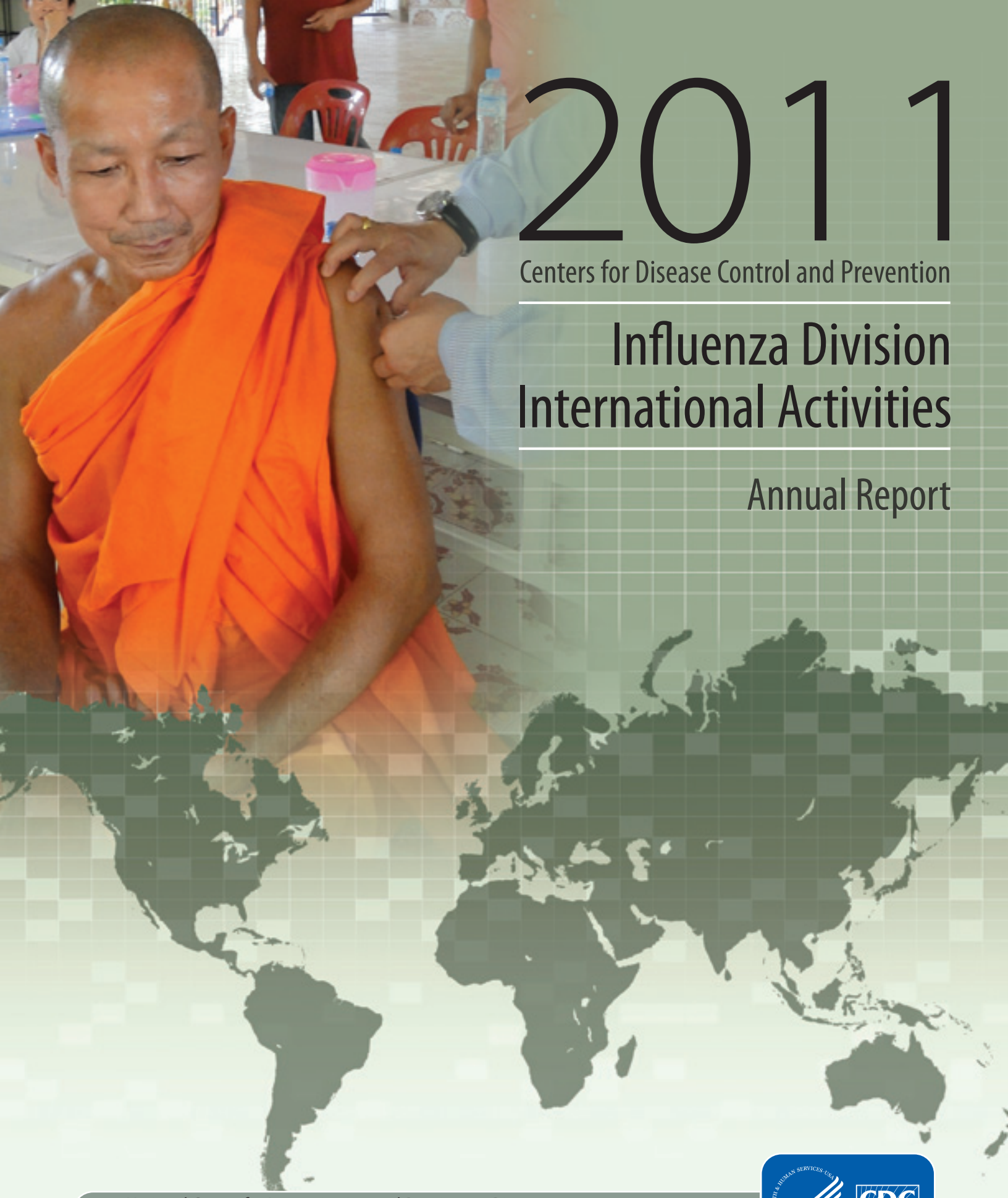

2011

Centers for Disease Control and Prevention

Influenza Division International Activities

Annual Report

National Center for Immunization and Respiratory Diseases
Influenza Division

Acknowledgement

The U.S. Centers for Disease Control and Prevention's (CDC) Influenza Division would like to acknowledge the World Health Organization (WHO) Regional Offices, the National Influenza Centers and all of our influenza surveillance cooperative agreement partners for their dedication and determination to establish, expand and maintain seasonal and pandemic influenza surveillance, locally and globally. Their notable efforts and contributions have significantly increased laboratory and epidemiologic capacity for the world to respond better to pandemic and other emerging infectious disease threats. Their collective work has contributed to greater global health security.

Special thanks to Emily Cramer, Lucinda Johnson, Pamela Kennedy, Ann Moen, Sajata Outin-Blenman, and Lanelle Wright for editing and producing the International Influenza Report FY 2011.

Special thanks to Kate Mollenkamp for designing the International Influenza Report FY 2011.

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Cover Photo Credit

Dr. Anonh Xeuatvongsa (Director, National Immunization Program) administering a vaccine for seasonal influenza at a clinic in a temple in rural Vientiane, Lao PDR.

Courtesy of Emily Cramer, Contractor with CDC, based in Atlanta.

Centers for Disease Control and Prevention

Influenza Division International Activities

Fiscal Year 2011 Annual Report

Contents

Influenza Division International Overview

Background

The U.S. Centers for Disease Control and Prevention's (CDC) Influenza Division has a long history of supporting the World Health Organization (WHO) and its global network of National Influenza Centers (NIC). With limited resources, most international assistance provided in the early years was through hands-on laboratory training of in-country staff, the annual provision of WHO reagent kits (produced and distributed by CDC), and technical consultations for vaccine strain selections. The Influenza Division (at that time, the Influenza Branch) also conducted epidemiologic research including vaccine studies and serologic assays and provided international outbreak investigation assistance.

In 1997, the first human cases of influenza A (H5N1) were reported in Hong Kong, and the Influenza Division played a key role in assisting with the outbreak investigations. The re-emergence of fatal human cases of avian influenza A (H5N1) in China in 2003 following the outbreak of SARS, followed by human outbreaks caused by highly pathogenic avian influenza A (H5N1) viruses in Vietnam and Thailand in 2003 and 2004 led to a growing concern that a pandemic of influenza may emerge. These outbreaks highlighted several important gaps that needed to be closed to improve the ability to rapidly identify novel influenza viruses with pandemic potential. These included:

- conspicuous geographic gaps in human influenza surveillance.
- critical gaps in information, laboratory and epidemiologic training and technology transfer for rapid identification and analysis of avian influenza viruses in many affected countries.
- longstanding obstacles and gaps in the sharing of information, resources and specimens between agriculture and human health authorities.

These events fostered the beginning of a larger international program to improve global pandemic preparedness and enhance capacity for laboratory and epidemiologic surveillance of influenza and avian influenza.

In 2004, the U.S. government (Health and Human Services (HHS)/CDC) committed resources and developed a multi-faceted approach to support global capacity for seasonal influenza and pandemic preparedness. Support was made available through cooperative agreements to enhance the existing support to WHO's Global Influenza Program (GIP) and WHO's regional offices. Substantial support was also provided to Ministries of Health in high-risk countries to enhance influenza surveillance and response capabilities. These cooperative agreements, paired with technical assistance, support the provision of training, staffing, direct assistance, supplies and reagents, formed the foundation for CDC's expanded role in international influenza control and prevention. The program accomplishes key goals by building on existing programs and infrastructure including WHO and its regional offices, CDC Global Disease Detection (GDD) sites and International Emerging Infections Program (IEIP) sites, Department of Defense (DoD) international program sites, and by utilizing the assistance of U.S. Embassies.

In April 2009, the first case of pandemic 2009 H1N1 influenza virus infection in the United States was identified. Subsequent cases were quickly identified in Mexico and other states. The influenza virus identified in these early cases was unique and contained a combination of gene segments that had not been previously reported in animals or humans. The 2009 H1N1 pandemic allowed many countries with cooperative agreements to showcase the progress they have made in the last few years. First-time investigations of influenza were conducted in response to the pandemic and labs that previously could not identify influenza virus were able to diagnose pandemic 2009 H1N1 using molecular techniques. Many countries that previously had not reported influenza routinely were able to report consistently and contribute to the global picture of influenza epidemiology during the pandemic. The global surveillance and response capacity built before the pandemic of 2009 was critical to the rapid global response and disease prevention.

Over the past six years the program has undergone remarkable growth [see Maps] and has expanded to provide support to over 40 countries, all WHO regional offices and WHO Headquarters. Partnerships have been developed with the DoD, United States Agency for International Development (USAID), Biosecurity Engagement Program (BEP), universities, nongovernmental organizations, private industry and other entities to enhance global surveillance and preparedness. Over 20 permanent staff have been placed in the field [see Map] to provide on-the-ground assistance and support to countries and to WHO, and to augment the GDD program and DoD field sites.

Recognizing that needs vary by countries, the program is designed as a continuum to include: improvements to surveillance, efforts to enhance pandemic preparedness, implementation of burden of disease studies to measure the impact of influenza, and studies to determine the effectiveness of intervention measures such as vaccination. With the data generated through surveillance, each country can determine which populations are most vulnerable to influenza-related morbidity and mortality and who should receive influenza vaccine. Based on surveillance and other analyses, influenza vaccination policy and issues related to vaccine production can be approached on a country-by-country and a regional basis. In 2010, we embarked on placing more emphasis on the development of data to help countries evaluate the need and feasibility of vaccine policy. In 2011, CDC entered a partnership with WHO's Global Action Plan for Influenza Vaccine, towards expanding prevention of global disease and improving health security through greater use of influenza vaccines worldwide.

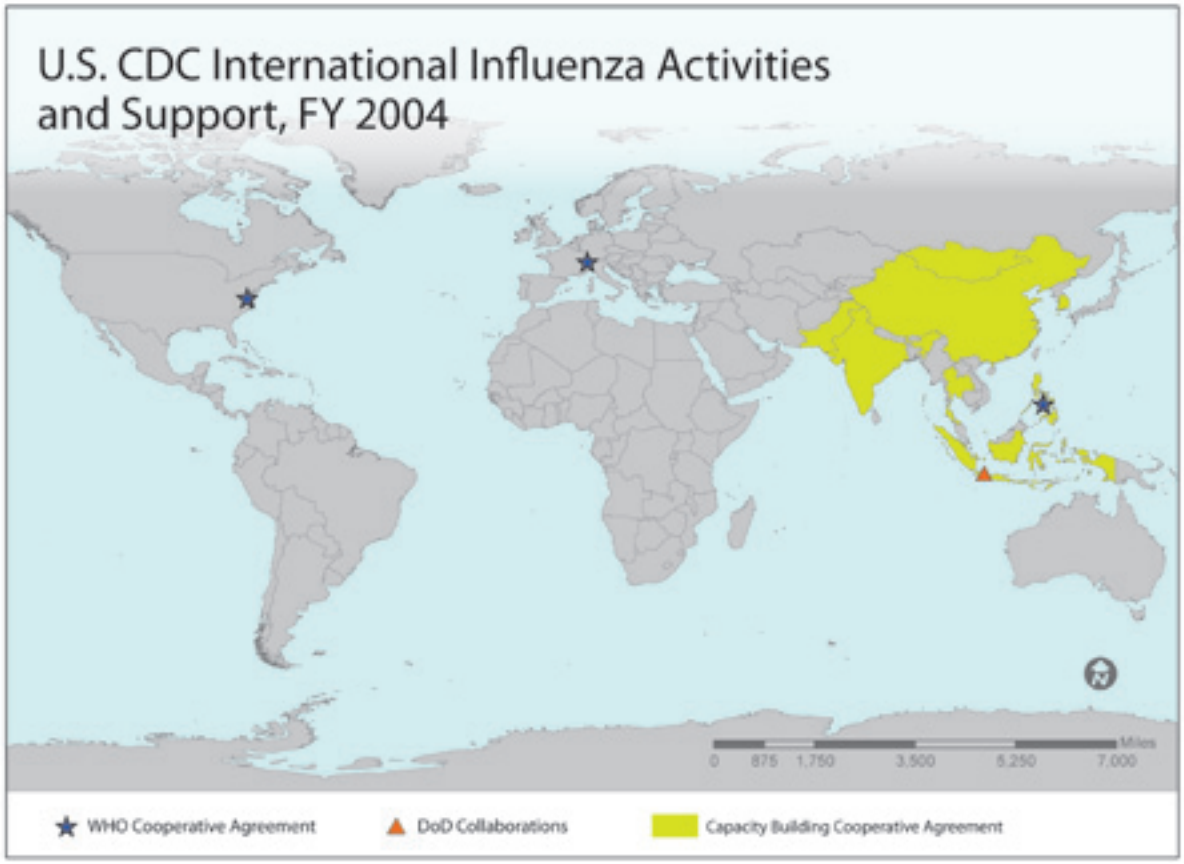
While the response to the 2009 H1N1 pandemic was an opportunity to show recent progress, avian influenza H5N1 outbreaks still pose a significant and ongoing global health threat and the threat to U.S. security. To sustain the gains made in the past years, a broad-based commitment to build and maintain influenza surveillance globally that is sustainable (and eventually self-sustainable) requires dedicated, annualized resources and staffing. It is our hope that these HHS/CDC resources and technical assistance will act as a catalyst for affected countries, neighboring countries and donor countries to commit resources to establish long-term influenza surveillance, prevention and control, and pandemic preparedness activities as high priorities. We also envision that each affected country will utilize the technical assistance and resources available to improve surveillance, develop influenza vaccination policy, make plans for the use of influenza vaccine both annually and during a pandemic, and work closely with regional and international partners to further preparedness.

This program has implications beyond influenza. The capacity being developed for laboratory and epidemiologic surveillance of severe respiratory disease has served as the basis for capacity for the diagnosis and investigation of other infectious diseases, particularly other respiratory pathogens. Laboratory equipment and training has enabled the diagnosis and investigation of other diseases. Likewise, through the implementation of a global rapid response training program, CDC has provided training and materials for thousands of people in all WHO regions. These courses have enabled the trained teams to participate in outbreaks not

A vial containing Influenza A H1N1 vaccine.

only for the recent pandemic but for other respiratory diseases and many other pathogens including Rift Valley fever, dengue, cholera, Ebola and rabies. Evidence shows that the technical assistance provided by the Influenza Division is assisting countries in increasing their capacity necessary for compliance with the new International Health Regulations 2005 (IHR). The generic approach, with a focus on influenza and avian influenza, contributes greatly to global capacity for laboratory, epidemiology and overall preparedness for emerging and re-emerging infectious diseases. Efforts are underway to plan for the sustainability of the gains that have been made. This report is the fourth annual update on the Influenza Division's international activities.

Two technicians working in the laboratory at the NIC in Madagascar.


U.S. CDC International Influenza Activities and Support, FY 2004
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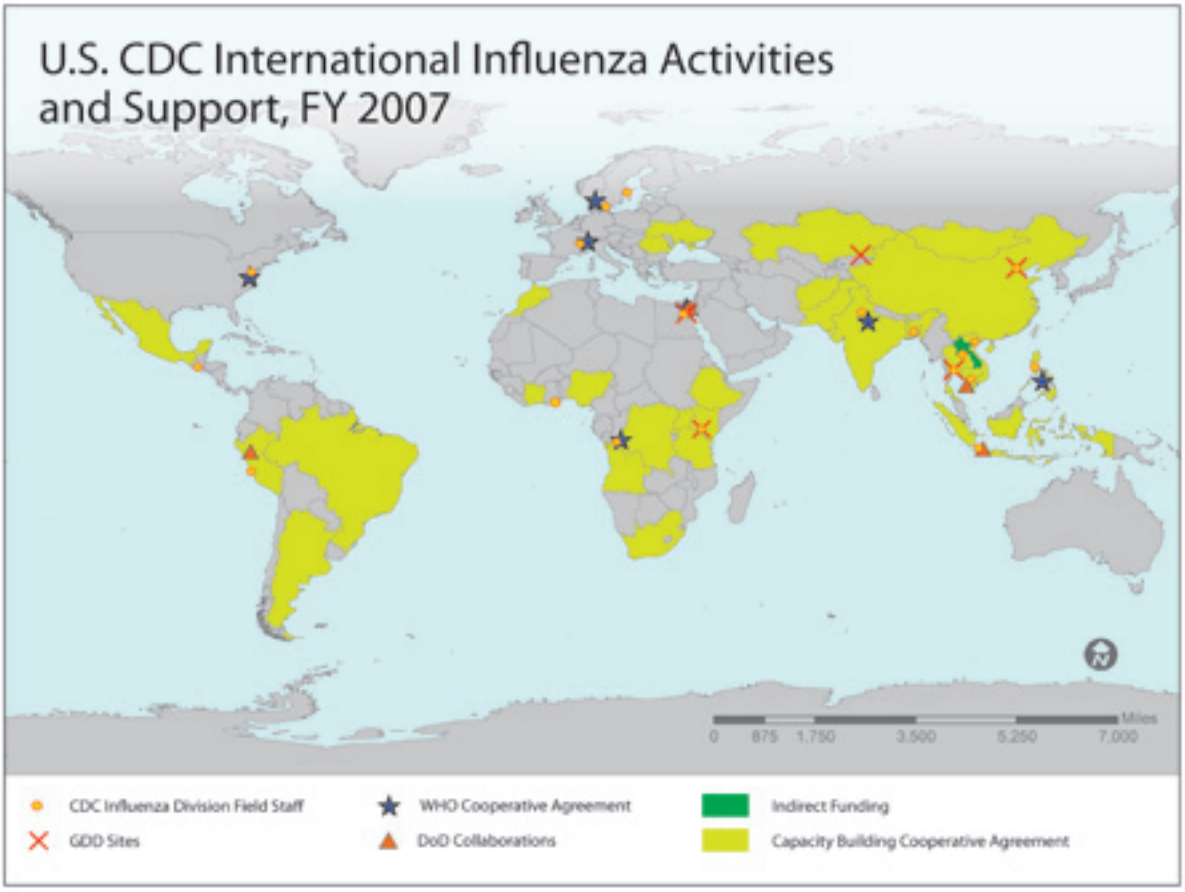
Miles
WHO Cooperative Agreement
DoD Collaborations
Capacity Building Cooperative Agreement


U.S. CDC International Influenza Activities and Support, FY 2007
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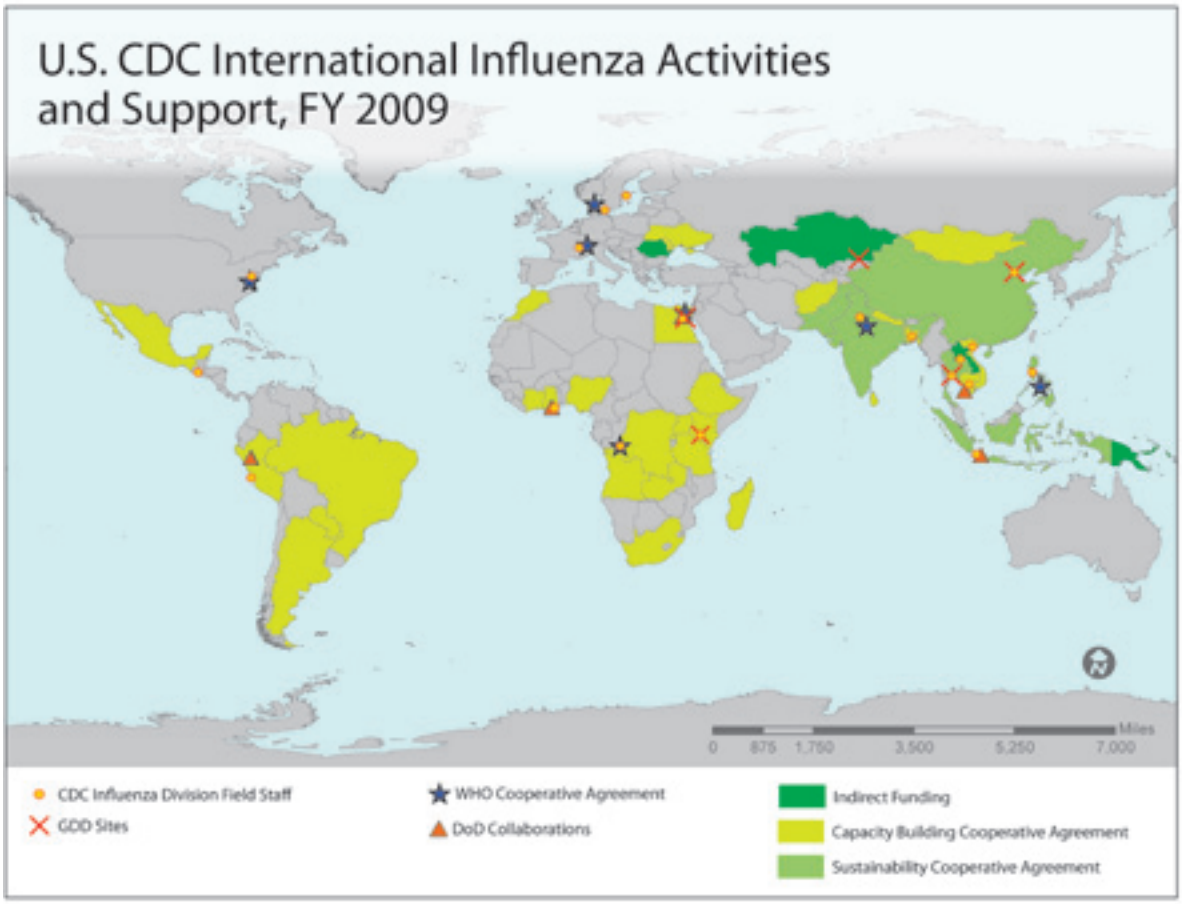
Miles
CDC Influenza Division Field Staff
GDD Sites
WHO Cooperative Agreement
DoD Collaborations
Indirect Funding
Capacity Building Cooperative Agreement


U.S. CDC International Influenza Activities and Support, FY 2009
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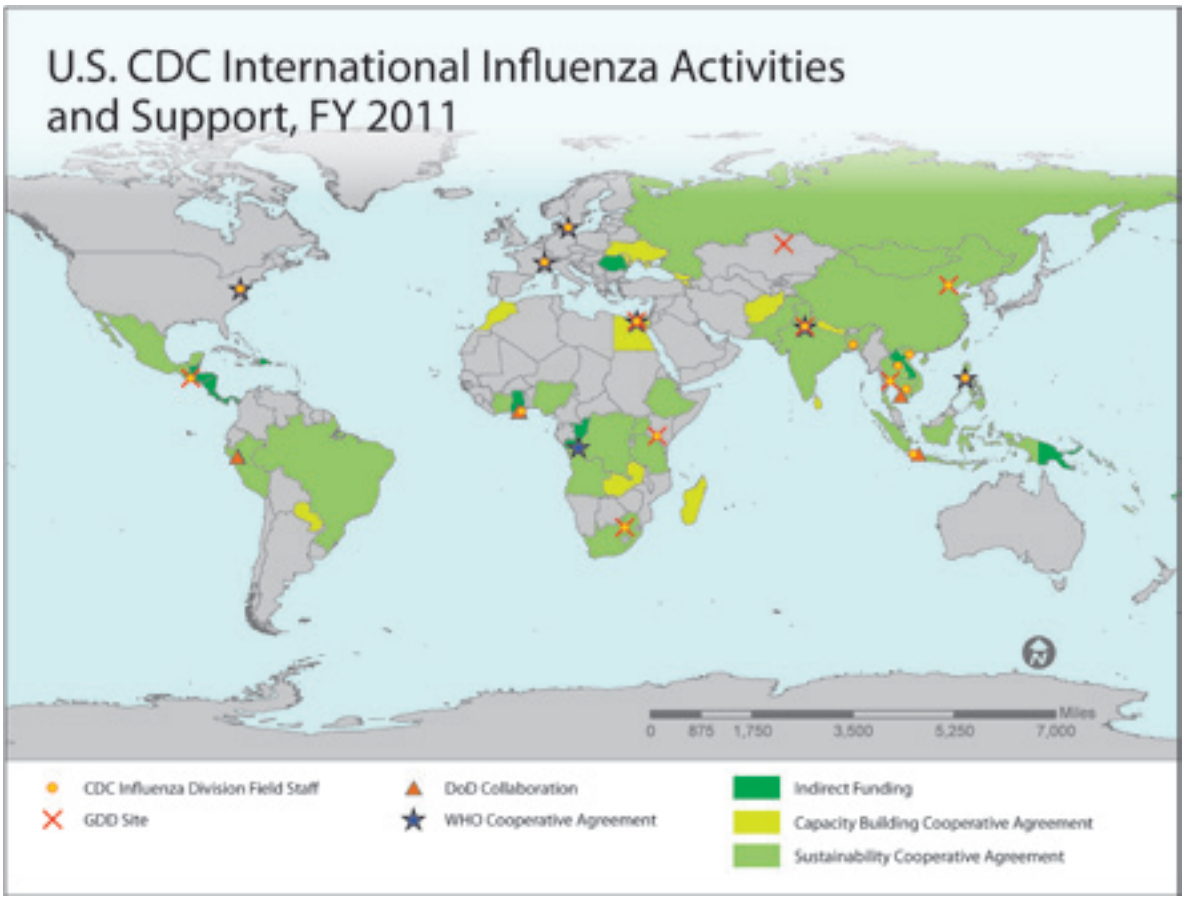
CDC Influenza Division Field Staff
GDD Sites
WHO Cooperative Agreement
DoD Collaborations
Indirect Funding
Capacity Building Cooperative Agreement
Sustainability Cooperative Agreement


U.S. CDC International Influenza Activities and Support, FY 2011
0 875 1,750 3,500 5,250 7,000 Miles
CDC Influenza Division Field Staff
GDD Site
DoD Collaboration
WHO Cooperative Agreement
Indirect Funding
Capacity Building Cooperative Agreement
Sustainability Cooperative Agreement

U.S. CDC and WHO Collaborations—Influenza

The HHS/CDC Influenza Division has maintained cooperative agreements with WHO Headquarters and the WHO Pan American Health Organization (PAHO) and Western Pacific Regional Offices (WPRO) for many years to address seasonal and pandemic influenza. In 2006, new cooperative agreements were put in place with the WHO South-East Asia Regional Office (SEARO), the Africa Regional Office (AFRO), the Eastern Mediterranean Regional Office (EMRO) and the European Regional Office (EURO). The main purpose of the cooperative agreements is to address global and regional preparedness for influenza—both seasonal and avian—through support to enhance the WHO Global Influenza Surveillance and Response System (GISRS), and technical support to countries' influenza prevention and control programs. This effectively increases the number of countries participating in the global system and more importantly enhances the early warning capacity and communications so there is a greater chance for early identification of a pandemic.

Recently, we have expanded our focus to also support efforts to increase influenza prevention through vaccination globally. Greater use of influenza vaccines will reduce the burden of influenza every year, but also provide a greatly expanded base of timely vaccine manufacturing to be used during pandemic influenza. Towards this goal, we have supported activities that will develop the evidence for use of vaccines globally and in partner countries. Activities include supporting partners to develop estimates of influenza-associated disease and cost burden, projects to understand the effectiveness of influenza vaccines in special populations relevant to policy expansion, and supporting countries' policy making bodies. Information about the project activities for the regional offices is integrated under the specific regions. CDC's Influenza Division provided funding and technical support to WHO Headquarters in 2011 for multiple projects related to influenza, outlined below.

Activities supported through WHO

Influenza Laboratory Surveillance

- Strengthening of global influenza laboratory surveillance through improved diagnostic capacity and enhanced shipping capacity of influenza viruses/specimens to WHO Collaborating Centers (WHO CC).
- Strengthening global coordination and communication of GISRS by conducting a third National Influenza Center (NIC) survey and feeding results of the analysis into a NIC meeting with all regions.
- Supporting NICs to attend the WHO vaccine composition consultations in September and February to support this goal.

Influenza Epidemiology and Surveillance

- Strengthening influenza monitoring at the global level including development of automated analysis and visual presentation tools.
- Developing a pandemic assessment tool.
- Supporting developing countries in risk assessment and response.
- Supporting countries in the development of influenza surveillance systems and assessment of disease burden to inform vaccine and antiviral use decisions.

- Developing estimates of influenza deaths during seasonal epidemics and pandemics.
- Developing a tool for community-level risk assessment for H5N1 infection in collaboration with OIE (World Organisation for Animal Health) and FAO (Food and Agriculture Organization of the United Nations).

Strengthening Influenza Pandemic Preparedness and Response Planning

- Review of national pandemic assessment and development of lessons learned to revise pandemic preparedness guidelines.
- Review of:
    - measures and indicators of severity during a pandemic.
    - the concept of pandemic phases for decision-making.
- Assessment of effectiveness of school closure in different settings.
- Maintenance and improvements to the digital library.

Public Health Leadership and Global Coordination

- Provision of technical guidance and support to member states for—
    - development of coordinated pandemic preparedness initiatives.
    - developing future strategies aligned with WHO Headquarters and regional office guidance for global pandemic preparedness with a view toward long-term public health capacity for vulnerable populations.
- Dissemination of guidance:
    - to minimize social and economic disruption.
    - to other United Nations agencies and programs.

Seasonal Influenza Vaccine Introduction

- Collection and dissemination of information on influenza vaccine availability and utilization.
- Assurance of quality and safety of influenza vaccines by visiting manufacturing sites and technical reviews of production procedures.
- Support for influenza vaccination policy through the development of mathematical models to estimate potential public health impact of various vaccine introduction strategies and potential impact of vaccine introduction on mortality among children younger than 5 years old.
- Capacity development and facilitation of influenza vaccine policy in WHO regions.
- Support of WHO's Strategic Advisory Group of Experts to update global vaccine recommendations.
- Support of WHO's Global Action Plan for Influenza Vaccines to expand the availability of influenza vaccines globally.

Influenza Reagent Resource (IRR)

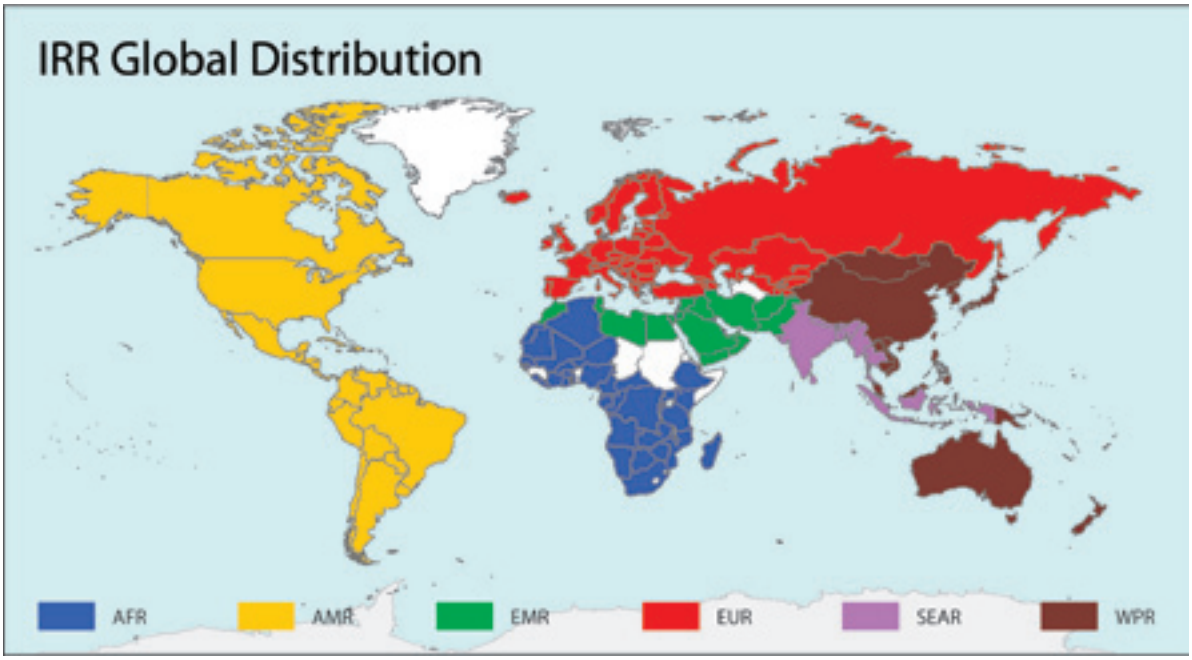
The Influenza Reagent Resource (IRR) was established by the U.S. CDC to provide registered users with reagents, tools and information for studying and detection of influenza virus. The IRR acquires, authenticates, and produces reagents that scientists need to carry out basic research and develop improved diagnostic tests, vaccines, and detection methods. Public health labs also use the reagents across the globe for the surveillance of newly emerging strains of influenza, such as H1N1 and H5N1. By centralizing these functions within the IRR, access to and use of these materials in the scientific and public health community is monitored and quality control of the reagents is assured.

The roles of IRR in pandemic preparedness and influenza research are:

- To manufacture and distribute influenza diagnostic kits, viruses, and reagents to public health, commercial, domestic, and international research laboratories.
- To improve pandemic preparedness, enhance detection and control of seasonal influenza, and provide better access to reagents via a secure, web-based system.
- To augment CDC's international pandemic preparedness plan to provide a surge option (~$10+ million per year) which can be exercised to distribute reagents and diagnostic kits to domestic and international public health laboratories.

Post pandemic, CDC and IRR continue to provide reverse transcriptase polymerase chain reaction (RT-PCR) 2009 H1N1 and seasonal influenza diagnostic kits, ancillary reagents, reference viruses and other materials to 128 countries supporting more than 187 international laboratories. These kits and reagents were also provided to more than 150 public health laboratories domestically in 50 states and territories.

Product	Total Kits International	# Countries Distributed	# Int Labs Distributed	Total Kits in U.S.	# of Domestic Distributed	# of U.S. State Labs Distributed	Total Kits
H1N1 RT-PCR Kit	226	128	187	129	50 + DC + PR	161	355
Seasonal RT-PCR Kit	671			683			1354
WHO Reference Kit	220			83	50		303



A map of IRR's distribution of diagnostic kits and reagents to countries/regions.

IRR is currently available via fluorder@cdc.gov. The IRR website is live and displays over 150 different reagents and kits available to the public health labs globally. Registration to the IRR should commence in the near future, allowing registrants to order reagents electronically as well as view a large amount of information relating to influenza reagents.

The IRR is providing better access to quality influenza-related reagents by manufacturing and distributing influenza viruses a la carte and as panels, recombinant proteins, antisera, monoclonal antibodies, ribonucleic acid (RNA) standards, non-influenza respiratory pathogens and more. Institutions that have access to these reagents are qualified domestic and international WHO NICs and public health laboratories, commercial test developers, vaccine manufacturers, and research institutions.

WHO African Region (AFR)

WHO African Region (AFR) Overview

Currently there are 11 bilateral influenza cooperative agreements in the sub-Saharan region of Africa. These agreements are with ministries of health or institutions designated by a country's ministry of health (MOH) to work with the U.S. Centers for Disease Control and Prevention (CDC) in building capacity to routinely identify, diagnose and respond to seasonal and pandemic influenza across the African continent.

CDC direct country support via cooperative agreements is established in the following countries:

- Angola
- Côte d'Ivoire
- Democratic Republic of Congo (which also supports surveillance in the Republic of Congo)
- Ethiopia
- Madagascar
- Nigeria
- Rwanda
- South Africa
- Tanzania
- Uganda
- Zambia

In addition, CDC supports the World Health Organization (WHO) African Regional Office (AFRO) via a cooperative agreement.

The core activities of our bilateral agreements and technical assistance are:

- To build sustainable national capacity for seasonal influenza, pandemic influenza and other emerging diseases and preparedness for implementation of International Health Regulations 2005 (IHR).
- To make routine contributions of surveillance data to WHO's Global Influenza Surveillance and Response System (GISRS).
- To increase the geographic reach of WHO GISRS.
- To provide early access to critical virus isolates from humans and birds for WHO GISRS.
- To increase the quantity of shipments and influenza isolates provided by African influenza laboratories for analysis by WHO Collaborating Centers.
- To develop sustainable epidemiologic and virologic surveillance systems for severe influenza, in order to gain an understanding of the burden of disease from influenza in the WHO African Region.

In addition to our bilateral work, we also partner with the U.S. Naval Medical Research Unit No. 3 (NAMRU-3) in Accra, Ghana to jointly support the following West African countries that have started influenza surveillance:

- Burkina Faso
- Ghana
- Mali
- Mauritania
- Togo

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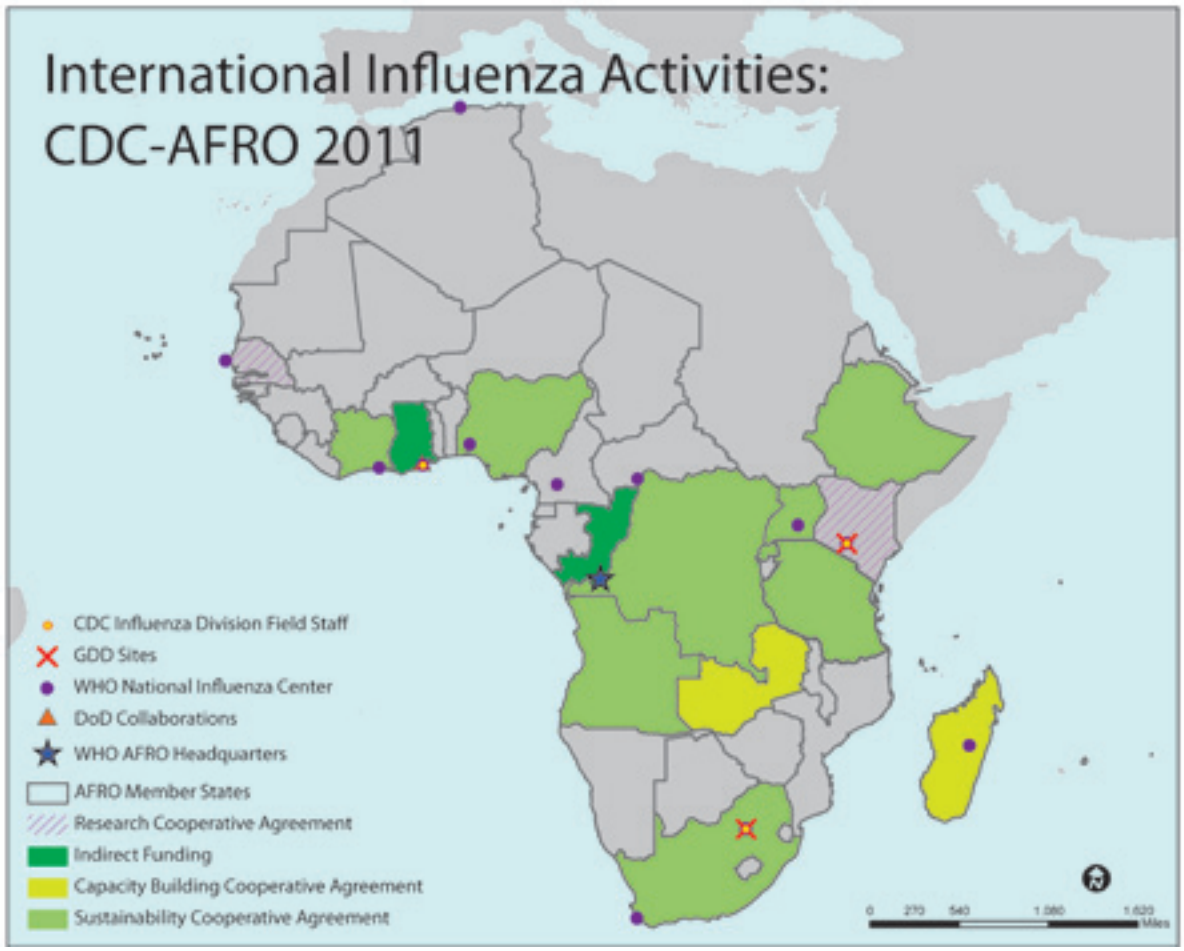
WHO African Regional Office (AFRO)



Highlights

- The World Health Organization (WHO) protocol for national influenza sentinel surveillance was finalized and is available in English, French and Portuguese.
- Weekly data on virological surveillance of influenza has been maintained in FluNet.
- The WHO African Region influenza laboratory network has sustained good performance with regard to the WHO External Quality Assessment Project (EQAP).

U.S. CDC Direct WHO Regional Office Support

The five-year cooperative agreement *Surveillance and Response to Seasonal and Pandemic Influenza by the World Health Organization (WHO) Regional Office for Africa* began on September 30, 2011 and is in its first year of implementation. WHO's African Regional Office (AFRO) is located in Brazzaville, Congo. The Office serves 46 countries, of which 30 are targeted by this project.

WHO AFRO staff and consultants provide standardized guidelines and protocols, and on-site training on both epidemiological and virological surveillance of influenza. Support has been provided in the form of technical assistance to member countries to strengthen surveillance, preparedness, and response to priority diseases, but with a special focus on influenza-like illnesses (ILI) and severe acute respiratory infections (SARI). Countries within the network are regularly supplied with laboratory equipment and reagents, thus enhancing and sustaining diagnostic capacity for influenza in the region.

Surveillance

WHO AFRO protocol for national influenza sentinel surveillance has been disseminated to Member States. Countries have strengthened epidemiological surveillance of influenza through promoting the use of standardized case definitions, and improving collaboration between the officers in charge of epidemiological surveillance within the Ministry of Health (MOH) and the focal person of the national influenza laboratory. This ensures that the information generated is used by the MOH as well as ensuring that the Integrated Disease Surveillance and Response (IDSR) is used as a platform for strengthening influenza surveillance.

Surveillance Activities

- Developed the WHO AFRO protocol for national influenza sentinel surveillance. A draft was prepared, reviewed, edited and translated to English, French and Portuguese and then disseminated to the countries.
- Adapted the generic protocol to the local context, thus generating national protocols in the following countries: Angola, Cameroon, Ghana, Malawi, Nigeria, Rwanda, Senegal, Sierra Leone and Zambia.
- Conducted site visits to assess needs and necessary adjustments, supported organization of national workshops for adaptation of the WHO generic guideline to the local context, conducted on-site training at the sentinel sites using the adapted protocol, and provided training on FluNet and FluID to improve reporting.
- Conducted a site visit to Sierra Leone for strengthening epidemiological surveillance of influenza through IDSR.
- Supported Malawi with a site visit and training on sentinel surveillance at the sites selected by the MOH. Mozambique received technical support to adapt the tools and prepare for the training.

Laboratory

The Regional Influenza Laboratory Network is comprised of 29 National Influenza Reference Laboratories in 24 countries. Two laboratories, one in Sierra Leone and the other in Malawi, have been supported to enhance capacity for virological surveillance of influenza. With the support from the cooperative agreement, the members of the Regional Influenza Laboratory Network are sharing weekly data on virological surveillance of influenza.

Laboratory Activities

- Five new laboratories (Angola, Burkina Faso, Mali, Mozambique and Togo) have joined the EQAP for influenza laboratories. As a result, the performance on influenza EQAP for 26 laboratories in 24 countries is being monitored.
- Fifteen countries (Algeria, Angola, Central African Republic, Cote d'Ivoire, Democratic Republic of Congo, Ethiopia, Ghana, Kenya, Mali, Niger, Nigeria, Rwanda, Senegal, Tanzania and Zambia) are being supported to maintain virological surveillance of influenza through provision of reagents and supplies for specimen collection and conducting PCR.
- Through provision and installation of equipment (including a real-time PCR machine) as well as reagents and essential laboratory supplies, Sierra Leone was able to start virological surveillance of influenza.

Preparedness

WHO AFRO, in collaboration with partners, is developing a framework for supporting countries to develop comprehensive epidemic and pandemic preparedness plans that will include influenza.

Preparedness Activities

- Financial and technical support was provided to South Africa to organize a national influenza vaccination campaign.
- Through the U.S. Centers for Disease Control and Prevention (CDC) project and Emerging Pandemic Threats program, collaboration was strengthened between human and animal health officials with regard to surveillance and outbreak investigation.
- A consultant was hired to provide a report on outbreaks occurring in the Region (including those related to influenza) in order to inform development of an epidemic preparedness and response framework.
- As part of the early warning system, information on ongoing acute public health emergencies in the Region is being collected, analyzed and shared through monthly bulletins.

Training

- Training on sentinel surveillance of influenza in collaboration with WHO's Global Influenza Program/ Agence de Médecine Préventive (GIP/AMP) for eight countries (Angola, Cameroon, Ghana, Nigeria, Rwanda, Senegal, Sierra Leone, and Zambia) has been organized.
- A scientist from Sierra Leone's influenza laboratory has been trained on conducting real-time PCR at Noguchi Memorial Institute for Medical Research (NMIMR) in Accra, Ghana.
- AFRO staff members were key facilitators during a training that was organized by CDC for nine West African countries (Burkina Faso, Cote d'Ivoire, Ghana, Mauritania, Mali, Niger, Nigeria, Senegal and Togo) on influenza sentinel surveillance. Participants were sensitized on the implementation of the surveillance of influenza in the context of IDSR.

Contacts

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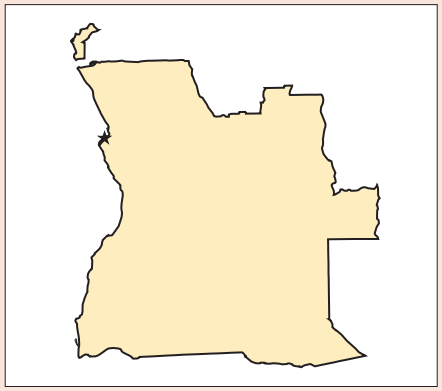
Angola



- **Capital:** Luanda
- **Area:** 1,246,700 sq km
- **Population:** 18,056,072 (July 2012 est.)
- **Age Structure:** 0-14 years: 43.2% (male 2,910,981/female 2,856,527); 15-64 years: 54.1% (male 3,663,400/female 3,549,896); 65 years and over: 2.7% (male 157,778/female 199,959) (2011 est.)
- **Life Expectancy at Birth:** Total population: 54.59 years; male: 53.49 years; female: 55.73 years (2012 est.)
- **Infant Mortality Rate:** Total: 83.53 deaths/1,000 live births; male: 87.39 deaths/1,000 live births; female: 79.47 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 67.4%; male: 82.9%; female: 54.2% (2001 est.)
- **GDP:** $115.9 billion (2011 est.)
- **GDP per Capita:** $5,900 (2011 est.)

Highlights

- National Public Health Institute (INSP) started collaboration with the Field Epidemiology Laboratory Training Program (FELTP).
- Influenza surveillance information started being reported weekly to the National Public Health Directorate, the World Health Organization (WHO), the U.S. Centers for Disease Control and Prevention (CDC), and FluNet by INSP personnel.
- WHO's African Regional Office (AFRO) contracted a national consultant through the Agence de Médecine Préventive (AMP) for the Strengthening Influenza Surveillance in Africa (SISA) project, with the aim to assess the influenza surveillance system in Angola and review protocols and standard operating procedures for influenza surveillance within the Ministry of Health.
- Along with the SISA project, surveillance activities were enhanced and a national influenza protocol was written.
- One fully operational sentinel site, a pediatric hospital in the capital city, Luanda, has been implemented.
- The second assessment for the WHO External Quality Assessment Project (EQAP) was completed in April 2011 with 100% correct.

U.S. CDC Direct Country Support

Acute respiratory disease is one of the major causes of morbidity and mortality within the Angolan population and the country is classified as high-risk for infection and spread of avian influenza within the Pandemic Risk Index scale. The Republic of Angola has been collaborating with CDC on influenza control since 2006 through a cooperative agreement for avian influenza. INSP is the Central Reference Laboratory (CRL) of the Ministry of Health (MOH).

Notably, influenza laboratory diagnosis capacity has improved since the beginning of the collaboration. The agreement has also enhanced the general level of preparedness and response capacity for influenza and other emerging diseases in Angola.

Laboratory surveillance activities in Angola are ongoing. During FY 2011 respiratory samples were tested for influenza A. A new RNA extractor has arrived, enhancing the laboratory's capacity to receive a higher number of samples.

Surveillance

In an effort to increase surveillance activities, sentinel sites were expanded to include a private hospital in Luanda (Clínica Sagrada Esperança) and two other main hospitals in the provinces of Huila and Cabinda.

The country has been able to implement one fully operational sentinel site—David Bernardino Pediatric Hospital—in the capital city Luanda. The National Public Health Directorate (DNSP) provides expertise in epidemiology surveillance matters; however, no one is specifically assigned to influenza surveillance data analysis. DNSP is making efforts to develop a stronger capacity to engage sentinel sites in order to produce, collect, analyze and interpret influenza surveillance data.

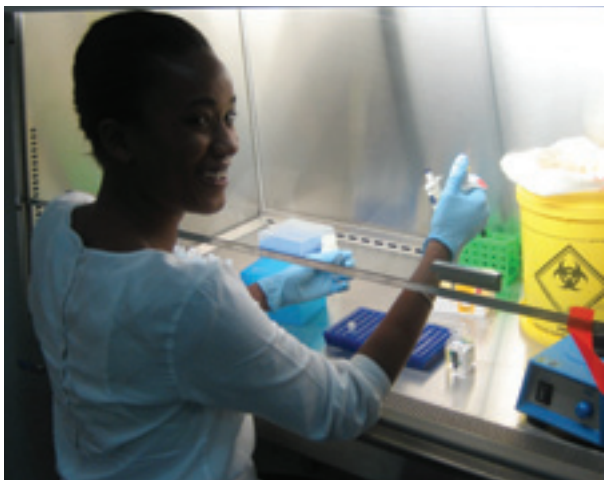
Surveillance Activities

- The influenza surveillance system was assessed by the SISA consultant and a report was written and discussed within the technical group.
- Influenza surveillance protocol based on the *WHO AFRO Sentinel Surveillance Protocol* was written.
- Case definitions were reviewed with all the provincial disease surveillance focal points.
- A health professional was hired in August. She has been trained to supervise and monitor the activities of the sentinel sites, and to develop an influenza epidemiological database.

Laboratory

The biosafety cabinets of the molecular biology laboratory of the INSP were certified, the exhaust and negative pressures system were remodeled; laboratory reagents and consumables were procured; and the laboratory was assessed by experts from the Association of Public Health Laboratories (APHL).

From September 23–30, 2010, the CRL was attended by the experts from the South African Maintenance Air Filter Service Company for the certification and installation of two new cameras, as well as assembly of an exhaust system to establish negative pressure in the extraction room for nucleic acids.



Laboratory Technician, Ms. Jocelyne Vasconcelos, preparing samples for a test-run using the laboratory's new QIAcube.

Technicians conducted preventive maintenance for equipment from Applied Biosystems, through a maintenance contract INSP established with the company for a period of three years.

Laboratory Activities

- December 13–14, 2010, training was conducted on practices for harvesting and packaging of samples of influenza at Américo Boavida Hospital.
- In May 2011, a QIAcube for extraction was received as a donation from CDC to strengthen the influenza activities.
- From June to July 2011, the laboratory participated in the WHO EQAP for the detection of influenza virus type A by PCR. Twelve samples were tested through this project and the results showed 100% concordance with the CRL.
- During August 2011, a surveillance and laboratory capacity review was conducted in collaboration with CDC.

Preparedness

In efforts to strengthen influenza surveillance awareness and commitment, the INSP and DNSP started collaboration with FETLP. INSP and DNSP personnel participated in lectures and conferences at national and international levels for the discussion of surveillance results.

INSP personnel began weekly reporting of influenza surveillance information to DNSP, WHO, CDC and FluNet in August 2011.

Preparedness Activities

- Ensure antiviral medications are in stock for influenza disease treatment.
- Produce and distribute educational and communication materials (i.e. pamphlets, fliers).
- Transmit television and radio spots.

Training

- One INSP technician participated in a workshop on cell culture and viral isolation at Noguchi Memorial Institute of Medical Research in Accra, Ghana.
- Three INSP technicians, in conjunction with a CDC consultant, participated in the assessment of laboratories in nine provinces of Angola (Luanda, Cunene, Huila, Cabinda, Moxico, Huambo, Kuando, Lunda Sul and Lunda Norte) for the elaboration of a strategic plan for national laboratories. The plan is meant to improve the supply and laboratory services and the formation of a single national standard in quality for accreditation by WHO.
- Two INSP technicians participated in a training course on influenza laboratory management in Johannesburg, South Africa.
- Two INSP technicians participated in a scientific writing workshop based on years of working with influenza in Nairobi, Kenya.
- Two technicians—one from INSP and one from DNSP—participated in the Second Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting held in Accra, Ghana.

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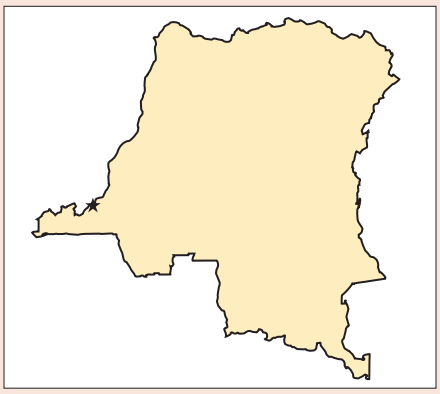

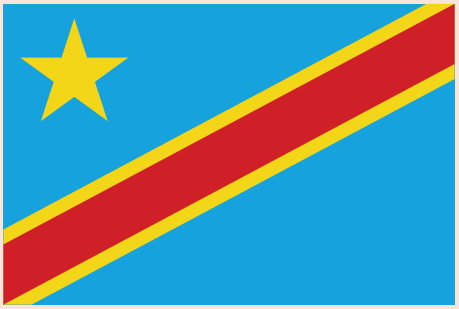

- **Capital:** Kinshasa
- **Area:** 2,344,858 sq km
- **Population:** 73,599,190 (July 2012 est.)
- **Age Structure:** 0-14 years: 44.4% (male 16,031,347/female 15,811,818); 15-64 years: 53% (male 18,919,942/female 19,116,204); 65 years and over: 2.6% (male 767,119/female 1,066,437) (2011 est.)
- **Life Expectancy at Birth:** Total population: 55.74 years; male: 54.28 years; female: 57.23 years (2012 est.)
- **Infant Mortality Rate:** Total: 76.63 deaths/1,000 live births; male: 80.36 deaths/1,000 live births; female: 72.79 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 67.2%; male: 80.9%; female: 54.1% (2001 est.)
- **GDP:** $25.19 billion (2011 est.)
- **GDP per Capita:** $300 (2011 est.)

Highlights

Influenza surveillance activities in the Democratic Republic of Congo (DRC) include:

- Presentation of the project to political authorities who adopted the initiative.
- Selection of sentinel sites.
- Training of site staff.
- Procurement of laboratory supplies and reagents.

U.S. CDC Direct Country Support

Surveillance of avian and pandemic influenza in DRC began in 2006, with a cooperative agreement between the U.S. Centers for Disease Control and Prevention (CDC) and the Kinshasa School of Public Health (KSPH). The agreement *Surveillance and Response to Avian and Pandemic Influenza* covered the period from October 2006 to September 2011. The project aimed to improve DRC's capacity in surveillance, diagnosis, and provision of rapid response to avian and pandemic influenza.

The KSPH managed this project in collaboration with the Ministry of Health (MOH) Fourth Directorate and the National Influenza Laboratory.

