union assembled over several decades. Although most strains have been isolated from nature, some possess features making them ideal raw materials for biological weapons: high virulence and inherent antibiotic resistance. Yet, pathogens are typically stored in kitchen refrigerators secured with simple locks or wax seals, making them highly vulnerable to diversion or theft. Moreover, vials containing the pathogens are typically labeled, facilitating their identification by intruders. In addition, accounting of pathogens is done on paper logs that are generally stored on bookshelves and could become accessible to intruders.

Another security risk is the absence of background security checks. Without the support of police or security services, most anti-plague facilities abstain from conducting such checks. Many facility directors admit that the only job requirements today for new applicants are "scientific qualifications and good health."

Diversion of pathogens could also occur during pathogen transfers from the natural foci where they are isolated to a field or regional station or during later transfers to central institutes for long-term storage. Neither reliable communications nor any position-location technology exists should emergencies arise. For instance, in the late 1990s an epidemiological team monitoring a plague focus in Kazakhstan's desert got lost and had a serious car accident. Out of radio contact range and without any bearing, several team members succumbed to injuries before their extended absence led to rescue operations. Should incidents occur during transfers, whether they are accidental or malevolent, there is a high probability that the chain of pathogen custody will be broken.

**Geography Matters**

Roughly 60 anti-plague facilities are located in Central Asia and the Caucasus, which concentrate the largest and most active natural disease foci. This area, however, is the meeting point of all the proliferation chain components: suppliers, established trafficking networks, and potential buyers. It is also a region where borders remain largely unprotected. [4]

Many anti-plague facilities are located on or near the trafficking routes for drugs, small arms, and weapons of mass destruction-related material that cross Central Asia and the Caucasus and proceed northwest through Turkey into Europe.

Several terrorist groups are also active in the region, such as the Islamic Movement of Uzbekistan, which seeks to overthrow the Uzbek president and install an Islamic regime. The wars in neighboring Afghani stan and Iraq have only exacerbated the problem. Moreover, since the Soviet Union's dissolution, political unrest and civil wars have fostered regional instability, as demonstrated by the recent revolutions in Georgia and Kyrgyzstan and public protests in Uzbekistan. This potentially explosive mixture puts anti-plague facilities at greater risk of being caught in factional entanglements and makes them more susceptible to intrusion or theft, with unpredictable proliferation consequences.

To be sure, there have been no indications to date that local terrorist groups have demonstrated an interest in or the capability to use biological weapons. Although there have been numerous outsider facility intrusions over the years, most often they involved intoxicated individuals or people interested in stealing scrap metal. Anecdotal accounts about the theft or attempted insider diversion of pathogens have not led to any known arrests because facility management preferred solving these problems without local police.

Nevertheless, more effective security measures at anti-plague facilities are imperative. In present conditions, dangerous biomaterials, as well as the knowledge and skills of system personnel, are at risk. More particularly, anti-plague specialists' ability to work in a low-technology environment and in field conditions makes them attractive to terrorist groups or states with limited access to high-technology bioequipment. Revelations about Iraq's use of calutrons for electromagnetic separation of uranium isotopes in the 1980s, a technology declassified by the United States in 1949, should serve as a reminder that technologies regarded as obsolete may still pose threats.

**International Assistance Wanting**

At present, the anti-plague system receives little assistance from the international community. Perhaps the most significant contribution, however, has come from the United States through its Cooperative Threat Reduction (CTR) program.

The CTR program currently supports security upgrades at three facilities in Kazakhstan , Uzbekistan, and Georgia. Security upgrades at the anti-plague institute in Almaty, Kazakhstan, transformed a facility with no security features into a secured area with a high fence topped with barbed wires, armed guards, motion detectors, and rein forced doors, among other things. Similar upgrades are planned or are under way at the anti-plague institutes in Tashkent, Uzbekistan , and Tbilisi, Georgia. With the recent signature of agreements with Ukraine and Azerbaijan, similar programs will be implemented at two anti-plague facilities in these countries.

To prevent brain drain, CTR has funded five scientific cooperative projects at the same facilities thus far: three at the Almaty institute, which also involves personnel at regional stations, and one each at the Tashkent and Tbilisi institutes. Together, these projects employ 52 scientific personnel and deal with dangerous pathogens of public health and security relevance.

Long-standing CTR intentions to implement a Threat Agent Detection and Response (TADR) system also appear to be making some progress. The TADR sys tem aims to create a disease surveillance network composed of central strain repositories and several sentinel laboratories in Kazakhstan, Uzbekistan, and Georgia to furnish early detection of a possible malevolent release of pathogens causing human or animal diseases. State governments, in cooperation with the Department of Defense, will decide which facilities to include in the TADR network. To date, the anti-plague institutes in Almaty, Tashkent, and Tbilisi have been chosen to be central strain repositories in each country, and one anti-plague station in Georgia was selected as a sentinel station. It is not clear yet how many other facilities will be chosen as sentinel laboratories.

**CTR Program Effectiveness**

Despite its positive results, the CTR program remains insufficiently comprehensive to address the system's proliferation threat. CTR-funded biosecurity upgrades, as well as cooperative research projects, reach only three anti-plague facilities while dozens of facilities still require support.

Although the TADR system is a model project because it addresses both security and public health concerns of national and international importance, it only superficially benefits the anti-plague system. Anti-plague facilities account for only a small number of TADR facilities, which include veterinary institutes, the SES, and epidemiological hospitals. It is at once surprising and mystifying that a program resting on disease surveillance to detect and prevent the malevolent use of dangerous pathogens does not exploit the very system with the best skills and experience in the field. The fault, however, does not necessarily lie with the CTR program. In some countries, revived conflicts between supporters of the anti-plague system and the SES have thwarted the inclusion of anti-plague facilities in the project.