The MOH Fourth Directorate instituted an integrated disease surveillance system, providing weekly routine reporting on 13 diseases that have epidemic potential, including influenza. This weekly surveillance is done in collaboration with the National Institute Biomedical Research (INRB), DRC's National Influenza Laboratory. CDC's support permitted the country to set up an influenza sentinel surveillance system.

The MOH revised the avian influenza national plan. Sentinel surveillance sites were strengthened by providing the necessary supplies and equipment for influenza specimen collection, storage, packaging and transportation. The DRC influenza laboratory was supported by receiving a set of equipment and reagents. Thus, its capacity for influenza diagnosis was improved.

Surveillance

In order to prepare DRC for a potential avian influenza outbreak event, the national surveillance system has been strengthened and seasonal influenza has been added to the list of diseases to be reported to the World Health Organization (WHO). The country has set up 10 sentinel sites. However, only five are operational and located in Kinshasa. There are two influenza-like illness (ILI) sites, and three ILI and severe acute respiratory infection (SARI) sites.

The sentinel surveillance sites submit samples and reports of suspected cases of influenza to the INRB. Weekly reports on the number of suspected cases of influenza and the actions undertaken are written and disseminated by the MOH Directorate in charge of disease surveillance.

Health care providers from sentinel sites are managed by a pool of supervisors including clinicians and medical biologists previously trained by the project. The supervisors aim to ensure adequate performance in the detection of cases, reporting, sampling and case management.

Surveillance Activities

- The MOH, in collaboration with CDC, revised the influenza surveillance protocol.
- Five trips were organized from Kinshasa to Brazzaville. Those trips aimed to prepare the implementation of influenza surveillance activities in Republic of Congo.
- A total of 3,075 influenza suspect cases were reported by sentinel sites; among them, 2,159 (70.2%) were ILI cases.
- The influenza coordination committee organized four monthly meetings.
- Twelve supervisory inspections were done in Kinshasa sentinel sites, and two were done in Brazzaville sentinel sites.
- The MOH Fourth Directorate produced 52 weekly reports.

Laboratory

INRB is well equipped and currently uses four trained staff to analyze samples in real time using RT-PCR testing. In Kinshasa, samples are collected daily from sentinel sites and delivered to INRB by car.

Laboratory Activities

- INRB tested 2,960 influenza specimens. Among them, 197 (6.7%) were positive: 191 (6.5%) for influenza A and 6 (0.2%) for influenza B. Concerning the 191 influenza A viruses, 121 (63.4%) were seasonal influenza A (H3N2), 51 (26.7%) were influenza A(H1N1)pdm09, and 19 (9.9%) were unclassified by real-time RT-PCR.
- The laboratory sent unclassified specimens to a WHO Collaborating Center through the Kenyan CDC team.

Preparedness

The avian influenza national plan, developed in 1996, was last revised in October 2009 by the avian influenza national technical committee. The aim was to adapt this plan according to the current epidemiologic context and available resources.

Training

- INRB staff members were trained on isolation of influenza virus on MDCK cells and influenza serology in Kinshasa.
- The Kinshasa and Brazzaville national laboratory managers were trained in laboratory management.
- Sentinel site staff members from the Republic of Congo were trained in influenza case definitions and specimen collection, packaging and transporting.
- Refresher training was organized for Kinshasa sentinel site staff members.
- The National Influenza Laboratory deputy director was trained on how to write scientific articles.

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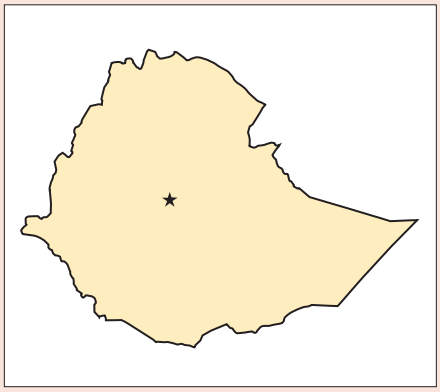
Ethiopia



- **Capital:** Addis Ababa
- **Area:** 1,104,300 sq km
- **Population:** 93,815,992 (July 2012 est.)
- **Age Structure:** 0-14 years: 46.3% (male 20,990,369/female 21,067,961); 15-64 years: 51% (male 22,707,235/female 23,682,385); 65 years and over: 2.7% (male 1,037,488/female 1,388,301) (2011 est.)
- **Life Expectancy at Birth:** Total population: 56.56 years; male: 53.99 years; female: 59.21 years (2012 est.)
- **Infant Mortality Rate:** Total: 75.29 deaths/1,000 live births; male: 86.03 deaths/1,000 live births; female: 64.23 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 42.7%; male: 50.3%; female: 35.1% (2003 est.)
- **GDP:** $94.76 billion (2011 est.)
- **GDP per Capita:** $1,100 (2011 est.)

Highlights

- A manuscript on influenza surveillance in Ethiopia was finalized and submitted to an international journal.
- Two members of an influenza technical working group participated in a scientific writing workshop sponsored by the U.S. Centers for Disease Control and Prevention (CDC) in Nairobi, Kenya.
- Influenza surveillance data was analyzed and used to improve public health.
- In September 2011 the oral presentation "A Two-year Review of Influenza A (H1N1)pdm09 cases in Ethiopia" was given at the First International Congress on Pathogens at the Human–Animal Interface in Addis Ababa.

U.S. CDC Direct Country Support

Ethiopia is supported in its efforts to enhance laboratory and surveillance capacity to detect and respond to avian, seasonal, and pandemic influenza through a CDC cooperative agreement. The first cooperative agreement between the Federal Ministry of Health (MOH)-Ethiopia Health and Nutrition Research Institute (EHNRI) and CDC began in August 2007. Fiscal Year 2011 is the first year but the second round of this funding opportunity. The overarching goal of this project is to sustain and strengthen the influenza surveillance, preparedness and response to seasonal and pandemic influenza in Ethiopia.

Implementation of these cooperative agreements has resulted in established laboratory-based influenza surveillance, national public health laboratory capacity to perform molecular detection of influenza viruses, and strengthened public health emergency management capacity to rapidly detect, assess, respond to, and contain the public health risks that could be brought about by a pandemic.

Surveillance

Sentinel surveillance has the potential to provide more complete data about some of the epidemiologic characteristics of severe acute respiratory infections (SARI). Ethiopia has made it mandatory to report 20 priority diseases. Among those that are required to be reported immediately are avian-human influenza, pandemic influenza, and severe acute respiratory syndrome (SARS). The MOH Ethiopia started sentinel surveillance activities for SARI and influenza-like illness (ILI) in September 2008. Currently, there are a total of eight sentinel surveillance sites located in five mega regions–five are dedicated to SARI and three are dedicated to ILI. The four newly selected SARI sites are expected to be fully functional in FY 2012.

Surveillance Activities

- Site visits were conducted in mega regions of the country to assess the establishment of new SARI sites.
- Based on the assessment, four additional SARI sites were established.
- Regular supervision was provided to all SARI/ILI sentinel surveillance sites.
- Technical meetings were conducted regularly to improve influenza surveillance activities.
- A review of laboratory-confirmed cases was presented at local and international scientific meetings.
- The national SARI/ILI surveillance implementation guideline was revised and distributed to sentinel surveillance sites.
- A manuscript on the Ethiopia weekly surveillance report was prepared.

Laboratory

The National Influenza Laboratory (NIL) at EHNRI is the only laboratory capable of influenza diagnostic testing in the country. The laboratory became functional in June 2009. The NIL has worked closely with CDC to establish a state-of-the-art laboratory. Routine testing of respiratory samples collected through the SARI/ILI sites commenced in 2009. Collaboration between human and animal health laboratory staff is also being supported.

Laboratory Activities

- Provided technical support and on-site training to influenza sentinel surveillance sites.
- Conducted PCR testing. A total of 121 influenza specimens were collected in 2011 and 17 of them tested positive; eight were influenza B, seven were seasonal influenza A (H3), and two were influenza A(H1N1)pdm09.
- Reported laboratory findings on a weekly basis to the World Health Organization (WHO) African Regional Office (AFRO).
- Participated in the WHO External Quality Assessment Project (EQAP) for the detection of influenza virus and achieved 100% accurate scores in all three proficiency panels.
- Achieved biosafety cabinet annual certification and performed real-time PCR maintenance.
- Participated in outbreak investigations of respiratory illnesses reported in the country. Twenty-nine samples were collected and analyzed from outside routine influenza sentinel surveillance; one tested positive for influenza A(H1N1)pdm09.
- Shipped a total of 31 specimens to the WHO Collaborating Center in Atlanta for confirmation and further antigenic characterization.
- Coauthored a manuscript for a peer-reviewed journal supplement on influenza in Africa. Data were provided for the Global SARI Survey Project.

Preparedness

An overhaul of the entire health sector was carried out in 2009, during which new organizational structures were set up, including the Public Health Emergency Management Center (PHEMC). This Center is responsible for preparedness, early warning and response to any public health emergencies including avian and human influenza and pandemic influenza. This newly established body is now situated at EHNRI in order to spearhead epidemiological surveillance of diseases and events, with the EHNRI laboratory providing the technical support.

Preparedness Activities

- The public health emergency management center annual plan was prepared and implemented.
- An automatic extractor (QIAcube) was received from CDC.
- Communication and education materials were produced.

Training

The FMOH, EHNRI, and CDC-Ethiopia hosted the following training activities in 2011:

- Two laboratory personnel from the NIL attended training on laboratory management for influenza in South Africa from February 28–March 4, 2011.
- SARI/ILI refresher training was provided for 16 surveillance officers and health care providers from all sentinel sites in October 2011.
- One staff member from the NIL attended "Bio-risk Management and Transport of Infectious Substances" training in Dar es Salaam, Tanzania, July 11–15, 2011.
- FMOH, EHNRI and CDC-Ethiopia jointly conducted a national workshop on influenza surveillance systems, functions and its operational components in such a way that all 55 participants were able to implement influenza surveillance in their respective regions.

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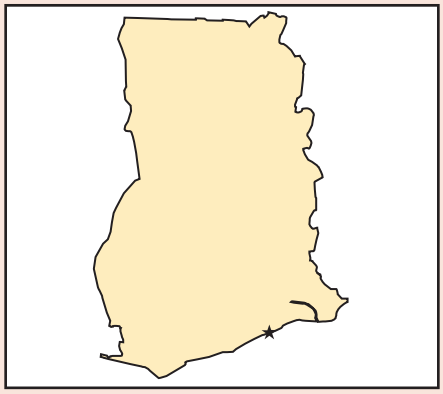
The Public Health Emergency Management Center (PHEMC) and CDC-Ethiopia's Technical Officer provided training on influenza sentinel surveillance in Addis Ababa for select participants from surveillance sites.

Ghana



- **Capital:** Accra
- **Area:** 238,533 sq km
- **Population:** 25,241,998 (July 2012 est.)
- **Age Structure:** 0-14 years: 36.5% (male 4,568,273/female 4,468,939); 15-64 years: 60% (male 7,435,449/female 7,436,204); 65 years and over: 3.6% (male 399,737/female 482,471) (2011 est.)
- **Life Expectancy at Birth:** Total population: 61.45 years; male: 60.22 years; female: 62.73 years (2012 est.)
- **Infant Mortality Rate:** Total: 47.26 deaths/1,000 live births; male: 50.64 deaths/1,000 live births; female: 43.79 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 57.9%; male: 66.4%; female: 49.8% (2000 census)
- **GDP:** $74.77 billion (2011 est.)
- **GDP per Capita:** $3,100 (2011 est.)

Highlights

A number of manuscripts presenting influenza data in Ghana have been prepared for publication:

- Influenza Virus Strains among Young Children in Accra, Ghana.
- Building Military Influenza Surveillance Capacity in West Africa.
- Troop Education and Avian Influenza Surveillance in Military Barracks in Ghana.

U.S. CDC Direct Country Support

Influenza surveillance in Ghana is carried out through collaboration between the U.S. Centers for Disease Control and Prevention (CDC), the U.S. Naval Medical Research Unit No. 3 (NAMRU-3) based in Egypt, the Ghana Health Service (GHS), and the Noguchi Memorial Institute for Medical Research (NMIMR). This partnership has been in place since 2007. Influenza surveillance in Ghana is conducted through sentinel sites located in all regions of the country. In addition, Ghana serves as a platform to assist regional neighbors in developing influenza surveillance systems. Countries benefiting from this partnership are Togo, Burkina-Faso, Mali, Angola, Mauritania and Sierra Leone.

Surveillance

Seasonal influenza surveillance began at sentinel sites in Ghana in September 2007. Between October 1, 2010, and September 30, 2011, NMIMR, the country's National Influenza Center (NIC), processed more than 2,000 influenza specimens and cultured 189 isolates. Samples were collected from a total of 24 sentinel sites (civilian and military) located nationwide in all 10 regions of Ghana.

In addition to the human samples, the country's NIC also processed over 600 avian samples.

Surveillance Activities

- Sentinel surveillance sites for ILI were established and expanded in all ten regions in Ghana, including military sites.
- New surveillance staff were trained on sample collection, storage and transportation.
- Refresher trainings were organized at already existing sites in the 10 regions of the country.
- Fourteen demographic surveillance sites were identified in the Dangme-West District of Ghana toward the implementation of a population-based surveillance study.
- Identified surveillance staff from these 14 sites were trained on human ethics
- Avian influenza surveillance was conducted within military barracks in Ghana.
- Monitoring was conducted for circulating influenza strains.

Laboratory

The NIC, which is located at NMIMR at the University of Ghana campus, Legon, has been continuously provided with influenza reagents through the Influenza Reagent Resource (IRR) established by CDC. This provision enabled the NIC to process 2,115 human specimens and 680 avian specimens during FY 2011.

Laboratory Activities

- Ensured availability of sample collection kits at all sentinel sites and also coordinated transportation of specimens from all sites within 48 hours.
- Worked closely with NAMRU-3 and the WHO Collaborating Center in London to maintain high quality-control standards as well as influenza genotyping technology transfer.
- Submitted weekly and timely reports to the World Health Organization (WHO) African Regional Office (AFRO) and to FluNet.
- Enabled staff to participate in international meetings and training workshops where they shared their work with other colleagues on the continent and worldwide.

Sampling from domestic poultry for influenza viruses, Ghana.

Preparedness

With the occurrence of influenza A (H1N1)pdm09 flu in April 2009, GHS, in collaboration with key influenza partners including NMIMR, CDC, NAMRU-3, U.S. Agency for International Development (USAID), WHO, United Nations Children's Fund (UNICEF), Red Cross, Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) and the National Disaster Management Organization (NADMO), took specific measures to mitigate the health, social and economic impacts of the pandemic in the country.

Preparedness Activities

- Conducted an annual review meeting at NMIMR to deliberate on surveillance issues within the year and come up with innovative ideas to improve surveillance activities.
- Continued surveillance and management of cases by regional and district teams.
- Collected and transported specimens from sentinel sites to NIC.

Training

Training activities in FY 2011:

- A member of the NIC attended a training on shipment of biological substances in November 2010, in Dar es Salaam, Tanzania.
- The Second Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting organized by CDC was hosted by GHS, NAMRU-3, and NMIMR in Accra, Ghana, January 2011.
- Two laboratory staff (one from the NIC and the other from NAMRU-3 in Ghana) attended a training course on influenza laboratory management in Johannesburg, South Africa in March 2011.
- The second annual "Military-to-Military Influenza Surveillance Review and Training Workshop" was held by NAMRU-3 and the NIC in May 2011 at Accra. Participants were from Ghana and Togo.
- A regional influenza training workshop for West African countries was hosted by NMIMR in June 2011 in Accra.
- NMIMR organized a influenza data writing workshop in June 2011 at Prampram, Ghana.
- The NIC successfully provided technical assistance to the National Influenza Laboratory Bobo Dioulasso in Burkina Faso to troubleshoot RT-PCR for influenza working protocols in July 2011.
- Three staff from GHS and NMIMR attended an international course in applied epidemiology at the Rollins School of Public Health, Emory University in Atlanta, Georgia in September and October 2011 with support from NAMRU-3 and CDC.

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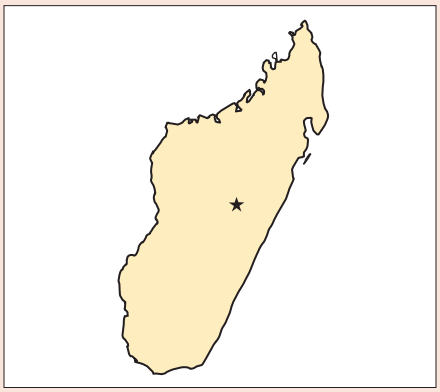
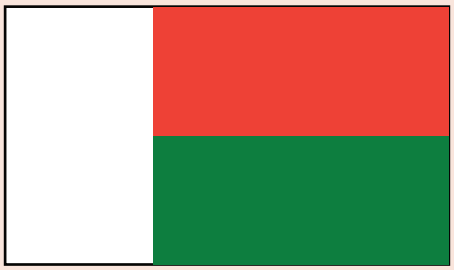
Madagascar





- **Capital:** Antananarivo
- **Area:** 587,041 sq km
- **Population:** 22,585,517 (July 2012 est.)
- **Age Structure:** 0-14 years: 43.1% (male 4,762,589/female 4,693,259); 15-64 years: 53.8% (male 5,864,520/female 5,938,029); 65 years and over: 3% (male 295,409/female 372,415) (2011 est.)
- **Life Expectancy at Birth:** Total population: 64 years; male: 61.97 years; female: 66.1 years (2012 est.)
- **Infant Mortality Rate:** Total: 50.09 deaths/1,000 live births; male: 54.8 deaths/1,000 live births; female: 45.24 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 68.9%; male: 75.5%; female: 62.5% (2003 est.)
- **GDP:** $20.6 billion (2011 est.)
- **GDP per Capita:** $900 (2011 est.)

Highlights

- Implemented SARI surveillance in two more hospitals (Antananarivo and Moramanga). These hospitals recruit all patients with SARI. This surveillance aims to describe viral etiology of SARI and risk factors for hospitalization.
- Supported the training of rapid response teams at the national and provincial level in order to develop responsiveness to influenza A (H5N1) and other influenza viruses. A total of 150 staff members attended, including epidemiologists and clinicians from the Ministry of Health and veterinarians from the Ministry of Livestock.

U.S. CDC Direct Country Support

Fiscal Year 2011 is the second year of the U.S. Centers for Disease Control and Prevention's (CDC) cooperative agreement with Pasteur Institute of Madagascar (IP-Madagascar). The agreement *Developing Seasonal, Pandemic, and Influenza Surveillance Networks* provides support to substantially sustain the capacity of the National Influenza Center (NIC) and health authorities for surveillance and diagnosis of influenza-like illnesses (ILI) and severe acute respiratory infections (SARI) (including highly pathogenic avian influenza (HPAI) in humans) in Madagascar. The cooperative agreement, awarded by CDC, has also increased the capacity of the central, regional and district health authorities in Madagascar to provide rapid public health intervention in response to pandemic outbreaks, and to implement appropriate disease containment measures. It aims to support national efforts to address a possible pandemic of avian influenza from a disease prevention and control standpoint. In addition, the project intends to address preparedness in the following ways for other SARI that could emerge:

- Monitor the emergence of pandemic viruses (including HPAI in humans).

- Reduce morbidity and mortality due to possible emerging respiratory infectious diseases, both through rapid detection and containment.
- Reduce economic effects and social upheaval/unrest due to a pandemic.

Surveillance

To date, the ILI sentinel surveillance system encompasses 33 sites. All these sites send daily epidemiological information regarding influenza. Nine of them send respiratory specimens for analysis to the NIC on a weekly basis. A sentinel network for SARI surveillance is functional and encompasses 17 hospitals. Nevertheless, in order to implement virological surveillance of hospitalized cases, we selected two hospitals (Antananarivo and Moramanga) that recruit all SARI cases. We hired two clinicians in situ that are dedicated to this surveillance. Since the majority of the population cannot afford hospitalization and to ensure full compliance of the patient, the current project supports all costs associated with hospitalization. This will be an opportunity for us to estimate economic burden of SARI for resource-poor countries.

Surveillance Activities

- The cooperative agreement supported training for national and regional task forces.
- The NIC expanded its influenza surveillance network to include 33 ILI sites.
- The NIC expanded its SARI surveillance, including sampling and analyses, in two hospitals.
- Two clinicians dedicated to SARI surveillance (sample collection, data capturing at the pediatric and intensive care unit wards, coordination and monitoring of SARI surveillance in their respective sites) were recruited.
- All costs of hospitalization for the SARI surveillance project were supported.
- IP-Madagascar held the Second Annual Sentinel Surveillance Network Meeting.
- IP-Madagascar held the second "Workshop on Epidemiological Surveillance and Outbreak Investigation."
- Weekly data was shared with the Ministry of Health (MOH), World Health Organization (WHO) and other partners.

Laboratory

Before the cooperative agreement, the NIC in Madagascar already had the capacity for performing diagnostic tests, but there was room to improve diagnostic capacity and additional ways to prepare for a surge in testing during future pandemics. The cooperative agreement supported the laboratory through the acquisition of new equipment and sampling material, which allowed for an increase in the number of specimens that could be processed.

In order to implement improved diagnostic capacity, the MOH gave its agreement to implement two regional laboratories for influenza detection. We

A technician working in the BSL-3 laboratory of Madagascar's NIC.

visited and selected two hospitals—one in Mahajanga (West Coast) and another in Toamasina (East Coast). These two cities are provincial capitals and are potential ports of entry for new pathogens (via the harbor or direct international flight).

The Malagasy NIC developed an assay for the detection of 14 respiratory viruses. This aimed to perform research on etiology of respiratory infections. All SARI cases are routinely tested for all the 14 viruses.

Laboratory Activities

- The MOH gave its agreement to set up two regional laboratories for influenza detection.
- All SARI cases (222) were tested at the NIC for the in-house panel of 14 respiratory viruses.
- NIC tested a total of 1,546 influenza specimens.
- NIC of Madagascar submitted a total of 56 positive isolates and 49 positive swabs to the WHO Collaborating Center in London as part of the WHO Influenza Program.
- The NIC participated in the WHO External Quality Assessment Project (EQAP) and scored 100% for quality assurance.
- Several staff from IP-Madagascar, including one technician from NIC, received their International Air Transport Association (IATA) certificates for the shipment of infectious substances.

Preparedness

CDC support has allowed the NIC to implement ILI surveillance through the increase of sentinel sites, and SARI surveillance through the set-up of two active SARI surveillance sites in two hospitals.

The project also will increase laboratory capacity due to the set-up of two regional laboratories for influenza detection (Toamasina and Mahajanga).

CDC support enabled the NIC to train 22 rapid response teams at the national and provincial (regional) level as part of implementing responsiveness to pandemic influenza viruses. Each team at the regional level includes 6–7 members including clinicians, epidemiologists, diseases surveillance officers, veterinarians and communication officers.

Preparedness Activities

- Implemented ILI and SARI surveillance.
- Selected two hospitals where two regional laboratories will be implemented for influenza detection.

Training

- Between November 2010 and February 2011, 150 staff from the MOH were trained with veterinarians in Mahajanga, Toamasina, Fianarantsoa and Toliara, Madagascar on surveillance and response to pandemics.
- IP-Madagascar staff were trained on IATA certification during July 2011 in Antananarivo, Madagascar.
- During May 2011, the second "Workshop on Epidemiological Surveillance and Outbreak Investigation" was held in Antananarivo, Madagascar by IP-Madagascar for staff involved in sentinel surveillance.
- During March 2011, the Second Annual Meeting of the Sentinel Surveillance Network was held by IP-Madagascar in Antananarivo, Madagascar.

- From February 28–March 4, 2011, trainees attended workshops on bioinformatics and sequencing and laboratory management at the National Institute for Communicable Diseases (NICD) in Johannesburg, South Africa.
- May 30–June 3, 2011, a writing workshop was held in Moramanga, Madagascar.
- Staff participated in the Second Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting, January 11–12, 2011 in Accra, Ghana.
- Staff participated in the WHO global technical consultation for global standards and tools for influenza surveillance, March 8–10, 2011, Geneva, Switzerland.

Publications

- Rajatonirina S, Heraud JM, Randrianasolo L, Razanajatovo N, Ramandimbisoa T, Ratsitorahina M, Richard V. Pandemic influenza A(H1N1) 2009 virus outbreak among boarding school pupils in Madagascar: compliance and adverse effects of prophylactic oseltamivir treatment. Journal of Infections in Developing Countries. 2011;5(3):156-62.
- Razanajatovo NH, Richard V, Hoffmann J, Reynes JM, Razafitrimo GM, Randremanana RV and Heraud JM. Viral etiology of influenza-like illnesses in Antananarivo, Madagascar, July 2008 to June 2009. PLoS ONE. 2011;6(3):e17579.
- Van Kerkhove MD, Vandemaele KA, Shinde V, Jaramillo-Gutierrez G, Koukounari A, Donnelly CA, Carlino LO, Owen R, Paterson B, Pelletier L, Vachon J, Gonzalez C, Hongjie Y, Zijian F, Chuang SK, Au A, Buda S, Krause G, Haas W, Bonmarin I, Taniguichi K, Nakajima K, Shobayashi T, Takayama Y, Sunagawa T, Heraud JM, Orelle A, Palacios E, van der Sande MA, Wielders CC, Hunt D, Cutter J, Lee VJ, Thomas J, Santa-Olalla P, Sierra-Moros MJ, Hanshaoworakul W, Ungchusak K, Pebody R, Jain S, Mounts AW, on behalf of the WHO Working Group for Risk Factors for Severe H1N1pdm Infection. Risk factors for severe outcomes following 2009 influenza A (H1N1) infection: A global pooled analysis. PLoS Med. 2011;8(7):e1001053.

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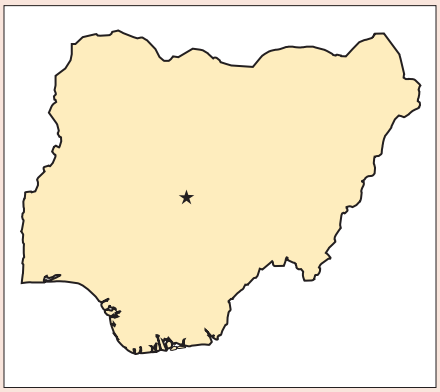
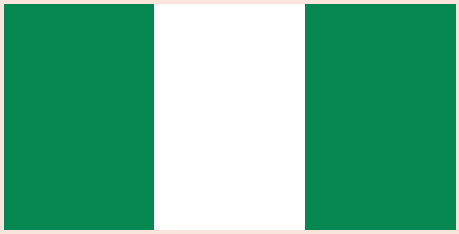
Nigeria





- **Capital:** Abuja
- **Area:** 923,768 sq km
- **Population:** 170,123,740 (July 2012 est.)
- **Age Structure:** 0-14 years: 40.9% (male 32,476,681/female 31,064,539); 15-64 years: 55.9% (male 44,296,228/female 42,534,542); 65 years and over: 3.1% (male 2,341,228/female 2,502,355) (2011 est.)
- **Life Expectancy at Birth:** Total population: 52.05 years; male: 48.95 years; female: 55.33 years (2012 est.)
- **Infant Mortality Rate:** Total: 74.36 deaths/1,000 live births; male: 79.44 deaths/1,000 live births; female: 68.97 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 68%; male: 75.7% female: 60.6% (2003 est.)
- **GDP:** $414.5 billion (2011 est.)
- **GDP per Capita:** $2,600 (2011 est.)

Highlights

- The joint U.S. Centers for Disease Control and Prevention (CDC) and Nigeria Federal Ministry of Health avian and pandemic influenza project was relocated to the National Epidemiology Division [now under the Nigeria Center for Disease Control] for better integration, coordination and sustainability.
- In a bid for the National Influenza Reference Laboratory (NIRL) to qualify for National Influenza Center (NIC) designation, a building has been renovated and necessary equipment is being put in place for viral culture activities.
- NIRL laboratory personnel has been trained on virus culture and immunofluorescence antibody testing.
- The National Influenza Sentinel Surveillance System (NISS) team has been trained on the new influenza sentinel surveillance protocol.

U.S. CDC Direct Country Support

The Nigerian Federal Ministry of Health (FMOH) has been collaborating with CDC on influenza control since 2006. The collaboration is through the cooperative agreement *Surveillance and Response to Avian and Pandemic Influenza Project*. The support has enabled Nigeria to establish a system for early detection and effective response to avian and pandemic influenza. Fiscal Year 2011 is the fifth year of the grant and incidentally marks the end of the initial phase of the project.

In 2007 and 2008, NIRL and NISS were established. In addition, guides to avian influenza pandemic preparedness and response were also developed by FMOH.

Surveillance

Prior to the beginning of the CDC-FMOH cooperative agreement in 2006, there was no known surveillance system to monitor influenza epidemiology in Nigeria. In 2008, the NISS was established. Currently there are four sentinel sites, located in four tertiary health institutions in four of the six geopolitical zones of the country. Each of these sites has an influenza-like illness (ILI) component in the outpatient clinic and a severe acute respiratory infection (SARI) component in the inpatient unit. The surveillance system also captures suspected cases of avian influenza and other pandemic influenza viruses, including influenza A(H1N1)pdm09. From the limited data available so far, Nigeria's peak influenza activity appears to be concurrent with the dry harmattan season, which occurs between November and March.

Surveillance Activities

- The NISS, as part of its ongoing effort to provide the needed epidemiological and laboratory experience to higher education students, trained six public health students under the Nigeria Field Epidemiology and Laboratory Training Program (NFELTP) and two bio-medical sciences students.
- The FMOH, with assistance from CDC staff, carried out quarterly monitoring and supervision of the four sentinel sites.
- Key influenza surveillance information is published in the Weekly Epidemiological Report of the FMOH (the report includes the laboratory results of samples submitted from sites).
- Two staff members attended the Second Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting in Accra, Ghana in January 2011.
- All NISS officers were reviewed in March 2011.
- During June 2011, three staff members attended a regional training workshop that discussed building capacity for influenza sentinel surveillance sites in West Africa at NIC in Accra, Ghana.
- A new protocol for national influenza sentinel surveillance was developed in collaboration with the World Health Organization (WHO) in December 2011.

The National Influenza Sentinel Surveillance Team at Nigeria's Influenza Annual Review Meeting.

Laboratory

In 2007, the FMOH, with the financial and technical support of CDC, established NIRL situated in Abuja, the nation's capital. It is currently the only functional laboratory with real-time RT-PCR diagnostic capacity for influenza in the country. Seven additional FMOH laboratories with RT-PCR diagnostic capacity, located in the six geopolitical zones of Nigeria, are currently being upgraded to support influenza and other viral disease diagnosis. In addition, NIRL has commenced establishing a laboratory with cell culture diagnostic capacity, with the longer goal of attaining NIC status.

Laboratory Activities

- Tested 2,397 samples from four influenza sentinel sites.
- Participated in the WHO African Region laboratory network and FluNet by sending weekly virology reports; weekly epidemiology reports are sent via FluID.
- Submitted 60 oro- and naso-pharyngeal specimens that are unsubtypable, influenza positive or negative to the WHO Collaborating Center in Atlanta.
- Submitted influenza A(H1N1)pdm09 positive specimens to the National Institute for Communicable Diseases (NICD) in Johannesburg, South Africa.
- Participated twice in the WHO External Quality Assessment Project (EQAP) and received an excellent score (100%) for each proficiency test. In addition, the laboratory scored very high (90%) for a CDC FluPEP.
- Conducted a fire inspection and fire drill in collaboration with the Federal Fire Service for the laboratory.

Preparedness

In 2006, Nigeria initiated the development of its avian and pandemic influenza preparedness plan following the emergence of the global threat of influenza A (H5N1). In 2010, a tabletop exercise was conducted to test the revised version of the national avian and pandemic influenza preparedness and response plan. In 2011, the staff of NIRL participated in a pandemic mock exercise organized by the Federal Airport Authority at the Nigeria Civil Aviation Authority (NCAA), Nnamdi Azikiwe International Airport in Abuja.

Preparedness Activities

- Prepositioned antiviral medications at NISS sites for management of cases.

Training

The FMOH hosted the following training activities in 2011:

- One staff member completed the first year of NFELTP, a two-year program.
- Influenza sentinel surveillance refresher training was offered to officers from all influenza sentinel sites.
- Continuing education courses were organized weekly in the laboratory and offered to staff members. Topics included influenza surveillance issues and laboratory quality management systems.

Staff at the National Influenza Reference Laboratory in Nigeria participating in a fire drill exercise.

- In March 2011, two managers attended a week-long workshop on laboratory management for influenza in Johannesburg, South Africa.
- Three NIRL staff members were trained on biological safety cabinet principles in April 2011 by the Institute of Human Virology in Nigeria.

- One staff member attended the influenza writing workshop sponsored by CDC-Kenya in April 2011.
- One staff member attended the training course "Strengthening Laboratory Biosafety and Biosecurity" in June 2011, which was organized by the African Centre for Integrated Laboratory Training.

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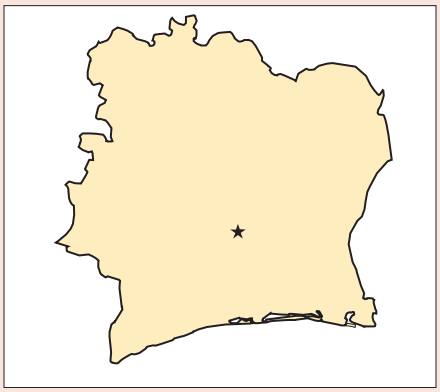

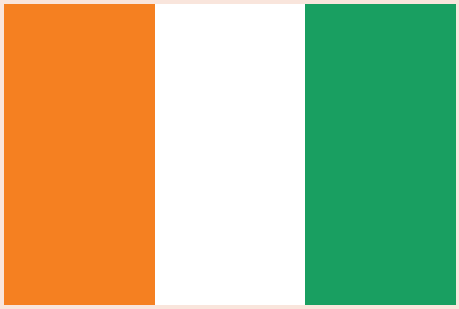

- **Capital:** Yamoussoukro
- **Area:** 322,463 sq km
- **Population:** 21,952,093 (July 2012 est.)
- **Age Structure:** 0-14 years: 39.8% (male 4,312,133/female 4,240,500); 15-64 years: 57.2% (male 6,262,802/female 6,039,458); 65 years and over: 3% (male 320,396/female 328,873) (2011 est.)
- **Life Expectancy at Birth:** Total population: 57.25 years; male: 56.21 years; female: 58.33 years (2012 est.)
- **Infant Mortality Rate:** Total: 63.2 deaths/1,000 live births; male: 69.77 deaths/1,000 live births; female: 56.42 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 48.7%; male: 60.8%; female: 38.6% (2000 est.)
- **GDP:** $35.6 billion (2011 est.)
- **GDP per Capita:** $1,600 (2011 est.)

Highlights

- Reactivated sentinel sites after the post-electoral crisis.
- Increased laboratory staff and strengthened diagnostic capacity at Pasteur Institute of Côte d'Ivoire (IPCI), the National Influenza Center (NIC).

U.S. CDC Direct Country Support

The Ministry of Health and Public Hygiene (MSHP) of Côte d'Ivoire has obtained financial and technical support from the U.S. Centers for Disease Control and Prevention (CDC) for pandemic preparedness and reinforcement of influenza surveillance. The National Institute for Public Hygiene (INHP) is the technical beneficiary at the MSHP for *Developing Influenza Surveillance Networks*, a cooperative agreement that began in 2006; FY 2011 is the fifth year of the cooperative agreement.

During the 2010–2011 budget period, all planned operational activities were not implemented. However, implemented activities led to a number of results and achievements, namely the reinforcement of laboratory diagnostic and epidemiologic capacities. Quick access to information and results has been improved by providing sentinel sites with surveillance and communication software such as internet (using USB modems) and phone cards (for mobile phones).

Surveillance

Distribution of reporting tools, influenza surveillance standard operational procedures (SOP) and policies to sentinel sites has become routine and effective. Sample collection and transportation to NIC is operational.

To ensure timely information and availability of laboratory results, eight sentinel sites were provided with internet connection. In addition to internet access, INHP, the NIC located at IPCI and five sentinel sites received information technology equipment (i.e. desktop computer, uninterruptable power supply, scanner, printer, and fax).

Surveillance Activities

With regard to capacity building of health care providers in the framework of influenza surveillance and response to influenza epidemics and pandemics, the following activities were implemented:

- Conducted nationwide vaccinations against influenza A(H1N1)pdm09 in September 2010. The targeted populations were pregnant women, people with underlying chronic diseases, health care providers, children aged 0–6 months and staff in strategic sectors of the government (water/electricity, bank, police, army, etc.).
- Revitalized the influenza surveillance system after the post-electoral crisis with a workshop in July 2011.

A laboratory technician at the INHP.

Laboratory

The NIC was provided with reagents and laboratory consumables through the cooperative agreement in order to fulfill its role as a NIC and reinforce its operational capacity. The laboratory was able to analyze 517 influenza samples in the fourth quarter of 2010 and approximately 275 samples in first three quarters of 2011. (The post-electoral crisis drastically impacted the health system in the country in 2011.)

Preparedness Activities

- Organized a workshop to evaluate the response against the 2009 H1M1 pandemic with the seaports (Abidjan and San Pedro), airports and land border offices in July 2011.
- Conducted a series of campaigns at military barracks in 12 cities to sensitize them to influenza transmission, prevention and control measures. During these campaigns, leaflets and brochures that explained influenza infection, pandemic flu, and preventive measures, were distributed to the militaries and their families.

Training

- Participated in the Second Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting that was held in Accra, Ghana in January 2011.
- Participated in a regional training workshop in Accra, Ghana in June 2011.
- Trained 33 laboratory technicians from all sentinel sites at IPCI on sample collection, packaging, storage and transportation, as well as sample analysis (i.e., PCR), and cell culture.
- Provided information about detection and the care and treatment of pandemic influenza cases to health care providers of sentinel sites in Abidjan.

- Supervised and reviewed records for the identification of suspected influenza cases at reference hospitals in Abidjan, Agnibilékrou, Abengourou, Akoupé, Adzopé, Agboville and Aboisso. At the sentinel sites, daily constraints (high workload, time-consuming registration of flu cases), communication challenges (internet connection issues) concerning health care providers were assessed. These site visits allowed INHP to address health care providers' concerns and suggest solutions to enable them to operate more efficiently and improve their working skills and conditions.

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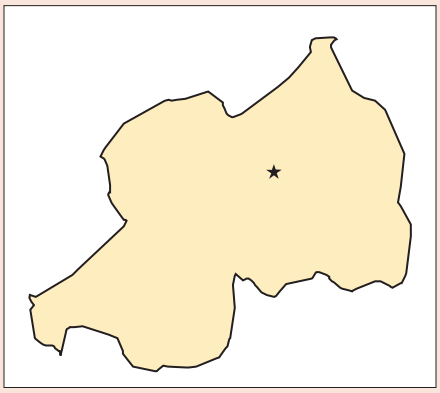
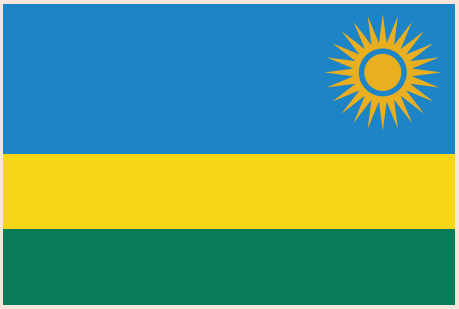
Group photo from Côte d'Ivoire's Fourth Annual Sentinel Surveillance Meeting.

Rwanda





- **Capital:** Kigali
- **Area:** 26,338 sq km
- **Population:** 11,689,696 (July 2012 est.)
- **Age Structure:** 0-14 years: 42.9% (male 2,454,924/female 2,418,504); 15-64 years: 54.7% (male 3,097,956/female 3,123,910); 65 years and over: 2.4% (male 110,218/female 164,913) (2011 est.)
- **Life Expectancy at Birth:** Total population: 58.44 years; male: 56.96 years; female: 59.96 years (2012 est.)
- **Infant Mortality Rate:** Total: 62.51 deaths/1,000 live births; male: 66.09 deaths/1,000 live births; female: 58.83 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 70.4%; male: 76.3%; female: 64.7% (2003 est.)
- **GDP:** $13.46 billion (2011 est.)
- **GDP per Capita:** $1,300 (2011 est.)

Highlights

- Two influenza manuscripts were developed and accepted for publication in peer-reviewed journals.
- For the first time, epidemiological and virologic data were reported in FluID and FluNet.
- Influenza-like illness (ILI) and pneumonia in children younger than five were included in the Integrated Disease Surveillance and Response (IDSR) guidelines for the first time.
- The U.S. Centers for Disease Control and Prevention (CDC) donated a QIAcube extractor to the National Reference Laboratory (NRL).

U.S. CDC Direct Country Support

Fiscal Year 2011 is the last year of the four-year grant between CDC and the Rwanda Ministry of Health's (MOH) Center for Treatment and Research on AIDS, Malaria, Tuberculosis and Other Epidemics (TRAC Plus). The cooperative agreement *Preparedness and Response to Avian and Pandemic Influenza in Rwanda* was formed with the objective of building capacity to strengthen preparedness and communication for avian and pandemic influenza, initiate human influenza surveillance, and develop a rapid response team at national and subnational levels.

Country support included the following: procurement and maintenance of laboratory equipment, joint quarterly supervision of sentinel sites, provision of laboratory reagents, joint training of surveillance officers and health care workers on virologic and epidemiological surveillance and technical assistance for data analysis, and manuscript writing and publication. The cooperative agreement has strengthened influenza surveillance in Rwanda and has supported building capacity, which enhanced the level of preparedness and response of the country.

Surveillance

Influenza sentinel surveillance (ISS) for influenza-like illness (ILI) and severe acute respiratory infection (SARI) began in Rwanda in July 2008. It is established in six sentinel hospitals: two referral hospitals (University Teaching Hospital of Kigali and University Teaching Hospital of Butare) and four district hospitals (Gihundwe, Kibagabaga, Kibungo and Ruhengeri) representing the country's five provinces. ISS is conducted in the outpatient department, and in the pediatric, internal medicine, emergency and intensive care wards.

The bustling capital of Kigali, Rwanda.

At these sites, persons older than eight weeks are assessed for SARI as part of routine influenza surveillance activities. Identified SARI cases are assessed for high-risk exposures and underlying medical conditions. Surveillance officers (trained nurses or laboratory technicians) at each of these sites are aware of the need to refer all possible high-risk cases to TRAC Plus for further evaluation. These activities are detailed in a complete protocol for influenza sentinel surveillance and in the standard operating procedures for each sentinel site.

Surveillance Activities

- The MOH's Epidemic Infectious Diseases Division (EID), in collaboration with the NRL and CDC, conducted four quarterly supervisory visits to the six sentinel sites.
- A total of 1,464 questionnaires were entered into the central database.
- The senior influenza surveillance officer analyzed data and produced monthly epidemiology and virology reports.
- A monthly summary of laboratory and epidemiological data was sent to sentinel sites and to Rwanda Biomedical Center, MOH and CDC.
- Weekly aggregated data was reported via FluID.
- The Integrated Disease Surveillance and Response guidelines were reviewed and updated to include ILI and SARI case definitions.
- A manuscript describing influenza sentinel surveillance in Rwanda during 2008–2010 was written and accepted for publication in *Journal of Infectious Diseases*.
- A manuscript describing the 2009 H1N1 pandemic and response in Rwanda was written and accepted for publication in *PLoS ONE*.
- EID and NRL conducted a joint seasonal influenza outbreak investigation in Mpanga and Miyove Prisons.
- Three epidemiologists and one laboratory scientist attended the Second Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting in Accra, Ghana and gave two oral and three poster presentations.

Laboratory

The National Reference Laboratory in Kigali has been the National Influenza Testing Centre since 2008. The laboratory is a Biosafety Level II (BSL-2) with some enhanced BSL-3 procedures and has capacities to perform molecular biology testing (PCR) services. It has supported the Influenza Sentinel Surveillance Network with RT-PCR assays for detection of seasonal human influenza A (H1), (H3), and B viruses, avian influenza A (H5N1) viruses and influenza A(H1N1)pdm09 viruses using CDC-provided primers/probes and protocols. Samples are collected and transported from the six sentinel sites throughout Rwanda from influenza-like illness (ILI) and severe acute respiratory infection (SARI) cases. As of September 31, 2011, over 4,976 respiratory specimens were tested; 15% (732/4976) were positive. Of the 732 specimens testing positive to influenza, 115(15.7%) were influenza A (H3); 20(2.7%) were seasonal influenza A (H1); 530(72.4%) were influenza A (H1N1)pdm09, and 67(9.2%) were influenza B viruses.

Laboratory Activities

- Tested a total of 1,464 influenza specimens from sentinel hospitals.
- Reported weekly test results to sentinel sites.
- Reported on a weekly basis to FluNet as part of the World Health Organization (WHO) Global Influenza Surveillance and Response System (GISRS).
- Conducted four supervisory visits to sites and provided logistical support to sentinel sites in the influenza surveillance network.
- Purchased an ice machine.
- Received a donated QIAcube extractor from CDC.
- Conducted a joint seasonal influenza outbreak investigation in prisons.

Preparedness

Rwanda's national pandemic disaster response tabletop exercise commenced on July 11, 2011, with preliminary briefings and training for all participants on International Health Regulations 2005 (IHR), United Nations Sphere Guidelines, and other disaster/medical issues which would impact preparation for and response to a severe global pandemic.

The exercise was designed to examine the issues associated with a response to a global influenza pandemic by the Rwandan government, non-governmental organizations, medical institutions and international/regional partner organizations. Participants included organizational leaders who were likely to have a significant role in pandemic response operations. The exercise was a three-day scenario-driven event that incorporated a myriad of complex and challenging injects designed to elicit participants' response and expose gaps in existing plans, policies and procedures. The scenario focused on a global influenza pandemic beginning in Southeast Asia and progressing into a global humanitarian emergency with significant impact to Rwandan society.

Preparedness Activities

- Held the national pandemic exercise in Gisenyi, July 11–15, 2011. It was supported by the U.S. Africa Command, the Center for Disaster and Humanitarian Medicine, and the U.S. Agency for International Development (USAID).
- Captured the following key issues by participants during the post-exercise review and gap analysis:
    - Lack of a comprehensive national all-hazards disaster plan and pandemic preparedness and response plan.

- Lack of disaster management training and exercises at all levels of government.
- Lack of incident command system.
- Lack of adequate stockpiled equipment and supplies for disaster response.
- Need for reasonably robust national disaster operations center that is capable of monitoring disaster situations, coordinating response efforts, and providing command and control.

Training

During 2010–2011, the following trainings were organized in and outside of Rwanda to ensure the functioning of the influenza sentinel surveillance network; collection of good quality data; and data analyses and integration of influenza into routine surveillance:

An influenza surveillance nurse obtaining a nasopharyngeal swab from a pediatric ILI case at a local hospital, Rwanda.

- Refresher training on epidemiological and virologic surveillance of influenza for 25 health care providers (four doctors, 19 nurses, one laboratory technician, and one monitoring and evaluation expert) from Kibungo Sentinel Hospital.
- Refresher training on epidemiological and virologic surveillance of influenza for 30 health care providers (two doctors, 25 nurses, one laboratory technician, one monitoring and evaluation expert, and one human resources person) from Ruhengeri Sentinel Hospital.
- Refresher training on epidemiological and virologic surveillance of influenza for 13 health care providers (two doctors, five nurses, and one laboratory technician from Kibagabaga sentinel site, and four nurses and one laboratory technician from University Teaching Hospital of Kigali).
- The Principal Investigator and the Business Official attended training on grant administration for grantees.
- The CDC Avian Influenza Specialist attended a training module on project officer roles, grants, contracts and cooperative agreements in Kampala, Uganda.
- The CDC Avian Influenza Specialist attended training on leadership education and development at CDC-Rwanda.
- Three epidemiologists and two laboratory technicians at the central level were trained to report aggregated data into the WHO's FluID.

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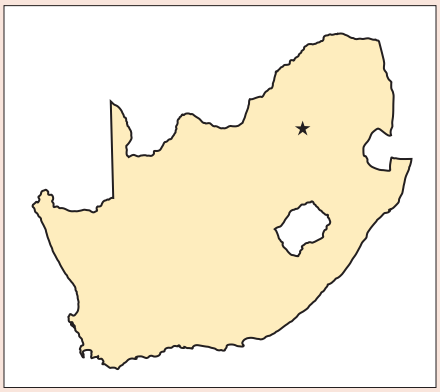
South Africa



- **Capital:** Pretoria
- **Area:** 1,219,090 sq km
- **Population:** 48,810,427 (July 2012 est.)
- **Age Structure:** 0-14 years: 28.5% (male 6,998,726/female 6,959,542); 15-64 years: 65.8% (male 16,287,314/female 15,972,046); 65 years and over: 5.7% (male 1,125,709/female 1,660,694) (2011 est.)
- **Life Expectancy at Birth:** Total population: 49.41 years; male: 50.34 years; female: 48.45 years (2012 est.)
- **Infant Mortality Rate:** Total: 42.67 deaths/1,000 live births; male: 46.54 deaths/1,000 live births; female: 38.73 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 86.4%; male: 87%; female: 85.7% (2003 est.)
- **GDP:** $554.6 billion (2011 est.)
- **GDP per Capita:** $11,000 (2011 est.)

Highlights

- The South African severe acute respiratory infection surveillance program case definition was extended at selected sentinel sites to include patients with suspected or confirmed tuberculosis to investigate the association between influenza and tuberculosis.
- Real-time PCR assays were implemented for the influenza HA and NA genes respectively, to distinguish between influenza B Brisbane and Yamagata lineages and to detect the oseltamivir resistant H275Y mutation.
- The Discovery Clinical Excellence Award was received at the Federation of Infectious Diseases Societies of Southern Africa Conference.
- An award was won for the best poster at the Seventh International Respiratory Syncytial Virus Conference in Rotterdam, held December 2–5, 2010.
- First runner-up was won for the best publication by a young researcher: University of Pretoria, 2010, for a paper on pandemic H1N1 influenza virus infections in South Africa.

U.S. CDC Direct Country Support

The National Influenza Center (NIC) at the National Institute for Communicable Diseases (NICD) is leading the Influenza Surveillance Programme in South Africa and has both a national and regional focus, especially in the Southern African Development Community (SADC). The cooperative agreement *Preparedness and Response to Avian and Pandemic Influenza in South Africa* between the U.S. Centers for Disease Control and Prevention (CDC) and the NICD at the National Health Laboratory Services (NHLS) began in August 2007. The main purpose of this agreement is to strengthen the capacity of national health authorities for surveillance of severe acute respiratory infection (SARI) and influenza-like illness (ILI) and

the health authorities in selected countries of the SADC for the diagnosis of influenza. In 2011, a new cooperative agreement *Sustaining Surveillance Networks and Response to Seasonal and Pandemic Influenza in South Africa* was awarded for a five-year period. The key objectives of this agreement are (i) to optimize and consolidate the ILI and SARI surveillance systems and generate robust data while working toward down-scaling SARI surveillance to ensure long-term sustainability, (ii) to consolidate the laboratory capacity so as to serve as national and regional influenza reference center, and (iii) to establish additional technology and infrastructure required to obtain H5 reference center status.

Surveillance

Influenza surveillance in South Africa consists of three main active surveillance programs. 1) The Viral Watch program has ILI sentinel surveillance in all nine provinces. This program focuses on outpatients seen mainly by general practitioners as well as pediatricians and primary health care clinics across the country. 2) The Enhanced Viral Watch program was established following the emergence of influenza A (H1N1)pdm09 with the aim of expanding Viral Watch to include hospitalized patients. Eleven hospitals in nine provinces participate and submit specimens from hospitalized patients with SARI. 3) The SARI surveillance program was established in 2009 and monitors hospitalized patients with more severe respiratory disease from whom detailed epidemiologic data are collected. This program currently includes six hospitals and covers four of the nine provinces. In addition, NICD also offers support to NHLS laboratories that perform routine testing for respiratory virus disease across the country.

Surveillance Activities

- Regular site visits to sentinel hospitals were conducted. These focused on the following: data and process reviews, ensuring that study procedures were being followed correctly, and training for surveillance officers.
- Presentations on surveillance data results were given to clinicians at three of the sentinel surveillance sites.
- The annual SARI and rotavirus surveillance meeting for investigators was held on November 10, 2011, at NICD in Johannesburg. The purpose of the meeting was to share surveillance and research findings with stakeholders and discuss future projects.
- A SARI and rotavirus surveillance meeting for officers was held from December 5–6, 2011, at NICD in Johannesburg. The purpose of the meeting was to provide ongoing surveillance officer training, give updates on projects and introduce new projects planned for 2012.
- Annual influenza symposia were held in March 2011 at NICD in Johannesburg. This annual meeting shares data from NICD influenza surveillance programs with stakeholders and provides updates on topical issues related to influenza surveillance, diagnosis, prevention and management.

Staff from the Edendale surveillance site in South Africa. From left to right: Wendy Ngubane (Surveillance Officer), Ulenta Chetty (Surveillance Officer), Wisdom Malinga (Research Assistant), Khadija Shangase (Surveillance Officer), Wanjiru Maina (Medical Officer).

Laboratory

The NIC in the Centre for Respiratory Diseases and Meningitis, NICD, is earmarked as a World Health Organization (WHO) Regional Reference Laboratory for Influenza and plays a key role in the support for the establishment of influenza laboratory and surveillance capacity in the SADC. The Centre is also working toward becoming a Reference Laboratory for H5 Avian Influenza human cases in the region. The NIC performs laboratory surveillance, molecular diagnosis and typing of influenza viruses and is tasked with investigation of the annual influenza molecular epidemiology, as well as resistance testing as part of the annual consultations for WHO vaccine recommendations. Influenza virus isolation and antigenic characterization using hemagglutination inhibition assays are key activities of the NIC. As part of the African Influenza Procurement program, the NIC has assisted 10 African countries with procuring reagents, consumables and sample collection materials for influenza testing during FY 2011.

Research assistant, Wisdom Malinga collecting data.

Laboratory Activities

- The NIC processed 6,373 respiratory specimens from January to September 2011. Influenza A was detected in 1,321 (20.9%) specimens and influenza B in 122 (2.1%).
- The hemagglutinin gene fragment 1 (HA1) of 22 influenza A (H3N2) viruses, 41 A(H1N1)pdm09 viruses and six influenza B viruses was sequenced for the 2011 season.
- The neuraminidase (NA) genes of 19 influenza A (H3N2) viruses and 25 A(H1N1)pdm09 viruses collected in 2011 were sequenced.
- Eighty SARI and 214 ILI clinical samples tested in 2011 had the H275 wild type signature by real-time PCR.
- Using the phenotypic drug resistance assay, influenza A (H1N1)pdm09 and influenza A (H3N2) isolates from 2010 and 2011 were screened for sensitivity to oseltamivir and zanamivir; isolates from 2007 to 2009 were also screened.
- A total of 149 isolates were made, of which 83 were A(H1N1)pdm09, 12 were influenza A (H3N2) and eight were influenza B isolates.
- The NIC offered ongoing support, technical assistance and testing to the Region.
- A multiplex real-time RT-PCR assay (10 respiratory viruses) was accredited by the South African National Accreditation System.
- A method for detection of influenza subtypes using CDC real-time RT-PCR was accredited by the Department of Agriculture, Forestry and Fisheries for assisting in testing of ostriches during the influenza A (H5N2) outbreak.