Even assuming that the CTR program will eventually expand to include a greater number of anti-plague facilities, it may still fail to address the system's proliferation threats because of a conceptual flaw in the U.S. approach. In the biological weapons area, the CTR program aims to consolidate dangerous material at a small number of sites to facilitate their protection. This approach makes sense with former biological weapons facilities that were, in Soviet times, primarily engaged in military work because many have struggled unsuccessfully to find a new civilian or commercial mission.

When applied to the anti-plague sys tem, however, this approach negatively impacts the system's public health mission because it ignores the nature of the anti-plague system's work. The prevention of outbreaks necessitates the constant monitoring of natural foci and the isolation of natural strains. Funding limits and the loss of qualified personnel have already decreased anti-plague facilities' disease surveillance activities by 60 percent since 1992. As a result, whole areas endemic for plague, anthrax, and other dangerous diseases have remained un monitored, some for more than a decade. In this context, consolidating facilities or closing them will only exacerbate the public health threat, and ignoring them will increase the proliferation threat.

**A More Comprehensive and Nuanced Approach**

Addressing threats associated with the anti-plague system requires a more comprehensive and nuanced policy composed of measures that simultaneously grapple with security and public health challenges. CTR-funded projects, because they concentrate on a narrow set of security threats, constitute only a small part of this approach. Other agencies in Canada, Europe, the United States, and other Group of Eight members must become engaged to deal with the other security and public health challenges posed by the system. Newly independent state governments must also be involved to ensure that pro grams funded by the international community will be useful and sustainable in the long term.

Given the current state of the anti- plague system, priority should go to improving security to prohibit unauthorized access to dangerous pathogens. Unlike the traditional one-size-fits-all approach used thus far in the CTR program, tailored security solutions should be implemented depending on a facility's location and size, the character of its pathogen collection, and the activity level of the natural foci it monitors.[5]

All anti-plague facilities have collections of pathogens, but some house temporary collections while others retain permanent ones. Central anti-plague facilities in each country serve as national repositories, housing large and permanent collections. These require a complex security system, involving fences, alarm system, guards, video cameras, outside lights, and secured refrigerators to store the pathogens. Ac counting system modernization is also essential; a computerized system would provide fewer opportunities to conceal the movement of pathogens. The use of bar codes to replace the existing labels on vials would reinforce the system by making it more difficult for intruders to identify the pathogens.

Regional anti-plague stations, which store pathogens for six months to a year before transferring them to an anti-plague institute, require a lower level of security, primarily composed of secured refrigerators and alarm systems. A computerized accounting system might be useful but not necessary. If the facility is not located in an area that presents specific security concerns, introducing an access-restricting system such as magnetic card access and secure storage for accounting logs will be sufficient.

An even lower security level may be envisioned for stations located at driving distance from the central institutes by providing vehicles and allowing more frequent transfers. Field stations, which store pathogens from a few days to a few weeks, primarily need equipment to secure the pathogens for short periods and during transfers. Local governments may also find innovative solutions to reduce the threat associated with pathogen collections.

In Kazakhstan, for instance, all dangerous pathogens will be consolidated at the central institute. Regional stations will receive simulants instead to conduct their research work. Such an approach, however, means more frequent transfers of pathogens from regional sites, making secure transfer imperative.

The location of a facility will also affect the type and level of security upgrades. One located in an area where major illicit trafficking occurs regularly, such as in the south of Kazakhstan, or with terrorist activity nearby obviously requires a higher level of security. Similarly, facilities monitoring particularly active natural foci also require a higher degree of security, as they isolate and store a larger number of strains each year.

Reinforcing the chain of pathogen custody during field work and transfers is also an essential task. This can be achieved by providing Global Positioning System receivers, satellite phones, and all-terrain vehicles to enhance secure transportation and foster continuous communications between teams in the field and their facilities.

A second priority is the prevention of brain drain. In this regard, it is important to involve anti-plague specialists in inter national cooperation projects that will not only support them financially but also use their knowledge to benefit the international community. It is important to engage scientists and technicians who have contributed to the Soviet biological weapons program as well as other anti-plague specialists who, without working on biological weapons programs, still have years of unique knowledge and experience working with dangerous pathogens.

Disease surveillance is also vital. European countries in particular should contribute to such efforts since an epidemic in these states would most likely spread to Europe, as shown by the avian flu and SARS out breaks recently. In addition, European countries could strengthen the alert and response system by establishing telephone lines to reach local hospitals and doctors in isolated areas. Supporting information campaigns for the local population living on natural foci and training local doctors to recognize the symptoms of endemic dangerous diseases would also improve disease surveillance. These activities were in Soviet times part of the anti-plague system’s duties. Today, however, very few facilities have maintained such activities because of the lack of funding.

Using the experience of Soviet-era rapid response teams would also help in the fight against bioterrorism. Their training in identifying the source of an outbreak quickly and deploying an appropriate response would certainly improve the level of preparedness for such events whether in the United States, Europe, or the former Soviet states.

Besides security upgrades and brain drain prevention, improving laboratory equipment is essential in order to mitigate the consequences of laboratory incidents. Ventilation systems at anti-plague facilities conducting research on dangerous pathogens—regional stations and anti-plague institutes—are desperately needed, especially those located in residential or urban centers. Today, researchers sometimes work with open windows due to the absence of ventilation or air conditioning systems. Upgrades, however, should not lead to excessive reliance on technology. Soviet-era methods, emphasizing rigorous and technique-driven training, should be maintained and encouraged to ensure biosafety.