Preparedness

Much of the work to develop a pandemic influenza preparedness plan paid off as the country responded to the 2009 H1N1 pandemic. The state of the national preparedness plan for South Africa in 2010 was greatly improved and significantly more efficient compared to its pre-pandemic status. Key factors

contributing to this include the implementation of an influenza vaccination campaign steering committee, mass vaccination campaign training in every province, influenza management training in many provinces, and the capacitation of public health laboratories to enable increased access to influenza PCR testing.

The NIC hosted and participated in a laboratory management and bioinformatics training program presented by CDC for African laboratories at NICD. NHLS laboratories in Natal, Freestate and Gauteng were trained to run the multiplex real-time PCR assay of 10 respiratory viruses as part of the viral watch program. The Democratic Republic of Congo was also trained in using the 10 plex real-time PCR assay for respiratory viruses.

Preparedness Activities

- Hosted meetings with the Department of Health and other stakeholders to discuss the objectives of influenza surveillance and additional data needs to guide influenza vaccination policy in South Africa.
- Attended the TEPHINET Sixth Global Scientific Conference on December 13, 2010, in Cape Town and a staff member served as a co-facilitator for the influenza workshop which included discussions of preparedness activities.
- Accredited by the Department of Agriculture, Forestry and Fisheries, the NIC supported testing for influenza A (H5N2) viruses during the avian influenza outbreak in ostriches and tested over 700 ostrich specimens.

Training

- A staff member attended the sixth annual African vaccinology course at the University of Cape Town on November 8–12, 2010.
- Staff members facilitated various training sessions for laboratory staff, data clerks, surveillance officers, public health registrars and medical officers in 2010 and 2011.
- Three staff members attended the Second Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting held in Ghana from the January 12–13, 2011.
- A laboratorian attended a meeting with NICs on strengthening the WHO Global Influenza Surveillance and Response System (GISRS) in Tunisia, November 30–December 3, 2010.
- In collaboration with CDC, we hosted a laboratory management training course for influenza viruses at the NICD, February 28–March 4, 2011.
- Two staff members led training sessions organized by the WHO for laboratory scientists in Ndola, Zambia and Kinshasa, Democratic Republic of Congo in 2011.

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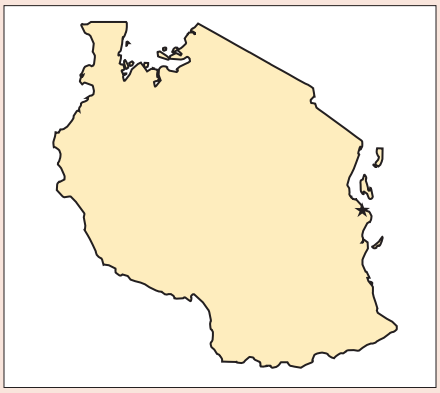
Tanzania



- **Capital:** Dar es Salaam
- **Area:** 947,300 sq km
- **Population:** 43,601,796 (July 2012 est.)
- **Age Structure:** 0-14 years: 42% (male 9,003,152/female 8,949,061); 15-64 years: 55.1% (male 11,633,721/female 11,913,951); 65 years and over: 2.9% (male 538,290/ female 708,445) (2011 est.)
- **Life Expectancy at Birth:** Total population: 53.14 years; male: 51.62 years; female: 54.7 years (2012 est.)
- **Infant Mortality Rate:** Total: 65.74 deaths/1,000 live births; male: 72.42 deaths/1,000 live births; female: 58.87 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 69.4%; male: 77.5%; female: 62.2% (2002 census)
- **GDP:** $63.44 billion (2011 est.)
- **GDP per Capita:** $1,500 (2011 est.)

Highlights

- Increased collaboration between public and private health facilities on public health issues.
- Developed the capacity to detect, diagnose, and manage other emerging and re-emerging diseases.

U.S. CDC Direct Country Support

Tanzania began avian and pandemic influenza preparedness and response activities in 2006 with creation of a national multi-sectional taskforce and development of a national preparedness and response plan. In 2008, the Ministry of Health and Social Welfare (MOHSW) through the Epidemiology and Diseases Control Section, with the assistance of the U.S. Centers for Disease Control and Prevention (CDC), established the National Influenza Laboratory (NIL) in Dar es Salaam and initiated virologic and epidemiologic influenza sentinel surveillance in five hospitals around the country. This surveillance enhancement contributed to the country's timely response to Rift Valley fever in 2007, the 2009 H1N1 influenza pandemic, and the dengue fever outbreak in 2010.

In the previous cooperative agreement, the Tanzanian government worked closely with CDC to build capacity to prepare, detect and respond to pandemics and other disease outbreaks including avian influenza. This was done under three pillars: preparedness and communication, surveillance and response, and containment.

Surveillance

The influenza surveillance system in Tanzania uses both the Integrated Disease Surveillance and Response (IDSR) system of suspected cases of severe acute respiratory infection (SARI) from 137 registered districts, and sentinel surveillance of sampled influenza-like illness (ILI) cases and all SARI cases in six sentinel hospitals. The linkages between human and animal surveillance have been established through sharing

of influenza surveillance reports, technical committee meetings, joint trainings and public awareness sessions on regular basis. SARI reports are being sent to the MOHSW through the IDSR system from the sentinel sites, and reports on aggregated data are shared with all stakeholders, including the World Health Organization (WHO) Country Office.

Surveillance Activities

- Conducted influenza surveillance at six sentinel sites; a total of 1,531 samples were sent to the NIL.
- Hosted three biannual meetings with various stakeholders to evaluate achievements and challenges of influenza surveillance and came up with steps to tackle these challenges. Consequently, tremendous improvement has been realized by the sites, including increasing the target of specimen collection by 70%.
- Supported sentinel sites with mentoring and training of new/additional staff.
- Submitted weekly influenza surveillance information and virus isolates to WHO Reference Laboratories.
- Provided communication and coordination capabilities to Program Officers.

Laboratory

The influenza laboratory network consists of six sentinel hospital laboratories that are mainly involved in specimen collection, storage and transportation to the NIL. The NIL is the only laboratory in Tanzania with the capacity to diagnose influenza viruses.

Dr. Jennifer Faulwetter trains Laboratory Technologist, Ms. Miriam Matonya, in virus isolation at Tanzania's NIC.

Laboratory Activities

- Conducted PCR testing; preparing to perform virus culture.
- Participated in internal and external quality assurance conducted by WHO.
- Tested all suspect specimens for influenza A (H1) and (H3), influenza B, swine influenza A (H1), and avian influenza A (H5) using real-rime RT-PCR.
- Tested a total of 1,531 influenza specimens from five sentinel sites.
- Equipped the laboratory with modern diagnostic equipment including thermocyclers for RT-PCR, liquid nitrogen storage tanks, dry shippers and safety cabinets.
- Increased the capacity of the MOHSW for diagnosis and surveillance of avian influenza and human influenza together with other diseases.

Preparedness

Tanzania's MOHSW continues to work with CDC, the United Nations, and other stakeholders in the implementation of the preparedness and response plan for avian and pandemic influenza.

Following the outbreak of influenza A (H1N1)pdm09 in 2009, the MOHSW, in collaboration with the Ministry of Livestock and Fisheries Development, initiated review of the national avian influenza preparedness and response plan.

Preparedness Activities

- Produced and broadcasted TV and radio spots on seasonal and pandemic influenza awareness.
- Developed communication materials including leaflets, posters, billboards, TV and radio spots in collaboration with other partners such as CDC, WHO, and the United Nations Children's Fund (UNICEF).

Training

Tanzania MOHSW hosted the following training activities:

- Trained and activated 36 district rapid response teams for timely response of influenza.
- Provided refresher and on-the-job training to sentinel surveillance staff during on-site supportive supervision.
- Provided cell culture training to two laboratory technicians in South Africa.

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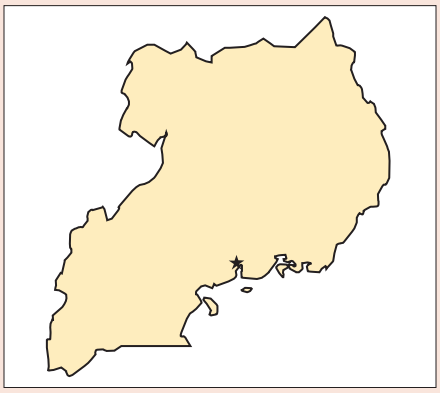
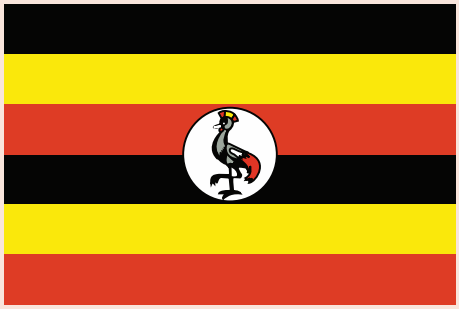
Uganda





- **Capital:** Kampala
- **Area:** 241,038 sq km
- **Population:** 35,873,253 (July 2012 est.)
- **Age Structure:** 0-14 years: 49.9% (male 8,692,239/female 8,564,571); 15-64 years: 48.1% (male 8,383,548/female 8,255,473); 65 years and over: 2.1% (male 291,602/female 424,817) (2011 est.)
- **Life Expectancy at Birth:** Total population: 53.45 years; male: 52.4 years; female: 54.54 years (2012 est.)
- **Infant Mortality Rate:** Total: 61.22 deaths/1,000 live births; male: 64.78 deaths/1,000 live births; female: 57.56 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 66.8%; male: 76.8%; female: 57.7% (2002 census)
- **GDP:** $45.9 billion (2011 est.)
- **GDP per Capita:** $1,300 (2011 est.)

Highlights

- Design and environment impact assessments have been completed and all other required permits and authorizations for building have been obtained for extensions to the influenza laboratories.
- The National Influenza Center (NIC) received a QIAcube machine to support RNA extractions for PCR diagnostic activities.
- Data collection continued for burden of diseases studies.
- Severe acute respiratory infection (SARI) surveillance in regional referral hospitals continued.

U.S. CDC Direct Country Support

U.S. Centers for Disease Control and Prevention (CDC) support of the Influenza Surveillance Program in Uganda was initiated in 2007 when *Strengthening of National Capacity for Surveillance and Containment of Avian and Pandemic Influenza in Uganda* was approved. The purpose of these funds was to help support the national avian flu preparedness plan and to establish a sustainable influenza surveillance network in Uganda. With funds provided by CDC under the influenza cooperative agreement, influenza sentinel surveillance for influenza-like illness (ILI) and severe acute respiratory infection (SARI) were initiated and are now well-established in Uganda. There are nine routine sites and three sites that provide specimens periodically. The national preparedness plan which was developed with support by this funding is also being implemented.

Surveillance

Influenza surveillance was initiated in Uganda in the 1960s. However, at the time of the cooperative agreement, no influenza surveillance activities were being undertaken. Sentinel sites were started in different parts of the country beginning in 2007. By the end of 2010, monitoring of influenza activity was

carried out routinely in nine locations: five outpatient clinics where ILI was assessed, and four hospitals where both ILI and SARI were being assessed. There were also three other sites providing specimens periodically. In 2011 more emphasis was shifted to SARI surveillance. Presently there are five sentinel sites collecting samples for SARI alone, and three sites collecting ILI samples alone. Only one site (Entebbe) collects both SARI and ILI samples. The NIC works with the Makerere University Walter Reed Project (MUWRP), which has four hospital-based sentinel sites.

Surveillance Activities

- Training on SARI surveillance was carried out in six hospitals (Mbarara Regional Referral Hospital, Tororo Regional Referral Hospital, Arua Regional Referral Hospital, Fort Portal Regional Referral, Arua Regional Referral Hospital and Koboko District Hospital).
- A revision of the case investigation forms and follow-up forms was made and these were introduced to the different sentinel sites through review meetings.
- Data collection for burden of disease information is now routinely collected. Forms for data collection were introduced and analysis is ongoing.

Laboratory

The NIC is the only laboratory carrying out human influenza diagnostic testing in the country. The MUWRP and the CDC-funded influenza program work together in the NIC laboratory.

Laboratory Activities

- The laboratory carries out RT-PCR testing to confirm diagnosis and typing, and also carries out virus culture and HAI for subtyping.
- A subset of the influenza isolates are sent to CDC for further testing and characterization. Data on resistance to adamantines is provided for the isolates and then sent to CDC.
- The laboratory participated in the World Health Organization (WHO) External Quality Assessment Project (EQAP) panels and received a 100% score for all panels.
- The laboratory also participated in the influenza Performance Evaluation Pilot RT-PCR panel.
- The laboratory is a key training facility for the Institute and the country on PCR diagnostic techniques.

Preparedness

The national preparedness plan for Uganda was finalized in 2007. Activities to implement the plan were delayed because of funding. In 2010, the World Bank provided a $10 million loan to facilitate its execution. Many related activities have been undertaken by the government of Uganda. At the Institute, we expect some of the funds to be used for extension of the laboratories and to also build a Biosafety Level 3 facility.

Preparedness Activities

- Improving laboratory capacity at the NIC.
- Training district personnel on identifying influenza patients and rapid response in case of outbreaks.
- Building isolation centers at Mulago National Referral Hospital and Entebbe Hospital.
- Building mechanisms for public awareness.
- Production of a communication strategy and production of information, education and

communication materials.

- Expanding and strengthening surveillance and reporting in the districts.
- Regularly investigating SARI upsurges with laboratory support.

Training

Uganda's NIC did not host any training for influenza activities, but the Uganda Virus Research Institute (UVRI) sent personnel to participate in training in Kenya and South Africa. Our data officer was trained and there has been a lot of improvement in our data output.

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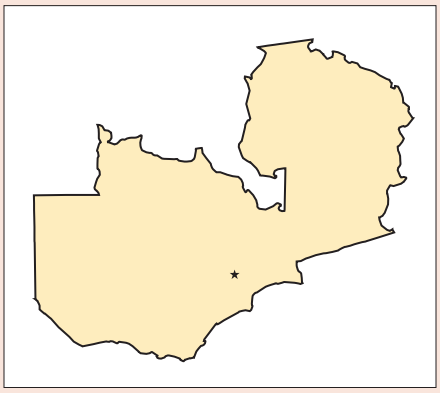
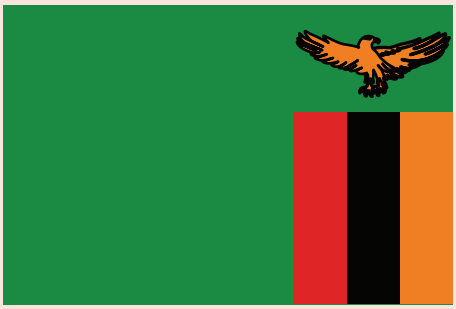
Dr. Julius and Dr. Barnabas award a certificate to the second place winner from Entebbe Hospital. Performance awards were provided to the best performing sites.

Zambia





- **Capital:** Lusaka
- **Area:** 752,618 sq km
- **Population:** 14,309,466 (July 2012 est.)
- **Age Structure:** 0-14 years: 46.7% (male 3,253,125/female 3,228,844); 15-64 years: 50.8% (male 3,544,640/female 3,508,344); 65 years and over: 2.5% (male 148,531/female 197,852) (2011 est.)
- **Life Expectancy at Birth:** Total population: 52.57 years; male: 51.35 years; female: 53.83 years (2012 est.)
- **Infant Mortality Rate:** Total: 64.61 deaths/1,000 live births; male: 69.26 deaths/1,000 live births; female: 59.82 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 80.6%; male: 86.8%; female: 74.8% (2003 est.)
- **GDP:** $21.93 billion (2011 est.)
- **GDP per Capita:** $1,600 (2011 est.)

Highlights

- The U.S. Centers for Disease Control and Prevention (CDC)-donated QIAcube extractor was commissioned at the virology laboratory.
- The Zambia Ministry of Health (MOH) is preparing to designate surveillance nurses to collect data on SARI, in order to keep influenza patients separate from other patients in the University Teaching Hospital (UTH) pediatric ward.

U.S. CDC Direct Country Support

CDC has a four-year (2009–2013) cooperative agreement with the MOH. This cooperative agreement is helping to strengthen influenza surveillance and the surveillance of other communicable diseases in Zambia by bolstering the public sector laboratory and surveillance capacity for influenza-like illness (ILI) and severe acute respiratory infection (SARI). The cooperative agreement was implemented by the UTH and the Lusaka District Health office on behalf of the MOH and in close collaboration with CDC-Zambia, CDC-South Africa, and the National Institutes for Communicable Diseases (NICD-South Africa), and the World Health Organization (WHO).

Surveillance

Before the cooperative agreement, Zambia had a developing influenza surveillance system. The cooperative agreement enabled Zambia to strengthen its developing surveillance system, and surveillance of emerging pandemic viruses. Currently, Zambia has two ILI sites and two SARI surveillance sites, all in Lusaka.

Surveillance Activities

- Three staff members presented posters at the International Conference on Emerging Infectious Diseases (ICEID) in Atlanta, Georgia.
- A nurse and clinical officer in Ndola received additional training on the use of a new data collection tool.

Laboratory

Since the induction of the cooperative agreement, the virology laboratory has been strengthened through training of laboratory scientists and the provision of reagent and consumables. It now functions as the country's reference laboratory and is on its way to becoming an accredited National Influenza Center (NIC).

Laboratory Activities

- A draft influenza manuscript was submitted to the *Journal of Infectious Diseases*.
- A WHO consultant visited the virology laboratory and surveillance sites and provided ways to strengthen epidemiological data management.
- The virology laboratory, with the support of CDC, has started screening influenza-negative specimens for other respiratory viruses.

Preparedness

The MOH conducts Integrated Disease Surveillance and Response (IDSR) for communicable diseases and is moving toward integrating influenza. This mechanism serves as an early warning system for the detection of outbreaks.

Preparedness Activities

- Developed a national action plan for preparedness and response to influenza threats.

Training

The MOH hosted the following training activities in 2011:

- Rapid response team trainings in high-risk provincial and district areas.
- Additional pandemic preparedness and response training, in conjunction with CDC.

Training course for sentinel surveillance staff hosted by Zambia's Ministry of Health.

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WHO Eastern Mediterranean Region (EMR)

WHO Eastern Mediterranean Region (EMR) Overview

There are four bilateral influenza cooperative agreements in the World Health Organization (WHO) Eastern Mediterranean Region (EMR). These cooperative agreements are with ministries of health (MOH) or other institutions to build capacity to routinely identify, diagnose, and respond to seasonal and pandemic influenza in WHO EMR.

U.S. Centers for Disease Control and Prevention (CDC) direct country support through cooperative agreements is established in the following countries:

- Afghanistan
- Egypt
- Morocco
- Pakistan

In addition, CDC supports the WHO Eastern Mediterranean Regional Office (EMRO) via a cooperative agreement to provide coordination and technical support to WHO EMR Member States.

The core activities of these bilateral agreements are:

- To build sustainable national capacity for the detection, identification of, and response to, seasonal influenza, pandemic influenza, and other emerging diseases in accordance with International Health Regulations 2005 (IHR).
- To build capacity for integrated laboratory and epidemiologic surveillance for influenza-like illness (ILI) and severe acute respiratory infections (SARI). This includes making routine contributions to WHO's Global Influenza Surveillance and Response System (GISRS) and implementing IHR (2005).
- To develop sustainable epidemiologic and virologic surveillance systems for severe influenza in order to gain an understanding of this disease and its economic burden and that of other respiratory viruses.
- To develop and sustain interagency, national preparedness plans.
- To develop and train local rapid response and containment teams.

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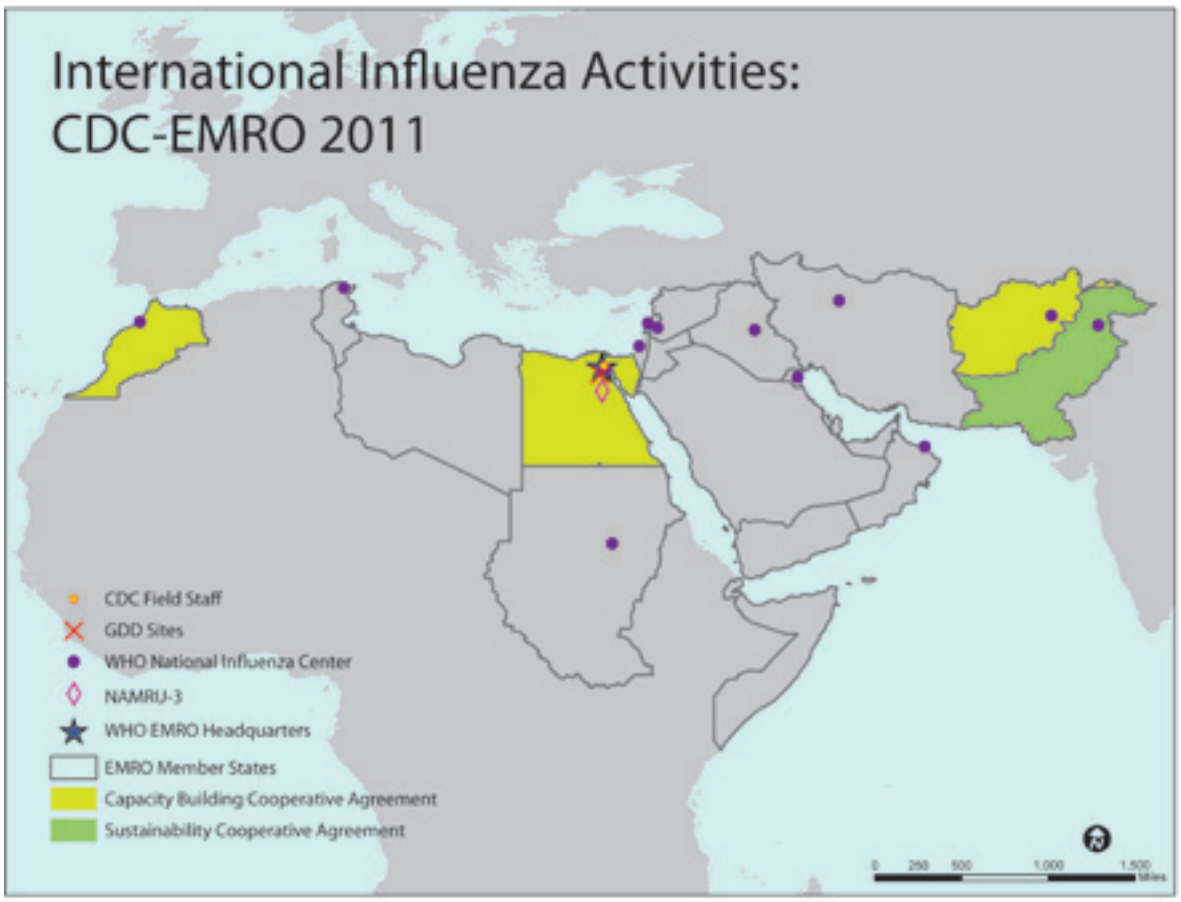
WHO Eastern Mediterranean Regional Office (EMRO)



U.S. CDC Direct WHO Regional Office Support

A five-year project titled *Strengthening Surveillance and Response to Avian and Pandemic Influenza in the Eastern Mediterranean Region* was launched in October 2006, under a cooperative agreement between the WHO Eastern Mediterranean Regional Office (EMRO) and the U.S. Centers for Disease Control and Prevention (CDC). The current reporting period is the fifth year of the cooperative agreement.

The goal of this project is to strengthen the capacity of all 23 countries in the WHO Eastern Mediterranean Region (EMR) to rapidly detect, assess, respond to and contain public health threats emanating from highly pathogenic avian influenza (HPAI) and human pandemic influenza.

Surveillance Activities

- WHO EMRO organized a sub-regional training workshop on strengthening preparedness for, and mitigation of, pandemic influenza in refugee and displaced population settings.
- WHO EMRO collaborated with CDC and U.S. Naval Medical Research Unit No. 3 (NAMRU-3) to organize a regional influenza surveillance network meeting in October 2011. WHO EMRO supported the participation of 27 representatives from nine countries. The meeting explored ways to expand sentinel surveillance in the region, and a formal regional network was established, the *Eastern Mediterranean Acute Respiratory Infection Surveillance (EMARIS) Network*. This network was formed to foster greater collaboration and coordination across the region.

- Technical missions to Afghanistan, Jordan, Sudan, and South Sudan were conducted to assess surveillance capacities for integrating influenza-like illness (ILI) and severe acute respiratory infections (SARI) in their routine reporting systems. As a result, Afghanistan and South Sudan have now added ILI to their routine surveillance systems.
- WHO EMRO developed a draft regional guideline for influenza surveillance delineating the objectives, strategy, methods of data collection, analysis and reporting as well as methods for periodic monitoring and evaluation of the surveillance system for ILI and SARI.
- Representatives from WHO EMRO participated in a WHO Headquarters (HQ) meeting to develop global influenza surveillance guidelines. These representatives gave a voice to experiences gained in WHO EMR to help shape those guidelines.

Laboratory

Fifteen National Influenza Centers (NIC) are now functional in WHO EMR due, in part, to technical and financial support provided to countries through the CDC-WHO EMRO cooperative agreement.

Laboratory Activities

- Assessments of influenza virus isolation units were conducted in collaboration with NAMRU-3 in Bahrain, Jordan, Yemen, and the Kingdom of Saudi Arabia. The missions included on-site training courses on influenza virus isolation. Following the course, these laboratories have begun the formal designation process to be accredited as NIC by WHO.
- WHO EMRO provided support to seven NICs through the provision of reagents, primers, and other laboratory supplies to further improve capacity for isolation and sequencing of influenza viruses.
- WHO EMRO supported two laboratory staff from two countries in the region to attend training on biosecurity and biosafety management for novel influenza viruses at the NAMRU-3 laboratory.

Preparedness

National preparedness plans for human pandemic influenza were reviewed and updated in all 23 countries in WHO EMR drawing on lessons learned during the 2009 H1N1 pandemic. Technical support was provided in the areas of assessment, infection prevention and control, and risk management.

Preparedness Activities

- Regional personnel visited Saudi Arabia to advise national health authorities on public health preparedness measures for prevention and control of respiratory virus infections, including influenza, during the annual Hajj. This mission drew on lessons learned for appropriate public health responses to epidemic-prone disease in mass gathering situations.
- WHO EMRO organized a workshop for the assessment of infection prevention and control of influenza and other respiratory disease programs in health care settings. As a result of this workshop, evidence-based tools were developed to guide effective infection control measures, including the *Infection Prevention and Control Assessment Tool (IPCAT)*. The intended use of this tool is for self-assessment of national infection and control policies and programs, and to guide changes to those programs.
- WHO EMRO participated in the WHO HQ revision of the pandemic influenza preparedness guidelines and the development of the pandemic influenza preparedness (PIP) framework.

- WHO EMRO participated in the Global Infection Prevention and Control Network (GIPCN) meeting organized by WHO HQ in Geneva from June 7–8, 2011, where they contributed to the development of a global work plan for the prevention of infection in health care settings from influenza and other acute respiratory infections (ARI).

Training

- A sub-regional training course for the improvement of epidemiological surveillance capacity for ILI and SARI was held in Beirut, Lebanon. Four additional courses were held on methods for setting up surveillance for ILI and SARI.
- A training package on building ILI and SARI surveillance and response capacities for district level health officials has been developed and standardized.
- Two training courses on infection prevention and control for ARIs in health care facilities were organized in the region.
- All 23 countries in WHO EMR were trained on infection control measures in health care facilities.
- WHO EMRO and the WHO Global Influenza Program (GIP) jointly conducted two training courses on the packaging, transportation and shipment of influenza viral specimens following IATA guidelines in South Sudan and Sudan.
- WHO EMRO held a workshop on the management of public health risk for pandemic influenza. The focus of this course was management in displaced population settings.

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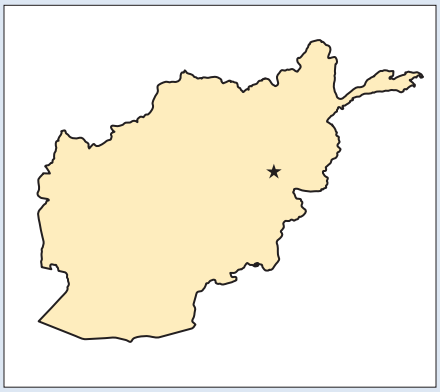
Afghanistan



- **Capital:** Kabul
- **Area:** 652,230 sq km
- **Population:** 30,419,928 (July 2012 est.)
- **Age Structure:** 0-14 years: 42.3% (male 6,464,070/female 6,149,468); 15-64 years: 55.3% (male 8,460,486/female 8,031,968); 65 years and over: 2.4% (male 349,349/female 380,051) (2011 est.)
- **Life Expectancy at Birth:** Total population: 49.72 years; male: 48.45 years; female: 51.05 years (2012 est.)
- **Infant Mortality Rate:** Total: 121.63 deaths/1,000 live births; male: 129.51 deaths/1,000 live births; female: 113.36 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 28.1%; male: 43.1%; female: 12.6% (2000 est.)
- **GDP:** $29.99 billion (2011 est.)
- **GDP per Capita:** $1,000 (2011 est.)

U.S. CDC Direct Country Support

The Islamic Republic of Afghanistan's Ministry of Public Health (MOPH) entered into a cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC) for capacity building in surveillance and response to avian and pandemic influenza in 2006. Fiscal Year 2011 was the last year of that cooperative agreement. This bilateral collaboration has supported the Afghan Public Health Institute (APHI), a division of the MOPH, in a number of activities, including: planning and conducting pandemic preparedness and response activities, establishing surveillance for influenza-like illness (ILI) and severe acute respiratory infections (SARI), building laboratory capacity for testing of influenza specimens, health education, and training activities.

Surveillance

The Disease Early Warning System (DEWS) is Afghanistan's primary disease surveillance system. It was established in 2006, with funding from WHO and the U.S. Agency for International Development (USAID). Influenza is one of 15 reportable diseases for which DEWS collects weekly data. Influenza surveillance includes routine specimen collection for both ILI and SARI from ten countrywide sentinel sites. Specimens are also collected during suspected outbreaks. DEWS officers submit data weekly to APHI from over 296 sentinel surveillance sites, located across all 34 provinces in the country.

Surveillance Activities

- Ten ILI and SARI surveillance sites have been established in Afghanistan and integrated into the DEWS system. Data from these sites are included in a weekly DEWS report.
- Weekly reporting by regional DEWS officers has been very successful, with a reporting rate greater than 99.9%.

- The existing Codan radio network communication system in the MOPH collects information on cases of acute respiratory illness (ARI) and ARI-related deaths from all 34 provinces.

Laboratory

The virology department of the Central Public Health Laboratory (CPHL) was accredited as a WHO National Influenza Center (NIC) in 2009. The NIC is capable of performing RT-PCR, virus isolation and sub-typing using hemagglutination inhibition (HAI) tests.

Laboratory Activities

- Processed 515 ILI and SARI specimens; 11 were positive for 2010/2011 H1N1.

Preparedness

In FY 2011, Afghanistan has detected and responded to 319 disease outbreaks, including several outbreaks of ARI cough and cold, and ARI pneumonia. Additionally, the MOPH has established 30 sentinel preparedness sites across the country. Daily morbidity and mortality reports for ARI, diarrhea, and injury are collected from all 34 provinces through the Codan communication system. This system enhances preparedness by allowing timely dissemination of information.

Preparedness Activities

- Refresher training on outbreak investigation and response was conducted for all regional response teams.
- Personal protective equipment (PPE) kits and viral transport media (VTM) were procured and readily available for use during outbreak investigations.

Training

Afghanistan hosted the following training activities in 2011:

- A three day geographic information system (GIS) workshop for all field coordinators and central staff.
- Six coordination meetings were held in 2011.
- A seven day workshop on H1N1 and ARI for regional surveillance officers and other key stakeholders.
- A one day workshop on internal project evaluation.
- Surveillance directorate staff participated in the International Health Regulations 2005 (IHR) training in France.
- DEWS regional coordinators may pursue a Master's of Public Health (MPH) degree through a new distance learning program that has been introduced.

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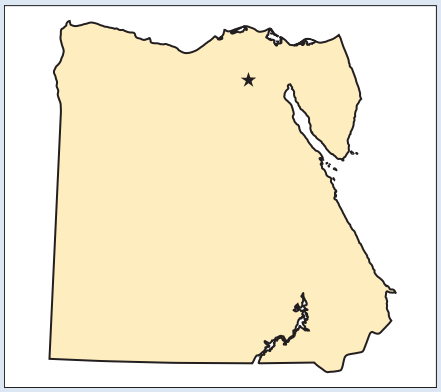

- **Capital:** Cairo
- **Area:** 1,001,450 sq km
- **Population:** 83,688,164 (July 2012 est.)
- **Age Structure:** 0-14 years: 32.7% (male 13,725,282/female 13,112,157); 15-64 years: 62.8% (male 26,187,921/female 25,353,947); 65 years and over: 4.5% (male 1,669,313/female 2,031,016) (2011 est.)
- **Life Expectancy at Birth:** Total population: 72.93 years; male: 70.33 years; female: 75.66 years (2012 est.)
- **Infant Mortality Rate:** Total: 24.23 deaths/1,000 live births; male: 25.8 deaths/1,000 live births; female: 22.59 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 71.4%; male: 83%; female: 59.4% (2005 est.)
- **GDP:** $515.4 billion (2011 est.)

Highlights

- All influenza-related activities are currently being coordinated by a newly formed influenza surveillance group at the Ministry of Health and Populations (MOHP). Included in these activities are the nationwide hospital-based surveillance for avian and pandemic influenza, and the influenza-like illness (ILI) and severe acute respiratory infections (SARI) sentinel surveillance system.
- A web-based reporting system has been launched by the MOHP in 8 of 16 sentinel sites.
- Seven subnational laboratories for influenza detection and diagnosis are now functional, allowing for more rapid detection of outbreaks and identification of viruses.
- The national capacity for risk assessment has been improved by the establishment of a framework to link epidemiologic and laboratory groups from both human health and animal health.
- The MOHP has upgraded its national surveillance guidelines for, and case definitions of, priority communicable diseases including influenza.
- The MOHP is updating, printing and distributing the reporting forms for ILI and SARI sentinel surveillance sites.
- The web-based electronic reporting system, National Egyptian Disease Surveillance System (NEDSS-online) is operational in 27 governorates (provinces), 270 health districts and 57 main fever and chest hospitals.
- Population-based surveillance for SARI (with plans to expand to ILI) is being conducted in Damanhour, Behera Governorate in conjunction with U.S. Naval Medical Research Unit No. 3 (NAMRU-3).

U.S. CDC Direct Country Support

In 2009, the MOHP of the Arab Republic of Egypt entered into a cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC) titled *Surveillance and Response to Avian and Pandemic Influenza*. Initial funding provided through this cooperative agreement was used to build laboratory and epidemiology capacity for influenza surveillance. The objectives of the CDC-Egypt cooperative agreement are to prevent the emergence and spread of a pandemic influenza virus, to reduce morbidity and mortality caused by influenza viruses, and to improve the state of preparedness and the quality of response to an influenza pandemic. The MOHP collaborates with the U.S. Naval Medical Research Unit No. 3 (NAMRU-3) in Cairo and WHO's Eastern Mediterranean Regional Office (EMRO), to review and enhance ongoing national surveillance activities.

Surveillance

Egypt has multiple activities for influenza within their surveillance system. General influenza surveillance takes place in all government hospitals (up to 450) and approximately 5,000 outpatient clinics. Sentinel surveillance for ILI was established in 1999 in eight outpatient clinics of selected fever and chest hospitals. Sentinel surveillance for SARI began in 2009 and occurs in eight inpatient wards of selected fever hospitals. Both ILI and SARI sentinel surveillance continue in collaboration with NAMRU-3. Surveillance also occurs for suspected novel influenza viruses and pneumonia and avian influenza surveillance started in early 2006. Influenza data from hospitals throughout 29 governorate surveillance units is collated and then submitted electronically to the MOHP's central Epidemiologic Surveillance Unit (ESU).

Surveillance Activities

- A weekly report is generated from surveillance data for pneumonia and avian influenza.
- A weekly report is also generated from sentinel SARI and ILI surveillance data and distributed to designated persons within the MOHP and to regional epidemiologists.

Laboratory

The Central Public Health Laboratory (CPHL) serves as the National Influenza Center (NIC) and provides laboratory support to the ESU for surveillance activities related to human influenza in Egypt. Four of the eight sentinel hospitals have subnational laboratories that perform RT-PCR testing for influenza. Two additional subnational laboratories will begin functioning under the quality assurance in 2012; one in upper Egypt in the Assiut Governorate and the other in Kafr el-Sheikh Governorate in lower Egypt.

Laboratory Activities

- CPHL has the capacity to detect and subtype seasonal, H5N1, and 2009 H1N1 influenza viruses using both molecular and culture-based techniques; culture is only used for virus isolation with specimens collected for the purposes of ILI and SARI surveillance.
- CPHL routinely provides training to laboratory staff members and offers technical support to subnational laboratories.

Preparedness

The MOHP has devoted time and resources to establishing, and building the capacity of rapid response teams. These teams investigate and implement control measures for combatting zoonotic transmission of H5N1, and to contain and mitigate pandemic influenza.

Preparedness Activities

- Rapid response teams from all levels (central, governorate and district) have been trained on the preparedness guidelines outlined in Egypt's national preparedness pandemic plan.
- Personal protective equipment (PPE) has been procured and stored for rapid deployment if required.

- The MOHP has stockpiled 2.5 million doses of oseltamivir.
- The Central Epidemiology Team and virology laboratories in the MOHP and veterinary sector have collaborated in a joint risk assessment at the national level.

Training

The MOHP conducted the following trainings in FY 2011:

- Seven training courses were implemented for 175 physicians working in health care establishments, with the purpose of improving awareness in the early detection and diagnosis of influenza cases.
- Five training courses on enhancing human surveillance for H5N1 influenza infection were conducted for 175 participants in nine high-risk governorates.
- Six training courses were implemented for surveillance teams with 183 participants (88 physicians, 74 specialists in public sanitation and health, and 21 statistical technicians) from 14 governorates.
- Training courses were held to improve capacity for immediate reporting and rapid response to sporadic cases or clusters of illness, including nine training courses for 325 participants from all 27 governorates of Egypt.
- Twenty-two training courses were held for 865 participants (325 physicians and 540 nurses) to improve the quality of infection control practices in isolation wards and critical care units at MOHP hospitals.
- One training course was held for the ILI surveillance team including 28 physicians, two nurses, and five lab technicians.

Hajj Pilgrim Measures

- The MOHP provided Hajj pilgrims with seasonal influenza vaccine that included the 2009 H1N1 strain. In total, 300,000 doses were dispensed among pilgrims and health care workers.
- The MOHP offered pilgrims health education in the prevention of influenza.

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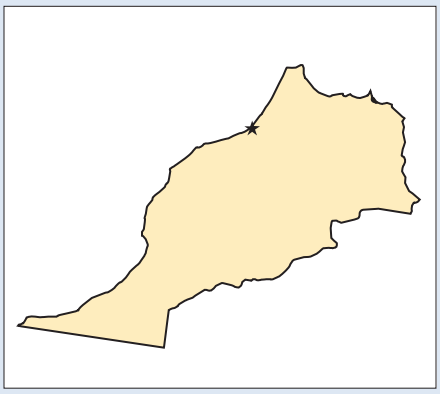
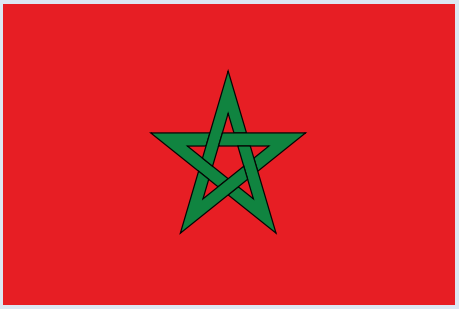
Morocco





- **Capital:** Rabat
- **Area:** 446,550 sq km
- **Population:** 32,309,239 (July 2012 est.)
- **Age Structure:** 0-14 years: 27.8% (male 4,514,623/female 4,382,487); 15-64 years: 66.1% (male 10,335,931/female 10,785,380); 65 years and over: 6.1% (male 881,622/ female 1,068,318) (2011 est.)
- **Life Expectancy at Birth:** Total population: 76.11 years; male: 73.04 years; female: 79.32 years (2012 est.)
- **Infant Mortality Rate:** Total: 26.49 deaths/1,000 live births; male: 31.16 deaths/1,000 live births; female: 21.59 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 52.3%; male: 65.7%; female: 39.6% (2004 census)
- **GDP:** $163 billion (2011 est.)
- **GDP per Capita:** $5,100 (2011 est.)

Highlights

- During the 2010–2011 Northern Hemisphere influenza season, Morocco's National Influenza Center (NIC) strengthened its capabilities by including strain sequencing and phylogenetic analysis. Morocco has also developed capacity for phenotypic analysis of drug susceptibility; this allows the NIC to participate in the World Health Organization (WHO) Global Influenza Surveillance and Response System (GISRS) surveillance of susceptibility to, and detection of, M2 and neuraminidase inhibitor resistance.
- Morocco has extended their severe acute respiratory infections (SARI) diagnostic testing to include bacterial pathogens. The bacterial department of the National Institute of Hygiene (NIH) is coordinating this activity with Morocco's 16 regional laboratories.
- An article documenting Morocco's influenza surveillance was published in 2011.

U.S. CDC Direct Country Support

The Kingdom of Morocco's National Institute of Hygiene (NIH) is both an NIC and the recipient of a U.S. Centers for Disease Control and Prevention (CDC) cooperative agreement for influenza surveillance titled *Strengthening Influenza Surveillance Networks in Morocco*. The NIH was initially funded in 2006 to strengthen laboratory and epidemiology capacity for influenza surveillance.

The NIH has developed a web-based database to collect both epidemiologic and laboratory information related to influenza-like illness (ILI) and SARI. The NIH collaborates on influenza surveillance activities in the 16 administrative regions of Morocco with the epidemiological disease and surveillance units in the country's Ministry of Health (MOH).

Surveillance

Morocco's MOH uses multiple surveillance systems to characterize the epidemiology of influenza, both for the observation of seasonal influenza trends, and to be prepared in the event of a pandemic. SARI is tracked through a network of 16 regional hospitals where syndromic and virologic data is collected. ILI is tracked through a network of 380 health units and a network of 110 private physicians. Sixteen of the 380 health units collect both syndromic and virologic data.

The internet database developed by NIH provides instant notification of influenza activity. Influenza data is entered into the database by the sentinel sites and the NIC.

Surveillance Activities

- In Morocco's 2010–2011 influenza season, 779 ILI specimens were tested for influenza with a positivity rate of 37% (124 A(H1N1)pdm09, 39 A(H3N2) and 122 influenza B). Approximately 70% of these specimens were collected through the physicians' network and the remaining 30% through the health unit network.
- In the same period, 139 SARI specimens were collected through regional hospitals and tested for influenza, with a positivity rate of 17% (17 A(H1N1)pdm09 and A(H3N2) and 6 influenza B). A further 26 (19%) specimens tested positive for bacterial pathogens.

Laboratory

Morocco's surveillance network includes one NIC and 16 regional laboratories. The NIC has the capacity to conduct real-time PCR testing, virus culturing, HAI testing, DFA testing, sequencing and phenotypic analysis of drug susceptibility. Four regional laboratories are equipped with PCR machines.

Laboratory Activities

- CDC supports Morocco's NIC, bacterial laboratories and influenza network laboratories through the supply of laboratory consumables and standard reagents, such as immunofluorescence assay (IFA) kits, PCR reagents and bacterial tests.

Training

Morocco's NIH hosted the following training activities in 2011:

- A two-site technical assistance and hands-on training for regional laboratory staff in SARI bacterial diagnosis.
- Supervision and monitoring visits to ensure the functioning of the sentinel surveillance system and the quality of the surveillance data.

Publications

- Barakat A, Ihazmad H, Benkaroum S, Cherkaoui I, Benmamoun A, Youbi M, El Aouad R. (2011) Influenza Surveillance among Outpatients and Inpatients in Morocco, 1996–2009 PLoS ONE 6(9): e24579.

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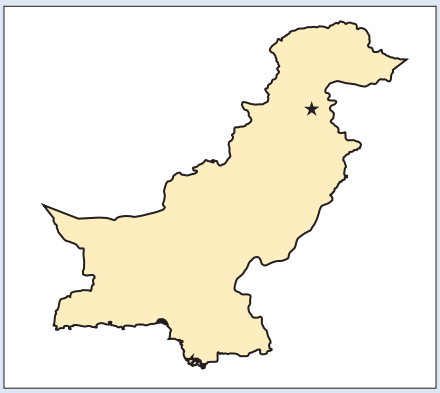

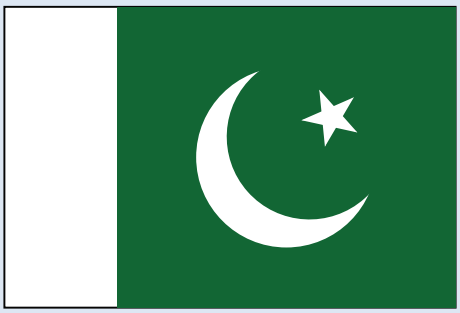

- **Capital:** Islamabad
- **Area:** 796,095 sq km
- **Population:** 190,291,129 (July 2012 est.)2011 est.)
- **Age Structure:** 0-14 years: 35.4% (male 34,093,853/female 32,278,462); 15-64 years: 60.4% (male 58,401,016/female 54,671,873); 65 years and over: 4.2% (male 3,739,647/female 4,157,870) (2011 est.)
- **Life Expectancy at Birth:** Total population: 66.35 years; male: 64.52 years; female: 68.28 years (2012 est.)
- **Infant Mortality Rate:** Total: 61.27 deaths/1,000 live births; male: 64.51 deaths/1,000 live births; female: 57.88 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 49.9%; male: 63%; female: 36% (2005 est.)
- **GDP:** $488 billion (2011 est.)
- **GDP per Capita:** $2,800 (2011 est.)

Highlights

- The Sindh sentinel laboratory at Civil Hospital in Karachi started processing seasonal and pandemic samples in October 2010.
- Rapid response team (RRT) trainings were held in Gilgit Baltistan, Punjab, Sindh and KPK provinces. Public health professionals were trained on how to respond to suspected outbreaks including, how to investigate suspected cases, use of personal protective equipment (PPE) and infection control measures.
- Two officers from Pakistan's National Institute of Health (NIH) participated in a comprehensive training workshop on avian influenza in April 2011 in China.
- A scientific poster on the 2009 H1N1 pandemic work in Pakistan was presented at the Keystone Symposia held in May 2011 in Hong Kong.

U.S. CDC Direct Country Support

The U.S. Centers for Disease Control and Prevention (CDC) and Pakistan entered the first year of a five-year cooperative agreement in FY 2011, titled *Developing Sustainable Influenza Surveillance Networks and Response to Avian and Pandemic Influenza*. This cooperative agreement has supported the development of state-of-the-art laboratories in designated sentinel sites across Pakistan for rapid confirmation of human and novel influenza cases. CDC also supports activities aimed at pandemic influenza preparedness through improved national influenza surveillance as well as the development of a national vaccine policy. Significant progress has been made in light of continuing social and political challenges. Five sentinel sites are located in outpatient departments of major tertiary care hospitals in four provinces and the federal capital, Islamabad.

These sentinel sites were selected on the basis of geographic representation, high population density, and patient turnover rates.

Pakistan's five sentinel sites are operational after biosafety enhancements, installation of laboratory equipment, and basic training of physicians in the collection of epidemiological data and specimens from influenza-like illness (ILI) and severe acute respiratory infections (SARI) cases. Relevant standard operating procedures (SOP) and protocols for laboratory techniques have been developed per CDC protocols.

Surveillance

Prior to the 2011 cooperative agreement, no sentinel site, laboratory-based surveillance system existed in Pakistan. At present, five sentinel sites are reporting ILI and SARI cases through active and passive case-finding to Pakistan's NIH. Standard case definitions, together with SOPs for sampling, storage, and specimen transportation have been developed and implemented in the surveillance system and are being periodically reviewed based on the emerging situation. Epidemiologic surveillance data gathered through this system is being submitted online to the World Health Organization's (WHO) FluNet and that process is being strengthened. Seasonal influenza vaccine has been procured and administered to personnel engaged in influenza surveillance. Viral transport medium (VTM) is dispatched to provincial health departments and high-risk districts on a regular basis, and rapid response teams have been trained and activated for timely response to outbreaks. Sentinel site and rapid response trainings were conducted in Hayatabad Medical Complex (HMC) and in the newly evaluated sentinel site in Gilgit-Baltistan province.

Surveillance Activities

- Laboratory-based surveillance for ILI and SARI cases has been activated at five sentinel sites through both active and passive case-finding.
- Epidemiological data on ILI and SARI cases is being submitted online to WHO's FluNet.
- ILI and SARI reporting forms have been reviewed and updated.
- Monitoring and evaluation of sentinel sites began through onsite visits, and gaps in both laboratory and surveillance activities have been identified and addressed.
- Two CDC staff visited Pakistan in March 2011 to observe ongoing surveillance activities and made recommendations for improvements.

Laboratory

The first CDC cooperative agreement with Pakistan (2004–2009) supported the establishment of five key laboratories for influenza surveillance. This laboratory network consists of the central laboratory at Pakistan's NIH, which is engaged in virus isolation and the molecular diagnosis of influenza viruses, and sentinel influenza laboratories in each of the four provincial capitals. The Sindh sentinel laboratory at Civil Hospital in Karachi started processing samples in 2010, while the three remaining sentinel laboratories routinely process specimens and send aliquots to NIH for confirmation and virus culture. Under Pakistan's current cooperative agreement with CDC, three additional influenza laboratories are planned for construction in Multan (Punjab), Gilgit (Baltistan) and AJK provinces. A preliminary evaluation of the designated sentinel laboratory at Gilgit was completed in 2010.

Laboratory Activities

- From Pakistan's five sentinel surveillance sites, 1,086 specimens were processed and reported.
- Logistic and technical support was provided to sentinel influenza laboratories.
- Seasonal and pandemic virological data has been regularly shared with the Global Influenza Surveillance and Response System (GISRS) using WHO's FluNet.

- Epidemiological data submission was initiated on FluID.
- A manual for influenza diagnostic protocols, to be distributed to various laboratories, is under development.

Preparedness

Pakistan's national preparedness plan for prevention and control of avian and pandemic influenza, established at the NIH, was developed by the multi-sectoral National Expert Committee in 2005. Based on this document, Pakistan's MOH implemented the *National Programme for Prevention and Control of Avian and Pandemic Influenza* in 2006. Some of the program's major components include emergency response, clinical health services, antiviral medicines, vaccine deployment, containment and quarantine, and public health communication. Influenza surveillance has been strengthened through the cohesive efforts of the MOH and the NIH laboratory-based project.

Training

Physicians, public health professionals and laboratory personnel throughout Pakistan have received training:

- Seven influenza surveillance trainings were conducted for 93 sentinel site physicians.
- Rapid response training was conducted and attended by 26 persons in Gilgit province, an area considered at high-risk for influenza transmission.
- Twenty laboratory staff members at sentinel sites received refresher PCR training.

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A visit to the Lok Virsa National Institute of Folk and Traditional Heritage in Islamabad after completing a review of Pakistan's influenza surveillance systems in March 2011. From left to right: Charlene Sanders (Senior Program Manager, CDC), Nazish Badar (Microbiologist, Pakistan NIH), Uzma Bashir (Senior Virologist, Pakistan NIH), Fatimah Dawood (Medical Epidemiologist, CDC), Nadia Nisar (Statistician, Pakistan NIH), Rashid Mehmood (Senior Epidemiologist, Pakistan NIH).

WHO European Region (EUR)

WHO European Region (EUR) Overview

The World Health Organization (WHO) Regional Office for Europe (EURO) and the European Centre for Disease Prevention and Control (ECDC) work collaboratively to support public health programs in 53 Member States in Europe. Currently, there are four bilateral influenza cooperative agreements that support influenza activity in the EURO Region. These cooperative agreements are with ministries of health or other institutions that work with the U.S. Centers for Disease Control and Prevention (CDC) to build capacity in order to routinely identify, diagnose and respond to seasonal and pandemic influenza.

CDC direct country support through cooperative agreements is established in the following countries:

- Armenia
- Georgia
- Moldova
- Russian Federation
- Ukraine

In addition, CDC supports WHO EURO via a cooperative agreement to provide technical and coordination support to Member States. This cooperative agreement also supports influenza activities in Romania and Kyrgyzstan.

The core activities of these bilateral agreements are:

- To build sustainable national capacity for the detection, identification and response to seasonal, avian and novel influenza.
- To develop interagency pandemic preparedness plans.
- To strengthen capacity for integrated laboratory and epidemiologic surveillance for influenza-like illness (ILI) and severe acute respiratory infections (SARI), which includes making routine contributions to WHO's Global Influenza Surveillance and Response System (GISRS) and implementing International Health Regulations 2005 (IHR).
- To develop and train local rapid response and containment teams.

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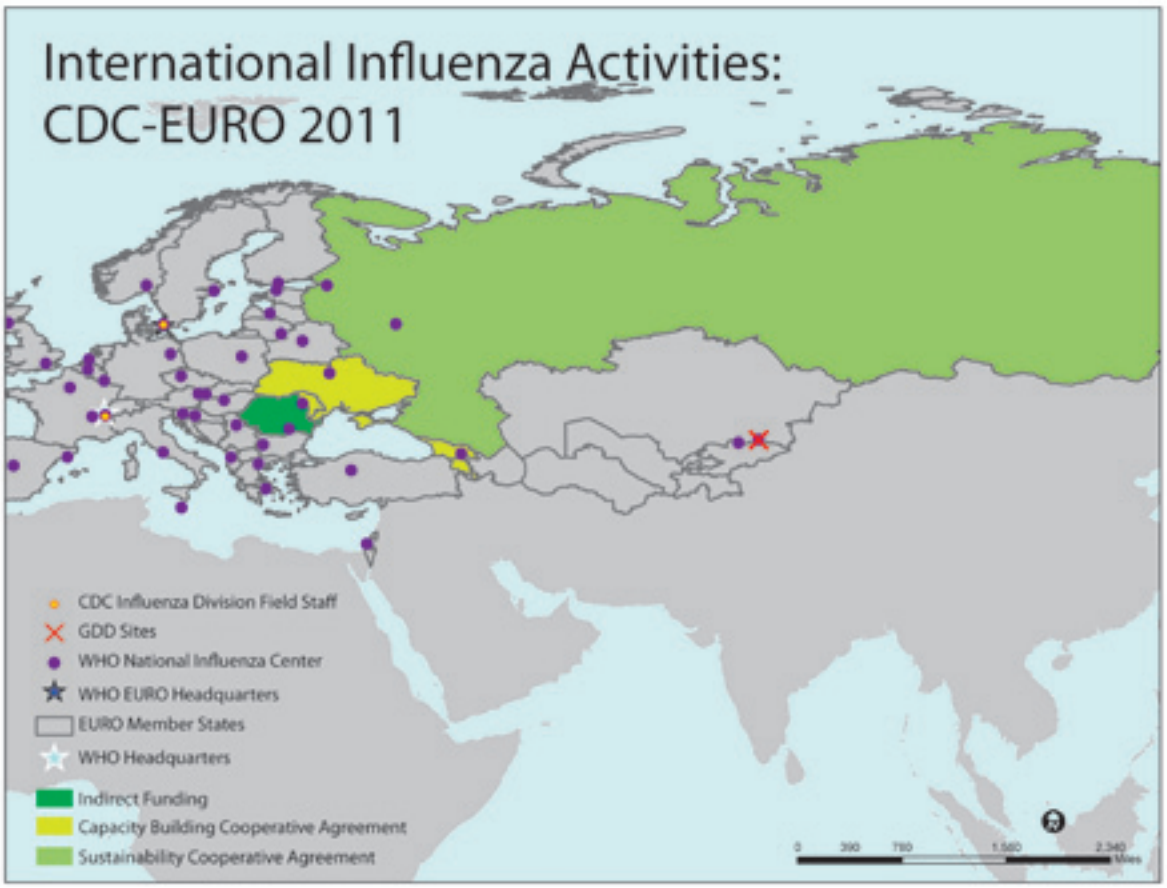
WHO European Regional Office (EURO)



Highlights

- Thirty-two weekly EuroFlu influenza surveillance bulletins were published. On average, 47 out of 53 Member States reported data and sentinel severe acute respiratory infection (SARI) data from 12 countries was included for the first time.
- Updated guidance for sentinel surveillance incorporating lessons learned from the 2009 H1N1 influenza pandemic was published.
- For the first time, pandemic and seasonal influenza vaccine policies were surveyed and used in all 53 Member States.
- The National Influenza Center (NIC) in Malta recognized by the World Health Organization (WHO).
- Published recommendations for best practices in pandemic preparedness, which were identified through evaluation of the 2009 H1N1 influenza pandemic.
- Three peer-reviewed articles were accepted for publication.

U.S. CDC Direct WHO Regional Office Support

The five-year cooperative agreement *Surveillance and Response to Pandemic and Avian Influenza by Regional Offices of the World Health Organization* began in September 2006 and is in its final year. The WHO Regional Office for Europe (EURO) is located in Copenhagen, Denmark. The Office serves 53 Member States that together have a population exceeding 900 million people. Five of the 53 countries receive funding via bilateral cooperative agreements with the U.S. Centers for Disease Control and Prevention (CDC): Armenia, Georgia,

Moldova, Russian Federation and Ukraine. In 2011, WHO EURO staff ran the regional surveillance platform EuroFlu (www.euroflu.org), which is organized in collaboration with the European Centre for Disease Prevention and Control (ECDC). At the annual WHO European Regional Influenza Surveillance Network Meeting, WHO EURO staff provided training and technical assistance to Member States to establish and strengthen sentinel surveillance for influenza (including SARI), supported the sharing of influenza viruses for influenza vaccine development, implemented a first survey on vaccine policies and uptake in the whole region, supported pandemic plan revisions, and developed and disseminated technical guidance.

In 2011–2012, WHO EURO will continue the aforementioned activities and will focus on assisting countries in establishing burden estimates for influenza disease and determining risk factors for severe disease associated with influenza infection. These efforts will support the work of National Immunization Technical Advisory Groups with a view of increasing influenza vaccine uptake in priority groups. At least one NIC will be assessed for recognition by WHO and a training for laboratories from Eastern Europe will be provided to that center. To further enhance the harmonization of surveillance data in the WHO European Region, expert meetings will be held on SARI data and qualitative indicators and missions will be conducted in selected countries with established sentinel SARI surveillance. WHO EURO/ECDC/European Commission pandemic indicators will be revised.

Surveillance

During the first post-pandemic season, the influenza A(H1N1)pdm09 (2009 H1N1) virus was dominant in the Region. Vigilance for disease outbreaks and potential changes to the 2009 H1N1 virus was high. Some countries experienced strains on their critical care services similar to those experienced during the pandemic and persons who developed severe disease had similar risk factors. Surveillance activities in the European Region showed the 2009 H1N1 virus to be virtually unchanged genetically or antigenically compared with strains that were circulating in 2009.

WHO EURO increased its activities related to seasonal influenza vaccine recommendations, policies and use in the Region.

Surveillance Activities

- The EuroFlu bulletin was published weekly including sentinel SARI data from 12 new countries.
- The WHO Regional Office for Europe guidance for sentinel influenza surveillance in humans was updated, incorporating lessons learned from the 2009 pandemic.
- The first regional influenza surveillance network meeting for the 53 Member States was organized jointly with ECDC.
- A report describing the key features of the 2010–2011 influenza season was published.
- For the first time, WHO EURO published recommendations for seasonal influenza vaccine, combining WHO recommendations on influenza virus strains for inclusion in the 2010–2011 vaccine and the current WHO recommendations regarding risk groups to target for vaccination.
- WHO EURO collaborated with the Vaccine European New Integrated Collaboration Effort (VENICE) and ECDC to perform an annual survey on influenza vaccination in EU/EEA Member States and facilitate the start of a regular, standardized collection of information on seasonal influenza vaccination strategies from all WHO EURO Member States. The data collected will allow vaccine uptake to be monitored over time and to assess gaps in provisions.
- Surveys on vaccination policies and uptake of 2009 H1N1 monovalent influenza vaccines were administered among the 53 Member States. The results of both surveys have been presented at international meetings.

Laboratory

Forty of 53 the Member States conducting influenza surveillance currently have NICs recognized by WHO. Through the cooperative agreement, NICs receive training, support to improve laboratory quality, reagents and funds to ship viruses to WHO Collaborating Centers for Reference and Research on Influenza (WHO CC). Best practices in pandemic preparedness have been developed.

Laboratory Activities

- Guidance on how to become a WHO recognized NIC was published.
- The NIC in Malta was formally recognized by WHO, bringing the number of countries in the Region with a WHO-recognized NIC to 40.
- Twenty-two countries sent 40 shipments of viruses to the WHO CC using the global WHO Shipment Fund.
- International Air Transport Association (IATA)-certified training was provided to 36 staff from NICs and WHO Country Offices on the shipment of infectious substances.
- In FY 2011, 59 influenza laboratories in 44 Member States participated in WHO's External Quality Assessment Project (EQAP) for PCR (80% correct).
- Of 22 southeastern and eastern European Member States, 19 laboratories from 16 countries participated in a Regional External Quality Assessment (EQA) for virus isolation compared with 11 laboratories from nine countries in 2008. Also, seven laboratories from five countries participated in a Regional EQA for antiviral susceptibility testing.
- As a follow up to the Regional EQA, NICs from Kazakhstan, Kyrgyzstan, Moldova and Uzbekistan were provided with a practical course on influenza virology isolation in collaboration with the NIC in St. Petersburg, Russia.

Preparedness

During the first post-2009 H1N1 pandemic influenza season, a number of countries experienced severe cases in the same risk groups as during the pandemic; information sharing on clinical management was arranged at the Regional level.

In addition, WHO EURO's efforts focused on the evaluation report of the pandemic response in the Region and on three multi-country workshops which provided an update on countries' pandemic preparedness plans and changes made based on evaluations of the pandemic response.

WHO Europe conducted a separate evaluation of NIC pandemic preparedness.

Preparedness Activities

- In October 2010, WHO EURO convened a workshop to develop recommendations for best practices in pandemic preparedness based on the evaluation conducted in the WHO European Region on the usefulness of pandemic preparedness activities in response to the 2009 pandemic.
- A report describing best practices in pandemic preparedness for NICs was published.
- WHO EURO, in collaboration with ECDC and the Health Protection Agency, United Kingdom, established a platform for critical care clinicians to share, in real-time with other clinicians across the Region, their experiences regarding the clinical management of severe cases associated with influenza A(H1N1)pdm09 infection. This allowed countries that were affected later in the influenza season to prepare their critical care services.

- Between September and November 2011, WHO EURO and ECDC conducted four workshops on pandemic preparedness that included 45 Member States. Twenty-eight Member States have evaluated their pandemic response (12 have been published) and 32 Member States are in the process of revising their national pandemic plans (three have been published). Key changes being made to pandemic plans by Member States and requirements for future pandemic preparedness planning were documented.
- WHO EURO staff participated in the external review of the pandemic response conducted by the IHR (2005) review committee.

Training

WHO EURO, in conjunction with selected Member States, hosted the following regional and inter-country trainings in 2010–2011:

- In collaboration with the NIC in St. Petersburg, Russia, a practical course on influenza virology isolation was conducted.
- IATA-certified training was provided to 36 staff from NICs and WHO Country Offices on the shipment of infectious substances.
- The first regional influenza surveillance network meeting for the 53 Member States was organized jointly with ECDC in June 2011.
- Training for 200 sentinel network clinicians and laboratory specialists was provided in Romania.
- A workshop on best practices in pandemic preparedness was held.

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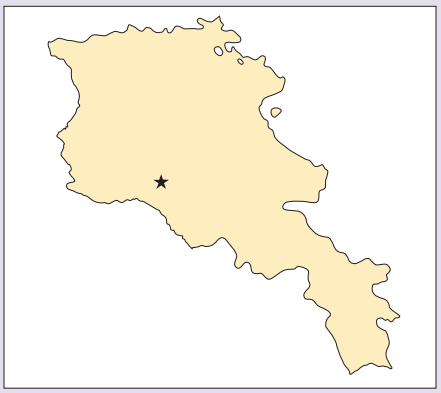
Armenia



- **Capital:** Yerevan
- **Area:** 29,743 sq km
- **Population:** 2,970,495 (July 2012 est.)
- **Age Structure:** 0-14 years: 17.6% (male 279,304/female 242,621); 15-64 years: 72.4% (male 1,006,312/female 1,141,430); 65 years and over: 10.1% (male 112,947/ female 185,361) (2011 est.)
- **Life Expectancy at Birth:** Total population: 73.49 years; male: 69.85 years/female: 77.56 years (2012 est.)
- **Infant Mortality Rate:** Total: 18.21 deaths/1,000 live births; male: 22.63 deaths/1,000 live births; female: 13.28 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 99.4%; male: 99.7%; female: 99.2% (2001 census)
- **GDP:** $17.95 billion (2011 est.)
- **GDP per Capita:** $5,400 (2011 est.)

Highlights

- Developed software for an influenza reporting and recording system based on criteria defined by local experts.
- Conducted an assessment of the influenza sentinel surveillance system with support from the State Hygiene and Anti-Epidemic Inspectorate (SHAEI), PCR laboratories and the U.S. Centers for Disease Control and Prevention (CDC).

U.S. CDC Direct Country Support

Fiscal Year 2011 marks the fifth and last year for Armenia under the cooperative agreement titled *Surveillance and Response to Pandemic and Avian Influenza*. Armenia has attained appropriate laboratory and diagnostic capacity to rapidly detect suspected cases of avian influenza, to run sentinel surveillance of seasonal influenza, and to pilot laboratory testing according to the developed influenza sentinel surveillance scheme, including appropriate specimen sampling and testing methods during the influenza season. Armenia has also enhanced their epidemiological surveillance capacity with a particular focus on avian and human influenza, including strengthening human resources capacity by updating a small operational library/training room with relevant scientific documents, and participating at international/regional conferences, meetings, and workshops.

Surveillance

The sentinel surveillance system in Armenia is integrated into the infectious diseases surveillance system. Influenza-like illness (ILI) sentinel surveillance includes four polyclinics: two in the capitol city of Yerevan, one in the city of Vanadzor in the Northern Province of Lori Marz, and one in the city of Kapan in the Southern Province of Syunik Marz. Severe acute respiratory infection (SARI) sentinel surveillance includes nine hospitals: seven in Yerevan, one in Vanadzor of Lori Marz, and one in Kapan of Syunik Marz.

Each hospital has doctors in key departments designated as surveillance doctors. The sentinel sites include one pediatric hospital (Yerevan), one maternity hospital (Yerevan), two adult hospitals (Yerevan) and five general hospitals (Yerevan, Vanadzor and Kapan). The selected sentinel sites provide a representative sample of age groups, gender, ethnicity, socio-economic status and risk factors/medical conditions for the region. Protocols, ILI and SARI forms, specimen collection supplies, and training were provided by the Ministry of Health (MOH)/SHAEI staff to all sites.

Surveillance Activities

- Supervision was established for each sentinel site.
- Internet connectivity was established for all sentinel sites, stakeholders, and sanitary-quarantine border posts.
- Subscriptions to relevant periodicals and scientific magazines were maintained for the library/ training room at SHAEI.

Laboratory

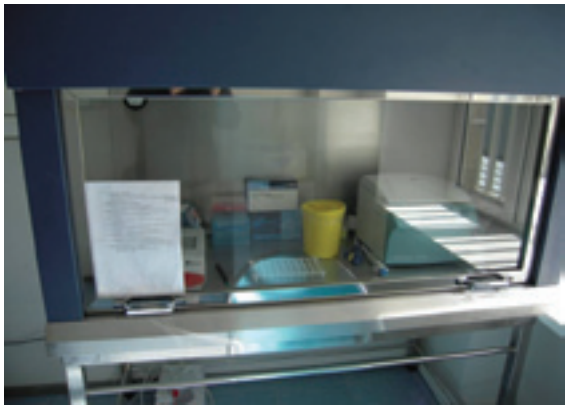
The Yerevan PCR laboratory and Lori Marz PCR laboratories have been an active part of the influenza sentinel surveillance system. Although the Syunik Marz laboratory is not completely functional, the site has begun to operate by collecting samples and sending them to the Yerevan virological laboratory for testing. Data is being uploaded to the EuroFlu site regularly.

Laboratory Activities

- Tested 352 influenza specimens from nine hospitals and seven polyclinics.
- Procured laboratory reagents and supplies.

Training

- Fifteen data specialists were trained to work with the influenza reporting and recording database software.



Biosafety cabinet for PCR set-up at a hospital laboratory in Vanadzor, Armenia which serves as an influenza sentinel site.

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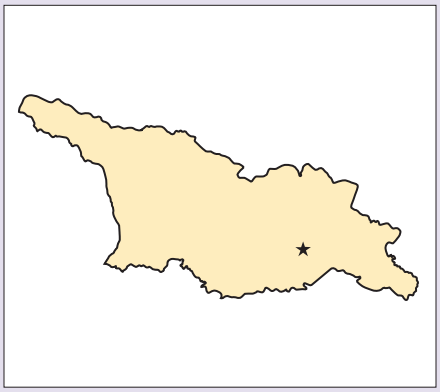
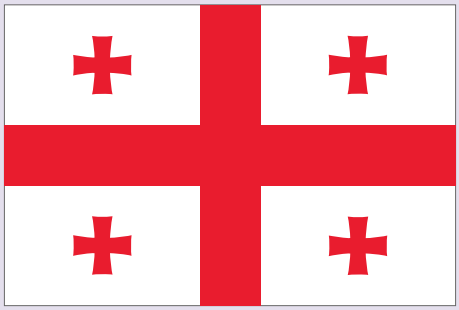
A modern church in Yerevan.

Republic of Georgia





- **Capital:** Tbilisi
- **Area:** 69,700 sq km
- **Population:** 4,570,934 (July 2012 est.)
- **Age Structure:** 0-14 years: 15.6% (male 383,856/female 333,617); 15-64 years: 68.3% (male 1,511,844/female 1,620,727); 65 years and over: 16% (male 293,143/female 442,687) (2011 est.)
- **Life Expectancy at Birth:** Total population: 77.32 years; male: 73.99 years; female: 81 years (2012 est.)
- **Infant Mortality Rate:** Total: 14.68 deaths/1,000 live births; male: 16.58 deaths/1,000 live births; female: 12.59 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 100%; male: 100%; female: 100% (2004 est.)
- **GDP:** $24.51 billion (2011 est.)
- **GDP per Capita:** $5,400 (2011 est.)

U.S. CDC Direct Country Support

Fiscal Year 2011 is the fifth year of the U.S. Centers for Disease Control and Prevention (CDC) cooperative agreement with the National Center for Disease Control and Public Health of Georgia (NCDC Georgia). The agreement is titled *Surveillance and Response to Avian and Pandemic Influenza by National Health Authorities outside the United States.*

The purpose of the award was to improve laboratory, epidemiologic and preparedness capacity for surveillance and response to avian and pandemic influenza. Major goals of the cooperative agreement included: 1) improving laboratory capacity and infrastructure for virologic surveillance of influenza; 2) enhancing epidemiologic capacity and infrastructure for disease surveillance; 3) developing and establishing sentinel, laboratory-based surveillance; and 4) developing, training, and testing local rapid response and containment teams.

The following significant achievements have been made since the cooperative agreement began:

- The National Influenza Lab (NIL) at NCDC Georgia was recognized by the World Health Organization (WHO) as a National Influenza Center (NIC) in 2007.
- An influenza sentinel surveillance system has been established throughout the country.
- Quality assurance measures have been developed and implemented in the laboratory and at the surveillance sites.
- The influenza surveillance system has been enhanced by conducting annual rounds of surveillance system monitoring and trainings of epidemiologists and clinicians in influenza epidemiology and surveillance.

Surveillance

All activities conducted from FY 2006 to FY 2010 became a platform for the fifth budget period of the project. During FY 2011, all objectives were focused on strengthening already established systems and structures.

Before 2011, Georgia had non-sentinel sites (mostly for laboratory surveillance) in high-risk areas and one large sentinel site in Tbilisi at the largest outpatient clinic. Since 2011, two additional sentinel sites for severe acute respiratory infection (SARI) cases have been established.

In the fifth budget period, multiple rounds of visits by monitoring teams were reduced to one visit to all districts of Georgia. During the visits, National Monitoring Teams monitored the completion of reporting, notification and registration forms. They also assessed the progress made as a result of the on-the-job trainings held during previous monitoring activities. The assessment was performed using questionnaires developed during the previous budget periods.

A demonstration of personal protective equipment (PPE) use, Georgia.

Surveillance Activities

- Sentinel sites received data and routine surveillance was monitored by the Project Management Unit. The sentinel surveillance system precisely reflected trends reported by the national routine surveillance system.
- NCDC staff monitored 75 health care facilities in ten regions to reveal gaps and challenges in the influenza surveillance system. Results of the previous surveillance system monitoring showed that on-the-job training and monitoring were useful and effective; reporting from districts has been improved.
- Circulation of seasonal influenza viruses [influenza A (H1N1) and influenza B] were detected during the 2010–2011 influenza season in Georgia.
- Data received from sentinel and laboratory surveillance were entered into EuroFlu on a weekly basis.
- Sentinel and non-sentinel sites were provided with all necessary equipment and supplies, including liquid nitrogen, for adequate storage and transportation of collected specimens. A project vehicle transported specimens from sentinel sites to NCDC.
- The NCDC rapid response team (RRT), which was established in 2008, was active during the pandemic as well as the post-pandemic influenza season, which was more severe than the pandemic.

- The abstract "Epidemiological characteristics of laboratory confirmed fatal influenza cases during the 2009–2010 and 2010–2011 influenza seasons in Georgia" was prepared using sentinel surveillance data. The abstract was submitted and accepted for the Fourth European Influenza Conference held in Malta on September 11–14, 2011.

Laboratory

The NIL was established at NCDC in 2006. Laboratory capacity was strengthened as a result of staff training on RT-PCR testing, virus isolation and hemagglutination inhibition, and the procurement of essential equipment and supplies. Since the 2009 H1N1 pandemic, all specimens are tested by RT-PCR.

Laboratory Activities

- A total of 3,210 specimens were tested for influenza at NIL from October 2010 to October 2011. Among them 2,067 specimens collected from SARI cases and 1,143 from influenza-like illness (ILI) cases; from SARI specimens 409 samples were found to be positive for 2009 H1N1, 506 were positive for influenza B and 19 for non-subtyped influenza A.
- Twenty samples from the specimens collected during 2010–2011 flu season were sent to the WHO Collaborating Center in London for virus isolation, sequencing and resistance screening.
- Two lead specialists from the NIC were trained on influenza antiviral susceptibility at the National Institute of Public Health and Environment, Netherlands. It is proposed that in FY 2012 the method will be established at the NIC.
- The capacity for influenza surveillance at the NIL was enhanced with the implementation of gene sequencing.

Preparedness

A national preparedness plan was developed in 2006 and approved by the Ministry of Health (MOH) in 2009. This plan was activated during the pandemic with great success. In FY 2011, some parts of the plan were updated and a new version should be approved next year.

Preparedness Activities

- The influenza surveillance guidelines were updated in FY 2011.
- Some large hospitals in high-risk areas that do not participate in sentinel surveillance were provided with influenza rapid tests for the diagnosis of SARI cases.

Training

Georgia hosted the following training activities in 2010:

- During monitoring visits to sentinel surveillance sites, on-site surveillance training was conducted for epidemiologists responsible for risk-assessment, registration and reporting in order to improve their skills and strengthen the system.

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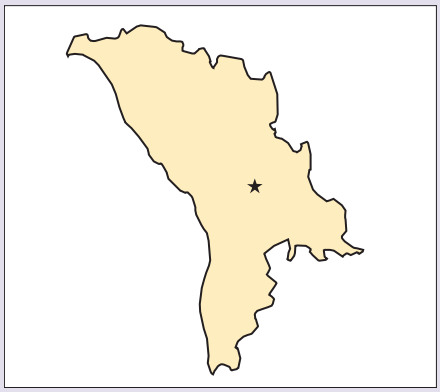

- **Capital:** Chisinau (Kishinev)
- **Area:** 33,851 sq km
- **Population:** 3,656,843 (July 2012 est.)
- **Age Structure:** 0-14 years: 15.5% (male 344,101/female 325,995); 15-64 years: 74% (male 1,550,386/female 1,643,108); 65 years and over: 10.4% (male 164,512/ female 286,275) (2011 est.)
- **Life Expectancy at Birth:** Total population: 69.51 years; male: 65.64 years; female: 73.63 years (2012 est.)
- **Infant Mortality Rate:** Total: 13.65 deaths/1,000 live births; male: 15.59 deaths/1,000 live births; female: 11.58 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 99.1%; male: 99.7%; female: 98.6% (2005 est.)
- **GDP:** $11.93 billion (2011 est.)
- **GDP per Capita:** $3,400 (2011 est.)

U.S. CDC Direct Country Support

The cooperative agreement *Enhancing Pandemic Preparedness and Response Capacity in the Republic of Moldova* began in August 2009. FY 2011 was the third year of funding through the agreement. The Moldovan Ministry of Health (MOH)/National Centre of Public Health (NCPH) is working with the U.S. Centers for Disease Control and Prevention (CDC) under this agreement to strengthen human and infrastructure capacities for pandemic preparedness, influenza surveillance, monitoring and early response, communication and infection control.

Cooperative agreement activities were implemented by national counterparts from the ministries of agriculture, information, education, internal affairs, and trade and tourism, in close collaboration with the World Health Organization (WHO) Regional and Country Offices and other international partners.

Surveillance

In 2006, Moldova implemented hospital-based surveillance in nine sentinel sites, where data was collected on acute respiratory infection (ARI), influenza-like illness (ILI), and severe acute respiratory infection (SARI). National counterparts began to update the documents for implementing the integration of laboratory-based surveillance in accordance with recommendations made by CDC and WHO experts on a site visit. The MOH started laboratory-based surveillance at five sites in 2011. The doctors swab ARI, ILI and SARI cases following a case definition and sampling algorithm. Each sentinel site reports data to the National Viral Laboratory (NVL), which publishes regular surveillance reports regarding epidemiologic and laboratory data and reports weekly information through WHO's EuroFlu network.

Surveillance Activities

- Guidelines for data collection (ARI, ILI, and SARI) in the national influenza surveillance networks were adapted to international case definitions, following WHO requirements and CDC recommendations.
- Guidelines for sample collection, storage and shipment from sentinel sites to the NVL were developed.
- A MOH order for implementing laboratory-based sentinel site surveillance was approved.
- Five sites participated in integrating hospital and laboratory-based surveillance.
- Epidemiology, Laboratory, and Network Coordinators from NCPH made supervisory visits to influenza sentinel sites.
- The MOH National Focal Point of International Health Regulations 2005 (IHR) has provided the notification of new influenza cases and deaths to the WHO Focal Point.

Laboratory

The NVL was renovated for BSL-2 and BSL-2+ capabilities with the financial support of a World Bank project. The laboratory was fitted with new equipment to support these levels of influenza testing. Experts from CDC and WHO assessed laboratory capacity, provided recommendations for improvement, and provided assistance to national counterparts in the NVL in their efforts to become a National Influenza Center (NIC). The NVL uses molecular diagnostics (i.e. PCR), virus isolation and antigenic characterization techniques.

The NVL performs confirmatory ARI, ILI and SARI testing on suspected cases and provides support for training in specimen collection and quality control.

Laboratory Activities

- Developed standard operating procedures (SOP) for the shipment of specimens from sentinel sites to the NVL.
- Procured consumables and reagents for laboratory diagnosis of influenza.
- Purchased hardware for the reporting of results from the influenza laboratory network at the national level to WHO and other international partners.
- Tested 482 influenza specimens from sentinel and outbreak sites. A total of 266 samples tested positive, including 154 for 2009 H1N1, 41 for influenza A (H3N2), and 71 for influenza B.
- Submitted a total of 65 positive clinical samples which were confirmed by the WHO Collaborating Center in London as part of WHO Global Influenza Surveillance and Response System (GISRS). The WHO Shipment Fund Project covered in transportation costs.
- Participated in the WHO External Quality Assessment Project (EQAP) for the detection of influenza virus subtypes A and B.
- Conducted supervisory visits and provided logistical support to sentinel sites in the influenza surveillance network.

Preparedness

The 2009 H1N1 influenza pandemic revealed challenges and gaps in the *National Pandemic Preparedness Plan (NPPP)* in 2009. Intersectoral interaction, coordination and communication proved to be weaker than expected, and public and private sector organizations and essential services providers were not sufficiently engaged in pandemic preparedness and response. A NPPP working group updated the plan to ensure a high-level political commitment and involvement by the whole of society.

Pandemic Preparedness Self-Assessment Indicators were developed and tested in collaboration with ECDC and WHO partners.

Preparedness Activities

- An intersectoral working group was established to review and update the NPPP.
- The existing legal framework for pandemic preparedness and sentinel surveillance was adjusted based on the recommendations of the NPPP working group and international experts: 1) case definition guidelines and clinical management protocols were elaborated; 2) a set of documents related to preventive measures was issued; and 3) documents for implementing laboratory-based sentinel surveillance were approved.
- The MOH held a successful series of national planning exercises.
- Assessed national capabilities for pandemic preparedness and response together with ECDC and WHO using monitoring and evaluation tools to optimize planning.

Training

Moldova hosted the following training activities:

- A workshop on influenza surveillance and pandemic response, and collection and analysis of ARI, ILI and SARI data from the sentinel sites was held for 150 people.
- A series of training courses on strengthening the informational system for epidemiological alert and sentinel-based surveillance was held for 240 participants.
- Sixty participants attended regional seminars for sentinel sites with discussion on the following topics:
    - Improvement of the biosafety sample collection and shipment to the NVL.
    - Improvement of the process of information collection for ARI, ILI, and SARI based on a standard case definition.
    - Strengthening the reporting system of ARI, ILI, and SARI by improving the process of preparing and providing regular weekly reports at the national and international levels.
    - Improvements of the storage condition of original clinical materials to ensure cold chain condition was mentioned for epidemiologists, laboratory staffs, and clinicians.

Publications

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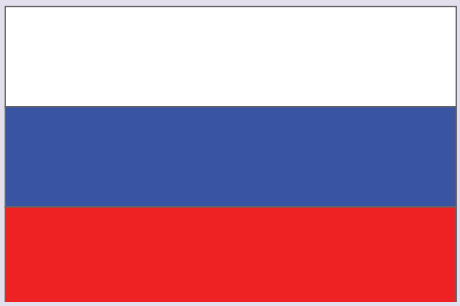
Russian Federation



- **Capital:** Moscow
- **Area:** 17,098,242 sq km
- **Population:** 138,082,178 (July 2012 est.)
- **Age Structure:** 0-14 years: 15.2% (male 10,818,203/female 10,256,611); 15-64 years: 71.8% (male 47,480,851/female 52,113,279); 65 years and over: 13% (male 5,456,639/female 12,614,309) (2011 est.)
- **Life Expectancy at Birth:** Total population: 66.46 years; male: 60.11 years; female: 73.18 years (2012 est.)
- **Infant Mortality Rate:** Total: 9.88 deaths/1,000 live births; male: 11.36 deaths/1,000 live births; female: 8.3 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 99.4%; male: 99.7%; female: 99.2% (2002 census)
- **GDP:** $1.85 trillion (2011 est.)
- **GDP per Capita:** $17,000 (2011 est.)

Highlights

- Organized sentinel surveillance for severe acute respiratory infection (SARI) in 18 hospitals.
- Implemented real-time RT-PCR in 45 regional base laboratories (RBL) for influenza surveillance.
- Recognized the Research Institute of Influenza (RII) as a World Health Organization (WHO) National Influenza Center (NIC).

U.S. CDC Direct Country Support

The cooperative agreement *Sustaining and Enhancement of Influenza Surveillance and Response* was awarded to the Russian Federation in September 2011. This agreement aims to enhance the level of preparedness and response to annual influenza epidemics and future pandemics.

Influenza activity during the 2010–2011 season was high and associated mainly with influenza A(H1N1) pdm and influenza B viruses. The group most affected was children. Sentinel surveillance data determined that patients with chronic cardiovascular and lung diseases, asthma and healthy, pregnant women should be priority groups for vaccination.

The U.S. Centers for Disease Control and Prevention (CDC) provided support by analyzing and presenting findings on conclusive antigenic analysis of influenza strains isolated in Russia.

Surveillance

Influenza activity is supported through collaboration with 49 regional base laboratories (RBL) which send weekly data to the NIC on acute respiratory infections (ARI), influenza-like illness (ILI) morbidity, hospitalization and death cases. Laboratory information including virus isolation, indirect immunofluorescence assays (IFA) and RT-PCR data resulting from investigation of identified patients are

also required. Isolates are sent to the NIC for antigenic and genetic investigation. As a result of integration of epidemiological and laboratory data, and comparison of intensity of morbidity with epidemic thresholds and baselines, an epidemic's beginning and ending can be determined in each region.

Surveillance Activities

- Conducted supervisory visits to sentinel sites and RBLs in Kaliningrad and St. Petersburg.
- Implemented the WHO European Regional Office (EURO) requirements and CDC recommended surveillance standards.
- Established internet connectivity between the NIC and 49 RBLs at the Federal Center for Hygiene and Epidemiology.

Laboratory

The Russian NIC at RII has worked closely with CDC to establish state-of-the-art laboratories. Virologists and epidemiologists from NIC laboratories participated in training courses with scientists from CDC and RII on typing, subtyping, PCR, real-time PCR and reverse genetics techniques. Notable progress in laboratory surveillance capacity has been achieved over the past five years, and the success of this partnership has led to significant enhancements benefiting both Russia and the Global Influenza Surveillance and Response System (GISRS). The Russian influenza surveillance network now includes 59 laboratories throughout Russia which are working in collaboration with two NICs—one in St. Petersburg and one in Moscow.

Laboratory Activities

- Tested 9,565 specimens for influenza virus isolation (580 were positive for influenza).
- Tested by rRT-PCR a total of 49,934 specimens (12,224 of them were positive for influenza).
- Submitted 26 influenza viruses in a lyophilized condition to the WHO Collaborating Center (CC) in Atlanta and another 26 influenza viruses to the WHO CC in London as part of WHO's GISRS.
- Conducted two supervisory visits and provided consultative support to laboratories in the network.

Preparedness

CDC support, through WHO, has considerably advanced the pandemic influenza preparedness pandemic plan which could be used as a model for updating pandemic plans in other countries adjusting specific state resources and possibilities. An analysis of the previously implemented pandemic preparedness plan was conducted at RII.

Preparedness Activities

- Included new suggestions in the State pandemic plan and regional pandemic plans are currently under development.

Training

The NIC at RII continues to provide technical assistance and training to ensure the functionality of the sentinel surveillance system (SS) in Russia and Commonwealth of Independent States (CIS) countries. The following trainings were organized:

- Training of virologists from nine sentinel RBLs in influenza virus isolation and identification at the NIC.
- Training of nine epidemiologists from sentinel RBLs in operation sequences to input sentinel surveillance data into the automated computer database at RII via the internet.

- Training of 18 workers from nine sentinel RBLs on completing the new SS forms. Six NIC scientists provided lectures during this seminar.
- Training of epidemiologists and virologists from six CIS countries in influenza virus isolation and identification at the NIC: "Strengthening Capacities of Influenza Laboratory Experts: WHO Practical Course on Influenza Virology" in Saint Petersburg, the Russian Federation, May 16–20, 2011.

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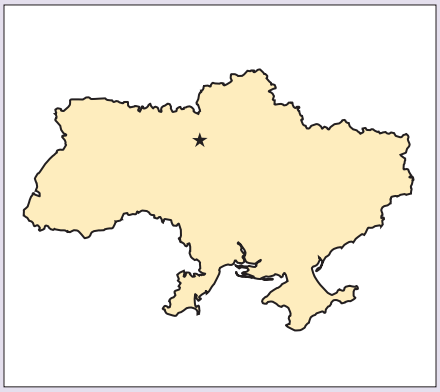
Ukraine



- **Capital:** Kyiv (Kiev)
- **Area:** 603,550 sq km
- **Population:** 44,854,065 (July 2012 est.)
- **Age Structure:** 0-14 years: 13.7% (male 3,186,606/female 3,014,069); 15-64 years: 70.8% (male 15,282,749/female 16,673,641); 65 years and over: 15.5% (male 2,294,777/female 4,682,865) (2011 est.)
- **Life Expectancy at Birth:** Total population: 68.74 years; male: 63.07 years; female: 74.77 years (2012 est.)
- **Infant Mortality Rate:** Total: 8.38 deaths/1,000 live births; male: 10.5 deaths/1,000 live births; female: 6.12 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 99.4%; male: 99.7%; female: 99.2% (2001 census)
- **GDP:** $329 billion (2011 est.)
- **GDP per Capita:** $7,200 (2011 est.)

Highlights

- The sentinel severe acute respiratory infections (SARI) and influenza-like illness (ILI) surveillance system is fully operational in all sites.
- International review of influenza diagnostic capacity at the Ukraine National Influenza Center (NIC) has demonstrated extensive improvements in laboratory facilities, staffing, equipment, quality assurance, biosafety and surveillance, and has identified areas for further assistance.
- Technical support provided by the Program for Appropriate Technology in Health (PATH) has been phased out.
- The Government of Ukraine has assumed responsibility for the continued operation of the system.

U.S. CDC Direct Country Support

Fiscal Year 2011 was the fifth year of the cooperative agreement *Influenza Surveillance and Pandemic Preparedness in Ukraine*. The U.S. Centers for Disease Control and Prevention (CDC) provided funds to PATH to assist the Ukraine Ministry of Health (MOH) in its efforts to strengthen influenza surveillance and pandemic preparedness.

Activities have been focused in the following areas:

- Improving the quality to ensure gold-standard functioning of sentinel SARI and ILI surveillance in the four sentinel sites.

- Maintaining the ability of the country's influenza laboratory system and the NIC in Kiev to confirm influenza diagnosis and rapidly determine if a suspected human case is caused by influenza A(H1N1)pdm09 (2009 H1N1) or another strain of influenza, and directly report suspected cases of novel influenza in humans to WHO Collaborating Centers (CC) in a timely manner, as mandated by the current International Health Regulations 2005 (IHR).
- Supporting the country influenza preparedness and response efforts focusing on analysis of lessons learned during the 2009 H1N1 pandemic, refining local preparedness plans, and training Sanitary Epidemiological Service (SES) personnel and clinicians throughout the country in proper communication, advocacy for immunization, outbreak investigation and response.
- Designing a comprehensive, phased transition plan that ensures that key reforms and interventions supported by CDC are carried forward through local leadership.

Surveillance

The MOH and PATH have established a fully functioning sentinel influenza surveillance system in Kiev, Odessa, Dnepropetrovsk and Khmelnitsky and developed a website to support electronic reporting, data analysis and presentation of the system. The sentinel surveillance network includes 18 hospitals and polyclinics. Data findings suggest that in the 2010–2011 season, 16% of ILI and 35% of SARI cases were caused by influenza; influenza A (H1N1) and influenza B were responsible for 99% of the confirmed cases. Information on seasonal and pandemic influenza is routinely submitted to EuroFlu.

Surveillance Activities

- Reporting timeliness and data quality were improved at all sites.
- The NIC and MOH updated the national guidelines for sentinel surveillance in partnership with WHO and CDC.
- Ownership of the ukinfluenza.com.ua domain was transferred to the NIC.
- New features and analyses have been added to the electronic data system.
- The surveillance system was evaluated to identify the areas for priority attention for the next cooperative agreement. They include national influenza control policy revision, further optimization of the influenza surveillance system to reduce operating cost, developing mechanisms for long-term viability of the surveillance system and plans to phase out U.S. government funding and sustain the system using national funds.

Laboratory

Funding from the partnership between CDC, PATH and the Ukraine MOH continued to support the NIC in Kiev and four regional virologic laboratories in the sentinel sites with equipment, reagents, consumables and other items to maintain optimal functionality of the laboratories. These laboratories can perform PCR and virus isolation using cell culture. Samples from Ukraine are routinely submitted to the WHO CC in Atlanta and the WHO CC in London.

An international assessment of influenza diagnostic testing capacity at the NIC, Academy of Medical Sciences, in Kiev, Ukraine has been carried out. Objectives included updating information and documenting progress on laboratory capacity with assistance of NIC staff, making recommendations for improvement, assisting with procuring necessary reagents and supplies, and providing technical assistance with the overarching aim of identifying areas that can be enhanced and supported by CDC and other stakeholders to improve influenza laboratory testing capacity at the NIC in Kiev during the next five years.

Laboratory Activities

- Trained sentinel site virologists in influenza virus isolation and identification and real-time PCR investigation.
- Tested 2,487 SARI and ILI cases in the sentinel sites during the 2010–2011 season: 24% were influenza positive. A total of 348 (58%) tested positive for influenza B, 233 (38%) tested positive for A/H1N1, 7 (1%) for A/H3, and in 16 cases (3%) influenza virus subtype was not identified.
- Demonstrated extensive improvements in laboratory facilities, staffing, equipment, quality assurance, biosafety and surveillance during an international review of influenza diagnostic capacity at the Ukraine NIC.
- Continued support of labs with equipment and consumables.
- Continued participation in the WHO Global Influenza Surveillance and Response System (GISRS).

Preparedness

The partnership on pandemic preparedness between the Ukraine MOH, PATH, CDC and WHO has resulted in the development of the national guidelines for health services of Ukraine that outline planning and organization measures to combat pandemic influenza. The document provides guidance on principles of planning, key capabilities needed for response, stakeholder role and responsibilities, MOH actions by pandemic phase, recommendations for pandemic vaccination, antiviral drug distribution and use, influenza control and prevention in the community, public health communications, clinical management of suspected and confirmed cases, health care planning, infection control, pandemic influenza surveillance, collecting/storing/transporting specimens for influenza diagnostics, hospital preparedness, business preparedness, management of mass fatalities, etc. It included all major WHO recommendations for pandemic preparedness available at the time.

Preparedness Activities

Project regions developed their own plans tailored to the local specifics and local budgets. Measures taken by one of the project sites (Kiev city) at the end of 2010 based on the preparedness training are listed below:

- Updated the city plan.
- Refined communication channels.
- Created a small stockpile of antivirals.
- Increased the reserve of antibiotics.
- Purchased additional influenza prevention supplies.
- Updated information for the city influenza hotline.
- Trained the city physicians.
- Developed a list of specialists responsible for communication with the media.
- Arranged for rapid mobilization of students in case of emergency with the National Medical University and nursing schools in the city.
- Ensured additional financing as necessary through the city's fund for epidemiological emergencies.

The L.V. Gromachevskyi Institute of Epidemiology and Infectious Diseases in Kiev is part of the Academy for Medical Sciences of Ukraine and houses the country's National Influenza Center.

- Lobbied the Deputy Minister of Health to update the legal documentation needed to support pandemic response activities.

Training

The NIC and PATH continued providing technical assistance and training to ensure the functioning of the sentinel surveillance system, quality of the surveillance data, prompt data analysis and integration of the information into preparedness and response activities.

During FY 2011, the following trainings were organized in Ukraine:

- Four training workshops for 120 health staff involved in sentinel surveillance work in all four sites.
- Two pandemic preparedness exercises for members of regional committees.
- Four regional SES virologists were trained in influenza virus isolation and identification at the NIC.
- Representatives of the NIC and PATH also participated in the CDC and WHO influenza surveillance and influenza burden of disease meeting in Ljubljana, Slovenia.

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WHO Region of the Americas (AMR)

WHO Region of the Americas (AMR) Overview

As of FY 2011, there are four bilateral influenza cooperative agreements in the Region of the Americas. These agreements with ministries of health (MOH) or institutions designated by the MOHs work with the Pan American Health Organization (PAHO)/the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC) to build capacity to routinely identify and respond to seasonal and novel influenza strains across the Americas.

CDC direct country support via cooperative agreements is established in the following countries:

- Brazil
- Mexico
- Paraguay
- Peru

In addition, CDC supports PAHO via a cooperative agreement. CDC also supports activities with the Center for Central America and Panama Program (CDC-CAP) at CDC's, Global Disease Detection (GDD) site in Guatemala. These activities support programs in eight Central American/Caribbean countries including Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, and the Dominican Republic.

The core activities of our bilateral agreements and technical assistance are:

- To build sustainable national capacity to identify and respond to seasonal influenza, pandemic influenza and other emerging diseases in accordance with International Health Regulations 2005 (IHR).
- To make routine contributions of surveillance and virology data to WHO's Global Influenza Surveillance and Response System (GISRS).
- To increase the geographic reach of WHO GISRS.
- To provide earlier access to critical virus isolates from humans and birds for WHO GISRS.
- To increase the numbers of shipments and influenza isolates provided by local influenza labs for analysis by WHO Collaborating Centers (CC).
- To develop sustainable epidemiologic and virologic surveillance systems for severe influenza in order to gain understanding of the disease and economic burden caused by influenza and other respiratory viruses.
- To develop and sustain interagency national preparedness plans.
- To develop and train local rapid response and containment teams.
- To sustain and leverage quality sentinel surveillance and study cohorts to explore the potential cost-effectiveness of expanding vaccination and incorporating new delivery mechanisms, formulations, and novel influenza vaccines in the PAHO Region.

In addition to our bilateral work, we also partner with the U.S. Naval Medical Research Unit No. 6 (NAMRU-6) in Lima, Peru to jointly support South American countries that are starting influenza surveillance.

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Pan American Health Organization (PAHO)

Highlights

- The *PAHO Nationwide Enhanced SARI Surveillance Protocol* was developed.
- PAHO is working with an information technology specialist who has developed a web-based data entry and analysis system that generates automated outputs of integrated laboratory and clinical data. This system is being scaled-up for replication initially in at least two other Member States.
- PAHO missions to Bolivia, Dominican Republic, Ecuador, Guatemala, and Nicaragua were carried out to provide technical assistance on appropriate practices for infection prevention and control of pandemic influenza in health care centers and on clinical management of severe and critically ill cases. During the missions, PAHO provided training on infection prevention and control practices, including the correct use of the personal protective equipment (PPE) for health care workers.
- Questionnaires were developed to assess the risks to health care personnel and piloted in Mexico.

- Guidelines on epidemiological surveillance of health care associated infections, specifically ventilator-associated pneumonia were developed and reviewed by regional experts. Implementation of the guidelines will follow training courses in El Salvador, Paraguay, Trinidad and Tobago, and Uruguay. Chile, Colombia, and the Dominican Republic are interested in utilizing the guidelines as well.

- Central to all the post-pandemic evaluations is the need to include and support risk communication as a public health tool. Countries are evaluating the results of studies assessing perceptions to create messages to reach targeted audiences. Countries also expanded training to address all public health emergencies.

- PAHO tested a pilot risk communication International Health Regulations 2005 (IHR) simulation during a three-day workshop and published all PAHO training materials in risk communication on an online site at www.paho.org/riskcomm.

U.S. CDC Direct WHO Regional Office Support

Technical cooperation activities initially centered on influenza and pandemic influenza preparedness through the strengthening of three pillars; preparedness and communication, surveillance and detection, and response and containment. Post influenza pandemic, several key issues were identified which translated into important lessons learned.

First, the varied capacity of countries to detect unusual health events was noted. Second, the collapse during the pandemic of established sentinel surveillance systems to monitor influenza-like illness (ILI) and severe acute respiratory infection (SARI) due in large part to the overwhelming demand for clinical services and a lack of integration of these sentinel surveillance activities within the health care services sector. Third, public health laboratories, which had been trained and equipped to diagnose influenza with multiple diagnostic techniques, were also overwhelmed, due in large part to the fact that they were not being used for surveillance purposes, but rather for clinical diagnostic purposes. These lessons learned refocused PAHO's technical cooperation with the U.S. Centers for Disease Control and Prevention's (CDC) support to strengthen national SARI surveillance, integration between epidemiologic and virologic data, and obtain a better understanding of the mortality due to influenza during the pandemic.

Surveillance

During the 2009 influenza pandemic the surveillance of severe respiratory disease cases became increasingly important. This was because these cases in a hospital setting, are easier to capture, are smaller in number than the milder ambulatory cases, and during a pandemic, information about severe cases is of paramount importance for making decisions about response. The first step taken was to draft guidelines based upon the *PAHO-CDC Generic Protocol for Influenza Surveillance (GPIS),* but focused on strengthening SARI surveillance. Next, the tasks of sensitizing the countries and implementing the protocol proved to be relatively easy, as countries had identified this lack of data on severe cases to be important and were eager to improve their SARI surveillance. In 2010, this protocol was implemented in selected Caribbean countries, through technical cooperation with the Caribbean Epidemiology Centre (CAREC) and also in the Southern Cone in Uruguay and implementation was ongoing in Chile, Honduras, and Paraguay in 2011. Additionally, in 2011, Colombia, Ecuador, and Peru developed work plans to establish this surveillance and several other countries are considering adopting the strategy as well.

Surveillance Activities

- A specific protocol, the *PAHO Nationwide Enhanced SARI Surveillance Protocol*, which further develops the concepts and importance of SARI surveillance, was developed.

- SARI surveillance was established in six hospitals in Paraguay, which are providing weekly clinical and laboratory data to PAHO.

- SARI surveillance was established in the national hospital in Barbados, Dominica, Jamaica, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago and weekly laboratory and clinical data are being provided to the CAREC/PAHO.

- SARI surveillance was established in all hospitals in Uruguay with an intensive care unit and 80% of the remaining hospitals and real-time linked clinical and virologic information is available online (https://trantor.msp.gub.uy/epidemiologia/servlet/iraggrafmenu).

Laboratory

Considering the challenges faced during the pandemic, technical cooperation was directed to improve the capacity in the laboratory to process specimens for real-time RT-PCR, through the purchase of automated extractors and vacuum extractors. PAHO has continued to support the strengthening of laboratory capacity for the diagnosis of influenza and other respiratory viruses, including through the limited decentralization of real-time RT-PCR for influenza, through refresher courses for real-time RT-PCR and immunofluorescence, and through participation in the WHO External Quality Assessment Project (EQAP). Through these activities, PAHO continues to strengthen the regional laboratory network, which now consists of 23 National Influenza Centers (NIC) in Latin America and the Caribbean.

Laboratory Activities

- PAHO has been working with the regional laboratories to strengthen the diagnostic capabilities for influenza and other respiratory viruses, through the provision of supplies, equipment purchases, and training. Based on lessons learned during the 2009 pandemic, post-pandemic efforts have focused on the decentralization of real-time RT-PCR and immunofluorescence as well as automation of the extraction process for real-time RT-PCR.

Preparedness

PAHO has updated their emergency operation center (EOC) in Washington D.C. to coordinate activities and deploy rapid response teams (RRT) in the Region. As the point of contact, PAHO serves as a key communication link between the Ministry of Health (MOH) and technical assistance. PAHO continues to help all countries in creating situation rooms and EOCs to centralize data and coordinate preparedness activities.

Preparedness Activities

- PAHO is working with Peru to carry out a national and subnational evaluation of their core capacities for surveillance and response to public health emergencies under the IHR (2005) framework. Pandemic influenza will be used as the context for the evaluation and action plans for addressing the identified gaps will be a product of this meeting. This evaluation will continue to take place in other countries in South America.

Training

- PAHO developed a two and a half day training course, in conjunction with the University of North Carolina at Chapel Hill to train laboratorians about influenza data analysis and dissemination. More than 45 persons were trained, representing all four subregions. The course is currently available online in both English and Spanish at http://cphp.sph.unc.edu/paho/precurso.html.

- PAHO in conjunction with the Universidade de Norte in Colombia designed a one-day course to create tools to capture and sustain the work that has been done at the country level in risk communication to create a certificate program on the Virtual Campus for participants throughout Latin America. We also developed a field guide to capture the steps and lessons learned. Both products await English translation.

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Brazil

- **Capital:** Brasilia
- **Area:** 8,514,877 sq km
- **Population:** 205,716,890 (July 2012 est.)
- **Age Structure:** 0-14 years: 26.2% (male 27,219,651/female 26,180,040); 15-64 years: 67% (male 67,524,642/female 68,809,357); 65 years and over: 6.7% (male 5,796,433/female 7,899,650) (2011 est.)
- **Life Expectancy at Birth:** Total population: 72.79 years; male: 68.24 years; female: 76.53 years (2012 est.)
- **Infant Mortality Rate:** Total: 20.5 deaths/1,000 live births; male: 23.9 deaths/1,000 live births; female: 16.93 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 88.6%; male: 88.4%; female: 88.8% (2004 est.)
- **GDP:** $2.282 trillion (2011 est.)
- **GDP per Capita:** $11,600 (2011 est.)

U.S. CDC Direct Country Support

Brazil launched its national influenza surveillance system in 2000. After the pandemic, there was a need to adapt the strategy of influenza surveillance in Brazil and obtain a better understanding of the clinical, epidemiological and etiological cases of severe acute respiratory infection (SARI) since a variety of agents, beyond influenza are responsible for most of these cases and occurrence may occur in clusters of cases that deserve specific and timely interventions.

Given the need to structure influenza surveillance in Brazil to improve prevention and control activities and identify unusual or new human influenza subtypes, the Ministry of Health (MOH) issued ordinance Official n. 2,693 in 2011. This promotes the strengthening of epidemiological surveillance for influenza in 72 priority municipalities. This will be developed through financial transfers to municipality units. This ordinance also calls for a new model of sentinel surveillance for influenza and establishes criteria for these units in Brazil.

In this new structure, the sentinel influenza surveillance sites have three components: surveillance for severe acute respiratory infection (SARI) cases; influenza-like illness (ILI) cases and weekly aggregate reporting of SARI cases.

Surveillance

The epidemiological surveillance activities for the monitoring of influenza-related respiratory diseases in 2011 are available in the *Brazilian Preparation Plan for Coping with Pandemic Influenza and Protocols for Epidemiological Surveillance of Influenza H1N1 2009 Pandemic: Notification, Research and Monitoring and Clinical Management of SARI*. These documents were based upon recommendations from the World Health

Organization (WHO) to: reduce morbidity and mortality, optimize existing resources through appropriate planning and programming and reduce the socio-economic burden, and impact upon national essential services functioning during an influenza pandemic.

Surveillance Activities

With regard to routine influenza surveillance, the state and municipal health departments:

- monitor unusual events.
- investigate serious cases.

In outbreak situations, the state and municipal health departments are prepared to:

- monitor acute respiratory infections and viruses circulating.
- maintain and update information.

Laboratory

Three central laboratories: Instituto Evandro Chagas (IEC) in Belém, Pará State, northern Brazil; Instituto Adolfo Lutz (IAL), in Sao Paulo; Oswaldo Cruz Foundation (Fiocruz), located in Rio de Janeiro, are classified as National Influenza Centers (NIC) in Brazil.

The Brazilian influenza team.

In addition to the NICs, an additional 27 laboratories also conduct surveillance, one in each federal unit. In 2011, this network of laboratories tested an average of 14,837 (5,214 cases of SARI and 9,173 cases of ILI) clinical samples of nasopharyngeal swabs. It is anticipated that in 2012, the network will process an average of 60,000 samples. The laboratory techniques utilized are: indirect immunofluorescence (IIF) and RT-PCR in real-time.

Laboratory Activities

- In 2011, the ILI sentinel sites sent 9,173 influenza clinical samples of nasopharyngeal secretions to the laboratory network to identify influenza virus. These samples identified 25.7% influenza A viruses and 13.6% for influenza B, by IIF technique. These units report weekly the number of visits, general and ILI cases to the electronic Information System of Epidemiological Surveillance of Influenza (Sivep_Gripe).
- One of the goals of the system is the identification of respiratory viruses circulating in the country. The system also allows for monitoring of the demand for care by the ILI sentinel sites.
- The hospitalized cases of SARI reported in 2011 were more concentrated in cities in the South and Southeast regions of the country. Influenza A/H1N1 2009 was confirmed in the following cities: Belo Horizonte (568 reported cases), Porto Alegre (346), São Paulo (189) and Curitiba (171).
- The NICs received 5,214 clinical samples of nasopharyngeal swabs from SARI cases in hospital, 790 were from Fiocruz, 905 from IEC and 3,519 from IAL. The notification of these cases has been done since the 2009 H1N1 pandemic, using the web-based National Notifiable Disease Information System (Sistema de Informação de Agravos de Notificação Compulsória). Influenza outbreaks are reported through a national information system (Sinan.net) designed to report outbreaks.
- Students from the Brazilian Field Epidemiology Training (FETP) Program participate in investigations of outbreaks and cases of SARI and ILI in the field.

- The MOH publishes an epidemiological bulletin monthly on its website (www.saude.gov.br/svs) with information on cases of SARI and ILI from sentinel sites.
- The NICs send samples of influenza viruses to WHO Collaborating Centers (CC), upload data to FluNet, and also work regularly with collaborators to develop quality control.
- The influenza MOH team has a general coordinator as well as epidemiological and laboratory coordinators. The team has five professionals who work directly with influenza surveillance in the country; one of them works with the administration of the CDC cooperative agreement.

Preparedness

In 2011, Brazil strived to strengthen influenza surveillance with new strategies and guidelines.

Preparedness Activities

- Studying the epidemiological profile of influenza in Brazil.
- Increasing the overall number of specimens collected in all Brazilian geographical regions.
- Monitoring the expansion of existing and new influenza sentinel sites.
- Decentralizing the real-time RT-PCR capabilities to provide capacity for all federal units in the country.
- Integrating epidemiological and laboratory surveillance.
- Enhancing the strategies and measures for control and prevention of influenza in Brazil.