In these three priority areas, the definition of each anti-plague facility’s needs should be the result of discussions among anti-plague representatives; their supervising agency, usually the Ministry of Health; and donor countries. The involvement of health organizations from donor countries in the process is critical to inject a dose of realism in host government expectations, by discussing sustainable options that address both security and public health concerns. Particular national requirements should also be taken into account while identifying present and future needs.

To reinforce security, steps should be taken to establish systems for managing back ground security checks. anti-plague specialists should also be educated on proliferation issues and ethics. The Department of State Bio Industry Initiative sponsors such training programs for scientists employed at facilities with Bio Industry Initiative-funded projects; these programs could be extended to anti-plague specialists.

Finally, it is essential to engage Russian anti-plague facilities that still remain closed to international cooperation. Europe and Canada may be better suited to do this because the Defense Department sharply decreased its biological weapons nonproliferation programs in Russia due primarily to failure to sign an implementing agreement with Moscow.

In the end, implementing cooperative threat reduction measures to deal with the former Soviet anti-plague system is necessary but not sufficient to cope with the system's complex dual-use nature. From the outset, the U.S. CTR program has acted in a fireman capacity by trying to put out the most urgent proliferation fires. To be sure, the system merits the CTR program's attention with respect to securing and consolidating dangerous pathogens, preventing their diversion, and forestalling brain drain. Yet, the anti-plague system differs fundamentally from other threat reduction challenges in that it has had and still assumes a critically important public health role. This capacity desperately needs to be sharpened if the international community is effectively to cope with the prospects of future and perhaps global epidemics.

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Sonia Ben Ouagrham-Gormley is a senior researcher at the Center for Nonproliferation Studies at the Monterey Institute of International Studies. Between 2002 and 2004, she and her colleagues conducted a study of the Soviet anti-plague system, which will be published in two reports; the first, "History of the Soviet Anti-Plague System," is forthcoming.

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**ENDNOTES**

1. Animal diseases that can be transmitted to humans.

2. The exception being the Volgograd Institute, which worked exclusively on the biological weapons program.

3. In many cases, the facilities were given new names and sometimes merged with other public health organizations. For simplicity's sake, we will refer to them here as anti-plague facilities.

4. Sonia Ben Ouagrham, "Proliferation Threat From Former Biological Weapons Facilities in the FSU," The Liechtenstein Institute for Self-Determination, Princeton University, 2003.

5. A natural focus is considered "active" when strains have been isolated during the previous monitoring campaigns. The activity of a natural focus is cyclical; the bacteria or virus may appear as dormant for several years and then become active again. It is therefore important to consider the data for a number of years to determine the activity level of a focus.

## Endnotes, Including References

[1] Sonia Ben Ouagrham-Gormley, "Plagued by Errors: New Approach Needed to Tackle Proliferation Threats from Anti-Plague System," *Arms Control Today*, March 2006; http://www.armscontrol.org/act/2006_03/MARCH-PlagueFeature.asp.
[2] Sonia Ben Ouagrham-Gormley, Alexander Melikishvili, and Raymond A. Zilinskas, 2006. "The Soviet Anti-plague System: An Introduction," *Critical Reviews in Microbiology* 32(1):15-14; Alexander Melikishvili, 2006, "Genesis of the Anti-plague System: The Tsarist Period," *Critical Reviews in Microbiology* 32(1):19-31; Sonia Ben Ouagrham-Gormley, 2006, "Growth of the Anti-plague System during the Soviet Period," *Critical Reviews in Microbiology* 32(1):33-46; Raymond A. Zilinskas, 2006, "The Anti-plague System and the Soviet Biological Warfare Program," *Critical Reviews in Microbiology* 32(1):47-64; Sonia Ben Ouagrham-Gormley, Alexander Melikishvili, and Raymond A. Zilinskas, 2006. "What Non-proliferation Policy for the Soviet Anti-plague System?" *Critical Reviews in Microbiology* 32(1):65-67.
[3] Sonia Ben Ouagrham-Gormley, Alexander Melikishvili, and Raymond A. Zilinskas, 2006, "The Soviet Anti-plague system"; http://cns.miis.edu/research/antiplague/index.htm.
[4] Center for Nonproliferation Studies, 2003. *Anti-Plague Service of Armenia* (in Russian). Monterey: Center for Nonproliferation Studies.
[5] From interviews with Armenian AP officials during the CNS staff tour of Armenian AP facilities during March 17-22, 2004.
[6] Epidemiological teams dispatched by the CPEDI and field AP stations use the seasonal AP laboratories to monitor natural foci of especially dangerous infectious diseases during seasons of high epizootic activity.
[7] From interviews with Armenian AP officials..., op. cit.
[8] The dram is the unit of currency in Armenia. Its accepted abbreviation is AMD.
[9] The difference in U.S. dollar equivalents can be explained by the fluctuations in the annual average currency exchange rates in Armenia, which is also typical for the transition economies of the NIS in general. Thus, the basis for calculating the U.S. dollar equivalents are the following annual average currency exchange rates: 1995, \$1=405.8 AMD; 2000, \$1=539.5 AMD; and 2002, \$1=573.3 AMD.
[10] Under the Soviet system, diseases were grouped according to the degree of danger they represented to people. Thus, group I diseases were the most dangerous and group IV the least. This categorization is the opposite of the biosafety level system used in the United States and most western countries where biosafety level 1 (BL-1) microorganisms are the least dangerous while BL-4 microorganisms the most dangerous. We use the Soviet designations in this report.
[11] Center for Nonproliferation Studies, 2003. *Anti-Plague Service of Armenia*, op. cit.
[12] With this purpose the CPEDI AP specialists regularly conduct educational outreach activities, including seminars, workshops and proficiency tests, at the hospitals, clinics and other public health institutions in Armenia.
[13] Ibid.
[14] Ibid.
[15] Center for Nonproliferation Studies, 2003. *Anti-Plague Service of Armenia*, op. cit.
[16] Ibid.
[17] From interviews with Armenian AP officials..., op. cit.
[18] The territory of Armenia is divided into eleven provinces (in Armenian – *marz* or plural – *marzer*). Prior to the dissolution of the Soviet Union, the territorial-administrative division of the territory of Armenia was different as it was divided into 37 districts.
[19] Center for Nonproliferation Studies, 2003. *Anti-Plague Service of Armenia*, op. cit.
[20] Ibid.
[21] Ibid.