Training

The following trainings were held in Brazil in FY 2011:

- The MOH developed a comprehensive peer training activity for professional workers in the following parts of the national health system: basic health, family health, high complexity services, emergency care, rescue, and public education. These professionals then provided the same training to their state partners.
- Training on treatment and clinical management protocols was conducted.
- This material is the basis for all regional courses for professionals and is available on the MOH web site.
- The NICs provided training in real-time RT-PCR for influenza diagnosis for the state lab network.
- The Brazil MOH hosted train-the-trainer sessions to develop rapid response teams in all states, including remote states.
- The influenza team at the Brazil MOH developed a web course about influenza surveillance to be provided in 2012 in all States and the Federal District.

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Central America and Panama (CDC-CAP)

Highlights

- Estimated the incidence and disease burden for influenza-like illness (ILI) and severe acute respiratory infection (SARI) for El Salvador and Costa Rica.
- Estimated the prevalence, associated risk factors, and health care utilization practices for ILI and SARI in Panama and Honduras.
- Estimated the excess of SARI cases during Influenza A(H1N1)pdm09 and characterized the clinical and demographic profile of all deaths reported in Central America.
- Described the circulation of respiratory viruses and the influenza seasonality by countries in Central America.
- Based on the results of studies of surveillance, the Ministry of Health (MOH) of El Salvador increased use of influenza vaccine in 2011.
- Provided regular and updated information on the influenza situation in Central America Region.

U.S. CDC Direct Country Support

Influenza program activities of the U.S. Centers for Disease Control and Prevention's (CDC) Regional Office for Central America provide support to eight countries: Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic. The main focus of the program included the maintaining and increasing the capability of influenza surveillance and laboratory systems to detect and respond to influenza within the framework of preparedness and response activities and the generation of public health evidence through the analysis of monitoring data, field investigations and assessments of effectiveness of preventive interventions (influenza vaccine).

Activities and funds of the influenza program for Central America were implemented through three CDC cooperative agreements:

- Universidad del Valle de Guatemala (UVG)
  - Strengthening infectious-diseases research capacity for public health in Central America. 2009–2013.
  - Implementing public health program and strengthening public health science in Guatemala and Central America Region. 2008–2013
- The Task Force Global Health, Inc.–Training Epidemiology and Public Health Intervention Network (TEPHINET Program)
  - Development of International Surveillance System. 2008–2012.
- Council of Ministers of Health for Central America and Dominican Republic (COMISCA)
  - Improving Health Surveillance and emergency response in public health under the International Health Regulations 2005 (IHR) for Central America and Dominican Republic. 2010–2015.

Surveillance

The influenza program supported the implementation of PAHO's *Operational Guidelines for National Intensified Surveillance of Severe Acute Respiratory Infection* in Central America's influenza sentinel surveillance network. Based on the influenza surveillance network experience the integration of routine sentinel surveillance for

various events such as influenza, other viral respiratory infections, pneumonia, meningitis, and rotavirus in El Salvador was developed. In 2010, the program implemented a population-based cohort study at an influenza sentinel unit located in Cartago, Costa Rica and San Marco, Guatemala. The first study assessing the effectiveness of seasonal influenza vaccine in El Salvador was conducted. The study found that the vaccine effectiveness might be higher in children than in adults 60% (95% CI=[-27% to 87%]) among children versus 34% (95% CI=[-21% to 89%]) among adults over 60 years of age.

Surveillance Activities

- Developed the *Guidance for Respiratory Disease Surveillance in Nicaragua, Panama and El Salvador* which integrates the protocol elements needed to integrate surveillance of influenza, pneumococcus and other respiratory viruses.
- Described the circulation of respiratory viruses and the influenza seasonality by countries in Central America: the monthly average positivity rates over 15%, and the influenza circulates with different patterns throughout the region with increase circulation at the middle of the year.
- Estimated rates of severe pneumonia and SARI associated with influenza and determined the influenza attributable risk percentage for pneumonia and influenza (P&I) and respiratory and cardiac (R&C) causes related to influenza circulation in El Salvador and Costa Rica.
- Incorporated mortality surveillance into the general surveillance system through an automated data system at hospitals and other health system units in Guatemala and Costa Rica.

Laboratory

In Central America there are eight national laboratory surveillance networks for influenza. Each of these networks (one per country) has a national reference laboratory capable of diagnosis of influenza based on immunofluorescence, qRT-PCR and virus isolation. In the past year, most countries have promoted the decentralization of indirect immunofluorescence assays (IFA) in order to strengthen their sentinel surveillance strategy. The influenza program has provided reagents and supplies to these laboratories to further support their influenza surveillance in the region and supported the development of web-based platform for automated data management at national laboratories and National Influenza Centers (NIC) in Guatemala, Honduras, Costa Rica and Panama.

Laboratory Activities

- Provided support for the new Information System of Laboratory Surveillance in Guatemala and Honduras with new computer equipment and the design of web-based software.
- Expanded the capacity to diagnose influenza using immunofluorescence in three new sentinel unit laboratories (Guatemala, El Salvador, and Panama). These labs are fully operational and maintained according to standard operating procedures developed by the program.
- Implemented real-time multiplex technology for the diagnosis of influenza and other respiratory viruses at the National Children's Hospital in Costa Rica for research use.

Preparedness

The influenza program supported the process of implementing the IHR (2005) in Central American countries, which drove the preparedness and response to pandemic influenza. The *Inventory of Core Capabilities for Preparedness and Response for Influenza Pandemic in Central America* exercise conducted in many countries provided quantifiable evidence of their progress. During 2010, participating countries scored higher on their overall pandemic preparedness than during 2008 (median=70 vs. 41, IQR 61–91) ($p<0.0001$). The largest reported gains in capacity occurred in communications, outbreak response, resources for containment, health sector, and national surveillance reporting. Also, we provided support for the implementation of Phase I of the Electronic Surveillance Project in Panama, Guatemala and Costa Rica and the development of the Surveillance Web Platform.

Preparedness Activities

- Implemented basic and intermediate levels of Field Epidemiology Training Program (FETP) capacities in Panama and Belize in collaboration with the Central America FETP Program.
- Supported the development of national risk communication plans and standards in the context of the IHR (2005) in all Central America countries.
- Supported the regional response to the cholera outbreak in the Dominican Republic in collaboration with COMISCA. All National Epidemiology and Laboratory Authorities of Central American MOHs conducted or will conduct a one week site visit to the Dominican Republic to support this initiative.
- Implemented new web based platforms for disease surveillance information systems and supported the implementation of *SAP Business Objects* software for data integration in the Ministries of Health in Panama, Costa Rica and Guatemala.

Training

In FY 2011, the following trainings were organized in Central America:

- "Regional Workshop in Central America on Risk Communication and Standards Development". Antigua City, Guatemala, October 2010. The workshop was held in collaboration with PAHO with 55 participants.
- "The Influenza and other Respiratory Viruses' Laboratory Data Analysis Workshop", Guatemala City, Guatemala, February 1–3, 2011. The workshop was held in collaboration with PAHO with 15 participants.
- "Crisis Leadership Workshop" led to the commission for support of a healthier El Salvador and Belize. June 2011. Collaboration with School of Public Health of Miami University with 105 participants.
- Thirty-five participants attended the workshop for "Early Aberration Reporting System (EARS) and EpiVigila Tool" in Guatemala and Panama, September 2011.

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A street vendor in San Marcos, Guatemala.

Mexico

- **Capital:** Mexico City (Distrito Federal)
- **Area:** 1,964,375 sq km
- **Population:** 114,975,406 (July 2012 est.)
- **Age Structure:** 0-14 years: 28.2% (male 16,395,974/female 15,714,182); 15-64 years: 65.2% (male 35,842,495/female 38,309,528); 65 years and over: 6.6% (male 3,348,495/female 4,113,552) (2011 est.)
- **Life Expectancy at Birth:** Total population: 76.66 years; male: 73.84 years; female: 79.63 years (2012 est.)
- **Infant Mortality Rate:** Total: 16.77 deaths/1,000 live births; male: 18.58 deaths/1,000 live births; female: 14.86 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 86.1%; male: 86.9%; female: 85.3% (2005 Census)
- **GDP:** $1.657 trillion (2011 est.)
- **GDP per Capita:** $15,100 (2011 est.)

Highlights

- Mexico's National Influenza Center (NIC) is now part of the Laboratory Response Network of the U.S. Centers for Disease Control and Prevention (CDC), and it has received an international quality assurance certificate.
- The Mexican influenza surveillance system has detected and studied more than 700 samples for antiviral resistance with less than 1% of oseltamivir resistance mutation. The system is sensitive enough to observe small outbreaks and to perform sentinel surveillance to detect changes in the virus that could be potential pandemic viruses.
- The Mexican influenza information system is a web-based up to date system.
- Mexico has started sharing human-animal surveillance data on a more regular basis. The plan to merge animal and human influenza epidemic surveillance data in an effort to integrate their surveillance strategies into one system is still ongoing.

U.S. CDC Direct Country Support

Since September 2006, CDC has supported influenza surveillance in Mexico through a cooperative agreement. The agreement has helped to strengthen federal, regional and local influenza surveillance sites by funding training, equipment and coordination of activities of laboratories and epidemiology units. The Mexican National Laboratory Network consists of a NIC, the Institute for Epidemiologic Diagnosis and Reference (InDRE) that coordinates training, quality control and reporting for 31 state laboratories. The cooperative agreement has assisted Mexico's Secretariat of Health (SOH) by increasing influenza laboratory capacity in Mexican states and improving diagnostic protocols.

Mexico's outbreak response begins with local-state level investigations that are then assisted, if needed, by the Mexican Federal SOH. This response system was instrumental during the pandemic and remains the cornerstone of binational collaboration during the investigation of public health events of international concern.

Surveillance

Mexico's influenza surveillance system is based on local sentinel sites that are spread out in all 31 states. Over the course of the CDC cooperative agreement the surveillance network has grown; it started with less than 100 sites and now has grown to more than 700 units. Each year this sentinel network along with the influenza surveillance regulations, which are national and obligatory for all states, are revised by the National Epidemic Surveillance Committee.

The purpose of the units is to collect detailed information of all influenza-like illness (ILI) cases and take laboratory samples from hospitals and primary health care centers to monitor influenza strains. Epidemiologic and laboratory data are collected at the local level and sent to centralized databases that facilitate rapid analyses, interpretation, and response to influenza activity throughout the country.

Surveillance Activities

- The Directorate General of Epidemiology develops a weekly newsletter that is distributed to the national epidemiological network and shared with partners; several specific analyses can be done and shared, like the influenza activity on the U.S.–Mexico Border States.
- The Directorate General of Epidemiology developed and sustained a web-based clinical-epidemiological and laboratory reporting system that facilitates rapid identification of unusual activity and response to potential public health events of international concern.
- An updated national plan for influenza preparedness was developed to include interagency coordination activities with the Mexico SOH, Army, Navy, and the Ministries of Agriculture, Communication and Transportation.
- Based on lessons learned from the 2009 influenza A (H1N1) pandemic, the SOH has updated and improved the quality of data that is collected in the Mexican National Influenza Surveillance System.
- The *North American Plan for Avian and Pandemic Influenza* has been updated with input of Canada, Mexico and the United States and it is now the *North American Plan for Animal and Pandemic Influenza (NAPAPI)*, taking account of the lessons learned in influenza pandemic 2009; this plan considers important activities to share information along the three countries and to make joint risk assessments.

Laboratory

InDRE serves as a full-service national public health laboratory, performing surveillance and diagnostic-reference testing for a broad range of agents and diseases, including respiratory viruses, rabies and arboviruses. As Mexico's NIC, InDRE cultures influenza viruses, conducts real time qRT-PCR testing for respiratory samples and sequences viral isolates.

InDRE also provides oversight and proficiency testing for the national network of laboratories several times a year. It has also developed an ambitious program to grow capacity with a new building, built with international standards and increasing the laboratory´s infrastructure with several BSL-3 laboratories.

Laboratory Activities

- InDRE has the capacity to do full antigenic and genetic characterization of influenza viruses, and has the capacity to isolate influenza viruses.
- All 31 labs in the National Public Health Laboratory Network perform influenza testing through real-time qRT-PCR.
- InDRE has detected four influenza cases with oseltamivir resistance mutation H275Y without epidemiological association and has reported them to the World Health Organization (WHO) according to International Health Regulations 2005 (IHR).
- SOH has developed an online platform to centralize data access and improve the communication system between the 31 state laboratories and InDRE.
- WHO´s laboratory´s performance assessment for InDRE has had perfect qualifications since 2010.
- InDRE has obtained international quality certification ISO-9001-2008.
- For the 2011–2012 influenza season, the virological niche was taken again by the influenza A (H1N1) 2009 virus.

Preparedness

The *National Influenza Preparedness Plan* was updated after the 2009 H1N1 pandemic. The National Laboratory Network was fully strengthened with diagnosis protocols based in real-time qRT-PCR and viral culturing. Mexico is part of the *North American Plan for Animal and Pandemic Influenza (NAPAPI),* in partnership with Canada and the United States.

In 2011, Mexico hosted the "High Level Technical Meeting to Address Risks in the Animal-Human-Ecosystems" interphase with participation from Ministries of Health, Agriculture and Wildlife from 35 countries as well as organizations such as the Food and Agriculture Organization of the United Nations (FAO), the World Organisation for Animal Health (OIE), and WHO.

Preparedness Activities

- The *National Preparedness Plan* has been updated to include the coordination of local and state plans and activities.
- Each state in Mexico has a rapid response team (RRT) that is equipped with medical doctors, epidemiologist, and laboratory staff.
- During the pandemic, there was successful distribution of antiviral medications to states and institutions.

Training

Mexico's SOH hosted the following training activities in 2011:

- Updated the National Public Health Laboratory Network leaders with regard to pandemic coordination.
- Several local epidemiologists are now studying for their Master´s Degree in Public Health with the National Institute of Public Health.
- Level two of the Incident Command System Course for federal staff has been developed, in cooperation with the Public Health Agency of Canada.
- Influenza surveillance, preparedness and response are always an important part of the regional and national meetings with the National Epidemic Surveillance System [SiNaVE].

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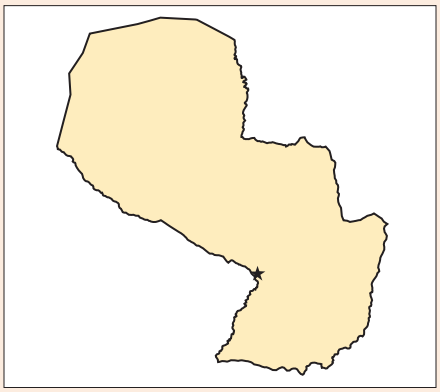
Paraguay



- **Capital:** Asunción
- **Area:** 406,752 sq km
- **Population:** 6,541,591 (July 2012 est.)
- **Age Structure:** 0-14 years: 28.5% (male 936,298/female 905,285); 15-64 years: 65.4% (male 2,121,632/female 2,100,740); 65 years and over: 6.1% (male 183,440/female 211,663) (2011 est.)
- **Life Expectancy at Birth:** Total population: 76.4 years; male: 73.78 years; female: 79.14 years (2012 est.)
- **Infant Mortality Rate:** Total: 22.24 deaths/1,000 live births; male: 26.06 deaths/1,000 live births; female: 18.23 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 94%; male: 94.9%; female: 93% (2003 est.)
- **GDP:** $36.21 billion (2011 est.)
- **GDP per Capita:** $5,500 (2011 est.)

Highlights

The Paraguay Ministry of Health (MOH):

- Developed exercises for rapid response teams for outbreaks response in two national and four subnational areas.
- Enhanced epidemiologic information and data management at each sentinel site.
- Developed a computer system for reporting online data for severe acute respiratory infections (SARI) surveillance.
- Decentralized the National Influenza Center (NIC) and three laboratories have been established for indirect immunofluorescence (IIF) technique at three sentinel sites.
- Developed a national influenza bulletin that reports counts and trends of influenza-like illness (ILI), SARI, deaths, and confirmed influenza cases. The bulletin is published weekly.

U.S. CDC Direct Country Support

Since August 2009, the U.S. Centers for Disease Control and Prevention (CDC) has provided funds to the Paraguay Directorate General of Health Surveillance via a cooperative agreement to help the Paraguay MOH strengthen influenza surveillance. These funds are intended to support subnational influenza preparedness and national communication strategies.

Paraguay has 12 sentinel sites, five of which include rural populations, 60% of these hospitals have an epidemiological unit, thereby improving the quality of information and sampling. In the remaining sentinel sites, the MOH directly works with a person in charge of surveillance.

The NIC has been decentralized and three laboratories have been established for IIF technique at three sentinel sites.

The major developments that took place in the surveillance system include the following:

- Strengthening SARI surveillance in six hospitals, implementing the hospital epidemiology units.
- Improving information and data management capacity at each sentinel site.
- Reporting online data for SARI surveillance.
- Improving information and characterization of the epidemiology of seasonal influenza and outbreaks in Paraguay.
- Enhancing epidemiology and communication capacity at local and national levels.
- Reporting counts and trends of ILI, SARI, deaths, and confirmed influenza cases via a national influenza bulletin.

Surveillance

Paraguay has been using the PAHO generic protocol surveillance standards and is adopting a new SARI surveillance protocol. Through their 12 sentinel sites, Paraguay collects influenza samples that are sent to their NIC. They continue to prioritize the strengthening of their surveillance at subnational levels including rural areas.

Surveillance Activities

- Increased the number of reporting sentinel sites for ILI and SARI; there are currently five sentinel sites for ILI and 12 sentinel hospitals for SARI.
- Improved information and data management capacity at each sentinel site.
- Developed national guidelines for ILI and SARI surveillance.
- Improved the information and characterization of the epidemiology of seasonal influenza in Paraguay.
- Enhanced the epidemiology and communication capacity at the local and national level via the provision of internet connections and cellular phones at each sentinel site.
- Vistited each sentinel site to oversee the development of their surveillance activities.
- Provided weekly updates on influenza surveillance in Paraguay to the World Health Organization (WHO).

Laboratory

In 1998, the Central Public Health Laboratory (LCSP) initiated viral isolation in cell culture and became Paraguay's NIC. The laboratory collects samples from each of their 12 sentinel hospital laboratories. With CDC funding and technical assistance, Paraguay has been increasing the capacity of local laboratories to collect and send samples to the NIC. The NIC is capable of performing influenza diagnostics including virus isolation, hemagglutination inhibition assays and real-time RT-PCR for seasonal, 2009 H1N1, and H5N1 viruses. Paraguay has been working on improving their ability to send samples out of the country.

Laboratory Activities

- Sent representative isolates of influenza virus strains to the WHO Collaborating Center in Atlanta for characterization, the selection of vaccine strains for the Southern Hemisphere, and monitoring antiviral drug sensitivity.
- Provided weekly updates on influenza activity in Paraguay to WHO's FluNet.
- Participated in WHO's External Quality Assessment Project (EQAP) that demonstrated the competence of the NIC to identify seasonal, 2009 H1N1, and avian influenza in accordance with WHO global standards.
- Developed and enhanced the integrated laboratory surveillance network for influenza. This included improving laboratory infrastructure, training staff, and providing resources for sentinel sites laboratories.
- Provided technical support and confirmatory testing for other influenza laboratories in the country.

Paraguay's national monument, 'Panteon Nacional de los Heroes' (the National Pantheon of Heroes), Asunción.

Preparedness

Paraguay has rapid response teams (RRTs) at the national level and has been continuing their process of developing RRT at the local area. Allocating staff and equipment to increase their regional area preparedness is a high priority area.

Preparedness Activities

- Strengthened the communication network at subnational level.
- Assessed the regional epidemiological units.
- Formed RRTs for outbreaks: two national and four subnational.
- Established a multidisciplinary team of people from national and subnational levels to work in to new operational plans for pandemics.

Training

- Media spokespersons and national and regional communicators were trained in risk communication.
- Mitigation strategies workshops were conducted with family health units.
- Two biochemists from sentinel sites were trained in the technique of indirect immunofluorescence assays (IFA) for the detection of respiratory viruses.
- Training was provided for RRT at the national and subnational level.
- Workshops with simulation exercises were provided for six regions, including two at the national level and four at the subnational level.
- Hospital surveillance training was provided to sentinel site staff members.

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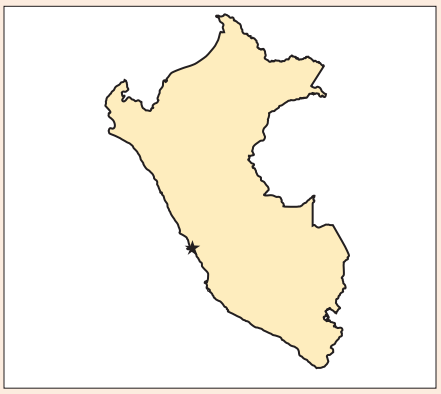
Peru



- **Capital:** Lima
- **Area:** 1,285,216 sq km
- **Population:** 29,549,517 (July 2012 est.)
- **Age Structure:** 0-14 years: 28.5% (male 4,245,023/female 4,101,220); 15-64 years: 65.1% (male 9,316,128/female 9,722,258); 65 years and over: 6.4% (male 885,703/female 978,611) (2011 est.)
- **Life Expectancy at Birth:** Total population: 72.73 years; male: 70.78 years; female: 74.76 years (2012 est.)
- **Infant Mortality Rate:** Total: 21.5 deaths/1,000 live births; male: 23.78 deaths/1,000 live births; female: 19.12 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 92.9%; male: 96.4%; female: 89.4% (2007 Census)
- **GDP:** $301.5 billion (2011 est.)
- **GDP per Capita:** $10,000 (2011 est.)

Highlights

General Directorate of Epidemiology (DGE) staff participated in the publication of several articles on influenza:

- "Circulating strains of human respiratory syncytial virus in Central and South America". Sovero M, Garcia J, Kochel T, Laguna-Torres VA, Gomez J, et al. (2011) PLoS ONE 6(8): e22111. doi:10.1371/journal.pone.0022111.
- "Mortalidad relacionada a influenza A H1 N1 en el Perú durante la pandemia en 2009–2010." Suárez-Ognio L, Arrasco J, Gómez J, Munayco C, Vílchez A, Cabezas C, Laguna-Torres V. Revista Peruana de Epidemiología. Vol. 15, Nº 1, 2011.
- "Spatial and Temporal Characteristics of the 2009 A/H1N1 Influenza Pandemic in Peru". Chowell G, Viboud C, Munayco CV, Gómez J, Simonsen L., et al. (2011) PLoS ONE 6(6): e21287. doi:10.1371/journal.pone.0021287.
- "The 1918-1920 influenza pandemic in Peru". Chowell G, Viboud C, Simonsen L, Miller MA, Hurtado J, Soto G, Vargas R, Guzman MA, Ulloa M, Munayco CV. Vaccine. 2011 Jul 22;29 Suppl 2:B21-6.

Implementation of enhanced surveillance of severe acute respiratory infections (SARI) in seven hospitals.

U.S. CDC Direct Country Support

The cooperative agreement *Sustaining Influenza Surveillance Networks and Response to Seasonal and Pandemic Influenza* began in August 2010. FY 2011 was the first year of funding through the agreement. The Peruvian Ministry of Health (MOH) and DGE are working with the U.S. Centers for Disease Control and Prevention (CDC) under this agreement to strengthen surveillance and detection for seasonal, avian, and human influenza in the country. Peru's influenza surveillance system uses sentinel sites to identify influenza-like illness (ILI) and SARI case-patients throughout the country. Laboratory testing for influenza takes place in the 15 regional laboratories, as well as the National Influenza Center (NIC), located in the National Institute of Health (INS) in Lima.

Surveillance

In 2006, the MOH sub-committee for influenza surveillance invited the Virology Department of the U.S. Naval Medical Research Unit No. 6 (NAMRU-6) in Lima to assist in increasing surveillance coverage by establishing new sentinel sites in order to strengthen the surveillance program. Since then, NAMRU-6 has augmented the existing program by supporting the collection and processing of samples at new sentinel sites as well as providing these data to DGE and INS.

Sentinel surveillance is conducted in 50 health centers throughout the country. This includes both ILI and SARI surveillance. SARI surveillance took place at 21 sentinel hospitals but has been reduced to seven sentinel hospitals to enhance SARI surveillance. ILI surveillance continues to take place at all 50 health centers throughout the country.

Surveillance Activities

- Advocacy meetings to develop ways to raise awareness regarding influenza to government organizations and the public.
- Meetings to analyze the influenza surveillance system and methods for improvement.

Laboratory

Peru has 15 regional laboratories, all of which receive respiratory samples from influenza sentinel sites. Samples are tested by immunofluorescent assays (IFA), and those that are positive are then sent to the country's NIC in Lima for testing by RT-PCR. At the NIC, specimens are tested the same day they are received and results are reported within 72 hours. Influenza positive samples are also cultured in MDCK cells. Positive isolates are shared with CDC at least three times per year for further characterization.

Preparedness

Peru has rapid response teams (RRT) in the regional governments. They recently updated and disseminated specialized guides on influenza outbreak management to each regional unit.

Preparedness Activities

- Updated new equipment for their emergency operation center (EOC).
- Conducted an annual workshop for RRT concerning the "Monitoring Evaluation Preparation and Response to Influenza".

Training

- Provided training to clinical staff, epidemiologists, and laboratory staff on monitoring of SARI.
- Provided training to information technology staff to manage and operate the web-based system that connects to all the sentinel units.
- Developed five macro-regional workshops on update on surveillance of influenza and SARI for priority staff at 70 hospitals.

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WHO South-East Asia Region (SEAR)

WHO South-East Asia Region (SEAR) Overview

The U.S. Centers for Disease Control and Prevention (CDC) funds eight non-research bilateral influenza cooperative agreements in the South-East Asia Region (SEAR). Cooperative agreements with ministries of health (MOH) or institutions designated by the MOH build capacity to routinely identify, diagnose and respond to seasonal, avian and pandemic influenza.

CDC direct country support via cooperative agreements is established in the following countries:

- Bangladesh
- India
- Indonesia (two)
- Nepal
- Sri Lanka
- Thailand
- WHO South-East Regional Office (SEARO) Headquarters in New Delhi

Four of the countries (Bangladesh, India, Indonesia and Thailand) were awarded sustainability grants and are in varying stages of completion. The new grants support the countries for a second five years. Countries are expected to do the following: create and implement a sustainability plan that phases out U.S. government funding, develop and maintain a surveillance system that allows countries to rapidly detect, identify and respond to seasonal, novel and pandemic influenza, and participate in the World Health Organization's (WHO) Global Influenza Surveillance and Response System (GISRS).

Core activities include improving laboratory and epidemiologic capacity and infrastructure for influenza virologic and disease surveillance; developing sentinel hospital-based surveillance for influenza-like illness and severe acute respiratory infections; integrating laboratory and epidemiologic influenza surveillance; developing and maintaining surveillance for cases and clusters of respiratory illnesses; and training local rapid response and containment teams. Nepal and Sri Lanka are still in the first five-year capacity building phase.

As of FY 2010, all WHO SEAR countries with CDC influenza cooperative agreements had active National Influenza Centers (NIC).

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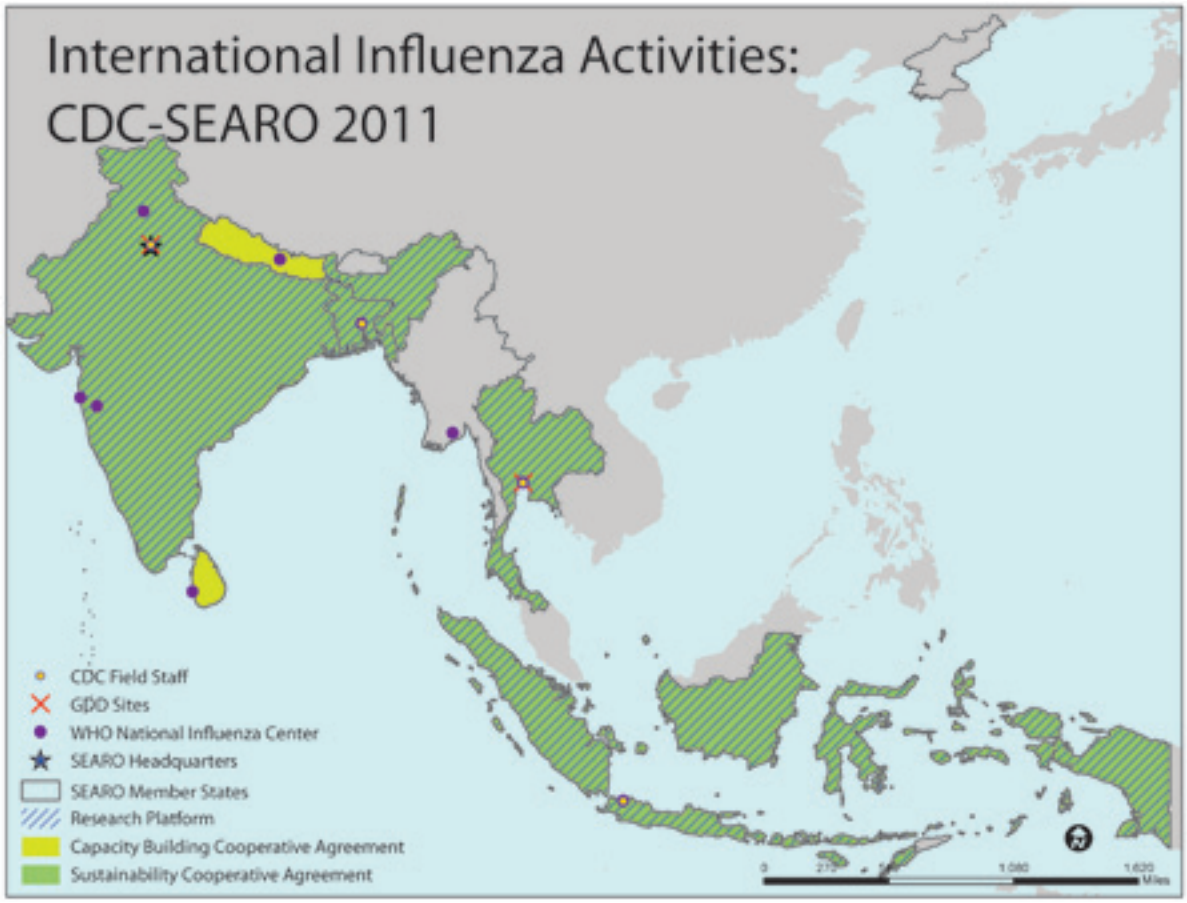
WHO South-East Asia Regional Office (SEARO)



U.S. CDC Direct WHO Regional Office Support

The five-year cooperative agreement *Surveillance and Response to Pandemic and Avian Influenza by Regional Offices of the World Health Organization (WHO)* began in September 2006 and is in its fifth year.

WHO's South-East Asia Regional Office (SEARO) is located in New Delhi, India. The office serves 11 countries; together their population exceeds 1.7 billion people. Member countries include Bangladesh, Bhutan, Democratic People's Republic of Korea (DPR Korea), India, Indonesia, Maldives, Myanmar, Nepal, Sir Lanka, Thailand and Timor-Leste. Six of the 11 countries received U.S. Centers for Disease Control and Prevention (CDC) cooperative agreement funds: Bangladesh, India, Indonesia, Nepal, Sri Lanka and Thailand. In 2011, WHO SEARO staff provided support and technical assistance to member countries to strengthen preparedness, surveillance, outbreak response, and laboratory capacity.

WHO SEARO is committed to assisting countries with reviewing policies and regulations, supporting regional production of influenza vaccine, enhancing capacity for disease surveillance activities and harmonizing regional reporting. WHO SEARO is working to sustain the diagnostic capacity of the regional influenza laboratory network and support the information sharing of the National Influenza Centers (NIC). There was a joint meeting of the NICs from the South-East Asia Region and the Western Pacific Region in June 2011.

Surveillance

The 2009 H1N1 pandemic provided an opportunity to expand and build influenza surveillance in the region. Prior to the pandemic, only a few WHO SEAR member countries had established routine sentinel surveillance for influenza and other acute respiratory illnesses.

- Throughout 2011 support was provided to strengthen disease surveillance and outbreak response for areas on the Thai-Myanmar-Thai border. Activities included strengthening early warning mechanisms and providing risk communication materials for displaced populations.
- In July 2011 influenza surveillance was included on the agenda of the annual WHO SEAR epidemiology (EPI) managers meeting for the first time, as a means to engage EPI staff at both the regional and country level.
- WHO SEARO has worked closely with member countries to ensure that reporting on influenza was shared transparently. Influenza-like illness (ILI) surveillance was initiated for the first time in two WHO SEAR countries: Bhutan and DPR Korea.
- WHO SEARO is encouraging close coordination between animal and human health sectors with regard to surveillance. This is especially relevant for member countries in the South-East Asia Region because of the high population density and frequent interaction between humans and poultry.

Laboratory

WHO SEARO continued to support efforts to strengthen laboratory infrastructure and build laboratory capacities to accurately and promptly diagnose influenza and monitor antiviral resistance.

- WHO SEARO helped establish a regional database to track and monitor results of specimens submitted by National Influenza Centers (NIC) in the South-East Asia Region.
- WHO's Global Influenza Surveillance and Response System (GISRS)—FluNet—is a web-based data tool for global influenza surveillance. Thailand provides weekly laboratory results and Bangladesh provides monthly information from their influenza laboratory sentinel sites. Indonesia, Bhutan and Nepal provide periodic laboratory reports.
- WHO SEARO has encouraged sharing of influenza laboratory data and will continue to foster information sharing within the Region.
- The National Public Health Laboratory in Kathmandu was strengthened and eventually designated as a NIC for Nepal. With this designation, Nepal became the eighth country in the Region to have a NIC and become part of GISRS.
- Bhutan, Maldives and Timor-Leste for the first time established polymerase chain reaction (PCR) facilities for influenza diagnosis with support from WHO.
- Bhutan successfully diagnosed an outbreak of influenza A(H1N1)pdm09 in April 2011 using their national facilities.

Preparedness

The 2009 H1N1 pandemic demonstrated that there is a significant amount of expertise and capacity within the Region to respond to pandemic influenza. Lessons learned from this experience guided several regional meetings and resulted in identifying opportunities for strengthening regional and national preparedness and response capacity.

- Regional tools for assessment of response to the 2009 H1N1 pandemic were prepared and plans are underway to carry out a review of member countries' implementation.
- WHO SEARO will continue to play a vital role in supporting member countries in the following activities: updating, revising and implementing national pandemic preparedness and response plans; sharing country experiences, lessons learned and best practices; and identifying future steps towards pandemic preparedness and response.
- Despite being one of the most densely populated areas of the world and having three vaccine-manufacturing countries (India, Indonesia and Thailand), the Region currently has limited capacity for influenza vaccine production. There remain many opportunities for developing partnerships to introduce new technologies for vaccine manufacturing, and to build on existing collaborations for regional vaccine and essential medicine production.
- As regional vaccine manufacturing capacity develops, technical assistance to member countries will be essential for developing national plans that reflect rational, sustainable and cost-effective new vaccine introduction. In the last half of 2011, the Region worked with member countries to update their vaccine deployment plans and planned for a regional workshop for the beginning of 2012 to review and share information within the Region.
- In early 2011, a tool was finalized by WHO SEARO to support the review of national response to pandemic influenza. In July 2011, the tool was used to support an assessment in DPR Korea and revision of the national pandemic plan.

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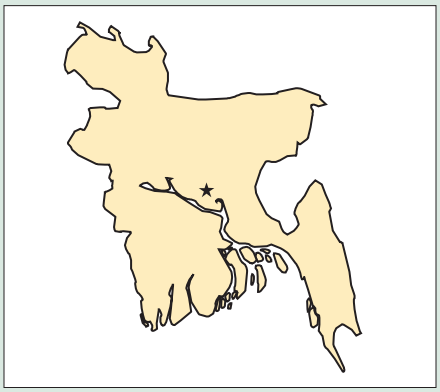
Bangladesh



- **Capital:** Dhaka
- **Area:** 143,998 sq km
- **Population:** 161,083,804 (July 2012 est.)
- **Age Structure:** 0-14 years: 34.3% (male 27,551,594/female 26,776,647); 15-64 years: 61.1% (male 45,956,431/female 50,891,519); 65 years and over: 4.7% (male 3,616,225/female 3,778,119) (2011 est.)
- **Life Expectancy at Birth:** Total population: 70.06 years; male: 68.21 years; female: 71.98 years (2012 est.)
- **Infant Mortality Rate:** Total: 48.99 deaths/1,000 live births; male: 51.48 deaths/1,000 live births; female: 46.39 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 47.9%; male: 54%; female: 41.4% (2001 Census)
- **GDP:** $282.5 billion (2011 est.)
- **GDP per Capita:** $1,700 (2011 est.)

Highlights

- Bangladesh strengthened its communicable disease surveillance system and reporting to increase the timeliness of outbreak response and compliance with International Health Regulations 2005 (IHR).
- The Institute of Epidemiology Disease Control and Research (IEDCR) and the U.S. Centers for Disease Control and Prevention (CDC) strengthened the laboratory testing capacities at the National Influenza Center (NIC).
- IEDCR and the International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) estimated disease and economic burden for respiratory viruses, which is anticipated to facilitate priority setting and funding allocation to programs intended to decrease the respiratory disease burden in Bangladesh.
- During FY 2010, IEDCR implemented a system to collect and investigate daily news reports about suspected outbreaks. This event-based surveillance system can be credited with the early detection of several notable outbreaks throughout the country. For example, it can be credited with the detection of pandemic influenza weeks before the virus was circulating in the general population.

U.S. CDC Direct Country Support

IEDCR, an organization under the Ministry of Health and Family Welfare of the Government of Bangladesh, has been a recipient of CDC cooperative agreements since 2006. They are currently in their first year of a sustainability cooperative agreement. IEDCR is the nation's focal point for conducting disease surveillance and outbreak investigations. Their CDC-funded influenza project concentrates on strengthening disease surveillance, laboratory capacity and pandemic response. IEDCR works closely with icddr,b, which also

receives CDC funding to do the following: perform research and characterize the epidemiology of seasonal influenza, help identify clusters of severe acute respiratory infections (SARI) and pneumonia that may be of international concern, and identify cases of zoonotic transmission of avian influenza. The two institutions collaborate on surveillance, training and research. Bangladesh has made substantial progress in the field of respiratory illness since the start of the cooperative agreement and collaboration with IEDCR, icddr,b and CDC.

Avian influenza outbreaks and the spread of pandemic influenza are of great concern for a country like Bangladesh because of the high population density and frequent interaction between humans and poultry. Bangladesh is a country with over 180 million poultry, 50% of which are raised in backyards. Collaborations on human and animal health also involve the Bangladesh Department of Livestock Services (DLS), the Food and Agriculture Organization (FAO), the World Health Organization (WHO), and the U.S. Agency for International Development (USAID).

Surveillance

CDC funding enabled IEDCR and icddr,b to establish Bangladesh's first influenza sentinel sites. Since 2007, these groups have been conducting hospital-based influenza surveillance in 12 tertiary hospitals across the country. Four of these hospitals expanded surveillance in 2008. These data have allowed Bangladesh to estimate its influenza disease and economic burden. In FY 2010, IEDCR expanded their government surveillance system by establishing 14 new national influenza surveillance sites at district hospitals, raising the total number of national surveillance sites to 26. The current surveillance identifies cases of SARI, influenza-like illness (ILI), and severe pneumonia. In addition, an event-based component of the surveillance system identifies clusters of severe disease, and all patients are screened for exposure to sick or dead poultry and tested for influenza A (H5N1). The system effectively shares staff, resources and data between icddr,b and IEDCR, with increasing ownership over time by public health authorities in Bangladesh. This strategy is anticipated to allow for sustainable influenza surveillance by IEDCR, with expanded investigations into disease transmission, burden, and cost-effectiveness of respiratory disease interventions in collaboration with icddr,b.

Bangladesh continues to experience outbreaks of highly pathogenic avian influenza A (H5N1). The DLS, IEDCR, and icddr,b conduct surveillance for avian influenza in domestic poultry in Bangladesh. The icddr,b currently performs monthly live bird market surveillance at 20 sites. Also, icddr,b performs active surveillance in 32 villages around the country. In addition to surveillance activities, DLS, the IEDCR, and the icddr,b participate in joint avian influenza outbreak investigations.

Surveillance Activities

- The IEDCR expanded their web-based disease surveillance reporting, which collects information from 64 districts and more than 450 Upazila (sub-districts). With this expansion, facilities all over the country will build capacity to submit reports of ILI and SARI electronically.
- Specimens are now collected and routinely tested for influenza from 14 new surveillance sites.
- Over 5,000 specimens obtained through surveillance activities were tested for influenza A virus. Influenza A virus subtypes (H3N2) and influenza A(H1N1)pdm09, as well as influenza B viruses were circulating throughout Bangladesh during that period. There was one peak of influenza activity in July 2011, during the regular influenza season that occurs annually from May through October.
- Data generated by the surveillance system and its associated burden of disease and economic burden studies have allowed the Bangladesh government to develop national treatment guidelines for groups at high risk of complications from influenza. These data have also guided pandemic preparedness efforts and informed seasonal influenza prevention strategies.

- Influenza surveillance results are publically reported with monthly updates on IEDCR's website.
- IEDCR and icddr,b continue to send detailed surveillance reports to CDC and WHO on a weekly basis during the influenza season.
- IEDCR and icddr,b routinely submit influenza isolates to CDC for further characterization as part of the global influenza network of WHO (100–200 seasonal influenza isolates per year). These samples are used for annual global vaccine preparation.
- During the FY 2011 period, approximately 2,000 poultry samples from routine surveillance activities were tested for influenza A virus, of which one fourth were positive for influenza A virus and over 100 samples were positive for influenza A (H5N1) by real-time RT-PCR in the Biosafety Level 2 (BSL-2) animal virology laboratory at icddr,b. Additionally, approximately 200 samples collected during investigations of poultry outbreaks were tested and about half of these were positive for influenza A (H5N1) by real-time RT-PCR. The poultry-related work of DLS and the health sectors in IEDCR has improved communication between the groups and has resulted in routine surveillance among persons who are involved in culling poultry infected with influenza A (H5N1).
- In March 2011, IEDCR and icddr,b jointly investigated cases of mild respiratory illness caused by avian influenza infection among young children in Dhaka. Two new cases of influenza A (H5N1) and a case of influenza A (H9N2) infection were identified. In all cases, IEDCR reported these findings to WHO within 24 hours as per the IHR (2005).
- During June–July 2011, DLS, FAO and icddr,b jointly investigated a cluster of high mortality in ducks and geese with suspected influenza A (H5N1) etiology in a north-eastern district of Bangladesh. Infections were caused by clade 2.3.2.1 influenza A (H5N1) viruses that were recently introduced into Bangladesh.

Laboratory

In 2007, IEDCR was nominated as a National Influenza Center (NIC) by WHO and has contributed specimens to the Global Influenza Surveillance and Response System (GISRS). An upgrade of IEDCR's BSL-2 laboratory was completed in 2010. State-of-the-art equipment was purchased and the new BSL-2 laboratory is performing real-time and conventional PCR to identify seasonal, influenza A(H1N1)pdm09, influenza A (H9N2) and influenza A (H5N1) viruses. Plans are currently underway to increase the serologic testing capacity of the NIC.

Laboratory Activities

- With funding from World Bank, IEDCR has installed a prefabricated Biosafety Level 3 (BSL-3) laboratory, which is now operational. The BSL-3 facility will enable IEDCR to isolate and culture highly pathogenic viruses.
- The BSL-3+ laboratory at icddr,b was accredited in July 2010. A new BSL-2 animal laboratory initiated poultry sample testing in November 2009, allowing them to identify outbreaks of avian influenza.
- In 2011, the upgraded IEDCR laboratory tested over 1,500 clinical samples for influenza.
- IEDCR and icddr,b send about 200–300 influenza isolates per year, including unsubtypables, to a WHO Collaborating Center for further characterization.

Preparedness

IEDCR, with key partners, has periodically updated their pandemic response and avian influenza plan with lessons learned from the pandemic. Training of public health officials and health professionals is an integral part of pandemic preparedness and IEDCR has led several training activities during FY 2011.

Preparedness Activities

- Standard operating procedures to roll out non-pharmaceutical interventions, triage, and alternate care facilities during a pandemic were updated to reflect lessons learned during the 2009 H1N1 pandemic.
- An emergency operations center was built and equipped to help centralize government response during major outbreaks and pandemics.

Posters in Bangladesh promote the safe handling of poultry to minimize exposure to avian influenza using images and Bengali text.

Training

- During the pandemic period, IEDCR routinely trained public health officials and clinical providers from the district and sub-district levels on management of patients with suspected pandemic influenza using evidence-based recommendations generated from collaborative IEDCR, icddr,b, and CDC research.
- A consultative workshop for improving data collection, reporting, and use by developing and implementing web-based surveillance was held at IEDCR in June 2011.
- Training of health help desk officers at points of entry for IHR (2005) implementation was held at IEDCR in October 2010.
- Training on the establishment of institutional disease surveillance at the district and Upazilla level for civil surgeons, a statistical assistant and key leadership took place at IEDCR in December 2010.
- Refresher training for physicians regarding standard operating procedures for avian influenza in humans was held at IEDCR in May 2011.

Special Influenza Projects

- IEDCR, icddr,b, and CDC estimated the disease and economic burden of influenza in Bangladesh, generated influenza mortality rates, and piloted scalable non-pharmaceutical interventions to control influenza.
- IEDCR continues to demonstrate its leadership within the Bangladesh government to guide the country through any influenza-related response, and through policy development related to pandemic preparedness in light of the endemic circulation of influenza A (H5N1) in the country.

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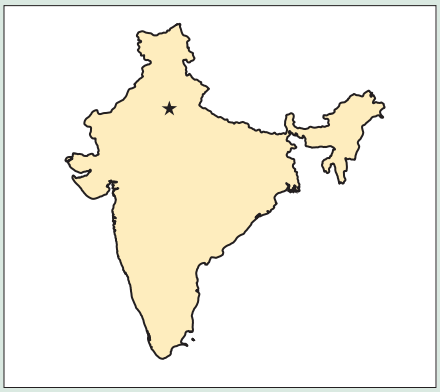

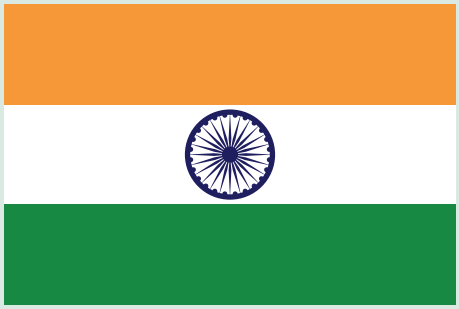

- **Capital:** New Delhi
- **Area:** 3,287,263 sq km
- **Population:** 1,205,073,612 (July 2012 est.)
- **Age Structure:** 0-14 years: 29.7% (male 187,450,635/ female 165,415,758); 15-64 years: 64.9% (male 398,757,331/female 372,719,379); 65 years and over: 5.5% (male 30,831,190/ female 33,998,613) (2011 est.)
- **Life Expectancy at Birth:** Total population: 67.14 years; male: 66.08 years; female: 68.33 years (2012 est.)
- **Infant Mortality Rate:** Total: 46.07 deaths/1,000 live births; male: 44.71 deaths/1,000 live births; female: 47.59 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 61%; male: 73.4%; female: 47.8% (2001 census)
- **GDP:** $4.463 trillion (2011 est.)
- **GDP per Capita:** $3,700 (2011 est.)

Highlights

- The India surveillance network uploaded data on influenza viral characteristics from nine sites throughout India to the World Health Organization (WHO) FluNet site in real time.
- Re-emerging influenza A (H3N2) viruses were genetically characterized and surveillance for A (H1N1)pdm09 viruses continued.
- Data on seasonality of influenza viruses identified the need to change the timing of influenza vaccination efforts. These findings have persuaded the Drug Controller of Government of India (the equivalent of the U.S. Food and Drug Administration) to permit importation of Southern Hemisphere vaccine for spring time vaccination.
- Sites collecting information on influenza disease burden contributed data for global pandemic influenza-related mortality estimates.
- Longitudinal data with pandemic influenza incidence rates for rural communities of India suggest that the public health response to a pandemic should consider targeted interventions for children during the early pandemic period, and targeted interventions for adults in later phases of the pandemic.

U.S. CDC Direct Country Support

The U.S. Centers for Disease Control and Prevention (CDC), in coordination with other U.S. government agencies, supports response measures against seasonal, avian and pandemic influenza in India through the following cooperative agreements and collaborative programs:

- *Development of Influenza Surveillance Networks in India*: This cooperative agreement is in the sustainability phase. A network of 10 influenza surveillance sites contribute data for surveillance of seasonal, pandemic and avian influenza for timely characterization (genetic and antigenic) of influenza isolates for inclusion in global vaccine selection.
- *Addressing Emerging Infectious Diseases in the Republic of India: Influenza Disease:* This cooperative agreement is established for five years to estimate population-based multi-site burden of disease related to influenza virus infection in India.
- *Direct and Indirect Protection by Influenza Vaccine Given to Children in India*: This cooperative agreement is established for three years to determine direct and indirect effects of immunization of young children with trivalent influenza vaccine in three rural villages near Delhi. This is a collaborative study between the University of Alabama, the All India Institute of Medical Sciences and CDC.
- *Understanding Host Innate Immune Responses against Influenza A Virus*: This bilateral research collaborative program between the International Center for Genetic Engineering and Biotechnology and CDC was initiated to study host-viral interactions for a better understanding of innate pathways involved in viral infection.

Surveillance

The Indian Council of Medical Research conducts sentinel surveillance at nine surveillance sites throughout India which are generating crucial epidemiological and virological data. Three new sites were added to the network at Srinagar, Lucknow and Allapuzha, improving geographical representation and providing crucial insight into the geographical and seasonal variation of influenza transmission within India. The National Influenza Center (NIC) at Pune has been sending timely isolates to CDC for antigenic analysis and has contributed cumulative weekly influenza surveillance data to the World Health Organization (WHO) FluNet web site.

Surveillance efforts have documented that influenza seasonality varied across India with peak influenza

A visit to the Serum Institute of India in August 2011. From left to right: Marc-Alain Widdowson (Team Lead, International Epidemiology and Response Team, CDC), Michael Shaw (Associate Director, Laboratory Science, CDC), Katie Lafond (Epidemiologist, CDC), Renu Lal (Influenza Coordinator, CDC), Rajeeve Dhere (Executive Director, Serum Institute), Nancy Cox (Director, Influenza Division, CDC), and Leena Yeolekar (Consultant, Serum Institute).

activity occurring during January–March in the northern-most tip of the country and during the rainy season (August–October) in the rest of the country. Previously, India was only using Northern Hemisphere influenza vaccine, but these findings have led to importation of Southern Hemisphere vaccine.

Surveillance Activities

- In 2011, several isolates were identified with the H275Y in the neuraminidase gene that confers oseltamivir resistance among influenza A (H1) isolates and resistance to adamantines (S31N) in some influenza A (H3N2) isolates.
- The NIC at the National Institute of Virology (NIV) in Pune submits virological and epidemiological data to the Global Influenza Surveillance and Response System (GISRS)/FluNet.
- An extensive analysis of four years of seasonal influenza data has shown that seasonality varies according to geographical location of the site:
    - Extreme North India demonstrates peak activity in winter and limited activity during rains.
    - North (Delhi), Eastern and Western India demonstrate highest activity during rains and limited activity in winter.
    - South India demonstrates a peak in the cooler season, during rains.
- Data from two different sites participating in a study in India on influenza disease burden have established that the influenza-like illness (ILI) and severe acute respiratory infection (SARI) case definitions that include measured or reported fever provide an optimal balance between sensitivity and specificity for the identification of patients hospitalized with influenza.

Laboratory

Indian surveillance network members have trained extensively with CDC scientists on typing, sub-typing, PCR, real-time PCR, and reverse genetics techniques. The Indian network of surveillance sites now has ten sites equipped with RT-PCR to detect seasonal and influenza A (H1N1)pdm09 viruses. Four of these laboratories are also equipped to handle avian influenza.

Genetic characterization of viruses is carried out mostly at the NIC. All India Institute of Medical Sciences (AIIMS) has developed capacity to carry out virus neutralization assays and testing for cell-mediated immunity (CMI) and nutritional factors as part of the vaccine study.

CDC-developed technologies for individual respiratory virus detection and multi-pathogen detection using TaqMan Low Density Array (TLDA) have been transferred to AIIMS. Laboratory studies of molecular mechanisms of influenza A and host cell interactions conducted with the International Centre for Genetic Engineering and Biotechnology (ICGEB) are leading to identification of unique host cell factors that may be manipulated by influenza A viruses.

Laboratory Activities

- The sentinel surveillance sites together processed 9,033 samples during the year: 1,021 tested positive, including 264(26%) positive for influenza A(H1N1)pdm09, 566(55%) for influenza A (H3N2) and 191(19%) for influenza B.
- Genetic characterization of circulating strains of influenza A(H1N1)pdm09 from India belong to clade 7 with minimal changes observed in recent isolates.
- Comprehensive databases with full-length HA and NA sequences for influenza A (H3) and influenza B have been generated and data analysis is underway. Additional scientific discussions have led to expanded genetic characterization of influenza viruses among longitudinal collection.

- Establishment of cytometry-based assays to measure cell-mediated immune response has been carried out at AIIMS with hands-on training from CDC. The protocol has been standardized, with titrations of antigens and staining with antibodies using influenza-vaccinated normal blood volunteers. Blood collection from study participants is underway to assess CMI response among vaccinated children.
- The collaborative work has been established on a bilateral exchange basis, with long-term hands-on training of ICGEB partners at CDC.

Preparedness

CDC activities have focused on supporting pandemic influenza preparedness programs and helping advance the field of influenza research (seasonal, pandemic and avian) in India. Many of the preparedness activities related to increased awareness and response to minimize the spread of human infections and disease were carried out with Ministry of Health and Family Affairs (National Center for Disease Control and the Indian Council of Medical Research) and WHO partners prior to 2009. These efforts contributed to India's ability to respond to the 2009 H1N1 pandemic. CDC continues to provide technical and laboratory support for ongoing surveillance activities.

Current activities are focused on influenza vaccination strategies, and increasing awareness and acceptance of influenza vaccine among health care providers. Support from the U.S. Biomedical Advanced Research and Development Authority (BARDA) has led to increased influenza manufacturing capacity. Studies are being planned to look at the efficacy of indigenously produced live attenuated vaccine in India.

Preparedness Activities

Current efforts have had policy effects in at least three major areas:

- First, evidence-based data on influenza seasonality has led to licensure to import Southern Hemisphere vaccine for vaccination prior to the influenza peak.
- Initial surveys in a tertiary care hospital revealed very low acceptance rates, due primarily to limited knowledge about influenza vaccines. Discussions are underway to provide influenza vaccinations to all health care providers within the federal government.
- The HHS-WHO supported Serum Institute of India (SII) in Pune led production of live attenuated influenza vaccine (LAIV), monovalent influenza A (H1N1)pdm09 vaccine, and is now in the process of producing trivalent LAIV. CDC-AIIMS, in collaboration with SII, are in the process of establishing the surveillance site to undertake an efficacy trial of indigenously produced LAIV.