[22] Ibid.
[23] Ibid.
[24] Ibid.
[25] From interviews with Armenian AP officials..., op. cit.
[26] "Gadrutu ugrozhaet chuma" (Plague threatens Gadrut), A1Plus News Agency (Armenia), October 20, 2005; http://www.a1plus.am/ru/?page=issue&id=32680.
[27] Ibid.
[28] "V Armenii uchastilis sluchai ranee ne vstrechavshikhsya infektsiy" (There is an increase in the cases of previously not recorded infectious diseases in Armenia), Independent News Agency ArmInfo (Armenia), December 2, 2006; http://www.armenia-online.ru/armnews/4606.html.
[29] The Coordinating Council on Problems of Sanitary Defense of Territories of the Commonwealth of Independent States Member-States from Importation and Proliferation of Especially Dangerous Infectious Diseases (Coordinating Council in short) was created by the resolution of the Council on Cooperation in the Field of Public Health of the Commonwealth of Independent States Member-States at the meeting in Dushanbe, Tajikistan on November 22, 2000. The Coordinating Council was established for implementing intergovernmental cooperation and fostering interaction in the area of sanitary defense of the territory and protection of epidemiological well-being of the population. The Coordinating Council is comprised of fifteen representatives from twelve CIS member-states. The activities of the Coordinating Council are geared towards achievement of the following objectives: (1) creation of an interstate system of information exchange on questions of fighting especially dangerous infectious diseases as well as the importation and distribution of shipments and commodities, which are potentially hazardous from the sanitary point of view; (2) harmonization and unification of legal and methodological bases for sanitary defense of territories of CIS member-states; (3) interaction in the area of epidemiological monitoring and control over epidemiological emergencies; (4) unification of contemporary diagnostic technologies and methods of laboratory analysis; (5) development of unified methodology of sanitary defense of territories and sanitary-epidemiological monitoring of the transportation system; (6) organization of cooperation in the field of training specialists in especially dangerous infections; and (7) interaction on questions related to the manufacturing of medical immuno-biological preparations for diagnostics and prophylaxis of especially dangerous infectious diseases.
[30] "Arkhiv – Obobshchennaya Informatsiya za 2004 god" (Archive – Aggregate information for year 2004), Coordinating Council on Problems of Sanitary Defense of Territories of Commonwealth of Independent States Member-States, Council on Cooperation in the Field of Public Health of the Commonwealth of Independent States Member-States; Federal State Institution of Public Health Russian Scientific-Research Anti-plague Institute "Mikrob"; http://www.microbe.ru/pages/index.asp?id=99.
[31] Ibid.
[32] From interviews with Armenian AP officials..., op. cit.
[33] Ibid.
[34] Ibid.
[35] Ibid. The prominent Soviet immunologist, virologist, and microbiologist L.A. Zilber, who had coordinated the emergency anti-epidemiological measures during the Gadrut plague outbreak, provided detailed account of events in his memoirs. According to Dr. Zilber, the etiology of the plague outbreak in Gadrut and surrounding settlements was nature, but its spread, according to local superstitions, was enhanced by ritualized cannibalism of dead bodies infected with plague. See: L.A. Zilber, "Opetatsiya "Ruda" (Operation "Ore"), *Nauka i Zhizn*, No.12, 1966.
[36] Center for Nonproliferation Studies, 2003. *Preliminary Report on the Anti-plague System of Central Asia, the Caucasus, and Kazakhstan* (in Russian). Monterey: Center for Nonproliferation Studies.