Entrance to the Vadu Rural Health Program outside Vadu Hospital, near Pune, India.

Efforts were made to maintain capacity for detection of both known and unknown viruses. To this effect two trainings were carried out:

- Hands-on laboratory training was provided in virus culture and real-time PCR to expand the surveillance network capacity piloted by the National Center for Disease Control (NCDC), Delhi. Two participants from each of the 13 network laboratories attended the workshop. CDC staff also participated in the workshop as faculty.
- The second workshop was an intense two-week hands-on training for phylogenetic characterization of human and avian influenza viruses at the NIC, Pune. The main focus was to enable countries to capture unusual variants of known viruses that may emerge during their routine surveillance.

Training

Consultations/Presentations:

- Consultation on influenza program meetings with AIIMS and WHO: March 14–18, 2011.
- Invited talk "Evolution of Influenza Viruses: Seasonal Epidemics and Pandemics" at the Third Annual Conference on Microbial Evolution-Adaptation and Challenges, AIIMS, New Delhi, March 26, 2011.
- CDC-India Influenza Program update, presented at "Strategic Planning Briefing", CDC, June 15, 2011.
- The CDC Director and Congressional staff members traveled to India. The trip included a visit to Ballabhgarh site, August 8–9, 2011.
- Influenza vaccine-related collaboration took place at the Serum Institute of India, August 10–12, 2011.

Trainings and Workshops:

- Scientific writing workshop (three Indian participants), Bangkok, January 10–14, 2011.
- Hands-on laboratory training for seasonal influenza surveillance, NCDC, Delhi, April 25–29, 2011.
- Regional bioinformatics workshop on the molecular evolution of influenza viruses, NIV, Pune, May 23–June 3, 2011.
- Long-term training of three pre-doctoral fellows from ICGEB at CDC.
- Training of two AIIMS staff members in TLDA technology at CDC, August 9–11, 2011.

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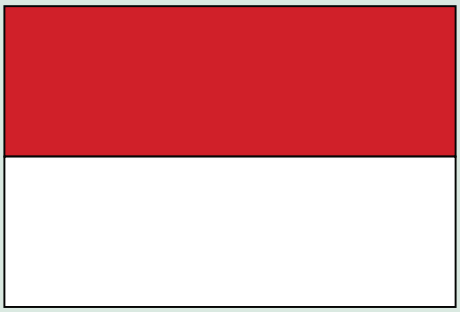
A street vendor in New Delhi, India.

Indonesia



- **Capital:** Jakarta
- **Area:** 1,904,569 sq km
- **Population:** 248,216,193 (July 2012 est.)
- **Age Structure:** 0-14 years: 27.3% (male 34,165,213/female 32,978,841); 15-64 years: 66.5% (male 82,104,636/female 81,263,055); 65 years and over: 6.1% (male 6,654,695/female 8,446,603) (2011 est.)
- **Life Expectancy at Birth:** Total population: 71.62 years; male: 69.07 years; female: 74.29 years (2012 est.)
- **Infant Mortality Rate:** Total: 26.99 deaths/1,000 live births; male: 31.54 deaths/1,000 live births; female: 22.21 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 90.4%; male: 94%; female: 86.8% (2004 est.)
- **GDP:** $1.121 trillion (2011 est.)
- **GDP per Capita:** $4,700 (2011 est.)

Highlights

- The East Jakarta Project that provides a model for harmonization of virologic and epidemiologic surveillance and intensification of influenza surveillance in one district in Indonesia was set up and started.
- Influenza surveillance systems conducted by various technical units at the Ministry of Health were more closely harmonized.
- Influenza-like illness (ILI) and severe acute respiratory infection (SARI) virological surveillance expanded to 24 ILI sentinel sites and 10 SARI sentinel sites.
- The national early warning alert and response system in two provinces was strengthened through trainings and monitoring missions.
- Technical support was provided to help establish a laboratory logistics management system that should increase laboratory efficiency.
- Lessons learned from the 2009 influenza pandemic were compiled.

U.S. CDC Direct Country Support

There are two cooperative agreements between the Indonesian Ministry of Health (MOH) and the U.S. Centers for Disease Control and Prevention (CDC). The agreement *Developing Influenza Surveillance Networks with the National Institute of Health Research and Development* (NIHRD) began in September 2004 and is in its second year of a sustainability cooperative agreement. The cooperative agreement with the Directorate General of Disease Control and Environmental Health (DG DC-EH) began in September 2006 and is in its final year. Partners for all activities under the two agreements include the World Health Organization (WHO) and the U.S. Agency for International Development (USAID).

Through the two cooperative agreements, technical support is provided by CDC staff to enhance surveillance capacity, laboratory support function, pandemic preparedness and National Influenza Center (NIC) activities. For surveillance, a number of routine systems were supported through the four CDC technical staff in-country. The supported systems included the sentinel influenza-like illness (ILI) and severe acute respiratory infections (SARI) surveillance systems administered by NIHRD, as well as the Early Warning Alert and Response System (EWARS) that is administered by the Subdirectorate of Surveillance and Outbreak Response in the DG DC-EH. With regard to the East Jakarta Project, to initiate surveillance CDC staff provided technical assistance for protocol development and establishment of standard operating procedures (SOP) for the project, including establishing laboratory support and diagnostic testing capacity.

Surveillance

For ILI surveillance, the systems continued to operate in 24 health care centers in 24 provinces over the last year. SARI surveillance also continued in 10 hospitals throughout the country. The systems provided important information about the virus subtypes circulating in different parts of the country.

The East Jakarta Project commenced in August 2011 and rapidly provided information about the epidemiology, clinical presentation and virus subtypes circulating in an urban area in one province in Indonesia.

EWARS is the national surveillance system for 22 epidemic-prone diseases. As part of strengthening this routine system, upgrades were implemented to the data collection, collation and reporting tools in two provinces (West Nusa Tenggara and Yogyakarta) in the last year. The improved system is now implemented in 10 provinces, and there are plans to further evaluate performance and present the upgrades to another 13 provinces in the next two years.

Surveillance Activities

ILI/SARI Surveillance

- The systems tested 3,378 specimens in 2010 and 3,754 specimens in 2011. Through the ILI surveillance, two cases of human influenza A (H5N1) infection were identified. One was in the East Java province and the other was in the Jakarta province. Both cases recovered.
- Analysis at NIHRD found that influenza B and influenza A(H1N1)pdm09 were the dominant viruses circulating in the latter part of 2010, and there was increased circulation of influenza A(H3) in 2011. This was aligned with findings from other South-East Asian countries.

East Jakarta Project

- In 2010 and 2011, a number of coordination meetings were held to prepare for the start of the surveillance activity. Protocols for data collection, reporting, specimen handling and laboratory testing were developed. Surveillance focal points in each health care center and hospital were selected and training was provided to all those involved in the project.

EWARS

- CDC staff worked with the MOH, provincial and district health staff to implement the changes, streamline activities and provide training to both surveillance officers and health care workers at the local level in two provinces.
- A number of advocacy meetings, training sessions and monitoring missions were held during the year to ensure that the changes were appropriately implemented and problems were addressed.

Laboratory

Two key surveillance activities received laboratory support during FY 2011: ILI/SARI surveillance through NIHRD and the East Jakarta Project.

For ILI/SARI surveillance, a key activity conducted was the establishment of a logistics management system. This system was necessary as there was no formal inventory, training or support for field staff involved in the surveillance. The lack of a logistics management system also burdened the technical staff at NIHRD with logistics trouble-shooting.

For the East Jakarta Project, two laboratories were empowered to conduct the diagnostic testing for specimens arising from case detection. CDC-Indonesia conducted laboratory assessments in the Jakarta Provincial Laboratory and the infectious disease hospital (RSPI Sulianti Saroso) in April 2011. Equipment was provided to set up the laboratories for PCR testing and training was provided to staff to reinforce the diagnostic protocol and biosafety requirements.

Laboratory Activities

ILI/SARI Surveillance

- An annual meeting was held with all sentinel data collection/reporting sites and laboratories.
- All laboratories in the ILI network participated in quality control (proficiency testing).
- Virological findings were submitted to FluNet.
- Logistics training material and master trainers were prepared for the roll out of the SOPs.
- Training rolled out to five ILI laboratories and 20 ILI data collection sites.
- Quarterly field monitoring missions were held jointly by NIHRD, U.S. Agency for International Development's (USAID) DELIVER Project and CDC.

East Jakarta Project

- The assessments conducted in April 2011 reviewed the laboratory layout to ensure adherence with good laboratory practice and safety for molecular work, suitability of equipment for PCR testing, and capacity and knowledge of laboratory technicians in conducting PCR testing.
- After the assessments, equipment including a PCR machine was provided to the provincial laboratory. This procurement was rapidly followed in May 2011 by training and monitoring of laboratory performance, and demonstration and training in use of real-time PCR and production of viral transport media.
- By the end of FY 2010, assistance was continually provided by CDC staff to both laboratories in PCR testing for ILI and SARI specimens, production of viral transport media, refresher trainings on laboratory SOPs and quarterly evaluation on laboratory practice.

Preparedness

Pandemic planning activities continued during FY 2010 through support of the cooperative agreement to DG DC-EH. A key activity was a meeting to gather lessons learned from pandemic planning exercises and research conducted in Indonesia. The meeting was held in Batam in 2011.

Preparedness Activities

- Preparations for the Batam meeting were conducted in the early half of the fiscal year. Participants included universities, provincial health offices, international partners such as WHO, and researchers.
- The meeting was held September 26–28, 2011. The meeting involved discussions about influenza pandemic planning strategies and responses, enhancing influenza surveillance, improving laboratory capacity on influenza testing, animal-human interface for influenza, reviewing influenza vaccination programs and non-pharmaceutical interventions during an influenza pandemic.
- Lessons learned were used to revise the national health influenza pandemic preparedness plan.

Training

Reflecting the key areas of CDC collaborative work in Indonesia, a number of training activities were conducted during FY 2010 to support ILI/SARI surveillance, EWARS and the East Jakarta Project. Trainings involved both technical and operational aspects such as:

- Laboratory techniques (for East Jakarta Project).
- Logistics management (ILI/SARI surveillance and East Jakarta Project).
- Surveillance processes including application of case definition for notifiable diseases, data collection, data collation and reporting (EWARS in Yogyakarta and West Nusa Tenggara). Trainings for enhancing EWARS involved training district and provincial surveillance staff in analyzing surveillance data to generate system alerts, investigation and verification, and response to disease outbreaks. Importantly, surveillance staff were also trained in generating feedback about surveillance findings to system stakeholders.
- Integrated (human and animal) influenza A (H5N1) outbreak investigations. Training was imparted by the Food and Agriculture Organization (FAO) and CDC to the Indonesian Ministry of Health and Ministry of Agriculture.

A sign for Avian Influenza at a sentinel site.

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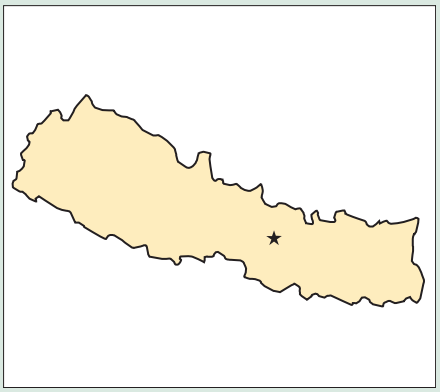
Nepal



- **Capital:** Kathmandu
- **Area:** 147,181 sq km
- **Population:** 29,890,686 (July 2012 est.)
- **Age Structure:** 0-14 years: 34.6% (male 5,177,264/female 4,983,864); 15-64 years: 61.1% (male 8,607,338/female 9,344,537); 65 years and over: 4.4% (male 597,628/female 681,252) (2011 est.)
- **Life Expectancy at Birth:** Total population: 66.51 years; male: 65.26 years; female: 67.82 years (2012 est.)
- **Infant Mortality Rate:** Total: 43.13 deaths/1,000 live births; male: 43.15 deaths/1,000 live births; female: 43.1 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 48.6%; male: 62.7%; female: 34.9% (2001 census)
- **GDP:** $37.74 billion (2011 est.)
- **GDP per Capita:** $1,300 (2011 est.)

Highlights

- Additional well qualified staff were hired and trained. The team now includes a virologist, a public health epidemiologist and an assistant to oversee consistent data and specimen collection at the sentinel site.
- Nepal's Patan Academy of Health Sciences (PAHS) has one year of reliable epidemiologic and virologic data for influenza-like illness (ILI) from Patan Hospital.
- Patan Hospital is transferring all written hospital charts into an electronic database with an identification number so it will be easy to analyze ILI and severe acute respiratory infections (SARI) data by age, gender and co-morbidities.

U.S. CDC Direct Country Support

Nepal's Patan Academy of Health Sciences (PAHS), a public health science university at Patan Hospital, was awarded Nepal's first influenza cooperative agreement in September 2009. The project, *Influenza Pandemic Preparedness and Response Project (IPPRP)*, is in their second year of a four-year award.

PAHS's goals are to support Nepal's Ministry of Health and Population (MOHP) in the following activities: establishment of routine influenza virologic and epidemiologic surveillance in three sentinel hospitals, characterization of circulating influenza viruses, understanding the pattern of respiratory illness, and assistance with outbreak response and management. A network of partners consisting of the National Public Health Laboratory (NPHL) at the MOHP, Walter Reed Research Unit Nepal (WARUN) and PAHS work closely to achieve these goals. The U.S. Centers for Disease Control and Prevention (CDC) cooperative agreement has strengthened influenza surveillance and supported building epidemiologic and laboratory capacity in Nepal.

Nepal has experienced several outbreaks of avian influenza in poultry. Teams that include NPHL staff are part of the rapid response. No human avian influenza A (H5N1) cases have been detected to date.

Surveillance

Currently, the network plans to have a total of 11 routine influenza surveillance sentinel sites. PAHS will oversee three ILI/SARI sites, WARUN oversees three ILI sites, and NPHL plans to oversee five ILI/SARI sites. All PAHS and NPHL sites will use the same reporting forms and standard operating procedures. Together the three agencies will cover key geographic areas around the country. The institutions share data, provide trainings together, and support each other through technical assistance and resources when needed.

Surveillance Activities

- PAHS has collected and analyzed ILI epidemiologic data by age and gender from Patan Hospital since January 2010. Specimens have been collected from ILI cases since January 2011. SARI surveillance is expected to begin in early 2012. PAHS reports the total number of outpatients seen, the proportion of ILI by age and gender, and the number and percent of cases testing positive for influenza.
- The MOHP uploads ILI and SARI cases into the World Health Organization's (WHO) FluNet on a quarterly basis.
- PAHS staff with expertise in epidemiology and collecting, storing and sending specimens made technical assistance visits to the additional two influenza sentinel sites, B.P. Koirala Institute of Health Sciences in eastern Nepal and Nepalgunj Medical College in western Nepal. Epidemiological and virological surveillance began in these sites in early January 2012.
- A pilot sentinel site is being established in a public health community center in Bhimphedi, Makwanpur district. ILI samples will be collected to determine prevalence of ILI in a local community where many families seek their non-urgent health care.
- Network partners have established two influenza seasons: July–September (monsoon) and January–March (cold weather).

Laboratory

NPHL was designated a National Influenza Center (NIC) in 2010. A newly constructed Biosafety Level 2 (BSL-2) laboratory is fully functional. The NIC is now capable of conducting tissue culture, virus isolation and sequencing. PAHS is establishing a BSL-2 molecular laboratory with real-time RT-PCR and will test samples from their sentinel sites as well as provide backup support to the NIC when asked. Until the PAHS laboratory is functional, ILI and SARI specimens are tested at NPHL using real-time RT-PCR.

Laboratory Activities

- PAHS hired a virologist who will oversee the molecular laboratory.
- PAHS staff trained sentinel site laboratory personnel and will continue to provide technical assistance on sample collection technique, specimen storage and shipping, and completing forms correctly.
- With reagents from CDC, the NIC is testing for influenza A (H1), influenza A (H3), influenza A (H5) and influenza B.
- The NIC has submitted 28 influenza viral isolates to the WHO Collaborating Center in Tokyo for advanced antigenic and genetic analysis. The results help form the basis for the WHO recommendations on the composition of influenza vaccine each year.
- A total of 311 samples were tested and 39% were positive for influenza. Of those that were positive, 98.33% were influenza A viruses and 1.67% were influenza B viruses.

Preparedness

PAHS uses the recording forms, formats and requirements as per national protocols which are consistent with International Health Regulations 2005 (IHR). PAHS continues to work with the sentinel sites in East and West Nepal to build their preparedness capacity for future outbreaks and pandemics.

Entry to Nepal's Department of Health Services.

Preparedness Activities

- Patan Hospital developed an emergency plan to be used in response to an outbreak, pandemic or disaster.
- With MOPH and other partners, PAHS developed mass media messages needed during an outbreak which will be broadcast when needed.
- Simulation exercises involving an outreach technical team occur twice a year in Patan Hospital.
- Each sentinel site (each is a tertiary hospital) has an isolation room that will be used during an outbreak or pandemic.
- A workshop is being planned for Ministry of Education, Nepal Police and journalists to discuss their roles during a serious outbreak or pandemic.

Training

- The PAHS virologist received training on occupational health and biosafety from the U.S. Army Medical Component of the Armed Forces Research Institute of the Medical Sciences in Kathmandu.
- The medical and laboratory personnel at the network sentinel sites were given an orientation workshop that taught case definitions, case identification and laboratory sample collection.
- The IPPRP team held a five-day workshop that included reviewing progress to date and setting milestones for future.
- IPPRP staff visited sentinel sites to provide hands-on training and technical assistance.

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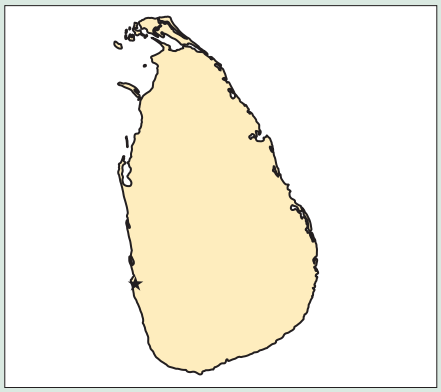
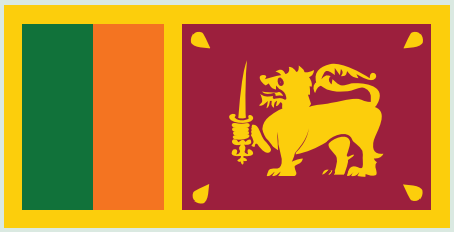
Sri Lanka





- **Capital:** Colombo
- **Area:** 65,610 sq km
- **Population:** 21,481,334 (July 2012 est.)
- **Age Structure:** 0-14 years: 24.9% (male 2,705,953/female 2,599,717); 15-64 years: 67.2% (male 6,993,668/female 7,313,440); 65 years and over: 7.9% (male 720,219/female 950,916) (2011 est.)
- **Life Expectancy at Birth:** Total population: 75.94 years; male: 72.43 years; female: 79.59 years (2012 est.)
- **Infant Mortality Rate:** Total: 9.47 deaths/1,000 live births; male: 10.44 deaths/1,000 live births; female: 8.45 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 90.7%; male: 92.3%; female: 89.1% (2001 census)
- **GDP:** $116.2 billion (2011 est.)
- **GDP per Capita:** $5,600 (2011 est.)

Highlights

- The three severe acute respiratory infection (SARI) sites established the previous year are now functioning optimally and are routinely collecting and sending epidemiologic data and the requested number of specimens.
- Major equipment was purchased for the National Influenza Center (NIC) that enhanced the capacity to process and store influenza specimens.
- The NIC continues to submit seasonal influenza samples to World Health Organization (WHO) Collaborating Centers (CC) twice a year and has been fulfilling NIC requirements as outlined by WHO.

U.S. CDC Direct Country Support

Sri Lanka is a developing nation with a sound public and curative health infrastructure. The Epidemiology Unit of the Ministry of Health (MOH), which is the government agency responsible for communicable disease surveillance, control and prevention, was awarded their first cooperative agreement in September 2009. The agreement is currently in its third year of a four-year award. The program's goal is to build the country's capacity to detect and respond to pandemic threats by building routine influenza surveillance, laboratory, planning and communications capacities.

Key collaborating partners include the Medical Research Institute (MRI), the national laboratory which serves as the country's NIC, the Health Education and Promotion Bureau and the Department of Animal Production and Health.

Surveillance

Human and animal influenza surveillance in Sri Lanka began in 2005 as part of their avian influenza preparedness program. With World Bank funding, the MOH established 20 sentinel hospitals, each of which set up influenza-like illness (ILI) surveillance. U.S. Centers for Disease Control and Prevention (CDC) funds are now used to help maintain the ILI surveillance in these and carry out SARI surveillance in three of the 20 sentinel sites.

Surveillance Activities

- All 20 ILI sentinel sites and three SARI sites showed considerable progress in targeted ILI and SARI surveillance in FY 2011.
- In order to strengthen the surveillance program, the Epidemiology Unit provided all ILI and SARI surveillance sites with stocks of commercial throat swabs (with and without viral transport media) and information technology equipment to units of Infection Control Nursing Officers (ICNO) in these sites.
- The Epidemiology Unit recruited a surveillance officer for each SARI site who is responsible for identifying patients meeting the case definition, collecting epidemiologic data and assuring swabs are taken.
- Epidemiology Unit staff conducted sentinel site visits to review procedures and provide technical assistance.
- The Unit conducted a special awareness program for directors and Officer Professional Development medical officers, and three training programs for ICNO of sentinel hospitals to strengthen surveillance activities.
- Sri Lanka regularly enters virological data via FluNet.

Laboratory

MRI was designated a WHO NIC in 1968. MRI also functions as the main national diagnostic laboratory in the MOH. The NIC has capacity to conduct real-time RT-PCR and viral isolation.

Laboratory Activities

- The NIC processed 2,066 ILI samples from the 20 sentinel sites and 389 SARI samples from the three SARI sites in FY 2011.
- MRI characterizes the influenza type and subtype of seasonal/circulating influenza viruses as well as avian influenza A (H5) using real-time RT-PCR and conventional PCR.
- The NIC submits seasonal influenza samples to a WHO CC twice a year and fulfills NIC requirements as outlined by WHO.
- With CDC funds, the Epidemiology Unit procured an incubator, a class II biosafety cabinet and -70°C freezer, and reagents and essential consumables were purchased for the MRI to enhance laboratory surveillance activities.

Preparedness

The *National Influenza Preparedness Plan*, originally drafted in 2005, was updated with experience gathered from the two waves of the pandemic.

Preparedness Activities

- Epidemiologists at central and regional levels held regular capacity-building sessions.

- The updated, revised preparedness plan was finalized and posted on the Unit website and moves are underway to print the document.
- The Epidemiology Unit initiated development of a web-based system that links data between the Unit and the NIC. This will facilitate data analysis.
- The national technical committee on influenza preparedness held monthly meetings to streamline the country's response to the second wave of the pandemic.

Training

The Epidemiology Unit hosted and attended the following training activities in 2011:

- Health care workers in sentinel hospitals were trained in pandemic preparedness and the national influenza preparedness plan.
- Infection control nursing officers who are responsible for ILI and SARI surveillance at sentinel hospitals were trained in laboratory and epidemiological components of ILI and SARI surveillance and infection control.
- Regional epidemiologists attended trainings on field epidemiology, including influenza surveillance and pandemic preparedness.
- Hospital administrators and senior medical officers in outpatient departments from all sentinel hospitals attended training sessions on the importance of ILI surveillance and pandemic preparedness.
- Two regional epidemiologists attended a field epidemiology training course conducted in India, July–October 2011.
- In November 2010, an epidemiologist participated in informal consultations at the South-East Asia Regional Office in New Delhi regarding the development of a national pandemic strategic response assessment tool.

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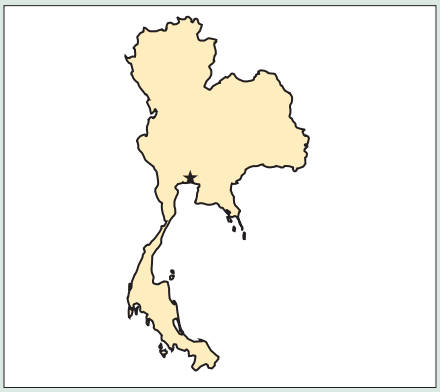
Thailand



- **Capital:** Bangkok
- **Area:** 513,120 sq km
- **Population:** 67,091,089 (July 2012 est.)
- **Age Structure:** 0-14 years: 19.9% (male 6,779,723/female 6,466,625); 15-64 years: 70.9% (male 23,410,091/female 23,913,499); 65 years and over: 9.2% (male 2,778,012/female 3,372,203) (2011 est.)
- **Life Expectancy at Birth:** Total population: 73.83 years; male: 71.45 years; female: 76.33 years (2012 est.)
- **Infant Mortality Rate:** Total: 15.9 deaths/1,000 live births; male: 16.88 deaths/1,000 live births; female: 14.86 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 92.6%; male: 94.9%; female: 90.5% (2000 census)
- **GDP:** $601.4 billion (2011 est.)
- **GDP per Capita:** $9,700 (2011 est.)

Highlights

- Published a paper describing seven years of sentinel surveillance data for influenza in Thailand.
- Expanded phylogenetic and antiviral resistance testing.

U.S. CDC Direct Country Support

Fiscal Year 2011 was the second year of a sustainability cooperative agreement with the National Institute of Health (NIH) in Thailand. The agreement *Strengthening Thailand's Influenza Surveillance Network to Support Influenza Control Policy and Improve Pandemic Preparedness* is NIH's second, five-year cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC).

Surveillance

The Thai National Influenza Center (NIC) continues to operate 11 sentinel sites for influenza-like illness (ILI) surveillance in outpatients; three of these also conduct severe acute respiratory infection (SARI) surveillance in their hospitalized patients. The sites are geographically diverse and are located throughout northern, central and southern Thailand. In 2011, peak influenza activity occurred from mid-July through September. The most commonly identified influenza virus circulating in Thailand during this time period was influenza A (H3N2).

Surveillance Activities

- Weekly data are summarized and posted online and are publically available at http://www.thainihnic.org/.
- Working with the Bureau of Epidemiology, the NIH surveillance sites now collect the total number

of outpatient visits using International Classification of Diseases (ICD) 10 codes so that they can better understand the burden of ILI.

- A summary of seven years of influenza data from Thailand was published in a peer-reviewed journal.
- There were 94,407 (3.8%) ILI cases identified from a total 2,513,048 out-patient department (OPD) visits.

Laboratory

The Thai NIC, a World Health Organization (WHO)-designated Regional Influenza Reference Laboratory for Southeast Asia, continued to test an average of 80 respiratory samples each week for influenza viruses. In addition to testing for influenza viruses, laboratories were strengthened and tested for antiviral resistance using pyrosequencing and detection for other respiratory viruses [adenovirus, parainfluenza viruses (PIV), human metapneumovirus (hMPV) and respiratory syncytial virus (RSV)] using PCR.

Eggs used for manufacturing vaccine in one of Thailand's Government Pharmaceutical Organization (GPO) plants.

Laboratory Activities

- The NIH tested a total of 4,008 respiratory samples (3,682 from patients with ILI and 326 from patients with SARI).
- Among the 3,682 patients with ILI, 780 (21%) were positive for influenza viruses (382 were influenza A (H3N2) viruses, 152 were influenza A (H1N1)pdm09 viruses, and 246 were influenza B viruses). Among the 326 patients with SARI, 56 (17%) were positive for influenza (32 were influenza A (H3N2) viruses, seven were influenza A (H1N1)pdm09 viruses, and 17 were influenza B viruses).
- Of the 310 influenza viruses tested for antiviral resistance, only one influenza A (H1N1)pdm09 virus was found to be resistant to oseltamivir.
- Of the 326 respiratory samples from SARI patients, 114 (35%) were positive for other respiratory viruses (42 RSV, 28 hMPV, 26 adenovirus, one PIV1, four PIV2 and 13 PIV3).

Preparedness

With the support and policy of the Ministry of Public Health (MOPH), Thailand expects to increase the capacity and ability of nationwide influenza testing to improve preparedness and response time in the next pandemic or emerging infectious disease event. The 25 regional hospital laboratories were encouraged to become a part of the laboratory network. Recently, these laboratories have participated in training on diagnosis of influenza A(H1N1)pdm09 by RT-PCR. In 2011, seven regional hospital laboratories and three private laboratories in Bangkok were evaluated according to the standard requirements of MOPH for molecular diagnostics of influenza A (H1N1)pdm09 detection by RT-PCR.

Preparedness Activities

- The Department of Medical Sciences participated in the working group for development of the national strategic plan for emerging infectious diseases that includes strategic plans for prevention, control, and preparedness and resolution of avian influenza and pandemic influenza.
- The Thai NIC provided positive controls to support regional hospital laboratories, ensure the supplies needed to establish a laboratory that is accessible, and provided an External Quality Assessment to assess performance and proficiency.

- The Thai NIC continued sampling and conducting antiviral sensitivity testing on at least 20 isolates per month.
- The Thai NIC holds a refresher PCR training workshop once a year for regional medical science laboratory staff to update and review diagnostic protocols, the global influenza situation and the external quality assurance program.

Training

To enhance the capacity of the Thai NIC as a key coordinating unit, scientists participated in the following trainings, conferences, and meetings:

- Participated in the training course "Construction of reverse genetic of drug resistant virus and study of phylogenetic tree for prediction of novel or drug resistant in influenza virus" at the WHO Collaborating Center in Melbourne, Australia, February 28–March 11, 2011.
- Attended the training course "EQAS preparation for qualitative and quantitative nucleic acid testing" at the National Serology Reference Laboratory in Melbourne, Australia, March 21–April 1, 2011.
- Visited the Virology Division at the Centre for Health Protection (CHP) in Hong Kong Special Administrative Region (WHO Influenza External Quality Assessment Project), May 26–27, 2011.
- Attended the workshop "The Molecular Evolution of Influenza Viruses" at the National Institute of Virology in Pune, India, May 23–June 3, 2011.
- Attended the meeting "International Union Microbiological Societies 2011 Congress" in Sapporo, Japan, September 10–17, 2011.

Publications

- Chittaganpitch M, Supawat K, Olsen SJ, Waicharoen S, Patthamadilok S, Yingyong T, Brammer L, Epperson SP, Akrasewi P, Sawanpanyalert P. Influenza in Thailand: 7 years of sentinel surveillance data, 2004–2010. Influenza and Other Respiratory Viruses. 2012;6(4):276-83.
- Chittaganpitch M, Waicharoen S, De Silva JW, Supawat K, Pattamadilok S, Auwanit W, Olsen SJ, Akrasewi P, Sawanpanyalert P. A study of oseltamivir resistant influenza viruses in Thailand, 2008–2010. Regional Health Forum WHO South-East Asia Region. 2011;15(1):57-62.

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WHO Western Pacific Region (WPR)

WHO Western Pacific Region (WPR) Overview

There are six bilateral influenza cooperative agreements in the World Health Organization (WHO) Western Pacific Region (WPR). These agreements, with ministries of health, or institutions designated by ministries of health, work with the U.S. Centers for Disease Control and Prevention (CDC) to build capacity to routinely identify, diagnosis, and respond to seasonal and pandemic influenza.

CDC direct country support via cooperative agreements is established in the following countries:

- Cambodia
- China
- Mongolia
- Secretariat of the Pacific Community (SPC)
- The Philippines
- Vietnam

In addition, CDC supports the WHO Western Pacific Regional Office (WPRO) via a cooperative agreement and therefore indirectly provides assistance to the following countries:

- Fiji
- Lao People's Democratic Republic
- Papua New Guinea

The core activities of these bilateral agreements are:

- To build sustainable, national capacity for seasonal influenza, pandemic influenza and other emerging infectious diseases and to prepare for implementation of International Health Regulations 2005 (IHR).
- To make routine submissions of surveillance data to WHO's Global Influenza Surveillance and Response System (GISRS).
- To increase the geographic reach of WHO GISRS.
- To provide early access to critical virus isolates from humans and birds for WHO GISRS.
- To increase the number of influenza isolates for analysis shipped from WHO WPR influenza laboratories to WHO Collaborating Centers (CC) for analysis.
- To develop sustainable epidemiologic and virologic surveillance systems for severe influenza, in order to gain an understanding of the burden of disease from influenza in the WHO WPR.

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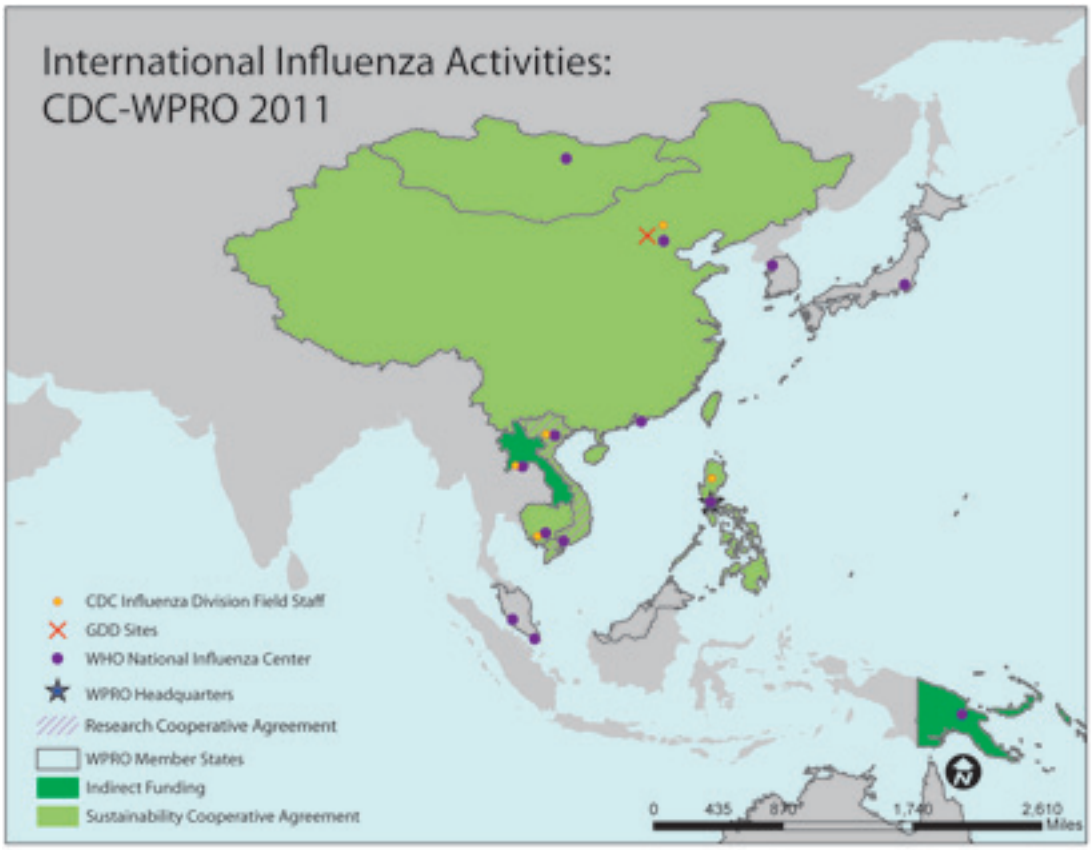
WHO Western Pacific Regional Office (WPRO)



Highlights

- China's National Influenza Center (NIC) at the National Institute for Viral Disease Control and Prevention, Chinese Center for Disease Control and Prevention, was officially designated a World Health Organization (WHO) Collaborating Center for Reference and Research on Influenza (CC).
- A five-year influenza work plan was developed by the Global Influenza Surveillance and Response System (GISRS) Member States of the WHO Western Pacific and South-East Asia regions, titled "Bi-Regional Plan for Further Strengthening National Influenza Surveillance: Guiding the way towards Influenza Control Policy and Regional Surveillance."

U.S. CDC Direct WHO Regional Office Support

WHO's Western Pacific Regional Office (WPRO) is located in Manila, The Philippines. The office serves 37 countries and an area that spans from the Northern Hemisphere, through the tropics and into the Southern Hemisphere. This region covers nearly one-quarter of the world's population with approximately 1.6 billion inhabitants. Influenza surveillance has been established in many countries in the region. GISRS in the Western Pacific Region (WPR) consists of 21 National Influenza Centers in 15 countries, three WHO CCs, one each in Australia, China, and Japan, and two Essential Regulatory Laboratories, one in Australia and one in Japan.

WHO WPR, together with WHO South-East Asia Region (SEAR), uses a common framework to strengthen national and regional capacities to manage emerging infectious diseases, improve pandemic influenza preparedness and comply with the requirements of the International Health Regulations 2005 (IHR). This framework is a product of the Asia Pacific Strategy for Emerging Diseases (APSED) which was expanded in

2010 and subsequently endorsed by the regional committee in July 2011. The strategy includes components such as surveillance and laboratory strengthening, necessary to support GISRS.

The five-year cooperative agreement between the U.S. Centers for Disease Control and Prevention (CDC) and WHO WPRO, which began September 30, 2006 (FY 2011 was the fifth year of the agreement), has supported the implementation of APSED, and therefore influenza surveillance and response capacity, through three pillars of work: 1) preparedness and communications; 2) surveillance and detection; and 3) response and containment. The agreement also included funds directed to countries through WHO offices in Cambodia, China, the Federated States of Micronesia, Fiji, Lao People's Democratic Republic (Lao PDR), Papua New Guinea and Vietnam.

Surveillance

The availability of data from WHO WPR during the 2009 H1N1 pandemic was a testament to the great strides countries and territories from this region have made in strengthening surveillance systems, including the establishment of syndromic surveillance (e.g. for influenza-like illness (ILI), severe acute respiratory infections (SARI), acute respiratory infections (ARI)) and laboratory capacity for influenza case confirmation. While the response to the recent pandemic indicated that efforts towards preparedness had been beneficial, it also revealed some gaps in influenza surveillance and laboratory-based diagnoses, and varying capacity among countries in the region. Consequently, since the 2009 H1N1 pandemic, surveillance activities, supported by WPRO, have focused on defining the epidemiology and burden of influenza by linking the epidemiological and virological aspects of influenza surveillance and strengthening national and regional networks. This has been achieved through support for:

- Annual bi-regional meeting of NICs;
- Strengthening of national and regional influenza laboratory and epidemiological surveillance and control capacities;
- Disease burden studies in the region;
- Human resources for strengthening national and regional management and coordination of influenza surveillance and control;
- ILI surveillance in Cambodia, China, Lao PDR, Mongolia, the Pacific Island Countries and Vietnam.

Surveillance Activities

- A scientific writing workshop for influenza researchers in the region was conducted in April 2011 in Seoul, Korea. Four manuscripts have been published in peer-reviewed journals, two manuscripts are under review and work continues on the remaining manuscripts.
- The bi-regional (WHO WPR and WHO SEAR) NIC meeting was conducted in June 2011 in Vientiane, Lao PDR. The outcomes from this meeting are published in the WHO Weekly Epidemiological Record: Fifth Meeting of National Influenza Centers–WHO Western Pacific and South-East Asia Regions. WER. 2012; 87(7):61-64.
- A five-year work plan titled "Bi-Regional Plan for Further Strengthening National Influenza Surveillance: Guiding the way towards Influenza Control Policy and Regional Surveillance" has been developed and is available online: www.wpro.who.int/topics/influenza/InfluenzaSurveillanceFiveYearWorkplan_website.pdf.
- A regional influenza research agenda meeting was held in June 2011 in Vientiane, Lao PDR, from which manuscripts are being developed.
- A surveillance data analysis and writing workshop was held in Ulaanbaatar, Mongolia, from June 20–23, 2011. Manuscript development is in progress.

- Mongolia's web-based surveillance reporting platform has been translated into English.

Laboratory

Influenza laboratory activities in the region focused on strengthening GISRS and improving virological testing capacity in an environment where safe laboratory practices and quality assurance are ensured through:

- Implementing quality systems that incorporate elements such as biosafety plans, standard operating procedures (SOP), adequate infrastructure, equipment and supplies, streamlined procurement, and administrative assistance;
- Implementing quality standards through the establishment of SOPs for quality assurance and quality control (QA/QC), laboratory algorithms, and participation in the WHO External Quality Assessment Project (EQAP);
- Conducting virus isolation using cell culture or embryonated hen's eggs;
- Enhancing molecular diagnostic capacity, such as real-time PCR for seasonal influenza, H5N1 and novel influenza viruses;
- Typing and subtyping influenza viruses using standard serologic WHO reagents;
- Enhancing systems and protocols to rapidly detect and respond to unsubtypable viruses;
- Regularly shipping representative influenza strains to a WHO CC and shipping any novel and unsubtypable strains as urgent;
- Developing additional testing as appropriate and feasible, such as gene sequencing, hemagglutination inhibition, micro-neutralization, and antiviral drug sensitivity testing;
- Where appropriate, developing in-country networks, such as networks of subnational laboratories that are mentored by NICs (e.g. in QA/QC, proficiency testing) and can respond rapidly in outbreak/pandemic situations.

Laboratory Activities

- WPRO supported the NIC, National Centre of Laboratory and Epidemiology, Ministry of Health, Lao PDR, with the procurement of a sequencing machine.
- WPRO supported the NIC, Institute of Medical Research, Papua New Guinea, with procurement of equipment to establish virus culture capacity.
- WPRO supported the NIC, Research Institute of Tropical Medicine, the Philippines, with procurement of equipment to strengthen laboratory capacity.
- In collaboration with the WHO CCs in Atlanta and Melbourne, a laboratory capabilities and capacity review was conducted at the NIC, Institute of Medical Research, in Papua New Guinea, June 27–29, 2011. Based on this review, a one-year work plan for improvement of the NIC was drafted and two graduate scientific officers from the NIC were trained in molecular techniques and virus culture at the WHO CC in Melbourne.
- A regional training workshop for laboratory staff in the International Air Transport Association (IATA) guidelines for shipping infectious substances was conducted in Phnom Penh, Cambodia, September 14–16, 2011. Fifteen participants from seven countries in the region (Cambodia, China, Lao PDR, Malaysia, Papua New Guinea, the Philippines and Vietnam) attended the training.
- A second regional training workshop for laboratory staff in the IATA guidelines for shipping infectious substances was conducted three months later in Hanoi, Vietnam, December 6–10, 2011. Thirty participants from nine countries in the region (Cambodia, China, Lao PDR, Malaysia,

Mongolia, the Philippines, Singapore, South Korea and Vietnam) attended the training.

Preparedness

Influenza preparedness and response activities in the region focused on support for:

- Member States and/or WHO country offices to exercise pandemic containment plans.
- Member States to develop and exercise risk communication plans.
- Member States to strengthen outbreak response capacity.
- Preparedness and response activities in Cambodia and Lao PDR.

Preparedness Activities

- A pandemic containment exercise was conducted jointly with WPRO, the WHO country office in Mongolia, and the Japan International Cooperation System (antiviral stockpile management) in December 2010. A regional pandemic review was conducted in Beijing, China, March 2011.
- Four countries (Cambodia, China, Mongolia, and the Philippines) were supported to conduct in-depth, retrospective reviews of media messages they produced at the time of the 2009 H1N1 pandemic and how these messages were reported by print, television and radio media. These countries have developed national reports on their pandemic-related, media-based communication experiences and lessons learned and these reports will be consolidated into a regional report.
- The establishment of WPRO's Emergency Operation Center (EOC) was supported with procurement of equipment.
- WPRO supported the establishment of an EOC in the WHO Lao PDR office through the procurement of equipment.

Training

- WPRO supported training on molecular techniques and virus culture for a Laboratory Specialist from the NIC in Fiji at the WHO CC in Melbourne.
- Forty-five people from 10 countries participated in the "Regional Training Workshop of Laboratory Staff for IATA Licensing for Transportation of Infectious Substances" either in Hanoi, Vietnam, or Phnom Penh, Cambodia.
- Three government staff from Papua New Guinea participated in the Field Epidemiology Training Program (FETP) short course in Chennai, India.
- ILI surveillance and outbreak response trainings were supported in Cambodia, China, Lao PDR and the Pacific Island Countries.

Publications

- McCallum L, Partridge J. Epidemiological characteristics of the influenza A(H1N1) 2009 pandemic in the Western Pacific Region. Western Pacific Surveillance and Response Journal. 2010;1(1).

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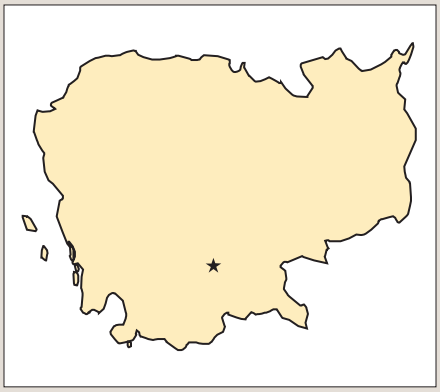
Cambodia



- **Capital:** Phnom Penh
- **Area:** 181,035 sq km
- **Population:** 14,952,665 (July 2012 est.)
- **Age Structure:** 0-14 years: 32.2% (male 2,375,155/female 2,356,305); 15-64 years: 64.1% (male 4,523,030/female 4,893,761); 65 years and over: 3.8% (male 208,473/female 344,993) (2011 est.)
- **Life Expectancy at Birth:** Total population: 63.04 years; male: 60.66 years; female: 65.53 years (2012 est.)
- **Infant Mortality Rate:** Total: 54.08 deaths/1,000 live births; male: 61.02 deaths/1,000 live births; female: 46.82 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 73.6%; male: 84.7%; female: 64.1% (2004 est.)
- **GDP:** $32.95 billion (2011 est.)
- **GDP per Capita:** $2,300 (2011 est.)

Highlights

- Cambodia's National Institute of Public Health Laboratory (NIPHL) commenced structural enhancements of their BSL-2, BSL-2+, and cell culture rooms.
- The NIPHL achieved perfect scores on panels nine and ten of the WHO External Quality Assessment Project (EQAP) for the detection of influenza A by PCR.
- Cambodia's Ministry of Health (MOH), together with the World Health Organization (WHO) finalized three national pandemic influenza strategic plans for 2011–2015: the Health Sector Pandemic Influenza Response Strategy, the Pandemic Influenza Communication Strategy, and the Pandemic Influenza Rapid Containment Strategy.

U.S. CDC Direct Country Support

Since 2006, the U.S. Centers for Disease Control and Prevention (CDC) has provided support to Cambodia's influenza surveillance through the following cooperative agreements: *Development of Influenza Surveillance Networks Overseas* with the Cambodian Ministry of Health (MOH), and *Surveillance and Response to Avian and Pandemic Influenza* with WHO. In addition, from 2006 to 2010 CDC funded a cooperative agreement titled *Avian Influenza Community Based Risk Reduction Project* with the non-government organization, CARE International. The collective goals of these cooperative agreements have been to build human capacity and infrastructure for influenza surveillance, response, laboratory diagnosis, and pandemic preparedness.

CDC's initial five-year cooperative agreements with Cambodia's MOH and WHO, respectively, ended in September 2010. A second five-year, sustainability cooperative agreement between CDC and Cambodia's MOH started in October 2010 titled *Sustaining Cambodia's Influenza Surveillance Networks and Response to Seasonal and Pandemic Influenza*.

Implementation of these cooperative agreements has resulted in the establishment of a molecular laboratory at NIPHL capable of detecting influenza viruses, seasonal and avian, and other respiratory viruses. CDC's support has also led to the expansion of laboratory-based national surveillance for influenza and other acute respiratory diseases, and strengthening of national and local response to respiratory and other communicable disease outbreaks.

Surveillance

Since 2006, laboratory-based influenza surveillance in Cambodia has been entirely supported by CDC's cooperative agreements with the MOH and WHO. Influenza-like illness (ILI) surveillance, which began in 2006 with four sites in four provinces, has since expanded to 13 sites covering eight provinces for improved geographical representation. Upper respiratory specimens from ILI patients are sent from each site to either the Institute Pasteur Cambodia (IPC) or NIPHL for testing every week.

In 2009, severe acute respiratory infection (SARI) surveillance was established at four referral hospitals in three provinces. Patients admitted for SARI at these sites are tested for influenza and other respiratory viruses, bacterial pathogens and acid-fast bacilli. Laboratory testing for SARI surveillance is performed exclusively at NIPHL.

CDC has also supported operational improvements of Cambodia's national communicable disease surveillance (CamEWAR) and event-based surveillance systems, as well as investigations of H5N1 and other outbreaks.

Surveillance Activities

- Maintained ILI surveillance operations, including weekly collection of specimens for testing and electronic disease reporting via mobile phone SMS, at all sites.
- Conducted multiple supervision visits to the country's 13 ILI surveillance sites.
- Maintained SARI surveillance operations, including collection of samples from each SARI patient and collection of individual and weekly aggregate case data, at all sites.
- Implemented conventional RT-PCR testing for human metapneumovirus and adenovirus among pediatric SARI cases (0–4 years of age) as part of SARI surveillance.
- Conducted supervisory site visits to each of the four SARI surveillance sites.
- Revised case definitions for certain disease indicators in CamEWAR surveillance, while also decreasing the number of reportable indicators from 12 to 10.
- Improved event-based surveillance operations, including the generation of a list of all hot-line telephone calls and monthly reports to better characterize the types of calls received and subsequent actions taken with assistance from WHO.
- Conducted field investigations for eight confirmed H5N1 human cases.
- Maintained production of their monthly respiratory disease and influenza bulletin.
- Presented antibiotic-resistance data from SARI surveillance at an antibiotic resistance meeting held in Phnom Penh.

Laboratory

Funding provided through the CDC-MOH cooperative agreement, together with close technical support and monitoring by the CDC Influenza Program in Cambodia, and technical guidance from laboratory staff at CDC's Influenza Division, has resulted in significant strengthening of laboratory testing capacity at the NIPHL. Since 2009, the NIPHL molecular laboratory has been performing real-time RT-PCR for seasonal, avian (H5N1), and pandemic (nH1N1) viruses. In 2010, the NIPHL initiated conventional PCR testing for

respiratory syncytial virus (RSV) and human parainfluenza viruses (hPIV-1, hPIV-2, and hPIV-3), followed by human metapneumovirus and adenovirus in 2011.

NIPHL's microbiology laboratory has also greatly benefited from cooperative agreement support, with testing activity substantially increased after the implementation of SARI surveillance. In turn, the NIPHL has been able to support the development of microbiology laboratories at national and provincial hospitals.

The CDC-WHO cooperative agreement entirely funds influenza testing of ILI surveillance and suspect H5N1 case specimens at the IPC.

Laboratory Activities

- Implemented testing for human metapneumovirus and adenovirus.
- Tested 778 ILI surveillance specimens for influenza; 23 tested positive (B, H3N2, nH1N1) and these samples were shared with the WHO CC in Melbourne.
- Tested 676 SARI surveillance specimens (nasopharyngeal, bronchoalveolar lavage (BAL), pleural fluid) for influenza and other respiratory viruses.
- Tested 264 outbreak specimens for H5N1 and other influenza viruses:
- Detected influenza B in a suspect H5N1 case.
- Detected novel H1N1 among symptomatic contacts of a confirmed H5N1 case.
- Detected novel H1N1 in specimens from a suspect H5N1 outbreak in Kandal Province.
- Performed culture/antibiotic sensitivity and/or acid-fast bacilli detection on 771 SARI surveillance specimens (sputum, BAL, pleural fluid, blood).
- Commenced structural enhancements of their BSL-2, BSL-2+ and cell culture rooms.
- Achieved perfect scores on panels nine and ten of the WHO EQAP for the detection of influenza A by PCR.
- Achieved a perfect score on CDC's pilot, RT-PCR, influenza performance efficiency panel.
- Detected two Vibrio cholerae species (serotype Inaba, non-O1/non-O139) in stool samples from separate diarrheal outbreaks in two different provinces.
- Completeted the microbiology laboratory at the Khmer-Soviet Friendship Hospital which is now functional and operating as a SARI site.
- Completed the microbiology laboratory at Takeo Provincial Hospital and is it now functional.

Preparedness

The CDC-WHO cooperative agreement has considerably advanced pandemic influenza preparedness and planning in Cambodia. The National Committee for Disaster Management, together with partnering ministries, has continued to work on a national pandemic plan, while the MOH and WHO have led the development of a health sector response plan. Furthermore, in 2009, a multi-sector pandemic planning pilot project was successfully completed in Siem Reap Province, resulting in a model planning process for use in other provinces.

CDC funding has extended to other areas of preparedness, such as hospital infection control (IC) and implementation of the International Health Regulations 2005 (IHR). In 2010, WHO assisted the MOH's Hospital Services Department in the development of Cambodia's first national IC strategic plan, IC guidelines for health care facilities, and an IC training program together with appropriate training materials.

Preparedness Activities

- MOH and WHO finalized Cambodia's:
  - *National Health Sector Pandemic Influenza Response Strategy*, 2011–2015.
  - *National Pandemic Influenza Rapid Containment Strategy*, 2011–2015.
  - *National Pandemic Communication Strategy*, 2011–2015.
- WHO provided select hospitals with training on how to prepare alcohol hand gel as part of improving IC practices.
- WHO developed a three-module, IC training tool based on national IC guidelines, consisting of hand hygiene, proper use of personal protective equipment, and waste management (segregation, handling, storage). This training was piloted at two national hospitals, the National Pediatric Hospital and the Maternal and Child Hospital and one provincial hospital, Kampong Cham Provincial Hospital.
- WHO developed a hand hygiene compliance tool for use in hospitals which was piloted at Kampong Cham Provincial Hospital.
- WHO visited Kampong Cham Provincial Hospital and Battambang Provincial Hospital on multiple occasions to assist in the development of these hospitals as regional centers of excellence for IC.
- WHO hired a consultant to assist in developing a work plan for future IC activities.
- WHO supported the attendance of a MOH IC focal person at the Asia Pacific International Conference for Infection Control, Melbourne.
- WHO assisted the MOH in the IHR (2005) certification process of Cambodia's international points of entry.

Training

- Two ILI and three SARI surveillance refresher training workshops were held for staff from all sites.
- A refresher course on CamEWAR was conducted for 153 rapid response team members from the MOH, provincial and district health offices, and hospitals from all 24 provinces.
- On-the-job microbiology training was provided by NIPHL and CDC-Cambodia to technicians from one SARI surveillance site.
- Microbiology training was provided by NIPHL staff for technicians from one provincial hospital and students from Phnom Penh's Technical School for Medical Care.
- Two NIPHL staff attended a training workshop in Vietnam for strengthening of GISRS International Air Transport Association (IATA) licensing for National Influenza Centers; both participants earned IATA certification.
- Five training courses on the case management of severe respiratory infections and avian influenza were held for 238 clinicians from provincial and district hospitals in five provinces previously affected by H5N1.
- Funding and technical support was provided to the MOH's applied epidemiology training program.

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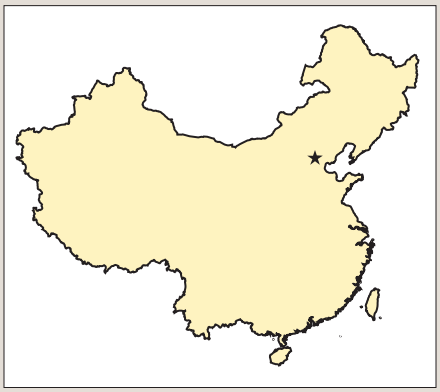

- **Capital:** Beijing
- **Area:** 9,596,961 sq km
- **Population:** 1,343,239,923 (July 2012 est.)
- **Age Structure:** 0-14 years: 17.6% (male 126,634,384/ female 108,463,142); 15-64 years: 73.6% (male 505,326,577/female 477,953,883); 65 years and over: 8.9% (male 56,823,028/ female 61,517,001) (2011 est.)
- **Life Expectancy at Birth:** Total population: 74.84 years; male: 72.82 years; female: 77.11 years (2012 est.)
- **Infant Mortality Rate:** Total: 15.62 deaths/1,000 live births; male: 15.38 deaths/1,000 live births; female: 15.9 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 92.2%; male: 96%; female: 88.5% (2008 Census)
- **GDP:** $11.29 trillion (2011 est.)
- **GDP per Capita:** $8,400 (2011 est.)

Highlights

- In October 2010, China's National Influenza Center (CNIC) was designated as a World Health Organization (WHO) Collaborating Center for Reference and Research on Influenza (CC). To ensure the quality of surveillance and enhance CNIC's support to surveillance network laboratories and neighboring countries, the U.S. Centers for Disease Control and Prevention (CDC) collaborated with CNIC on laboratory quality improvement, which covers both national and provincial level laboratories, with the goal of achieving national and international accreditation before 2014.
- In line with their national strategy, CNIC set up environmental surveillance to estimate infection rates of highly pathogenic avian influenza viruses among occupationally exposed populations and to describe the distribution of viruses in live bird markets, poultry farms, poultry slaughter sites and migrant bird habitats through environmental sampling in all 31 provinces.

U.S. CDC Direct Country Support

CDC and CNIC are in the second year of a five-year sustainability cooperative agreement titled *Developing Sustainable Influenza Surveillance Networks and Response to Avian Pandemic Influenza in China*. CNIC was established in 1954, and joined the, then-called, WHO Global Influenza Surveillance Network (now GISRS) in 1981. In 2009, in response to the H1N1 influenza pandemic, surveillance for influenza-like illness (ILI) among outpatients was expanded from 197 to 556 hospitals and the influenza surveillance network laboratories grew from 63 to 411. The second five-year cooperative agreement awarded by CDC in 2010 has strengthened the development of this influenza surveillance network, in particular, by improving the quality of new surveillance sites. In addition, the cooperative agreement has continued to support genetic, antigenic and drug resistance surveillance (in part to inform vaccine recommendations), established environmental surveillance, and strengthened influenza response capacity at all levels.

Surveillance

China's ILI surveillance network was expanded in 2009, and the CDC cooperative agreement improved its capacity for carrying out nucleic acid detection and egg-based virus isolation in network laboratories, by providing hands-on training, as well as intensive laboratory assessments. Through joint efforts of CDC-China and CDC, in October 2010, CNIC was designated as a WHO CC, just one of five globally. CDC continues to support antigenic, genetic and drug resistance surveillance, in part, to develop improved vaccine strain selection. In addition, the cooperation supported the establishment of environmental surveillance to estimate the rate of infection with highly pathogenic avian influenza viruses among occupationally exposed populations, and to investigate the distribution of influenza strains circulating in all 31 provinces.

Surveillance Activities

- The CNIC publishes ILI surveillance reports weekly in both Chinese and English on the public website.
- Laboratory technicians have been trained in nucleic acid detection and egg-based virus isolation.
- The CNIC has expanded the genetic and antigenic characterization and determination of drug resistant viruses collected through the ILI surveillance system.
- The CNIC share representative viruses with other WHO CCs in a timely fashion.
- The CNIC have established environmental surveillance to estimate infection with highly pathogenic avian influenza virus (H5N1 and H9N2) among occupationally exposed populations and to examine the distribution of these strains across the country.

Laboratory

In 2011, the CNIC and CDC worked closely together to enhance ILI surveillance quality and CNIC's capacity to better support their 411 network laboratories and neighboring countries such as Mongolia.

At the national level, two CNIC staff, an epidemiologist and a laboratory scientist, trained extensively at CDC in Atlanta. Moreover, most staff participated in international meetings and trainings. Notable progress has been achieved:

- Established analytic methods and indicators to assess ILI sentinel surveillance.
- Enhanced their ability to independently analyze the evolution of influenza antigens with antigenic cartography techniques.
- Detected respiratory pathogens rapidly via methods used for emergency preparedness.
- Established environmental virologic surveillance and surveillance in occupationally exposed populations.

In China's 411 network laboratories, achievements are as follows:

- Approximately 100 network laboratory staff received training to increase their capacity to conduct nucleic acid detection and viral characterization.
- The CNIC conducted comprehensive, hands-on training for laboratory technicians from 10 selected network laboratories.
- A laboratory quality improvement project was started in four provinces, including repeated field supervision.

Laboratory Activities

- Designated officially as a WHO CC in October 2010.
- Shipped influenza virus strains to other WHO CCs.
- Re-established at both the national and provincial levels laboratory quality improvement following the 2009 expansion of the laboratory network.
- Initiated vaccine seed selection and a preparation platform.
- Helped selected network laboratories successfully conduct egg-based virus isolation.
- Developed a reference kit for network laboratories in order to evaluate PCR kits used in surveillance.
- Conducted training and workshops on nucleic acid detection for selected network laboratories.
- Provided a comprehensive, hands-on training for 10 technicians from selected network laboratories.
- Participated and presented at international meetings, playing a greater role in global influenza control.
- Trained two senior staff members; one epidemiologist, and one laboratory scientist.

Training

In 2010–2011, CDC supported the following trainings for the CNIC:

- A national influenza surveillance quality control and ISO15189 laboratory accreditation training workshop was held for 28 provinces with approximately 120 staff in attendance.
- A laboratory quality improvement and ISO15189 laboratory accreditation training workshop was held for CNIC staff and conducted by the Hong Kong Accreditation Service..
- A workshop in environmental surveillance was held for 80 participants.
- Two training workshops on influenza laboratory detection techniques were held for approximately 100 key technicians from 69 network laboratories. The workshops were based on the requirements outlined in *China's National Influenza Surveillance Protocol (2010).*
- CNIC staff attended internal auditor training conducted by the China National Accreditation Association to improve laboratory management.
- Two CNIC staff attended an infectious material transportation training course held by the WHO and International Air Transport Association (IATA) in Vietnam.

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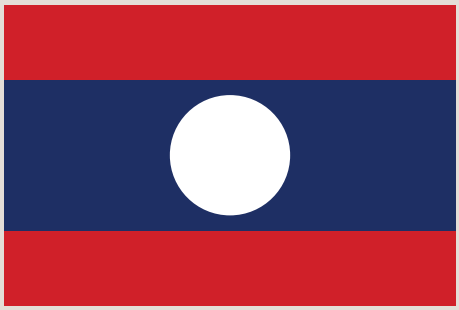
A view of the skyline in China.

Lao People's Democratic Republic (Lao PDR)



- **Capital:** Vientiane (Viangchan)
- **Area:** 236,800 sq km
- **Population:** 6,586,266 (July 2012 est.)
- **Age Structure:** 0-14 years: 36.7% (male 1,197,579/female 1,181,523); 15-64 years: 59.6% (male 1,908,176/female 1,950,544); 65 years and over: 3.7% (male 107,876/female 131,513) (2011 est.)
- **Life Expectancy at Birth:** Total population: 62.77 years; male: 60.85 years; female: 64.76 years (2012 est.)
- **Infant Mortality Rate:** Total: 57.77 deaths/1,000 live births; male: 63.68 deaths/1,000 live births; female: 51.62 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 73%; male: 83%; female: 63% (2005 Census)
- **GDP:** $17.44 billion (2011 est.)
- **GDP per Capita:** $2,700 (2011 est.)

Highlights

- In August 2011, CDC's memorandum of understanding (MoU) was renewed with the human and animal health sectors legitimizing country operations in Lao PDR.
- Lao PDR hosted the NIC annual WHO Western Pacific and South-East Asia regional meeting following the designation of their National Center for Laboratory and Epidemiology (NCLE) as a World Health Organization (WHO) National Influenza Center (NIC).
- Lao PDR has translated the "One Health" principal into practice with the establishment of molecular diagnostic capacity in both human and animal health laboratories.
- Lao PDR has advanced molecular diagnostics with the establishment of full genomic sequencing capability, again, in both the human and animal health sectors.
- CDC supported Lao PDR's Field Epidemiology Training (FET) including field activities to establish the safety of and demand for pandemic influenza vaccination, to determine rubella susceptibility in pregnant women, and to establish the importance of Japanese encephalitis vaccine (JEV).
- Lao PDR's Ministry of Health (MOH) continues to demonstrate seasonality and identify circulating strains associated with human influenza.
- Lao PDR's NCLE has started building renovations in partnership with the World Bank and with the CDC-WHO collaboration providing technical expertise on design, structural integrity assessments, and direct support for biosafety enhancements of new BSL-2+ facilities. Assistance for this project has also been provided by CDC International Emerging Infections Program (IEIP), Bangkok.

U.S. CDC Direct Country Support

The U.S. Centers for Disease Control and Prevention (CDC) developed an MoU with the Government of Lao PDR in May 2006, and formally renewed this memorandum for a further five years in August 2011. Uniquely, this agreement is with both the MOH and the Ministry of Agriculture and Forestry. This has enabled CDC, through its cooperation with WHO's WPR country office, to continue support for "One Health" practices including (i) shared human and animal health participation and representation in Lao PDR's FET; (ii) advanced laboratory genomic sequencing platforms; and (iii) outbreak response training with a focus on H5N1 and seasonal influenza. CDC-WHO also provides principal support to influenza laboratory capacity-building, to influenza-like illness (ILI) and severe acute respiratory infection (SARI) surveillance networks, and to outbreak response activities countrywide. CDC's Influenza Division, with WHO, provides technical and full financial assistance in the management of Lao PDR's FET, which now boasts 15 alumni. The CDC-WHO collaboration has worked (and funded) national infection control (IC) activities, that have seen newly developed guidelines implemented with the creation of the country's first infection control committees in all national and provincial hospitals, and the establishment of a model IC facility at a principal Vientiane hospital for the purpose of demonstrating "best practices" to newly identified IC committee staff.

Surveillance

The importance of virological influenza surveillance was demonstrated when Lao PDR experienced the 2009 H1N1 pandemic. As such, the NCLE expanded ILI surveillance from six to eight hospitals throughout the country, and SARI surveillance from two to four hospital sites, moving away from what was a Vientiane, urban-centric system to a more countrywide surveillance system. CDC-WHO has also supported the transformation and expansion of Lao PDR's early warning (EWARN) system to all 144 districts nationwide, making real-time electronic relay of clinical data, including SARI data more meaningful through instant (programmed) interpretation.

Field Epidemiology Training (FET) –providing health education for local residents.

Seasonal influenza circulated from October to December 2010, and again from August to September 2011, showing seasonality (as in previous years) during the August to December period. In 2010, the 2009 H1N1 pandemic strain continued to predominate but less so during the 2011 influenza season; in 2011, H3N2 resurged. Influenza B circulated throughout most of the 2011 non-influenza season, January to May.

One highly pathogenic avian influenza (HPAI) H5N1 poultry outbreak occurred in Luangprabang Province; however, no human H5N1 cases were identified.

Surveillance Activities

- Re-training of 120 national and provincial hospital staff by NCLE laboratory and epidemiology teams was conducted with support from the CDC-WHO collaboration at ILI/SARI sentinel surveillance sites in Champassak, Savannakhet, Khamnoune Vientiane Capital, Luangprabang, and Oudomxay, to increase both the number of specimens collected and influenza positivity yields.
- The MOH expanded SARI surveillance to hospital sites in Champassak and Oudomxay.
- Support and technical assistance was provided by the CDC-WHO collaboration for the annual national surveillance review conducted by NCLE (March 2011) with Health Authority

representation from all 17 Lao Provinces, and development of a five year national surveillance strategic plan with MOH partners throughout 2011. Lao PDR's NCLE contributed data to the WHO's FluNet for the first time as a designated NIC.

- Lao's MOH contributed over 100 viral isolates through CDC to the WHO Global Influenza Surveillance and Response System (GISRS) between October 1, 2010 and September 30, 2011.
- Strain recognition throughout the reporting period has contributed to the MOH's policy decisions regarding the introduction of seasonal influenza vaccine in 2012.

Laboratory

With funding and technical assistance provided through the CDC-WHO collaboration, NCLE was able to (i) adopt and adapt cell culture protocols from the Thai MOH to produce virus isolates; (ii) develop hemagglutination inhibition testing with assistance from CDC; (iii) work with CDC to develop full genomic sequencing capabilities; and (iv) mediate talks that led to an MoU between the human and animal health sectors to establish a single, advanced molecular diagnostic testing platform.

Laboratory Activities

- Procured laboratory reagents for processing over 3,000 samples with assistance from CDC IEIP Bangkok and CDC Atlanta's Influenza Reagent Resource (IRR).
- Negotiated the procurement and maintenance arrangements of a new genomic sequencing machine for NCLE, and the repair of an existing machine at the National Center for Animal Health (NCAH). This new capacity will enable Lao PDR to describe the phylogenic evolution of HPAI H5N1 from 2004, and contribute toward future recognition of avian, pandemic, and seasonal strain variability, regionally.
- Trained NCLE and NCAH laboratory staff in molecular sequencing capabilities for the first time, in Lao PDR.
- Maintained cell lines and produced reliable virus isolates for submission to the WHO GISRS.
- Conducted strain identification using HI testing for the first time.
- Established a roadmap for building sequencing capabilities; from sequencing of HPAI H5N1 samples from poultry outbreaks, to publishing the phylogenic evolution of HPAI H5N1 in Lao PDR.
- Cross-trained NCLE staff to conduct real-time PCR, cell culture testing, and HI testing.

Preparedness

Lao PDR's pandemic planning activities for FY 2011 were principally focused on lessons learned from the 2009 influenza pandemic experience. In the past, Lao PDR was able to quickly adapt to CDC-WHO supported pandemic plans in preparing for an H5N1 threat, and readily make changes at both national and provincial Levels. Using the CDC-driven Automated Disaster and Emergency Planning Tool (ADEPT), Lao PDR proved responsive to the 2009 H1N1 pandemic through the mobilization of public and private resources.

Successful pandemic planning, including deployment of pandemic vaccine to more than one million susceptible people in 2010, elevated discussions in the MOH about introducing seasonal influenza vaccination as part of a long-term strategy for influenza pandemic threats.

Preparedness Activities

- Lao PDR conducted review workshops in all 17 provinces to determine the effectiveness of pandemic plans, and how to better implement these in the future.

- CDC-Lao PDR technical advisory group (TAG) participated in the WHO sponsored pandemic planning meeting and workshops in Beijing, China (and included CDC's support for Lao PDR's participation).
- CDC-Lao PDR TAG participated in the WHO sponsored Asia-Pacific Strategy for Emerging Diseases (APSED) Meeting and workshops in Manila, the Philippines.
- CDC and WHO country teams contributed toward and reviewed a manuscript in which the Lao PDR example was used in illustrating the process and value of pandemic planning.

Training

- ILI and SARI re-training activities took place through hospital-based workshops held in Vientiane Capital, Savannakhet, Khamnoune, Luangprabang, Champassak and Oudomxay.
- Two training workshops in SARI surveillance were held in Champassak and Oudomxay provinces in order to expand SARI surveillance.
- The MOH supported an in-country APSED workshop to help develop Lao PDR's national five-year health strategy.
- Laboratory staff from NCLE and NAHC were trained in genomic sequencing at CDC Atlanta.
- Laboratory training for four NCLE and one NAHC staff for detection of influenza and other respiratory infections took place at CDC IEIP Bangkok, November 2010.

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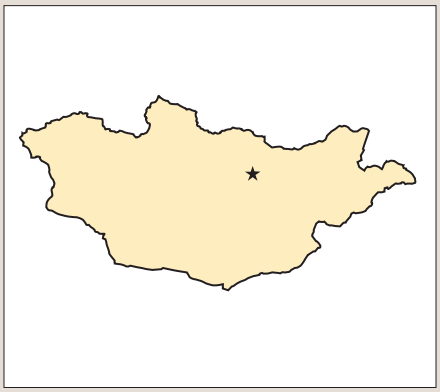
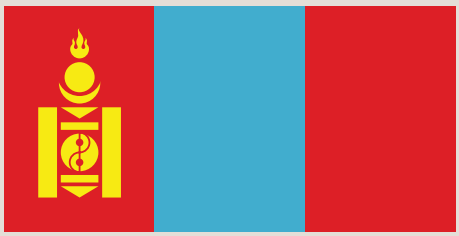
Mongolia





- **Capital:** Ulaanbaatar
- **Area:** 1,564,116 sq km
- **Population:** 3,179,997 (July 2012 est.)
- **Age Structure:** 0-14 years: 27.3% (male 437,241/female 419,693); 15-64 years: 68.7% (male 1,074,949/female 1,076,455); 65 years and over: 4% (male 54,415/female 70,565) (2011 est.)
- **Life Expectancy at Birth:** Total population: 68.63 years; male: 66.16 years; female: 71.23 years (2012 est.)
- **Infant Mortality Rate:** Total: 36 deaths/1,000 live births; male: 38.94 deaths/1,000 live births; female: 32.91 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 97.8%; male: 98%; female: 97.5% (2000 census)
- **GDP:** $13.28 billion (2011 est.)
- **GDP per Capita:** $4,500 (2011 est.)

Highlights

- A special program has been developed for the real-time, on-line reporting of influenza and influenza-like illness (ILI) events. Patient data is linked to specimens sent to the National Influenza Center (NIC) from influenza sentinel surveillance sites. The results of the laboratory testing are then made accessible to sentinel sites online. On-site trainings were organized and this reporting system is now routinely used.
- Weekly audio-conferencing from the NIC with all surveillance sites using Skype is also routinely used.
- Multiplex real-time PCR testing for respiratory syncytial virus (RSV), human parainfluenza viruses (HPIV), metapneumoviruses, rhinoviruses, adenoviruses, bocaviruses, enteroviruses and coronaviruses of selected samples negative for influenza viruses have become part of routine investigation.

U.S. CDC Direct Country Support

Mongolia is in the third year of a five-year sustainability cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC) titled, *Sustainable Influenza Surveillance Network* (2009–2014). The previous five-year capacity-building agreement, *Influenza Surveillance Network* was completed in 2009.

ILI has been a serious public health challenge in Mongolia since the 1970s, due to rapid growth in population size and urbanization. The NIC in Mongolia was established in 1974, and joined the WHO Global Influenza Surveillance and Response System (GISRS) in 1978. The system was damaged seriously due to economic difficulties in the 1990s in connection with political and economic transition. The CDC-Mongolia cooperative agreement activities that began in 2004 have restored the system and improved its quality to meet the requirements of WHO's NIC terms of reference and continued NIC designation of the laboratory in Ulaanbaatar.

Surveillance

The established outpatient and inpatient surveillance network covers the whole country and conducts ILI surveillance according to the rules approved by the Health Minister's order, issued in 2010. The surveillance sites have routinely entered ILI data into Mongolia's web-based, Flu-Information-System (FIS) since October 2010 and collect nasopharyngeal swabs from patients who meet case definitions for ILI and severe acute respiratory infection (SARI). FIS allows surveillance sites to access laboratory results from their own sites and to see surveillance summary reports in real time.

Surveillance Activities

- Countrywide, the outpatient surveillance sites reported 1,393 ILI morbidity per 10,000 population during the 2010–2011 seasons or 5.2% of all registered outpatient visits.
- Thirty-seven, hospital-based surveillance sites in Ulaanbaatar, and provincial centers reported diagnosed pneumonia and SARI cases among hospitalized patients; 19,603 pneumonia cases or 3.5% of all hospitalizations with 55 (0.3%) deaths registered.
- Weekly surveillance information is posted on Mongolia's NIC website, www.flu.mn, in both Mongolian and English and a monthly, audio conference among sentinel sites is conducted using Skype.
- Quarterly assessments are accomplished using regular performance criteria.

Laboratory

Influenza virological surveillance in Mongolia is based on a weekly collection of specimens from surveillance sites and detection and identification of influenza viruses by real-time RT-PCR. Influenza positive specimens are inoculated in MDCK cells and representative isolates are sequenced and submitted to GenBank. The susceptibility of viruses to neuraminidase (NA) inhibitors (oseltamivir and zanamivir), are examined by chemiluminescent assay using the NA-Star kit and sequence analysis of the NA gene if the inhibitory concentrations of 50% value increased. Randomly selected samples from influenza negative specimens are tested by real-time multiplex PCR for detection of other respiratory viruses. The virology laboratory at the NIC joined the WHO External Quality Assessment Program at the beginning of 2007 and the last eight panels have been tested with 100% accuracy. Also, the virology laboratory participated in the CDC pilot influenza performance evaluation panel in September 2011. Performance in the first panel from CDC was 100%.

Laboratory Activities

- Four hundred and seventy-one (11.2%) influenza viruses were detected by real time RT-PCR from 4,197 samples. Among them, 361 (76.3%) were A(H3N2) influenza viruses, 103 (21.8%) were H1N1 pandemic viruses and 7 (1.5%) were B viruses.
- One hundred and six (22.5%) influenza viruses were isolated by inoculation of MDCK cell culture from 471 influenza positive samples by RT-PCR. Among them, 71 (67.0%) isolates were A(H3N2) and 35 (33.0%) isolates 2009 A(H1N1)pdm viruses.
- Sixty-six influenza virus strains were tested for oseltamivir resistance by a chemiluminescence-based NA inhibition quantitative assay and all viruses tested were sensitive to oseltamivir and zanamivir.
- The HA, PB2, PB1, NP, NA, MP, NS and PA genes of three representative influenza strains were sequenced and submitted to and released by GenBank.
- Twenty novel influenza isolates were sent to the WHO Collaborating Centers (CC) in Tokyo and Atlanta for more detailed analyses.

- The multiplex RT-PCR detection of non-influenza respiratory pathogens has become routine surveillance. These tests were conducted on 342 clinical samples selected at random from those specimens testing negative for influenza during the 2010–2011 season.

Preparedness

Health facilities nationwide prepare for influenza pandemics and seasonal epidemics according to the revised guideline Influenza Pandemic Preparedness and Response issued by Mongolia's MOH in April 2010.

Preparedness Activities

- The "National Influenza Leaders Workshop" was held in October 2010; 265 participants representing all concerned parties convened and issued new recommendations for the government and other stakeholders.
- There has been an increase in the number of people vaccinated against seasonal influenza, and an increase in the number of vaccines purchased by the Government of Mongolia or received as donations from other countries and organizations. Approximately 800,000 people were vaccinated with the 2009 H1N1 pandemic vaccine according to the national plan during the 2009–2010 influenza season. During the 2010–2011 influenza season, 1,800 health care workers were vaccinated with seasonal trivalent vaccine.

Training

- Two training workshops in Mongolia's web-based FIS were organized at the National Center of Communicable Diseases (NCCD). The first group was trained in September 2010 and included 70 epidemiologists and statisticians from surveillance sites in Ulaanbaatar. The second group was held for 35 participants representing 16 provinces, and took place in October 2010. During the training, all participants were provided with flash-disks containing FIS program materials and microphones for audio conferencing with Skype.
- The first surveillance site training workshop took place in early September 2011 at the NCCD. The main goal of this workshop was to improve the participation of sites in surveillance activities. The workshop was attended by 250 participants including governors from 21 provinces, epidemiologists and statisticians from Ulaanbaatar and all provinces in Mongolia, and the heads of family group practices.
- A Mongolian epidemiologist attended the WHO "Consultation on Global Tools and Surveillance Manual on Influenza" in Geneva, Switzerland, in March 2011.
- A Mongolian epidemiologist and a virologist attended the "Workshop on Scientific Writing" in Seoul, Republic of Korea in April 2011.

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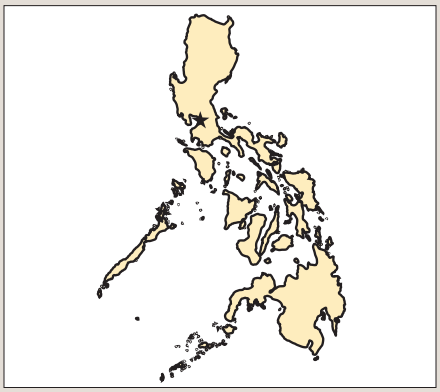
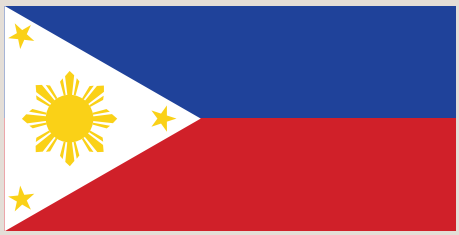
The Philippines





- **Capital:** Manila
- **Area:** 300,000 sq km
- **Population:** 103,775,002 (July 2012 est.)
- **Age Structure:** 0-14 years: 34.6% (male 17,999,279/female 17,285,040); 15-64 years: 61.1% (male 31,103,967/female 31,097,203); 65 years and over: 4.3% (male 1,876,805/female 2,471,644) (2011 est.)
- **Life Expectancy at Birth:** Total population: 71.94 years; male: 68.99 years; female: 75.03 years (2012 est.)
- **Infant Mortality Rate:** Total: 18.75 deaths/1,000 live births; male: 21.21 deaths/1,000 live births; female: 16.18 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 92.6%; male: 92.5%; female: 92.7% (2000 census)
- **GDP:** $389.8 billion (2011 est.)
- **GDP per Capita:** $4,100 (2011 est.)

Highlights

- Two-hundred and nine samples were tested to detect the H274Y mutation in the neuraminidase (NA) gene which is associated with oseltamivir resistance; results indicated that oseltamivir-sensitive viruses are still predominant in the Philippines. Nevertheless, two influenza A and two influenza B viruses, were found to have reduced NA inhibitor sensitivity.
- The Research Institute for Tropical Medicine (RITM) which is the Philippines National Influenza Center (NIC), correctly identified all 10 samples in the U.S. Centers for Disease Control and Prevention's (CDC) pilot, performance evaluation panel, to identify influenza using molecular diagnostic methods.
- Virological information is now integrated into the influenza-like illness (ILI) case report form of the Philippines' Integrated Disease Surveillance and Response.
- The NIC contributed to the manuscript titled, "Epidemiological and virological characteristics of influenza in the Western Pacific Region of the World Health Organization, 2006–2010," which was initiated by the WHO Western Pacific Regional Office (WPRO).

U.S. CDC Direct Country Support

The first five-year, CDC capacity-building cooperative agreement (CoAg) with the Philippines' RITM and Department of Health, titled, *Development of an Influenza Surveillance Network*, started in 2005. That CoAg enabled the establishment of an influenza surveillance network with 44 sentinel sites, both health centers and outpatient departments in tertiary level hospitals, distributed across 12 of the 17 regions in the country. The CoAg also supported the development of severe acute respiratory infection (SARI) surveillance in 16 health centers and seven hospitals in an urban setting, to establish the burden of disease associated with

influenza. The CoAg enabled the establishment of the Philippines' NIC and substantial capacity-building among staff in the virology department and the molecular biology laboratory of the RITM. The same agreement also allowed for the development and implementation of an upgraded data management system to ensure the accurate recording and reporting of surveillance information.

In 2009, CDC and RITM entered into a second, five-year sustainability cooperative agreement titled, *Developing a Sustainable Influenza Surveillance Network and Response to Avian and Pandemic Influenza*. This second grant is to ensure the sustainability of the RITM as an NIC and to plan for the continued existence of the surveillance network.

Surveillance

The CDC cooperative agreement supported an increase in sentinel sites from four to 44. Prospective ILI surveillance is conducted by trained nurses in 44 sentinel sites in order to establish seasonal influenza patterns. Each site is visited weekly to obtain epidemiological information and clinical specimens for virus culture and/or PCR. Virus culture is performed on all specimens collected through the national surveillance network. SARI surveillance has taken place in 16 health centers and six hospitals for establishing influenza burden of disease. Specimens collected from the influenza burden of disease sites are tested by real-time RT-PCR, while 25% undergo virus isolation.

Surveillance information is generated by trained nurses from each of the 44 ILI sites and used by the Regional Epidemiology Surveillance Units (RESU); the NIC provides weekly surveillance information for the whole country to the National Epidemiology Center (NEC) and WHO's FluNet.

The quality and efficiency of sentinel site performance is verified through regular monitoring visits and through a set of process and outcome indicators.

Influenza surveillance nurse collecting nasopharyngeal swab from a pediatric ILI case in one of the 44 sentinel sites in the country.

Surveillance Activities

- One hundred precent of specimens were received at the NIC in good condition, e.g. without frozen packs, spillage or desecration.
- One hundred precent of ILI cases sampled for testing had complete clinical and epidemiological information.
- One hundred precent of SARI cases sampled for testing had complete clinical and epidemiological information.
- A total of 14,805 ILI cases were reported through all sentinel sites; specimens were collected from 39.9% of these cases. The virus isolation positivity rate was 16.7% while influenza virus isolation positivity rate was 8.2%.
- A total of 22,847 health center consultations were recorded in the influenza burden of disease sites; 15.4% were for ILI. Specimens were collected from 42.5% of these ILI cases; the PCR virus detection rate was 13.5% while the influenza virus detection rate was 11.7%.
- A total of 32,185 hospital admissions were reported in the six surveillance hospitals, where 11.2% were SARI admissions. Specimens were collected from 25.3% of the SARI enrolled patients. Viruses were detected in 9.3% of these specimens while influenza viruses were found in 5.2% of the specimens tested.

- The local virologist, epidemiologist and biostatistician are required to visit and monitor regional sites.

Laboratory

The RITM performs a full array of culture-based and PCR-based testing producing high quality results to support surveillance activities for influenza and other respiratory viruses. Virus culture and indirect fluorescent antibody (IFA) testing are routinely performed to isolate and identify influenza A, B, human parainfluenza viruses (HPIV-1, HPIV-2 and HPIV-3), adenovirus, respiratory syncytial virus (RSV), and herpes simplex virus (HSV). Hemagglutination and hemagglutination inhibition tests are performed to characterize influenza viruses. Both real-time and conventional PCR assays are performed to identify and subtype influenza viruses. RITM is developing influenza PCR testing capacity in regional laboratories through training and monitoring to further assist in regional influenza surveillance and surge capacity. RITM has a system in place that supports the timely reporting of influenza surveillance data electronically, by fax, and/or by mail.

The NIC continued to send unsubtypable isolates and representative isolates, for quality assurance, to the WHO CC in Melbourne. In 2011, 141 isolates were shipped. The NIC continues to participate in the WHO External Quality Assessment Project (EQAP) and has consistently attained 100% in these proficiency panels.

Laboratory Activities

- In 2011, 690 specimens were positive for influenza based on virus isolation, of which 32.8% were positive for pandemic A (H1N1). A total of 1,368 specimens were tested using PCR; 164 were positive for influenza of which 62.2% were positive for pandemic A (H1N1).
- In collaboration with Tohoku University, studies were conducted on 209 samples from selected geographic regions of the country to investigate oseltamivir resistance to the 2009 H1N1 pandemic strain. RT-PCR and sequencing was used to detect the H274Y mutation in the NA gene associated with oseltamivir resistance. All 209 samples tested did not harbor the mutation, indicating that oseltamivir-sensitive isolates still predominate in the Philippines.
- ILI seasonal influenza surveillance yielded two influenza A and two influenza B samples which were found to have reduced NA inhibitor sensitivity.
- The NIC scored 100% in CDC's pilot performance evaluation panel, identify influenza using molecular diagnostic methods.
- Virological information is now integrated into the ILI case report form of the Philippines' Integrated Disease Surveillance and Response.
- The NIC developed a new software and barcode system for the routine receipt, processing and reporting of influenza specimens and their test results.

Preparedness

The 2009 H1N1 influenza pandemic tested the efficiency and functionality of the NIC procedures. This resulted in the development of a barcode system for influenza specimen receipt, processing and reporting of results. In addition, training of NIC second-line staff and staff from subnational laboratories was conducted as part of surge capacity planning and response. RITM, which is also the referral hospital for emerging and re-emerging infections, has reviewed and refined the clinical management guidelines for influenza based on the 2009 H1N1 pandemic experience.

CDC support has assisted in the continuous development of the Philippines' national preparedness plan. To coordinate influenza preparedness activities, the Philippines' Department of Health has four major committees including: a planning committee, an operations committee, a logistics committee and a finance committee. Each committee works on developing guidelines and making recommendations concerning

influenza such as quarantine and isolation at points of entry, containment, mitigation, vaccine purchases and guidelines for prioritization and rapid response teams (which are currently being reviewed and may be revised in the coming year).

Preparedness Activities

- The NIC has trained second line staff to perform molecular diagnostics.
- The NIC has provided proficiency training in molecular diagnostic tests to staff from subnational laboratories as part of surge capacity planning.
- The RITM has refined the clinical management guidelines for influenza.
- The RITM has reviewed, refined and disseminated infection control procedures in hospitals.

Training

- Panel one proficiency testing for RITM second line staff was conducted in November–December 2010.
- Panels three and four of proficiency testing was conducted for the subnational laboratory staff. In both tests, staff from three of the five laboratories obtained 100%.
- Three NIC staff participated in the "Scientific Writing Workshop on Influenza Surveillance" in Seoul, South Korea and two others participated in a similar training in Tohoku University, Japan.
- Refresher training for surveillance staff was conducted in August 31–September 2, 2010.

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Secretariat of the Pacific Community

Highlights

- Strengthened relationships between the Pacific Islands Countries and Territories (PICT) and reference laboratories in the region and among local PICT sentinel sites. Imported communication exists between local laboratory-based influenza surveillance and the Pacific Syndromic Surveillance (PSS) system.
- Supported laboratory-based influenza surveillance through the provision of, technical assistance and support, equipment, and laboratory supplies to enhance local testing capacities, as well as to facilitate the shipment of samples to identified reference laboratories for confirmatory testing.

U.S. CDC Direct Country Support

The Secretariat of the Pacific Community (SPC) is an international organization with a membership of 22 PICTs. Established in 1947, SPC was created to support the development of the region's land, marine, and human resources. SPC, through its Public Health Division, is the focal-point of the Pacific Public Health Surveillance Network (PPHSN), a joint initiative of SPC and the WHO, which is dedicated to targeted communicable disease control and surveillance, including influenza.

The current *Influenza Surveillance Networks Cooperative Agreement* between SPC PPHSN and the U.S. Centers for Disease Control and Prevention (CDC) began in 2005 and supports the development of influenza surveillance networks across a vast area, including both the North and South Pacific. This area includes ten time zones and wide geographic, socio-political, and cultural diversity. Key collaborating organizations include WHO, the Pacific Island Health Officers Association (PIHOA), PICT ministries and departments of health and reference laboratories in Australia, New Zealand, Fiji, and New Caledonia.

In August 2010, an additional five-year extension was awarded by CDC to SPC, to build on the successes of the first phase of the project, to consolidate and further develop the existing surveillance systems, and to address the challenge of pandemic preparedness.

The goal of the new cooperative agreement is to establish sustainable and integrated influenza surveillance systems in PICTs, to monitor activities to detect outbreaks, and to contribute to the WHO Global Influenza Surveillance and Response System (GISRS).

Surveillance

Since 2010, PICTs began implementation of a standard syndromic surveillance system with the assistance of WHO and SPC, comprising four core syndromes including influenza-like illness (ILI). The system is designed to provide data that can be used to fulfill the obligations of countries under the International Health Regulations 2005 (IHR). Project staff have been actively working to integrate ILI sampling into the syndromic surveillance system in each country with the aim of improving the number and quality of specimens that are collected from patients, for the detection (and isolation) of influenza viruses. This has been achieved by advocating for the dual use of sentinel surveillance sites for both syndromic and influenza surveillance.

Several trainings have been organized, together with regional partners, in order to strengthen the influenza surveillance system. September 2011 saw six PICTs come together in Fiji, with partners including CDC, to review developments and sustainable strategies for influenza surveillance.

Laboratory

LabNet is the three-tiered public health laboratory network of the PPHSN: (i) level one (L1) laboratories receive specimens directly from clinicians and where possible, conduct initial screening tests (e.g. influenza rapid tests), (ii) level two (L2) laboratories receive specimens from L1 laboratories (and may also receive specimens directly from clinicians), for first-level confirmation testing (e.g. influenza RT-PCR testing) and (iii) level three (L3) laboratories are internationally recognized reference laboratories for definitive diagnostic testing and further analysis of specimens received (e.g. influenza subtyping, sequencing and virus isolation). Reference laboratories of PPHSN continue to provide influenza diagnostic testing for all specimens sent from PICT L1 laboratories. This service is provided at no cost to the country shipping the specimens provided that the corresponding laboratories comply with the International Air Transport Association (IATA) shipping requirements. A technical working body (TWB) facilitates and coordinates the development of LabNet. In April 2011, the TWB has been revived with new members and revised terms of references.

Laboratory staff have continuously been certified or re-certified (biannually) to ensure shipments of all biological specimens across the Pacific comply with IATA regulations. This has been achieved by collaboration between SPC and PIHOA in the North Pacific Region. As the Pacific Regional Influenza Pandemic Preparedness Project wound down, IATA regulation manuals were provided to some PICTs for shipping reference.

Laboratory Activities

Activities to improve and strengthen laboratory-based influenza surveillance have taken place in the following PICTs:

- Vanuatu, American Samoa and FSM Phonpei: SPC oversaw the installation of a -80˚C freezer; supported the strengthening of communicable disease laboratory reporting; provided basic microbiology training to support typhoid and cholera identification; strengthened gram stain testing and culturing of gonorrhea for isolation and followed up on the reporting and laboratory forecasting of reagents for sexually transmitted infection (STI) testing.
- Solomon Islands: SPC oversaw the installation of a -80˚C freezer and strengthened laboratory-based surveillance and testing capacity for the detection of outbreaks.
- Palau: SPC helped strengthen communicable disease laboratory reporting; provided basic assistance to support typhoid and cholera identification; strengthened gram stain testing and culturing of gonorrhea for isolation and followed up on the reporting and laboratory forecasting of reagents for STI testing.
- Guam: SPC assisted BSL-2 laboratory capacity in Guam under the PPHSN Laboratory Network.
- Majuro, the Marshall Islands: SPC oversaw the installation of a -80˚C freezer; helped to strengthen communicable disease laboratory reporting, strengthened gram stain testing and culturing of gonorrhea for isolation and followed up on the reporting and laboratory forecasting of reagents for STI testing.
- Nauru: SPC conducted a two week microbiology enhancement training in Nauru.
- Fiji: SPC conducted a review of the public health food and water laboratory in Fiji.

A patient receiving a nasal swab from Dr. Tokon at the SPC-CDC Influenza Workshop.

Training

- SPC conducted microbiology enhancement and influenza laboratory-based surveillance training in Vanuatu, Nauru and Samoa for 31 participants.
- SPC provided influenza laboratory-based surveillance training for nine participants from the Solomon Islands, Samoa (second training) and American Samoa.
- The sub-regional workshop "Strengthening influenza surveillance networks in the Pacific" for 35 participants took place, with representatives from six PICTs, CDC, WHO-Fiji, PIHOA and reference laboratories.

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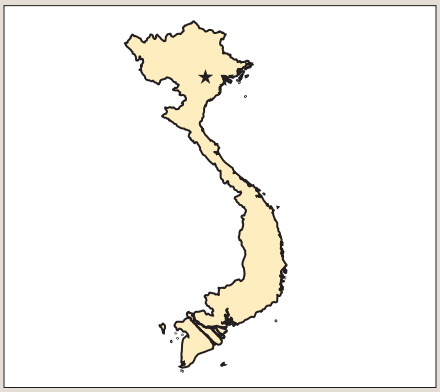
Vietnam



- **Capital:** Hanoi
- **Area:** 331,210 sq km
- **Population:** 91,519,289 (July 2012 est.)
- **Age Structure:** 0-14 years: 25.2% (male 11,945,354/female 10,868,610); 15-64 years: 69.3% (male 31,301,879/female 31,419,306); 65 years and over: 5.5% (male 1,921,652/female 3,092,589) (2011 est.)
- **Life Expectancy at Birth:** Total population: 72.41 years; male: 69.95 years; female: 75.16 years (2012 est.)
- **Infant Mortality Rate:** Total: 20.24 deaths/1,000 live births; male: 20.61 deaths/1,000 live births; female: 19.83 deaths/1,000 live births (2012 est.)
- **Literacy Rate:** Total population: 94%; male: 96.1%; female: 92% (2009 Census)
- **GDP:** $299.2 billion (2011 est.)
- **GDP per Capita:** $3,300 (2011 est.)

Highlights

- Vietnam's Ministry of Health (MOH), through the National Institute of Hygiene and Epidemiology (NIHE) and with support from the U.S. Centers for Disease Control and Prevention (CDC) Influenza Program in Vietnam as successfully initiated both severe acute respiratory infection (SARI) and burden of disease surveillance.
- The animal-human interface (AHI) Initiative at CDC-Vietnam, together with the NIHE, successfully completed a pilot extension of an AHI study in Thai Binh province, North Vietnam.
- CDC-Vietnam provided AHI technical assistance and information on the "One Health" Initiative to the Laos MOH and Ministry of Agriculture through a training workshop held by CDC Lao PDR and the U.S. Department of Agriculture (USDA).
- In December 2010, CDC's Influenza Program in Vietnam participated in, and provided recommendations during the "Capacity-building Workshop on Vaccination against Avian Influenza" held in Hanoi, with member countries of the Asia-Pacific Economic Cooperation (APEC). The U.S. Embassy published a press release about the workshop titled, *United States Provides Recommendations on Combating Avian Influenza*.
- The MOH has seen the graduation of its first class of eight field epidemiology training program (FETP) fellows. CDC-Vietnam has supported Vietnam's FETP through the provision of class instruction, abstracts, presentations, and manuscripts.
- CDC-Vietnam reviewed the veterinary diagnostic laboratory at the Ministry of Agriculture and Rural Development (MARD), identifying a functional laboratory with limited resources. CDC-Vietnam made recommendations for the laboratory's improvement.

- Data collected through Vietnam's influenza surveillance system has been analyzed and presented by NIHE at the Options for the Control of Influenza and TEPHINET conferences.

U.S. CDC Direct Country Support

The CDC-Vietnam Influenza Program has three cooperative agreements with Vietnam's MOH: (i) a five-year sustainability agreement with the NIHE provides support to the existing national influenza surveillance system developed under the first five-year capacity-building cooperative agreement (2005–2009), (ii) a five-year research agreement with NIHE is in its third year of activities and includes animal-human interface projects, and (iii) a five-year pandemic preparedness and response agreement with the General Department of Preventive Medicine (GDPM) is in its final year. CDC is developing a fourth cooperative agreement with MARD.

A patient receiving an influenza vaccine at a sentinel surveillance site.

The CDC-Vietnam Animal-Human Interface (AHI) Initiative continues to support and enhance the "One Health" strategy forged by the collaboration between Vietnam's MOH and MARD, through joint meetings, technical assistance, and cooperative agreement supported activities. The influenza and AHI programs provide mission support on a regular basis to the U.S. Embassy Health Team, including requests for infectious disease information. The programs also provide technical assistance to Vietnam's FETP, and in FY 2011, this included a CDC-NIHE presentation on AHI at the Sixth Training Programs in Epidemiology and Public Health Interventions Network (TEPHINET) Global Conference in December 2010. The influenza and AHI programs provide technical support to other U.S. government and non-government organization (NGO) partners in Vietnam, including the U.S. Agency for International Development (USAID), USDA, the World Health Organization (WHO), and the Food and Agricultural Organization of the United Nations (FAO).

Surveillance

In 2005, CDC entered into a five-year, capacity-building cooperative agreement with Vietnam's MOH to establish a national influenza surveillance system. The system was developed primarily as an outpatient surveillance system for influenza-like-illness (ILI), with just four sites. Later, a total of 15 sites were strategically located throughout the country's four geographic regions. The system now includes nationwide passive surveillance, which detects cases of unexplained severe pneumonia in hospitals, including the vast majority of Vietnam's confirmed human H5N1 cases. A second five-year cooperative agreement started in 2010 and expanded surveillance to include inpatient SARI. As of September 2011, there were 11 sentinel sites supported through the second sustainability cooperative agreement, including five sites for both ILI and SARI surveillance and six sites for ILI surveillance only.

Surveillance Activities

- With assistance from CDC Atlanta and CDC-Vietnam staff, the NIHE incorporated antiviral resistance surveillance into the national influenza surveillance system.
- NIHE trained staff and successfully initiated severe acute respiratory illness (SARI) surveillance in five hospitals.
- NIHE trained staff and successfully initiated burden of disease surveillance in three district hospitals. This surveillance collects economic data, in addition to demographic data from SARI patients, such as job type and family income.

- NIHE epidemiology and laboratory staff, with support from CDC-Vietnam, publish countrywide influenza surveillance data (including ILI, SARI, and severe viral pneumonia) in the Influenza Weekly Update Vietnam report. This report also contains updates on program staff activities, official reports on influenza and other zoonotic disease activities in Vietnam, as well as media reports. These reports are shared with CDC Atlanta, regional CDC colleagues, and CDC-Vietnam management.

Laboratory

Vietnam has two National Influenza Centers (NIC), the National Institute of Hygiene and Epidemiology (NIHE) in Hanoi and the Pasteur Institute of Ho Chi Minh City (PI-HCMC). The CDC Influenza Program in Vietnam works closely with both NICs. NIHE and PI-HCMC continue to provide influenza virus samples to the WHO Collaborating Center (CC) in Atlanta.

The CDC AHI Initiative in Vietnam continues to collaborate with the National Center for Veterinary Diagnosis (NCVD) of Vietnam's MARD. The NCVD provides poultry samples to CDC Atlanta for review and analysis.

The sharing of human and animal samples not only assists with providing information on influenza virus types, characterization, and co-evolution in Vietnam, but also contributes to the knowledge of tropical influenza viruses in Asia, as well as anti-viral resistant strains.

Laboratory Activities

- In 2011, 4,417 ILI samples were tested from the outpatient sentinel sites of the national influenza surveillance system, with an influenza positivity rate of 15%.
- In 2011, 992 SARI samples were tested from the inpatient sentinel sites of the national influenza surveillance system, with an influenza positivity rate of 6.5%.
- One-hundred and twenty-eight samples from persons with severe unexplained pneumonia were tested in 2011 and 29 (23%) of these cases were caused by seasonal influenza strains.
- Vietnam's two NICs, NIHE and PI-HCMC, together provided 123 influenza specimens to the WHO CC in Atlanta in 2011.

Poultry for sale at a market in Vietnam.

- CDC-Vietnam provided an informal review of laboratory capacities at NCVD in April 2011 at the suggestion of the AHI and by request from Vietnam's MARD. This informal review helped NCVD determine the capacity-building activities they would need to undertake in order to conduct influenza and other zoonotic disease testing in their laboratories, and therefore the plausibility of a future cooperative agreement with CDC. The NCVD advised they would use the informal review to: (i) assist their staff with recommendations for improvement; (ii) prepare for future International Organization for Standardization (ISO) reviews, and (iii) make recommendations to the Department of Animal Health (DAH) and MARD for future capacity and sustainability needs.

Preparedness

CDC support for Vietnam's pandemic preparedness started in 2006 in the form of a cooperative agreement with the MOH's GDPM. This agreement focuses on: (i) supporting the development, revision and testing of avian influenza and pandemic influenza preparedness plans for government, agencies, and organizations; (ii) coordinating activities and sharing information among partners, and (iii) developing and disseminating communication messages and materials.

Preparedness Activities

- Organized training courses for preventive medicine staff at the provincial level on the epidemiology of influenza and pandemic response.
- Conducted workshops for health staff at the district level to disseminate infection control Developed and disseminated avian influenza communication material for high-risk groups, focusing on people who work in poultry markets, slaughter-houses, and chicken farms.
- Developed guidelines for local communication staff describing how to communicate during an influenza pandemic.
- Continued maintaining and updating the MOH website, officially reporting on the status of influenza and other emerging diseases in Vietnam.
- Continued providing guidelines, policies, and legislation on influenza and other infectious diseases.
- Conducted a workshop to review the implementation of the CDC cooperative agreement from 2007–2011 and to identify their achievements, strengths, and weakness in influenza pandemic preparedness over this period.

Training

- CDC-Vietnam continues to support the MOH's FETP through the development of training modules, participation in classroom sessions, and technical oversight of abstracts, presentations, and manuscripts, required by FETP fellows for meetings and conferences. The FETP graduated its first cohort of fellows in August 2011
- CDC supported laboratory staff from PI-HCMC to attend laboratory management training in South Africa.
- CDC supported a workshop in Hanoi to help develop influenza antiviral resistance surveillance in Vietnam. The goal of the workshop was to establish laboratory tools for antiviral resistance surveillance based on pyrosequencing and neuraminidase inhibition assays.

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Meetings and Trainings

Meetings/Trainings

2nd Annual African Network for Influenza Surveillance and Epidemiology (ANISE) Meeting

Location: Noguchi Memorial Institute for Medical Research, College of Health Science, The University of Ghana Campus, Legon, Accra, Ghana

Dates: January 11–12, 2011

This meeting follows on from the outstanding inaugural meeting held in Johannesburg, South Africa, December 7-9, 2009. The meeting was co-hosted by the U.S. Centers for Disease Control and Prevention (CDC), the Noguchi Memorial Institute for Medical Research (NMIMR), and the U.S. Naval Medical Research Unit No. 3 (NAMRU-3). It brought together approximately 100 members from 23 African countries, along with representatives from Ghana Health Service, World Health Organization (WHO), Agence de Médecine Préventive (AMP), and Institut Pasteur.

Goals

The goal of the meeting is to share and promote the use of standardized surveillance methods in the regions among laboratorians, epidemiologists, veterinarians and other public health practitioners involved in influenza-related public health activities or influenza research in Africa.

Agenda

The two-day meeting included plenary sessions, breakout sessions, and poster presentations. Sessions concentrated on the following topics:

- Epidemiology in Africa
- Virologic Surveillance in Africa
- Other Respiratory Pathogens
- Animal-Human Interface/ Emerging Pandemic Threats
- Vaccine

Group photo from the 2nd Annual ANISE Meeting in Accra, Ghana.

Attendees discussed influenza surveillance and research projects that they had conducted over the past two years. Highlights of the meeting included brief presentations given by each country showcasing their surveillance achievements and epidemiologic and laboratory data. In addition, scientists presented posters on influenza research studies and projects in Africa.

Outcome

The meeting was a success that provided attendees an opportunity to present their data and share best practices. Future projects of the ANISE group that were proposed at the meeting included publishing a summary of 50 years of African influenza surveillance data, as well as giving each country the opportunity to publish its data in a 2011 issue of the Journal of Infectious Disease.

Laboratory Management Course for Influenza

Location: National Institute for Communicable Diseases [NICD] Campus, Johannesburg, South Africa

Dates: February 28–March 4, 2011

The U.S. Centers for Disease Control and Prevention (CDC) in partnership with the Association of Public Health Laboratories (APHL) and the National Institute for Communicable Disease (NICD) in Johannesburg, South Africa sponsored a laboratory management course for influenza laboratories in Africa and select Asian countries. The course brought together 36 participants representing 25 countries and 8 instructors from various agencies such as the CDC, NICD, APHL, and the World Health Organization (WHO) Collaborating Center in Australia.

Goals

The goal of the training course is to help laboratories achieve, maintain, and improve global influenza surveillance systems by presenting various laboratory management topics to influenza laboratory managers and staff.

Agenda

Course topics included: Human Resources Basics, Biosafety for Lab Managers, Quality Assurance and Quality Control, Inventory Management, Specimen Collection and Processing, Laboratory Testing and Test Result Reporting, and National Influenza Center (NIC) Designation. The format for the course was a combination of lectures, demonstrations, and hands-on exercises. This format allowed participants to gain knowledge and information for implementation within their laboratories.

Outcome

The participants learned how to describe key aspects of laboratory biosafety including risk assessment, incident management and BSL-3 (biosafety level three) security practices. Additionally, participants learned how to develop strategies to implement Quality Assurance and Quality Control best practices, describe and develop an inventory management system, describe specimen collections and processing best practices for influenza detection, and they learned the roles and responsibilities of becoming and/or maintaining a NIC designation.

Group photo from the Laboratory Management Course for Influenza in Johannesburg, South Africa.

Influenza Writing Workshop

Location: Safari Park Hotel, Nairobi, Kenya

Dates: April 2011

The CDC-Kenya Influenza Program hosted a writing workshop in Nairobi in April 2011. An epidemiology professor from the University of California at San Francisco was the facilitator. Approximately 25 participants from 7 countries attended, along with 8 mentors.

Goals

The objective of the workshop was to help public health officials and researchers develop manuscripts for publication in peer-reviewed journals based on their influenza-related work.

Agenda

The students learned how to compose the different parts of a scientific manuscript (abstract, introduction, methods, results, and discussion), how to present data clearly and concisely, how to organize references, and how to determine what scientific journal would be most appropriate for their manuscript.

Outcome

Apart from providing host countries' influenza experts with guidance on how to present their findings, the writing workshop also served to support the Influenza Division's goal of broadly sharing global influenza data. The sharing of this new data will assist in clearer understanding of influenza in places that have not published data previously. With a better understanding of influenza activity and how it is impacting their communities, Ministries of Health can put policies in place for influenza prevention and control that may help to decrease morbidity and mortality associated with influenza.

West Africa Regional Training Workshop

Location: Noguchi Memorial Institute for Medical Research, College of Health Science, The University of Ghana Campus, Legon, Accra, Ghana

Dates: June 7–10, 2011

The second West Africa Regional Training Workshop was held in Accra, Ghana. The main objective of the 2011 Training Workshop was to further strengthen the capacity for detection, diagnosis and monitoring of influenza. The Workshop convened 30 participants from nine countries in West Africa (Burkina Faso, Côte d'Ivoire, Ghana, Mali, Mauritania, Niger, Nigeria, Senegal, and Togo) as well as representatives from the U.S. Centers for Disease Control and Prevention (CDC), U.S. Naval Medical Research Unit No. 3 (NAMRU-3), Noguchi Memorial Institute for Medical Research (NMIMR), and the World Health Organization (WHO). Participants included epidemiologists, clinicians, laboratorians, and surveillance officers working with influenza.

Goals

The objective is to describe the epidemiology of influenza; the steps for setting up national or locality specific influenza sentinel surveillance and to formulate a work plan for action. It is also to describe respiratory specimen collection, handling, transportation and processing and to organize, summarize and present results from sentinel surveillance for influenza.

Agenda

The workshop included presentations on key surveillance topics, practical exercises, break-out sessions, site visits, and country surveillance presentations.

Outcome

The expected result is to have participants at the end of the workshop to have acquired knowledge and skills to set up, implement and monitor sentinel surveillance for influenza.

Group photo from the West Africa Regional Training Workshop in Accra, Ghana.