[37] From the interviews with the Azerbaijani anti-plague officials during the CNS staff tour of the Azerbaijani anti-plague facilities on March 23-28, 2004.
[38] Center for Nonproliferation Studies, 2003. *Preliminary Report on the Anti-plague System of Central Asia…*, op. cit.
[39] Ibid.
[40] From interviews with Azerbaijani..., op. cit.
[41] Ibid.
[42] Ibid.
[43] Ibid.
[44] Ibid.
[45] Ibid.
[46] The task of a zoological team mainly consists of setting up traps and capturing hosts and vectors, which are then brought either to a seasonal AP laboratory of a field AP station, where AP specialists, when possible, proceed with isolating *Y. pestis* or other pathogens. On the other hand, the main responsibility of an epidemiological team is to investigate outbreaks of especially dangerous infectious diseases, which implies that the team members can carry out: (1) examination of both animal samples and infected people, (2) isolation of pathogens when possible, (3) quarantine of affected areas, and (4) outreach to educate local population about public health dangers posed by particular diseases.
[47] From interviews with Azerbaijani..., op. cit.
[48] Ibid.
[49] "Na uchastke nefteprovoda Baku-Dzheykhan obnaruzheny ochagi rasprostranenya chumy" (Plague foci discovered along the section of the Baku-Ceyhan oil pipeline), Regnum News Agency, November 26, 2005; www.regnum.ru/news/550666.html.
[50] F.U. Mamedzade, "Situatsia po obespechenyu biobezopasnosti v Azerbaidzhane" (Situation with regard to maintaining biosecurity in Azerbaijan). From the compilation of materials of the First Seminar on Biosecurity and Nonproliferation of Biological Weapons, Almaty, Kazakhstan, May 12-16, 2003. The seminar was organized by the Center for Nonproliferation Studies of the Monterey Institute of International Studies in collaboration with the A. M. Aikimbayev Kazakh Center for Quarantine and Zoonotic Diseases (KSCQZD) and the financial support from the Nuclear Threat Initiative.
[51] From the interviews with Azerbaijani..., op. cit.
[52] "Nunn-Lugar Transports Dangerous Germs to U.S." *Nunn-Lugar Report*, August 2005, pp.1-3; http://lugar.senate.gov/reports/Nunn-Lugar_Report_2005.pdf.
[53] Jeff Zeleny, "Bacteria transferred in fight against bioterror," *Baltimore Sun*, September 4, 2005.
[54] "Nunn-Lugar Transports Dangerous Germs to U.S." op. cit.
[55] Commenting on the agreement Senator Lugar noted: "This is an important cooperation between our two governments to counter the threat of bio-terrorism and to prevent the proliferation of biological weapons, technology, materials and expertise. This is also an important step in assisting both countries to rapidly detect, diagnose and respond to infectious disease outbreaks, whether naturally occurring or as a result of bio-terrorism." "Nunn-Lugar Transports Dangerous Germs to U.S." op. cit.
[56] From interviews with Azerbaijani..., op. cit.
[57] Center for Nonproliferation Studies, 2003. *Several Aspects of the Biological Protection System in the Republic of Belarus* (in Russian). Monterey: Center for Nonproliferation Studies.
[58] Melikishvili, op. cit.
[59] Center for Nonproliferation Studies, 2003. *Several Aspects of the Biological Protection System in the Republic of Belarus*, op. cit.
[60] World Health Organization, Regional Office for Europe, *Health Care Systems in Transition: Belarus* (draft), Copenhagen, 1997; http://www.euro.who.int/document/e72448.pdf.

[61] Belarus, "Law of the Republic of Belarus of 18 June 1993 on Public Health (*Vedomosti Verkhovnogo Soveta Respubliki Belarus*, No. 24, 18 June 1993, Entry 290, as summarized in *International Digest of Health Legislation*, Vol. 46, No. 3, 1995, pp. 297-299; http://annualreview.law.harvard.edu/population/aids/BELARUS.htm.
[62] World Health Organization, Regional Office for Europe, op. cit.
[63] Belarus Ministry of Health homepage: http://minzdrav.by/.
[64] "Sanitary-Epidemiological System in the Republic of Belarus: History, Current Issues, and Prospects" (in Russian), op. cit.; Feldman, et al., op. cit.
[65] World Health Organization, Regional Office for Europe, op. cit.
[66] V.P. Filonov, "Stages in the Development of Public Prophylaxis. Status and Principal Ways of Improving the Sanitary-Epidemiological Well-Being of the People of the Republic of Belarus" (in Russian), in: *Materials of the 9th Congress of Preventive Medicine Workers of the Republic of Belarus*, Vol. 1, (Minsk, 1996), pp. 3–22; *Public Health in the Republic of Belarus. Official Statistical Handbook for 2002* (in Russian), (Minsk, GU RNMB, 2003).
[67] Yu.A. Grachev, "Significance of High-Risk Infections in the General Pathology of the Republic" (in Russian), in: *Principles of and Prospects for Diagnosis of New and Re-emerging Infections* (in Russian), (Smolevichi, 1997), pp. 46–56.
[68] Grachev, op. cit.; *Public Health in the Republic of Belarus. Official Statistical Handbook for 2002*, op. cit.
[69] Grachev, op. cit.
[70] Ibid.
[71] V.V. Maksimovich, "Urgent Issues of Infectious Pathology of Animals in the Republic of Belarus" (in Russian), in: *Urgent Issues of Farm Animal Pathology. Materials of the International Scientific-Practical Conference* (in Russian), (Minsk, 2000), pp. 40–42.
[72] Anthroponotic viral diseases refer to those of which humans are the reservoirs for the causative virus.
[73] "Biennial Collaborative Agreement between the Ministry of Health of Belarus and the Regional Office for Europe of the World Health Organization, 2006-2007," Copenhagen, 2005; http://www.euro.who.int/document/bca/blr06a.pdf.
[74] L.P. Titov, Bioterrorism and Issues of National Security" (in Russian), in: *Terrorism as a Threat to the National Security of the Republic of Belarus: Materials of the Interagency Scientific-Practical Conference, 25 February 2002* (in Russian), (Minsk, Institut natsionalnoy bezopasnosti Respubliki Belarus, 2002), pp. 69–71.
[75] World Health Organization, Regional Office for Europe, *Highlights on Health in Belarus 2005*, Copenhagen 2006; http://www.euro.who.int/document/e88389.pdf.
[76] World Health Organization, Regional Office for Europe, op. cit.
[77] Raymond A. Zilinskas, 2006, op. cit.
[78] Natallia Paklonskaya, "Improvement of the biosecurity system in the Republic of Belarus: Approaches to the establishment of controls over dual-use research," paper presented at the Center for Nonproliferation Studies, December 13, 2006.
[79] Center for Nonproliferation Studies, 2003. *Formation and Activity of Anti-Plague System of Georgia* (in Russian). Monterey: Center for Nonproliferation Studies.
[80] Ibid.
[81] Ibid.
[82] Ibid.
[83] According to the Article 1509 of the Civil Code of Georgia, the legal subjects of the public law include the following: a.) the state; b.) the self-governments; c.) the legal subjects established by the state on the basis of specific legal acts, other than the organizational types defined in the Civil Code and the Law on Entrepreneurs; d.) the state organizations or state foundations not established in compliance with the Civil Code or the Law on Entrepreneurs; e.) the non-

governmental organizations established under specific legal acts in order to pursue objectives of public interest (political parties, religious associations, etc.). The NCDCMS falls into the c.) category.

[84] From interviews with Georgian AP officials during a CNS staff tour of the Georgian AP facilities, May 20-23, 2003.

[85] From interviews with Georgian AP officials..., op. cit. Also based on the information posted on the official website of the L. Sakvarelidze National Center for Disease Control and Medical Statistics; http://www.ncdc.ge/.

[86] From interviews with Georgian AP officials..., op. cit.

[87] Center for Nonproliferation Studies, 2003. *Formation and Activity of Anti-Plague System of Georgia*, op. cit.

[88] Ibid.

[89] Ibid.

[90] Ibid.

[91] Ibid.

[92] From interviews with Georgian AP officials..., op. cit.

[93] Center for Nonproliferation Studies, 2003. *Formation and Activity of Anti-Plague System of Georgia*, opacity.

[94] From interviews with Georgian AP officials..., op. cit.

[95] Center for Nonproliferation Studies, 2003. *Formation and Activity of Anti-Plague System of Georgia*, op. cit.

[96] Ibid.

[97] Ibid.

[98] Ibid.

[99] Ibid.

[100] From a presentation by Katie Zaridze, Information Manager and Aide to the Director of the NCDCMS, The English Language and Nonproliferation Program (ELAN), Center for Nonproliferation Studies, Monterey Institute of International Studies, Monterey, California, March 7, 2007.

[101] Embassy of the United States in Georgia, “U.S. Senator Richard Lugar Tours National Center for Disease Control,” Press Release, August 22, 2006; http://georgia.usembassy.gov/releases/2006/release20060822LugarNCDC.htm.

[102] “US helps build biosecurity laboratory in Georgia,” ITAR-TASS News Agency, March 31, 2007.

[103] “US to fund new virus laboratories in Georgia – Lugar,” Interfax News Agency, August 23, 2006; and “US helps build biosecurity laboratory in Georgia,” ITAR-TASS News Agency, March 31, 2007.

[104] From interviews with Georgian AP officials… op. cit. With regard to the theft of the laboratory equipment in Kutaisi in December 2005, Robert Orttung and Louise Shelley cited this incident without providing more detailed information on what happened afterwards. See: Robert Orttung and Louise Shelley, “Linkages between Terrorist and Organized Crime Groups in Nuclear Smuggling: A Case Study of Chelyabinsk Oblast,” Program on New Approaches to Russian Security (PONARS) Policy Memo No.392, December 10, 2005; http://www.csis.org/media/csis/pubs/pm_0392.pdf.

[105] CNS e-mail and phone communication with the NCDCMS administration representative, December 14-16, 2005.

[106] Raymond A. Zilinskas, 2006, op. cit.

[107] Pamela Hess, “Spy Officials Tracking Key Scientists,” Associated Press, September 26, 2007.

[108] Almaty was called Alma-Ata in Soviet times but in this report we will use its current name throughout (except when in quotes).

[109] Decree of the RSFSR People's Commissariat of Public Health (Narkomzdrav) No. 1, on the Alma Ata Anti-plague Station, September 15, 1934 (in Russian).
[110] USSR Ministry of Health, Decree No. 739, On Reorganizing and Renaming the Alma Ata Anti-plague Station to the Central Asian Anti-plague Research Institute, December 9, 1948 (in Russian).
[111] The Soviet Ministry of Health's Second Directorate was responsible for supervising the Soviet AP system.
[112] The Soviet Ministry of Health's Third Directorate was in charge of space biology and health clinics in closed cities; it also undertook the program "Flute" as part of the Soviet BW effort, and had responsibilities for Problem 4 (responding to cholera outbreaks) and Problem 5. The Directorate was also responsible for the medical aspects of the clean-up of Chernobyl's aftermath.
[113] Raymond A. Zilinskas, 2006, op. cit.
[114] Ministry of Public Health of Kazakhstan, Decree No. 45, On Renaming the Central Asian Anti-plague Research Institute to the Kazakh Anti-plague Research Institute, January 28, 1992 (in Russian).
[115] Government of the Republic of Kazakhstan, Decree No. 582, On Renaming the Kazakh Anti-plague Research Institute of the Republic of Kazakhstan to the M. Aikimbaev Kazakh Science Center for Quarantine and Zoonotic Diseases, May 2, 2001 (in Russian).
[116] Interview with the Director of the Mangghystau AP station, October 15, 2002.
[117] Interview with the Director of the Shymkent AP station, January 15, 2003.
[118] Interview with the Director of the Mangghystau AP station, op. cit.
[119] "The Monthly average salary rose by 13.9 percent," (in Russian); http://www.stat.kz/index.php?lang=rus&uin=1171355968.
[120] "Small Business Sector Shows Strong Growth, A Sign of Growing Prosperity and Self-Reliance," December 22, 2004; http://www.kazakhembus.com/122204.html.
[121] Interview with the Director of the Mangghystau AP station, op. cit.
[122] Ibid.
[123] Ibid.
[124] Interview with the Director of the Shymkent AP station, op. cit.
[125] The word "phage" is short for "bacteriophages." A phage is specialized virus that destroys bacteria by lysis, which is a process of disintegration. However, phages are highly specific; i.e., a phage will only lyse a specific bacterial species and no other. By using this property, a microbiology laboratory can build up a library of phages and use them to relatively quickly identify bacterial species, in this case *Yersinia pseudotuberculosis*, without having to resort to the much lengthier culture procedure.
[126] Interview with the Director of the Shymkent AP station, op. cit.
[127] In 2002, KSCQZD was designated a repository for high-risk infectious pathogens and has the responsibility for operating the republic's collection of highly dangerous pathogens (Government of the Republic of Kazakhstan, Decree No. 850, On National Collections of Microorganisms, July 30, 2002 [in Russian]).
[128] Center for Nonproliferation Studies, 2003. *Preliminary Report on the Anti-plague System of Central Asia…*, op. cit.
[129] Ibid.
[130] Ibid.
[131] Ibid.
[132] Ibid.
[133] Ibid.
[134] Ibid.
[135] Ibid.
[136] Interview with the Deputy Director of the Atyrau AP station, August 11-12, 2003.

[137] Interview with the Director of the Jambul AP station, January 13-16, 2003.
[138] Center for Nonproliferation Studies, 2003. *Preliminary Report on the Anti-plague System of Central Asia*…, op. cit.
[139] From interviews with Kyrgyz AP officials during a CNS staff tour of Kyrgyz AP facilities, May 8-10, 2003.
[140] Center for Nonproliferation Studies, 2003. *Preliminary Report on the Anti-plague System of Central Asia*…, op. cit.
[141] After Kyrgyzstan achieved independence in late 1991, the indigenous names of many cities, cities, villages, and settlements were restored. Thus, Frunze was changed to Bishkek and Przhevalsk to Karakol.
[142] Interviews with Kyrgyz AP officials..., op. cit.
[143] Ibid.
[144] "Anthrax on the rise in South [Kyrgyzstan]," Integrated Regional Information Networks (IRIN) News [the humanitarian news and analysis system of the United Nations Office for the Coordination of Humanitarian Affairs], October 26, 2005; http://www.irinnews.org/.
[145] From interviews with Kyrgyz AP officials..., op. cit.
[146] Ibid.
[147] Ibid.
[148]The information stated here about the Moldova AP system was collected in course of interviews of Moldovan scientists, who shall remain anonymous, by Raymond A. Zilinskas during May 2003.
[149] In May 2003, the exchange rate was $ 1 = 14.1 lei.
[150] Soviet era laboratories were subdivided into specialty sub-laboratories that were called "boxes." Thus a bacteriology laboratory could have a cholera box, an anthrax box, and so on. This system still exists in most NIS.
[151] In Soviet times this institute was named Scientific Research Institute of Poliomyelitis and Viral Encephalitis.
[152] World Bank, *Moldova Health Policy Note: The Health Sector in Transition*, Report No. 26676-MD, Washington, D.C. November 2003.
[153] World Health Organization, Regional Office for Europe, *Healthcare Systems in Transition: Republic of Moldova 2002*, Copenhagen 2002; http://www.euro.who.int/document/e81265.pdf.
[154] Ibid.
[155] World Health Organization, Regional Office for Europe, *Highlights on Health in the Republic of Moldova 2005*, Copenhagen 2006; http://www.euro.who.int/Document/e88552.pdf.
[156] World Health Organization, Regional Office for Europe, *Republic of Moldova: 10 Health Questions*, Copenhagen 2006; http://www.euro.who.int/document/e88202_moldova.pdf.
[157] Science and Technology Center in Ukraine, "Board 23, November 16, 2006: Joint Statement"; http://www.stcu.int/documents/stcu_inf/gbm/gbm23/.
[158] See endnote 148.
[159] Center for Nonproliferation Studies, 2003. *Preliminary Report on the Anti-plague System of Central Asia*…, op. cit.
[160] From interviews with Tajik AP officials during the CNS staff tour of Tajik AP facilities, May 5-6, 2003.
[161] Ibid.
[162] Ibid.
[163] Ibid.
[164] Ibid.
[165] Ibid.
[166] Odessa City Duma Resolution, dated May 21, 1886, in Ukraine Ministry of Health, *I.I. Mechnikov Anti-plague Scientific and Research Institute of Ukraine* (in Ukrainian), Odessa, 2003.

[167] Ukraine Cabinet of Ministers Resolution #1201, dated July 7, 1999, and Ukraine Ministry of Health Order #180, dated July 23, 1999.

[168] These stairs were made famous due to having been the set for one of the most stirring scenes in the classic 1925 film "Battleship Potemkin" directed by Sergei M. Eisenstein.

[169] See the official website of the I.I. Mechnikov Scientific Research Anti-plague Institute of Ukraine; http://ukrantiplague.narod.ru/ (accessed 3/9/06). (This site, written only in Russian, is hopelessly outdated, having been last updated in 2001.)

[170] The information that follows on the institute's physical facilities is abstracted from the following three sources: observations by the author, interviews with institute administrators and scientists, and the brochure *I.I. Mechnikov Anti-plague Scientific and Research Institute of Ukraine* (in Ukrainian) by Ukraine Ministry of Health, Odessa, 2003.

[171] In 1991, the Ukrainian MOH decided that all cultures of Group I pathogens held in Ukraine were to be transported to the Mechnikov AP Institute. This was done according to well developed biosafety/biosecurity procedures in place from the Soviet era for packing and transporting pathogens. It appears as if these pathogens were then either destroyed or transferred to the Soviet Union before it dissolved in December 1991.

[172] The current culture collection situation in Ukraine is complex. The government has designated the L.V. Gromashevskogo Institute of Epidemiology and Infectious Diseases of the Academy of Medical Sciences in Kiev as its main depository of human pathogens. However, this institute has depository branches throughout Ukraine as follows: Kharkiv Institute of Microbiology and Immunology of the Academy of Medical Sciences has collections of bacteria, fungi, and viruses; the I.I. Mechnikov Anti-plague Scientific and Research Institute of Ukraine has especially dangerous bacteria and viruses; the Lviv Scientific and Research Institute of Epidemiology and Hygiene of the Ministry of Health has viruses and rickettsia; the Ukrainian Scientific and Research Institute of Venerology has chlamydia; and the Kiev Medical University has viruses. The source of this information is: Meeting of the State Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, "Procedure to Control Access and Work with Biological Agents and Toxins in Ukraine – Prepared by Ukraine," First Meeting, Geneva, 10-14 November 2003, document BWC/MSP.w003/MX/WP.42, August 22, 2003.

[173] No staff member of the CNS has had the opportunity to visit the Crimean AP Station. All information provided here originated from: A.B. Khaytovich and V.A. Shikulov, "Short Essay about the Krem Anti-plague Station" (in Russian), in Yu.G. Suchkov and N.N. Basova (eds.), *Interesting Stories About the Activities and People of the Anti-Plague System of Russia and the Soviet Union* (in Russian), no. 12, part 2, (Moscow: AOZT Informika, 2003), pp. 153–156.

[174] Interview with Ukrainian anti-plague scientist, May 2004.

[175] Meeting of the State Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, "Provisional List of Participants. A. States Parties," Second Meeting, Geneva, 6-10 December 2004, Meeting of Experts, Geneva, 19-30 July 2004.

[176] Ivan Rusev, "The Plague: One Hundred Years Later" (in Russian). *Slovo* (The Word – an Odessa weekly Internet newspaper), No. 50 (317), December 18, 1998.

[177] Valeria Lekhan, Volodomyr Rudiy, and Ellen Nolte, *Health Care Systems in Transition: Ukraine*, (Copenhagen: WHO Regional Office for Europe, 2004).

[178] Ibid.

[179] Interviews with scientists and administrators at the Central Sanitary-Epidemic Station of the Ukrainian Ministry of Health in Kiev, May 2004.

[180] L.V. Parkhomenko, V.V. Alexeenko, and E.V. Murashko, "Waterborne epidemic infections in Ukraine at last decade," in Centers for Disease Control and Prevention (ed.) *Proceedings of the*

*International Conference on Emerging Infectious Diseases, 2002*; http://www.cdc.gov/ideid/asm-ideid_program.pfd.

[181] This system is described in detail in the report: Meeting of the State Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, "National System of Epidemiological Surveillance in Ukraine – Submitted by Ukraine," Second Meeting, Geneva, 6-10 December 2004, Meeting of Experts, Geneva, 19-30 July 2004, document BWC/MSP/2004/MX/WP.47, July 22, 2004.

[182] Interview with Ukrainian anti-plague scientist, May 2004.

[183] Meeting of the State Parties to the Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction, "Procedure to Control Access and Work with Biological Agents and Toxins in Ukraine – Prepared by Ukraine," First Meeting, Geneva, 10-14 November 2003, document BWC/MSP.w003/MX/WP.42, August 22, 2003.

[184] United States Department of Defense, *DOD Global Emerging Infections System: Partnering in the Fight Against Emerging Infections, Annual Report Fiscal Year 2005*, Washington, D.C. 2005; http://www.geis.fhp.osd.mil/GEIS/DoDGEISNews/GEIS_AR_05.pdf.

[185] United States Embassy in Ukraine, "New Nunn-Lugar Biological Agreement Signed in Ukraine," August 29, 2005; http://kiev.usembassy.gov/press/050829_lugar_eng.html.

[186] The Lviv institute had an important role in the Soviet BW program and currently many of its responsibilities in the north-west part of Ukraine resemble that of a typical Soviet-era AP institute.

[187] See endnote #112.

[188] See endnote #113.

[189] Presidential Decree *On the State Program to Reform the Public Health System of Uzbekistan* of 1999 (in Russian).

[190] CNS interview with the director of the Center for Prophylaxis of Quarantine and High-Risk Infections (CPQHRI), Washington, D.C., March 28, 2002.

[191] CNS interviews at Zarafshan, Karakalpak, and Turtkul AP stations, September 8-17, 2003.

[192] Ibid.

[193] Center for Nonproliferation Studies, 2003. *The Evolution of the Anti-plague system of Uzbekistan and Its Objectives* (in Russian). Monterey: Center for Nonproliferation Studies.

[194] CNS interview with the head of Turtkul field AP station, Autonomous Republic of Karakalpakstan, Uzbekistan, September 9, 2003.

[195] Center for Nonproliferation Studies, 2003. *The Evolution of the Anti-plague system of Uzbekistan and Its Objectives*, op. cit.

[196] N. Dyagterev, *Aktualnie voprosy epidnadzora v prirodnykh ochagakh chummy. Prirodnaya ochagovost' v vysokogoryakh* (Contemporary problems of epidemiological monitoring of the natural plague foci. The formation of natural plague foci in the mountainous regions), Stavropol, 1985.

[197] Center for Nonproliferation Studies, 2003. *The Evolution of the Anti-plague system of Uzbekistan and Its Objectives*, op. cit.

[198] CNS interview with the head of the Zarafshan field AP station, Zarafshan, Uzbekistan, September 8, 2003.

[199] Center for Nonproliferation Studies, 2003. *The Evolution of the Anti-plague system of Uzbekistan and Its Objectives*, op. cit.

[200] CNS staff visit to the Center for Prophylaxis of Quarantine and High-Risk Infections (CPQHRI), September 2003.

[201] CNS interview with the head of the Zarafshan field AP station, op. cit.