Monitoring and Evaluation Tools

MONITORING AND EVALUATION

Under the cooperative agreements made between the U.S. Centers for Disease Control and Prevention's (CDC) Influenza Division and its partner countries, the Division supports the monitoring and evaluation (M&E) of activities associated with international Influenza program implementation. The purpose of M&E in this context is to:

- Demonstrate accountability for the resources used by programs to key stakeholders; CDC and the countries which receive funding.
- Document each country's capability and capacity for influenza surveillance, diagnostics and pandemic preparedness in order to:
    - identify program strengths and opportunities for improvement.
    - provide a mechanism to measure progress toward defined objectives and thereby demonstrate meaningful improvement in public health function over time.
- Guide ongoing investment in influenza surveillance, diagnostics and pandemic preparedness globally.
- Inform strategic and programmatic planning for countries and target technical assistance provided by CDC.
- Standardize and systematize practices.
- Identify good practices that can be shared between countries.

The Influenza Division has developed three tools which are described below. Countries participate voluntarily in these assessments.

National Inventory of Core Capabilities for Pandemic Influenza Preparedness and Response

Purpose: The National Inventory of Core Capabilities for Pandemic Influenza Preparedness and Response (National Inventory) is a comprehensive tool by which countries can systematically and quantitatively measure their capability and capacity to respond to an influenza pandemic.

Structure and content: The National Inventory covers 12 distinct domains, defined as 'core capabilities' and each capability is assigned a composite score based on the quality, coverage and timeliness of four related indicators. For example, the core capability of 'Infection Control' is measured by determining performance in the following indicators (i) standards of infection control by level of health-care system (ii) integration of infection control training for staff (iii) availability of logistical resources for infection control and (iv) level of institutionalization of infection control efforts. The end-points for the core capabilities are not identical which allows for variation in public health priorities across countries with differing resource constraints. For a copy of the National Inventory, please visit www.cdc.gov/flu/international/tools.htm.

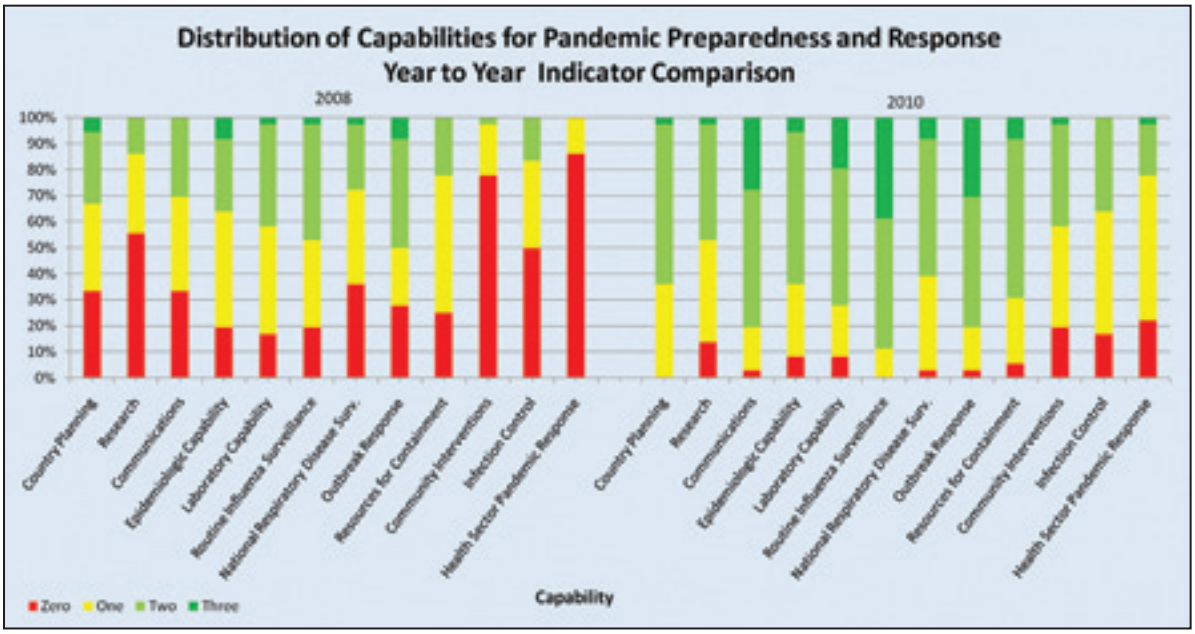
Implementation: Between May and October of 2008, 40 countries completed baseline self-assessments, facilitated by CDC staff. A further 12 countries participated in late 2009 and early 2010 to establish baselines. As of November 2010, 36 countries of the initial 40 countries which participated had repeated the tool after an approximate two year interval, allowing for comparing baseline and subsequent scores. From 2012 onwards, a new round of data collection will take place.

Outcomes: Comparison of data collected and analyzed for the 36 countries completing self-assessments between 2008 (baseline) and 2010 revealed the following:

- Total (aggregate) scores for the tool moved in a positive direction indicating an overall improvement in pandemic preparedness for each country over the period.
- Looking at all countries in aggregate, all 12 core capabilities showed statistically significant improvement from baseline.
- Examining each indicator in aggregate, 47 of 50 indicators showed statistically significant progress from 2008 to 2010.

Further to this:

- The assessments in 2008 helped countries to identify and target areas for preparedness improvement which in turn strengthened their ability to respond to the 2009 H1N1 pandemic.
- At the same time, the 2009 outbreak offered an enormous opportunity for countries to test their pandemic response with the outcomes captured when they repeated the tool in 2010.
- Identifying areas for Influenza improvement is also enhancing capacity-building for other infectious diseases as well as encouraging compliance with International Health Regulations 2005 (IHR).
- Using the tool to document progress is helping countries advocate for continued support.



International Influenza Laboratory Capacity Review Tool

Purpose: The International Influenza Laboratory Capacity Review Tool (IILCRT) is designed for assessing the capability and capacity of an influenza laboratory to perform influenza diagnostics.

Structure and content: The IILCRT is a series of questions divided into nine sections for assessing laboratories across a wide variety of influenza laboratory functions including, general laboratory functions, virology and molecular biology techniques, availability and maintenance of equipment, specimen handling, collection and reporting, staff training, laboratory safety and methods for quality assurance and quality control. The results from these sections form the basis for creating laboratory capacity summary reports and recommendations for countries. The structure and content of the tool was updated in 2011 for clarity and to include additional questions. For a copy of the tool, please visit www.cdc.gov/flu/international/tools.htm.

Implementation: Between September 2009 and October 2010, national laboratories in 33 countries completed baseline assessments, facilitated by staff from CDC and the Association of Public Health Laboratories (APHL). National laboratories in four additional countries have been assessed in FY 2011 with a further 6 countries assessed at baseline undergoing repeat assessments in the same period. From FY 2012 laboratories will be assessed using the updated version of the IILCRT.

Outcomes: The tool serves to highlight overall laboratory strengths while recommendations are provided by reviewers where opportunities for improvement present themselves. For example, a training needs assessment based on the first 26 laboratories reviewed, identified, six country laboratories in the Africa region which do not perform virus isolation; all of which expressed interest and readiness to receive technical assistance in these methods. Likewise, across all regions, many countries have received specific recommendations for improving the biosafety of their laboratories. As a consequence, APHL, CDC, the National Institute for Communicable Diseases in South Africa, the National Institute of Health in Thailand and the WHO Collaborating Centers for Reference and Research on Influenza in Melbourne and China delivered the first course on "Improving Influenza Laboratory Management Practices", in Johannesburg in 2011.

Analytic Framework: During FY 2011, CDC and APHL further developed the IILCRT by adding a quantitative component to the analysis of data collected through the assessments. A quantitative analysis of the data can be presented visually allowing quick identification of the status of an influenza laboratory's capacity. It can also provide a standardized approach to tracking changes in laboratory capacity over time. Approximately 150 questions have been selected for analyzing laboratory capacity across eight categories which have been identified as critical to the functioning of a national influenza laboratory. The eight categories for analysis include: National Influenza Center (NIC) Criteria, Laboratory Management, Biosafety, Quality Assurance and Quality Control, Molecular Biology, Virology, Specimen Handling, Collection, and Reporting and Equipment. Each selected question has been assigned one point. The points are aggregated by category and converted to a percentage performance measure. Beginning in 2012, each laboratory will receive a summary report of the quantitative analysis in addition to the full report. Data collected in 2009 through to 2011 will be analyzed retrospectively using the new analytic framework.

International Influenza Surveillance Assessment Tool

Purpose: The International Influenza Surveillance Assessment Tool (IISAT) is designed to standardize and systematize the review of national surveillance systems. The tool helps CDC and partners to clarify the objectives and structure of their surveillance systems, such that recommendations and technical assistance can be targeted to meet system goals such as, conducting data quality checks and establishing built-in laboratory and epidemiologic data integration.

Structure and content: The IISAT consists of six checklists covering national, central and sentinel site levels and covers all ILI and SARI related surveillance. For example, it includes a review of data management, analysis and reporting procedures. The tool uses a standard format for creating surveillance capacity summary reports where recommendations for countries can be provided. For a copy of the tool, please visit www.cdc.gov/flu/international/tools.htm.

Implementation: Between March and September 2010, the IISAT was piloted in three countries by CDC staff, with an additional seven reviews completed that year. A further eight countries have undergone surveillance reviews during FY 2011. In FY 2011, CDC's Influenza Division entered into a cooperative agreement with the Council of State and Territorial Epidemiologists (CSTE) who have provided epidemiologists to assist with conducting reviews in partner countries and will continue through FY 2012.

Outcomes: Reviews in pilot countries in 2010 were used to refine and finalize the tool. The tool has served to highlight overall surveillance strengths and challenges with recommendations for improvement provided to the 18 countries reviewed to date, nine of which took place in FY 2011. Recommendations have included: weekly and quarterly analysis of risk factor data, dissemination of data to stakeholders, and better coordination between national staff and sites.

Covers of three monitoring and evaluation tools used for International Influenza Programs. From left to right: The International Influenza Surveillance Assessment Tool, the International Influenza Laboratory Capacity Review, and the National Inventory of Core Capabilities for Pandemic Influenza Preparedness and Response.

Influenza Research

ARAB REPUBLIC OF EGYPT

Damanhour Integrated Population Based Surveillance

Infectious diseases such as respiratory infections and diarrhea are among the most important causes of morbidity and mortality worldwide, especially in developing countries and among children under 5 years of age. In 2009, in collaboration with the Egypt Ministry of Health (MOH), the International Emerging Infections Program (IEIP) and the U.S. Naval Medical Research Unit No. 3 (NAMRU-3), an integrated population-based infectious disease surveillance system for multiple conditions was established in the Damanhour District of the Beheira governorate in Lower Egypt, to provide information on burden and cause of disease. The conditions include the following: acute respiratory infection (ARI), acute diarrheal illness (ADI), acute febrile illness (AFI), acute infectious neurological disease (AIND), tuberculosis, and influenza-like illnesses (ILI) was established.

Study Objectives:

Primary Objectives

- To estimate age-specific incidence rates of disease due to ARI, TB, ADI, AIND and AFI in the Damanhour District.
- To identify the main etiologies of these disease syndromes in the Damanhour District.

Secondary Objectives

The study also aims to determine the following for each syndrome:

- Detect early increases in incident cases.
- Describe the epidemiology (seasonality, geographic distribution, etc.).
- Measure resistance of bacterial pathogens to available antibiotics.
- Establish a repository of biological specimens from patients with syndromes of interest for future etiological studies in collaboration with the MOH.

Approach: Patients admitted to any of the participating hospitals or examined at the participating primary health care units and private clinics in Damanhour District are screened to determine whether they meet a case definition. Patients who meet a case definition and agree to participate in the project are asked for symptoms, demographic and risk factor information and then have appropriate samples taken to determine the etiology of their infections.

Timeline: ARI surveillance began in June 2009 in three government hospitals with AIND and AFI added in April and September of 2010 respectively. Three outpatient clinics began ILI surveillance in January of 2011, and in May 2011, ARI, AIND and AFI surveillance were expanded to two more private hospitals.

Progress and Findings: Since beginning surveillance, over 20,000 patients have been screened for ARI or ILI. Over 1,000 patients have been in enrolled in ILI surveillance and over 4,800 were enrolled in ARI surveillance to date. Among 4,209 ARI naso- and oropharyngeal swabs collected, 12.7% (536) were positive for influenza virus. Among 829 ILI naso- and oropharyngeal swabs collected, 65 (7.8%) were positive for influenza virus. Additionally, 38 (4.6%) of naso- and oropharyngeal swabs from non-ARI or ILI cases tested positive for influenza virus, demonstrating that a small but significant proportion of influenza cases present with the absence of respiratory symptoms.

Conclusion: None yet.

Integrated Hospital-Based Infectious Disease Surveillance in the Greater Accra and Northern Regions

In 2002, infectious diseases accounted for 41% of all disability-adjusted life-years (DALY) lost and 41% of all deaths in Ghana. A 2004 WHO report on health status in Ghana indicated that approximately 20% of all infectious disease mortality was associated with respiratory infections, making it the third leading cause of infectious disease death in Ghana. Additionally, unexplained febrile illness and septicemia were among the five most common causes for clinic visits in children under 5 years of age. In collaboration with the Ghana Health Service (GHS), GDD/U.S. Naval Medical Research Unit No. 3 (NAMRU-3) and Noguchi Memorial Institute for Medical Research (NMIMR), an integrated hospital-based infectious disease surveillance system (IHBIDS) was established. Currently, 37 Military, Tema General, and Tamale Teaching hospitals participate as sentinel sites where surveillance for acute respiratory infections (ARI), acute diarrheal infections (ADI), and acute febrile illnesses (AFI) is ongoing.

Study Objectives:

- Determine the number of hospitalized cases due to each syndrome at participating hospital.
- Identify associated etiologies.
- Describe syndromic epidemiology.
- Strengthen local infectious disease surveillance capacity.

Approach: Demographic, and risk factor information as well as appropriate biological specimens are collected from eligible, hospitalized patients. Samples are processed at the NMIMR and NAMRU-3 (Cairo, Egypt) laboratories.

Timeline: In order to develop an effective multi-pathogen surveillance infrastructure, the study used a phased approach to initiate syndromic surveillance. ARI surveillance began in 2009 followed by ADI and AFI surveillance in 2010.

Progress and Findings: Preliminary results from IHBIDS data through September 2011 demonstrate that hospital-based influenza surveillance remains an important addition to ILI surveillance in Ghana, as it may differentiate between subtypes causing severe vs. mild illness. Among AFI patients, 20 influenza positive cases were identified (19% of all influenza positive cases). This finding demonstrates that severe influenza positive cases often present with undifferentiated febrile symptoms. Data also showed a seasonal distribution of hospitalized influenza cases peaking in June, coinciding with the annual rainy season. Influenza is a significant contributor to the etiology of both ARI and AFI.

Conclusion: IHBIDS data analysis demonstrates the effectiveness surveillance in detecting diseases of public health importance and providing the data to describe disease epidemiology, especially for AFI and ARI. In Ghana, IHBIDS syndromic surveillance can be leveraged to strengthen existing infectious disease outbreak early-warning systems and bolster efforts to gather data for sound public health decision-making.

This project is occurring in Egypt and Ghana.

BANGLADESH

Hospital Based Human Influenza Surveillance in Bangladesh

International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) collaborates with the Institute of Epidemiology, Disease Control and Research (IEDCR) of the Government of Bangladesh for the implementation of this influenza surveillance in 12 tertiary care hospitals from all seven administrative divisions of Bangladesh.

Study Objectives:

- To identify individuals and clusters of people who develop severe respiratory disease due to influenza virus.
- To characterize the diversity of influenza strains circulating in Bangladesh and causing both mild and severe respiratory disease.

Approach: Sentinel influenza surveillance in 12 hospitals (disease and virological surveillance).

Timeline: Initiated in 2007.

Progress and Findings: The surveillance is continuing in each of the participating hospitals to identify cases of influenza like illness in outpatient departments and severe acute respiratory illnesses (SARI), severe pneumonia and clusters of hospitalized cases (SARI and severe pneumonia) at the medicine and pediatric inpatient departments. The surveillance physicians at these hospitals are informing the surveillance personnel at IEDCR and icddr,b upon identification of clusters or suspected cases. During October 2010 to March 2011 a total of 1,044 samples were collected and tested in the laboratory to detect influenza A and B viruses. Among flu positive cases, there were 16 SARI patients (94%) and one severe pneumonia patient (4%). From October to March 2011, a total of 15 clusters of hospitalized severe respiratory disease were identified through this surveillance.

Kamalapur Population Based Surveillance

Community based surveillance for influenza and pneumonia in an urban slum of Dhaka, Bangladesh.

Study Objectives:

- To determine the incidence and seasonal distribution of influenza and other respiratory virus infections among all age groups, with continued emphasis on children less than 60 months old with signs and symptoms of acute respiratory illness, in a defined urban population.
- To identify the proportion of pneumonia associated with acute viral infection.
- To characterize the clinical signs associated with acute viral infection.

Approach: Active surveillance for respiratory illness among a defined urban population through weekly health screening and referral to a community clinic. Nasopharyngeal washes are collected from symptomatic participants and tested for influenza virus. A subset of influenza-positive samples are subsequently used for tissue culture and isolated viruses are typed and sent to CDC for further antigenic and antiviral resistance characterization.

Timeline: Initiated in 2004.

Progress and Findings: During March 2010 to March 2011, 3,898 children <5 years old and 1,412 persons ≥5 years old met the case definition for acute respiratory illness. Nasopharyngeal wash samples were collected from 772 children (20.0%) and 260 ≥5 years old subjects (20.0%) (every fifth child/adult who met case definition was recruited). All (100%) nasopharyngeal specimens were processed by RT-PCR to detect influenza virus. The influenza positivity rate among children was 13.7% and among ≥5 year olds was 2.7%.

Influenza B virus (Brisbane, Florida and Malaysia) was the predominant virus types circulating during this time frame. Influenza A H1N1 pdm 09 (32%) and influenza A H3N2 (7%) were less common. There was no seasonal influenza A H1N1 infection and no distinct seasonal peaks of influenza A were observed. The incidence of influenza was 10.1 children < 5 years per 100 child-years and 1.8 ≥ 5 years old per 100 person-years. All virus isolates have been cultured at icddr,b's virology lab. Monthly shipments of positive specimens have been sent to the influenza laboratory at CDC as well as monthly reports to CDC. Besides these as a part of enhanced surveillance 3,026 nasopharyngeal wash samples were collected from children <60 months and 1,061 from persons ≥5 years old from all eligible study participants who met the case definition. All samples were tested by RT-PCR. Positivity rate was 12% in children and 30% for ≥5 years old. There was co-circulation of influenza B and novel H1N1. Importantly, three human cases of avian influenza virus infection (two H5N1 and one H9N2) were identified in March 2011 among children less than 60 months old.

The surveillance site also continues to characterize the clinical signs associated with acute viral infection and serves as a critical platform for the Oseltamivir drug trial. The surveillance site also hosts an influenza vaccine trial to measure the influence of influenza vaccine on childhood pneumonia and incidence of influenza among household contacts of vaccinees. The site will continue to provide monthly influenza activity reports, as well as clinical and viral samples for vaccine surveillance.

Related Published Paper:

Brooks WA, Goswami D, Rahman M, Nahar K, Fry A, Balish A, et al. Influenza is a major contributor to childhood pneumonia in a tropical developing country. Pediatr Infect Dis J 2010;29:216-21.

Longitudinal Assessment of the Effect of Influenza on the Cognitive Development of Urban Poor Children, Bangladesh

Frequent, protracted, and severe influenza disease may cause cognitive developmental delays in very young children, as has been previously shown with other infectious pathogens. Substantiating whether frequent respiratory infections delay cognitive development is important because of the long term implications for affected children and their communities. This protocol proposes to study, during two years, the association between rates of influenza disease and delayed cognitive development in a birth cohort of urban poor children aged less than two years based in Mirpur.

Study Objectives:

- To assess the potential association between the frequency, duration, and severity of influenza disease and delayed cognitive development in a birth cohort.
- To assess the attributable risk of secondary tobacco exposure, indoor air pollution, and hand washing frequency, duration or severity of acute respiratory infections (ARI), and laboratory confirmed influenza infection in participating birth cohort children.
- To explore genome wide associations with frequency, duration, and severity of laboratory confirmed influenza disease in participating children.

Approach: Participants aged 3–12 months were enrolled in the study and followed for two years. During follow-up participants were evaluated for risk of delayed cognitive development, through quantifying individual incidence of ARI, laboratory confirmed influenza, and diarrhea. Annual cognitive tests were administered, and patients completed a survey in order to record a number of covariates. Field teams collected socio-demographic information from each of the enrolled participants and recorded indoor air particulate matter levels on monthly basis during 2009 for a sub-set of enrolled children. To assess the children's mental and psychomotor development, cognitive assessment teams administered the Bayley's Scale of Infant Development II. Children's behavior, language development and the quality of home stimulation were also assessed.

Study teams visited households every three days to administer a brief standard questionnaire using PDAs and to determine if participants developed ARI or acute diarrhea in the past three days. If field teams identified ARI case-patients, they recorded the onset and severity of symptoms and requested that the children be taken to the neighborhood clinic for sampling by nasopharyngeal washes. Respiratory samples were tested for influenza A and B, parainfluenza 1 and 3, RSV, adenovirus, rhinovirus, bocavirus, and human metapneumovirus by real-time RT-PCR. Blood samples were collected for genome-wide association analysis.

Timeline: This 2-year study started in April 2009 and finished at the end of March 2011.

Progress and Findings: We finished the second year of data collection and completed all field-related activities for the study on March 31, 2011. A total of 465 children aged 3-23 months were enrolled in the study. From October 2010 to March 2011, field research teams identified 400 episodes of acute respiratory infection and collected nasal and throat swab samples from them. Laboratory results demonstrated that 10% of these infections were caused by influenza. The Bayley's Scale of Infant Development has been administered on 397 children.

Between April 2009–March 2011, we followed 515 children for 730 child-years. We identified a total of 378 pneumonia episodes; 77% of the episodes were associated with a respiratory viral pathogen. The overall incidence of pneumonia associated with a respiratory virus infection was 40/100 child-years. The annual incidence of pneumonia/100 child-years associated with specific respiratory pathogens include the following: 12.5 for RSV, 6 for rhinoviruses, 6 for HMPV, 4 for influenza viruses, 3 for HPIV and 2 for adenoviruses.

Conclusion: Young children in Dhaka are at high risk of childhood pneumonia and the majority of these episodes are associated with viral pathogens. Developing effective low-cost strategies for prevention are a high priority.

Seroprevalence of Antibodies to Avian Influenza A Viruses among Poultry Market Workers

A study of poultry workers in markets found positive for presence of avian influenza virus through routine animal surveillance was performed, beginning in 2009. Multiple samples from live bird market surveillance have tested positive for H5 and unsubtypeable influenza A since the beginning of the project. These signals help study teams time the collection of sera from poultry workers 21 days after presumed exposure. Both pre-exposure and post-exposure paired sera specimens will be available to test for the antibodies to avian influenza A viruses. Serum specimens will be tested for neutralizing antibody against avian influenza viruses (H5, H2, H7 and H9) by microneutralization assay and confirmed by Western blot assay and/or modified haemagglutination-inhibition assay at CDC.

Study Objectives:

- To quantify the baseline seroprevalence of antibodies to avian influenza virus (e.g. H5, H9, H7, and H2) among Bangladeshi poultry market workers.
- To calculate the incidence of seroconversion during a one year study period.

Approach: Paired serosurvey among poultry workers.

Timeline: August 2009–April 2012.

Progress and Findings: Baseline sera was collected from over 400 poultry market workers from 11 live bird markets; baseline sera was also collected from 101 controls. Follow-up sera were collected from the enrolled workers in markets where environmental or poultry samples tested positive for avian influenza as part of ongoing animal surveillance. Serum samples have been shipped to the laboratories at CDC, where

serologic assays will be performed. Forthcoming laboratory test results will be merged with epidemiologic data for analysis. Investigators will calculate the incidence of seroconversion among poultry workers to H5N1 and other avian influenza viruses an important issue in a country in which 69% of the population raise poultry as an important protein source. The findings of the proposed study are expected to guide the response to H5N1 outbreaks and prevent the generation of novel influenza strains with pandemic potential.

Estimate Burden of Influenza Associated Mortality through Severe Acute Respiratory Infection in Matlab Population-based Surveillance

A recent study performed within a hospital-based surveillance platform documents a burden of 9 influenza cases per 100 person-years among persons of all age groups in Bangladesh. This influenza incidence rate is similar to rates calculated from a population-based surveillance site in urban Dhaka (10 per 100 person-years) and rates throughout Southeast Asia. These population-based efforts, however, have been unable to estimate influenza mortality. This longitudinal study aims to estimate the incidence of severe acute respiratory infection (SARI) and the mortality rate attributable to respiratory viral infections in Matlab, a rural sub-district of eastern Bangladesh during five months of the 2010 influenza season.

Study Objectives:

- To estimate the mortality rate due to influenza and other viral respiratory infections in this community-based surveillance site.
- To determine the sensitivity of commonly used influenza case definitions.
- To identify subpopulation at risk of dying with influenza.
- To quantify co-infections with preventable or treatable pathogens.

Approach: From June through October 2010, field staffs made weekly home visits and daily hospital visits to report potential severe acute respiratory infection (SARI) case-patients in the community or at the hospital. Criteria for reporting SARI case-patients included sudden onset of subjective fever, cough or sore throat and shortness of breath or difficulty breathing for persons over 5 years of age; and severe pneumonia or very severe disease or pneumonia for children under 5 years. A study physician visited potential case-patients to confirm diagnosis for enrollment, administered a standardized questionnaire to collect socio-demographic information, medical and treatment history, performed physical examination and obtained a nasopharyngeal swab from all enrolled case-patients. The physician also collected blood for culture from hospitalized case-patients. All swabs were tested for influenza A and B viruses, respiratory syncytial virus (RSV), human metapneumovirus (hMPV), adenoviruses and human parainfluenza viruses (HPIV) type 1, 2 and 3 by real time RT-PCR. Blood was tested for *Streptococcus* species, *Staphylococcus* species, *Hemophilus* species, *Klebsiella pneumoniae*, *Enterococcus faecalis*, *Acinetobacter* species, *Pseudomonas* species and *Candida* species. Deaths of any SARI case-patient were identified and a nested case-control study was planned to identify potential risk factors for death among SARI case-patients.

Timeline: Data and sample collection was completed from June–October 2010. Data analysis was performed in October 2010–September 2011 and write-up is currently ongoing.

Progress and Findings: During the study period, 172 SARI case-patients were identified in a community of 113,660 persons including 13,115 children of less than 5 years of age. Among the case-patients, 141 were children less than 5 years of age. Respiratory viruses were detected in 82 case-patients, with most of them being under 5 years of age. The incidence of SARI attributable to respiratory viruses among children aged <5 years was 19.3/100,000 child-week for RSV, 3.5/100,000 child-week for HPIV3, 3.2/100,000 child-week for influenza and 1.8/100,000 child-week for adenovirus. The incidence of SARI attributable to respiratory viruses among those aged ≥5 years was 0.2/100,000 person-week for influenza and 0.04/100,000 person-week for RSV. No death among SARI case-patients was reported.

Conclusion: Respiratory viruses, and in particular RSV are commonly associated with severe acute respiratory infection among children under five years in this rural setting. Further studies to provide influenza mortality data are critical to understand the burden of influenza disease in Bangladesh and to appropriately prioritize influenza prevention and control efforts in a country with many competing health priorities.

Characterization of Children Hospitalized with Respiratory Illness

Study Objectives:

- To describe the clinical characteristics, viral etiology, and demographics of children admitted with respiratory illness.
- To identify what factors associated with prolonged hospitalization among children admitted with respiratory illness.

Approach: Building upon ongoing surveillance in four hospitals, surveillance staff enrolls children admitted to hospitals residing in the primary catchment areas of the hospital two times per month. Children <5 years of age with any of the following two and/or more symptoms: fever, cough, difficulty breathing consistent with pneumonia or respiratory distress syndrome are eligible for the study. Investigators collect information on existing chronic medical condition, symptoms, treatment prescribed, and outcome of each hospitalized child. All study methodology will remain unchanged. We will continue to collect throat and nasal swab samples from these children. The respiratory samples will be tested for influenza A and B including rhinovirus, RSV, human metapneumovirus and adenovirus using RT-PCR. Findings will be compared 1:1 to children of the same age (in years) with influenza-like illness who visit the outpatient department but are not admitted.

Timeline: October 1, 2010–September 31, 2012.

Progress and Findings: We have completed six months of data collection from children presenting with acute respiratory symptoms at the outpatient and inpatient departments of the four surveillance hospitals where the study is being conducted (i.e. Jahurul Islam Medical College Hospital, Bajitpur, Comilla Medical College Hospital, Comilla, Shahid Ziaur Rahman Medical College Hospital, Bogura and Sher-e-Bangla Medical College Hospital, Barisal). Between October 2010 and February 2011, we have collected data and respiratory samples from 75 hospitalized children and 243 children attending the outpatient department. The data collection will continue until September 2012. All of the respiratory samples collected are being tested for influenza A and B, RSV, human metapneumovirus, adenovirus, parainfluenza viruses and rhinovirus. A monthly report is disseminated to co-investigators and collaborators within icddr,b, the Government of Bangladesh and CDC.

Conclusion: The study will help characterize the complications and determine the associated factors that result in hospitalization of children with acute respiratory tract infection. It will also help us estimate the burden of respiratory viruses on hospitalized children. The findings of the study will be shared with the government and the participating hospitals. Investigators will summarize the findings for publication and presentation.

Advancing Hospital Infection Control Systems to Detect and Contain Emerging Infectious Diseases

Timeline: Initiated in 2007.

Progress and Findings: We have been conducting surveillance for hospital-acquired respiratory illness in three tertiary care facilities in Bangladesh since 2007. Beginning in 2008, we started collecting biological specimens from patients with new onset of respiratory disease during hospital stay as well as from health care workers with respiratory illness and tested these specimens for the presence of influenza viruses. We have estimated the incidence of hospital acquired respiratory disease in these facilities. Data from the first year of surveillance activities was published in 2010. Currently we are conducting our surveillance activities in three tertiary hospitals and one district hospital.

Between October 2010 and February 2011, we identified 106 cases of hospital-acquired respiratory illness and collected nasal and throat swabs for influenza testing. None of them were positive for influenza viruses. However, this reporting period spans a period outside of the regular influenza season in Bangladesh. During our hospital surveillance activities of 2008–2009, we had identified other respiratory viruses such as respiratory syncytial virus, human metapneumovirus, and parainfluenza virus which had been circulating in these facilities. Based on these findings, we plan to test this year's samples for other respiratory viruses as well. In addition to hospital acquired respiratory illnesses, we have leveraged the nosocomial surveillance platform and have been collecting information on the onset of hospital-acquired diarrhea in the study hospitals since 2008. We have estimated the incidence of hospital acquired diarrhea and anticipate publishing a manuscript on this topic later this year.

Related Published Papers: Gurley ES, Zaman RU, Sultana R, et al. Rates of Hospital-Acquired Respiratory Illness in Bangladeshi Tertiary Care Hospitals: Results from a Low-Cost Pilot Surveillance Strategy. Clinical Infectious Diseases (2010), 50 (8):1084-1090

Effectiveness of Pandemic (H1N1) 2009 Influenza Vaccine in Bangladesh, 2010: Program Evaluation

During 2010, WHO and other international partners donated 15.5 million doses of 2009 pandemic influenza A H1N1 (pH1N1) monovalent vaccine to Bangladesh in an effort to protect those at highest risk of complications from influenza illness. While the Government of Bangladesh vaccinated high-risk groups, we took the opportunity to estimate the effectiveness of the vaccine (VE) among health care workers (HCW), pregnant women and children. Measuring vaccine effectiveness is critical for a new vaccine as this estimation will help to recommend or decide for the use of the vaccine.

Study Objectives:

- To estimate the vaccine effectiveness among health care workers, pregnant women and children who received pH1N1 vaccine during the vaccination campaign.

Approach: Local health officials implemented a vaccination campaign during May–July 2010 with the technical assistance of WHO Extended Program on Immunization experts targeting prioritized high-risk groups (HCW, pregnant women and children more than 6 months to 5 years of age). Starting in May 2010, 12 geographically diverse hospitals and the vaccination centers in three unions (i.e. administrative units of Bangladesh with about 10,000 persons each) nearest to those hospitals were visited during the vaccination campaign, to randomly enroll participants recorded as vaccinated. Unvaccinated individuals were enrolled at a 1:1 ratio from the same hospitals and the same vaccination centers as vaccinated participants. Following enrollment, investigators telephoned and/or visited participants weekly to obtain nasal and oro-pharyngeal swabs during episodes of influenza-like illness (ILI, defined as sudden onset of fever with cough or sore throat) during the influenza season (May–October). Samples were tested for influenza by real-time RT-PCR.

Timeline: The field study was performed from May to October 2010, spanning the annual influenza season in Bangladesh. Data analysis was performed November 2010–June 2011 and manuscript writing is currently ongoing.

Progress and Findings: The data collection of this project was completed on October 31, 2010. Over 500 vaccinated HCWs, 1,000 pregnant women and 300 children and their controls were enrolled in the study. None of the participating children tested positive for pH1N1. Study participants who tested positive for influenza were infected with influenza A H3N2 and pH1N1 viruses as well as influenza B virus. Of seven HCWs who were infected with pH1N1, two were vaccinated compared to five unvaccinated. Of 11 pregnant women who were infected with pH1N1, five were vaccinated compared to six unvaccinated.

We are currently working on the final data analysis which will incorporate other components such as the total number of pandemic vaccine recipients and the cost for the vaccination campaign, and the knowledge, attitude and practices' regarding influenza and influenza vaccines among health care workers. We expect to finalize a manuscript summarizing our key findings over the next few months.

Conclusion: Although the vaccine seemed effective, low circulation of pH1N1 hampered our ability to differentiate the proportion of pH1N1 infections among vaccine recipients and those unvaccinated. Further studies remain to be performed to fully evaluate the vaccine effectiveness of influenza vaccines considered for distribution in Bangladesh.

CENTRAL AMERICA AND PANAMA (CDC-CAP)

Surveillance of Incidence and Disease Burden for Influenza-Like Illness (ILI) and Severe Acute Respiratory Infections (SARI) for Influenza and Other Respiratory Viruses in Population Cohorts in Central America

This study will increase the knowledge of influenza epidemiological data in the Central American Region, particularly on the incidence of influenza-like illness (ILI) and severe acute respiratory infection (SARI) associated to influenza and other respiratory diseases, their association to socio-demographic characteristics, and their risk factors. The study will provide valuable information that will complement sentinel surveillance in the area.

Study Objectives:

- Estimate the incidence of ILI associated with influenza and other respiratory viruses in two Central American cities.
- Estimate the burden of ILI associated with influenza and other respiratory viruses in two Central American cities.
- Identify protective and risk factors associated with the development of ILI and SARI associated with influenza and other respiratory viruses in two Central American cities.

Approach: This is an observational study prospective cohort study. Approximately 600 households in each site will be enrolled through multi-stage random sampling. Each participating household will be visited twice a week to detect new cases of ILI or SARI. Nasal and throat swabs will be taken from each enrolled case. The respiratory sample will be tested for influenza and other respiratory viruses through IFA and RT-PCR. Other respiratory viruses will be detected through IFA. Each confirmed case will be followed until symptoms subside.

Timeline: Household enrollment in Cartago, Costa Rica and San Marcos, Guatemala was during June, 2011. There have been a total 41 weeks of follow up to date and it will continue until August 31st.

Progress and Findings: Five hundred and ninety households are enrolled in Guatemala, 51% in San Pedro and 49% San Marcos. Since June, 2011, 64 respiratory samples have been collected, 25 (39%) were found positive for a respiratory virus, 6 (9%) for influenza A H3, 6 (9%) for influenza A H1N1, 8 (13%) for influenza B, 1 (2%) for parainfluenza 1 and 1 (2%) for parainfluenza 3.

Six hundred and seventy households are enrolled in Cartago, Costa Rica, 40% in Paraiso, 36% in Santa Lucia and 25% in Orosi. From June 2011, 301 respiratory samples have been collected. From these samples, 26 (9%) were found positive for a respiratory virus, 8 (3%) for influenza A, 17 (6%) for adenovirus, and 1 (0.3%) for parainfluenza 1. Respiratory samples are still pending laboratory analysis.

Conclusion: Although the last influenza season was weaker than expected, the cohort was able to detect several cases of ILI in both sites. Most of them were confirmed as influenza cases. The cohort continues to follow the enrolled families weekly and we suspect a stronger flu season approaching during 2012.

This project is occurring in Costa Rica and Guatemala.

Household Survey to Estimate the Prevalence and Burden of Disease, Symptoms, Associated Risk Factors, and Health Care Utilization Practices for Severe Acute Respiratory Infection and Influenza-like Illness in Chiriquí, Panama and San Pedro Sula, Honduras

The study aimed to characterize the prevalence, burden of disease, risk factors, and health care utilization practices of cases with severe acute respiratory infection (SARI) during the previous 12 months and cases of influenza-like illness (ILI) during the previous 30 days before the date of onset of the survey among the resident of the catchment area of the José Domingo de Obaldía Hospital (JDOH).

Study Objectives:

- To quantify the proportion of persons living in the catchment area of the JDOH who seek care at these sentinel sites when ill with respiratory illness through household surveys.
- To use health utilization data to estimate influenza-associated rates of SARI and ILI.
- To assess the economic burden of influenza-associated SARI and ILI among the study population through interviews about the direct medical costs and indirect medical costs (e.g. work absenteeism).
- To describe household characteristics, health care utilization practices, illness signs and symptoms, and risk factors in individuals identified with SARI and ILI among the study population.

Approach: We conducted a household survey using cluster sampling, stratified by urban and rural area. Clusters were selected proportionate to size. A questionnaire comprised of seven forms was administered to all household members (if present) in order to record the occurrence of SARI cases (in the last 12 months) and ILI cases (in the last 30 days), defined according to *PAHO-CDC Influenza Surveillance Generic Protocol*. For each disease syndrome we asked for symptoms, burden of disease, type of health care services that were sought, reasons for not seeking health care services, and related risk factors. Specimens were not collected.

Timeline: Data collection and analysis was conducted between August 2011 and February 2012.

Progress and Findings: Preliminary results showed that influenza vaccination coverage was 42% in Panama and 32% in Honduras (informed by the interviewees); just 17% in Panama and 9% in Honduras had a vaccination card. In general population ILI prevalence was 0.75% (95%CI: 0.16-1.34) in Panama 2.5% (95%CI: 2.02-2.96), slightly higher in women 0.88% in Panama (3.04% Honduras) and those aged 50-60 1.36% in Panama and those aged 20-30 (2.77%) in Honduras). In general population SARI prevalence was 0.28% (0.1-0.45) in Panama and 0.7% (0.41-0.99) in Honduras. Two persons died due to SARI (adult and child < 5 years old) both of them in the urban area in San Pedro Sula, Honduras. ILI prevalence in households was 2.73% (0.64-4.82) in Panama and 8.4% (6.97, 9.83) in Honduras. Urban prevalence was higher (2.99%) especially in some districts in Panama and rural prevalence was higher (19.35%) in Honduras. SARI household prevalence was 0.94% (0.33-1.56) in Panama and 2.53% (1.54, 3.53) in Honduras. Rural households had higher prevalence. 74% percent of ILI cases had difficulties to perform daily activities in Panama (51% in Honduras). The median for total days lost due to disability was two, partially lost one day in Panama and 4(p25-p75: 2, 8) in Honduras. 11% of the cases needed a person to take care of them 68% in Honduras. Care taker incomes loss was $132 Balboas in Panama and $11 in Honduras. SARI cases could not performed daily activities in 70% in Panama (77% Honduras) of them, 40% could not attend school in Panama (29% Honduras); 30% couldn't do housekeeping in Panama (24% Honduras) and another 30% did not work in Panama (18% Honduras). The median of days lost due to a SARI episode was seven days (p25-p75: 5, 8) in Panama and five days in Honduras; the median for days partially lost was five in Panama (three days Honduras). SARI case 90% of the patients had additional expenses in Panama and 73% of them such as transportation, medical attention, food, medication and diagnostic tests in Honduras.

Conclusion: When compared SARI and ILI prevalence preliminary results with those of the health utilization surveys previously conducted in Guatemala, El Salvador and Costa Rica, we found that these are lower probably due a low circulation of the virus. A data review of hospital discharges for the same weeks in previous years in comparison to 2011, showed a decreasing trend. Nevertheless, SARI and ILI prevalence's found in Honduras are higher than those found in Panama.

This project is occurring in Panama and Honduras.

Nicaraguan Influenza Birth Cohort Study

The proposed pediatric influenza cohort study will build upon resources and infrastructure established through the Nicaraguan Influenza Cohort Study (NICS) in Managua. NICS is performed in a low- to middle-income district of Managua served by the Health Center Sócrates Flores Vivas (HCSFV), to characterize the incidence and severity of influenza virus infection in children under the age of 2 years.

Study Objectives:

- Characterize the burden of influenza in children aged 0 to 2 years in Nicaragua.
- Examine risk factors for influenza virus infection and severity of disease.
- Investigate sequential infections.

Approach: Subjects will be recruited in the catchment area of the Health Center Sócrates Flores Vivas (HCSFV) in District II of Managua, and socio-demographic data will be collected. GPS data from subject households will be recorded, and respiratory (nasal and throat swabs) and serological samples will be collected. These specimens will be tested for influenza virus and antibodies and sera samples to determine Vitamin D levels. A weekly visit will be conducted to participant households to identify suspect cases and collect samples and to provide care or refer to the hospital. Anthropometric measures will be taken to establish nutritional status.

Timeline: The cohort was established in August 2010, and data collection will continue through August 2013.

Progress and Findings: As of March 31, 2012, 154 participants have been enrolled; study acceptance has been consistently high. 89.0% of the parent/tutors approached gave permission for their newborn's participation after a thorough consent process. All participants were aged 4 weeks or less at enrollment. The median age at enrollment was 17 days. At present, the cohort is composed of 147 participants, 78 females and 69 males. Respiratory samples were collected from all participants meeting the influenza-like illness criteria. All samples collected were nasal swabs. A total of 81 samples were collected until March 31, 2012. To date, 100% of the samples have been processed. Two samples were positive for Influenza A H1N1 2009. Respiratory infections are rare in extremely young children, but become more common as children age. All participants transferred to the hospital for pneumonia (7) have been screened by PCR for other respiratory viruses, namely Respiratory Syncytial Virus (RSV), Parainfluenza 1-3, Rhinovirus, Metapneumovirus and Bocavirus. One participant tested positive for Rhinovirus.

Conclusion: None yet.

Viral Circulation and Influenza Seasonality in Central America

This study aims to describe influenza and other respiratory virus circulation in the Central American Region from 2002 to 2010. The systematization and interpretation of this information will allow improving influenza epidemiological knowledge in tropical developing countries for a better decision making process on prevention and control of influenza and other respiratory viruses.

Study Objectives:

- Describe the viral circulation of influenza in the Central American Region during 2002–2010.
- Describe the viral circulation of other respiratory viruses in the Central American Region during 2002–2010.
- Determine influenza seasonality in the Central American Region during 2006–2010.

Approach: Through a descriptive observational ecological study, the National Influenza Centers' databases from 6 countries from the region were analyzed. The aggregated or individual monthly databases from Guatemala, Costa Rica, Nicaragua, Honduras, Panama and El Salvador were analyzed. An influenza positive case was defined as any case positive for influenza by any laboratory diagnostic test (IFA, RT-PCR, viral culture). A case positive for any other respiratory virus was defined as any sample positive for this virus through IFA, the currently established diagnostic method. Monthly positivity proportions were calculated for each virus. GLM and ARIMA models were constructed to define influenza seasonality.

Timeline: January 2011 to July 2012.

Progress and Findings: From 2002–2010, the National Influenza Centers from these six Central American countries processed a total of 67,757 respiratory samples. Until 2008, the annual average increase of respiratory samples was of 648 (R2=0.70). On 2009 due to the pandemic effects, there was a significant increase in the number of samples analyzed in the region. The regional increase in 2009 was of 546.39% compared to 2008. The proportion positive for any respiratory virus was 27.4%. The percent positive was over 15% all year long, but it peaks during the months of July to October. Regionally during 2002–2010, monthly average influenza positivity percent was of 12.6%, 7.4% for respiratory syncitial virus, 4.4% for parainfluenza and for 3.6% for adenovirus. With the available data, influenza seasonality statistically proven for El Salvador, Nicaragua, Panama and Guatemala. Influenza circulation increases in the middle of the year, similar to the southern hemisphere seasonality. But in each country, influenza seasonality pattern is slightly different. The data available is limited and affected by the pandemic; more annual data should be collected to better describe seasonality in the region.

Conclusion: For the first time, circulation of respiratory viruses has been described for Central America. This analysis shows the improvement the region has made on respiratory viruses' diagnosis, particularly influenza. The analysis demonstrates that respiratory viruses circulate all year long in tropical countries, keeping monthly average positivity rates over 15%. But influenza circulates with different patterns throughout the region.

This project is occurring in Guatemala, Costa Rica, Nicaragua, Honduras, Panamá and El Salvador.

Demographics and Clinical Characteristics of Influenza A H1N1pdm Deaths in Central America and Dominican Republic during the 2009–2010 Pandemic

The epidemiology of influenza A H1N1pdm09 among low-income tropical countries during the last pandemic is not well documented. Based on data from national surveillance systems of 7 countries in Central America, we identified persons who died with influenza A H1N1pdm09 infection during 2009–2010. Using unified methodology and a web based database we explored the demographics and clinical characteristics. We include areas such as the use of antivirals, antibiotics, radiology, timing from onset to a visit to a health care provider, and pre-existing medical conditions.

Study Objectives:

- Explore the demographics and clinical characteristics of persons who died with influenza A H1N1pdm09 infection during 2009–2010.
- To identify potential risk factors for severe outcomes among influenza A H1N1pdm09 deaths in Central America and the Dominican Republic.

Approach: We identified influenza-associated deaths by hospital-based surveillance of severe acute respiratory infection (SARI). A case of influenza-associated death was defined as a person with SARI (defined as sudden onset of temperature >38˚C, cough or sore-throat, and shortness of breath or difficulty breathing requiring hospitalization) who tested positive for influenza A H1N1pdm09 rtRT-PCR in the two weeks prior to death. We then abstracted decedents' demographic and clinical information from medical records and described these characteristics through proportions using Chi square, T-test and ANOVA as appropriate.

Timeline: May 2009 to June 2010.

Progress and Findings: We identified 185 cases of influenza A H1N1pdm09 decedents. The median age was 33 years and 48% were aged 15–44 years. One-hundred and two (55%) were female of which, 21 (18%) were pregnant, and 12 (14%) were in their puerperium. Nine (43%) of 21 pregnant women had an underlying medical condition (5 [24%] had asthma, 2 [10%] were obese, 2 [10%] had cardiac disease, and 1 [5%] had diabetes). Of the 113 cases (61%) that had a pre-existing medical condition, 26 (23%) were obese, 25 (22%) had diabetes, 22 (19%) had asthma, 16 (14%) had other chronic metabolic diseases, 11 (10%) had chronic obstructive pulmonary disease, 11 (10%) had seizure disorder, and 7 (6%) had cerebral palsy. Sixty-nine percent of cases received treatment with oseltamivir, but only 9% received it within the first 48 hours of symptoms onset. There was no statistically significant difference in the average amount of time elapsed between symptom onset and health seeking by, age groups (p= 0.4), or country (p= 0.2). Among the 75 case-patients with CXR, 24 (32%) had consolidation or complete opaqueness at the time of admission and 19 (25%) developed these later during their hospitalization.

Conclusion: The pandemic affected the young and those with pre-existing medical conditions. Most patients sought health care too late for oseltamivir to provide much benefit. Based on the results it is recommended to review the indications and availability of oseltamivir in the country.

This project is occurring in Guatemala, El Salvador, Honduras, Costa Rica, Nicaragua, Panamá and the Dominican Republic.

Influenza Vaccine Effectiveness in El Salvador in 2010

Despite the substantial increase in the uptake of influenza vaccines since 2004 in Central America, no assessment of its effectiveness has been published to date. In order to support gains in vaccine coverage and explore the value of expanding vaccination, we conducted a retrospective case-control study among vaccination target groups in El Salvador to estimate effectiveness for 2010.

Study Objectives:

- To measure the effectiveness of the trivalent seasonal influenza vaccine against laboratory-confirmed severe acute respiratory infections (SARI) cases due to influenza, among children aged 6–23 months and adults aged over 60 years hospitalized at influenza sentinel hospitals in El Salvador in 2010.

Approach: We conducted a retrospective case-control study in 25 sentinel surveillance hospitals in El Salvador. The study population consisted of several target groups for vaccination: children aged 6–23 months and adults aged over 60 years. We reviewed SARI surveillance and national reference laboratory data. A SARI patient was defined as having suffered sudden onset of fever, cough or sore-throat, and difficulty breathing that required hospitalization. We identified influenza-positive hospitalized SARI case-patients and influenza-negative controls enrolled in surveillance. We used RT-PCR results for influenza illness confirmation. We compared the proportion of vaccinated among case-patients and among controls. We calculated vaccine effectiveness as 1-odds ratio. For each influenza case-patient, we matched a control of the same age. We collected information on demographics, SARI symptoms, underlying conditions, previous and current influenza vaccinations, respiratory sample taken and laboratory results.

Timeline: September 2010–2011.

Progress and Findings: We identified 227 SARI case-patients with complete information (SARI status, vaccination status, laboratory results); 157 children aged 6–23 months and 70 older adults aged over 60 years. Of 227, 43 case-patients had a positive test for influenza; 29 children and 14 older adults. Baseline characteristics did not differ between influenza-positive case-patients and influenza-negative controls. Twenty-two case-patients (51%) and 29 controls (67%) were vaccinated. Among children, 16 case-patients (55%) and 22 controls (76%) were vaccinated and among older adults, 6 case-patients (43%) and 7 controls (50%) respectively. Overall, vaccine effectiveness was 54% (95% confidence interval [CI] -21– 83%); 60% (95% CI -27–87%) among children and 34% (95% CI -21–89%) among older adults.

Conclusion: Results suggest a higher rate of vaccination among influenza-negative controls compared to influenza case-patients. However, results lack precision as the availability of vaccination status significantly reduced sample size. We are currently collecting further data (2011–12) in order to provide more precise estimates.

DOMINICAN REPUBLIC

Clinical Trial of Safety and Immunogenicity of Needle-free Jet Injection of Reduced-dose, Intradermal Influenza Vaccine Administered to Children aged 6 to 24 Months-old in the Dominican Republic

This was a sequential phase I and II, controlled, double-blinded study to determine whether immune responses suggesting protection against influenza can safely be induced in young children by two reduced doses one month apart of a trivalent inactivated influenza vaccine (INF) administered by the intradermal (ID) route with an investigational ID spacer on a needle-free jet injector (JI) (0.1 mL), compared to two standard intramuscular (IM) doses by needle-syringe (N-S) (0.25 mL).

Study Objectives:

- The primary endpoint of this study is to measure the percentage of participants with seroconversion on hemagglutination inhibition (HI) assay of serum collected at least one month after two doses of influenza vaccine (INF) administered in a reduced-dose volume of 0.1 mL intradermally (ID) by needle-free jet injector and intramuscularly (IM) by conventional needle-syringe (N-S), compared to standard IM injection of full 0.25 mL doses.
- Secondary objectives of this study are to determine for the above comparison seroprotection rates, geometric mean titers, and the extent and frequencies of local and systemic reactions.

Approach: Healthy participants were recruited from a large, public tertiary care children's hospital. Participants were randomly assigned to receive two doses of Sanofi-Pasteur Vaxigrip® influenza vaccine by one of the three study arms: a) Group "IM-NS-0.25" (controls)-two full 0.25 mL doses administered IM by standard N-S; b) Group "ID-JI-0.1" (investigational)-two reduced 0.1 mL doses administered ID by needle-free jet injector (JI), and c) Group "IM-NS-0.1" (investigational)-two reduced 0.1 mL doses administered IM by N-S. At the conclusion of the study, participants in the two investigational groups (reduced doses) received a third "insurance" dose via the conventional route, method, and dose. Six months later, all participants received a fourth "bonus" booster dose for protection during the following influenza season.

Timeline: This study started on October 2006 and the completion of data collection was November 2009. Final serologic results became available in final quarter of 2010. Currently working on final analysis and publication, estimated study end date is July 2012.

Progress and Findings: Our preliminary still-blinded results, show that local pain was mild in 111 (25%), moderate in 9 (2%), and severe in 5 (1%) participants (n=450). Moderate adverse event (AE) sizes of ≥10-<25 mm occurred for erythema (1%), and swelling (<1%). Systemic AEs were diarrhea (39%), fever ≥38.0°C (33%), loss of appetite (32%), vomiting (32%), sleepiness (18%), unusual crying (19%), irritability (13%), and convulsions (1%). Serious AEs (n=25) included: 10 asthma-related, 4 varicella, 4 febrile convulsions, 1 death (trauma), and 6 miscellaneous others. All but one possibly-related convulsion were deemed unrelated by DSMB. HAI inverse GMTs after dose 2 for multiple formulations and strains were 84 for H1N1, 62 for H3N2, and 100 for B. Seroconversion was 65%, 62%, and 75%; seroprotection 68%, 70%, and 85%, respectively.

Conclusion: Based on these preliminary results, we conclude that local AEs were tolerable, and immunity generally good. Definitive assessment awaits unblinded analysis by group of all participants.

GHANA

Dodowa Influenza Population-Based Surveillance (DIPS)

A population-based surveillance study is currently being implemented at the demographic surveillance site of Dodowa in the Dangme West District; this is a collaborative project between CDC, NAMRU-3, the Ghana Health Service and the Noguchi Memorial Institute for Medical Research. This population-based surveillance will take place in a well-defined population in a demographic surveillance site (DSS), and will serve as a platform for several influenza studies, including evaluating the disease burden and economic burden of influenza and identifying risk factors for severe influenza morbidity and mortality in Ghana. Initial activities planned in Dodowa include a health utilization survey to improve knowledge of health seeking behaviors and ensure that surveillance health facilities will identify the majority of ILI and SARI cases occurring in the population.

Study Objectives:

- Estimate the incidence of acute lower respiratory tract infections and the proportion attributable to influenza virus and to other pathogens in Ghana.
- Establish rates of severe respiratory disease and identify risk factors for severe influenza and other respiratory infections such as age, underlying medical conditions, malnutrition, co-infection with other pathogens, and environmental exposures.
- Evaluate case definitions for influenza and other emerging pathogens and identify clinical predictors of severe influenza and other respiratory infections in target populations.
- Characterize influenza and other respiratory infections in persons with coinfections (such as persons infected with HIV, tuberculosis, or malaria) that may place them at increased risk for severe influenza.

Approach: ILI and SARI screening at all health facilities and community health posts in the DSS.

Timeline: Surveillance initiated at the district hospital in April 2011.

Progress and Findings: N/A

Conclusion: N/A

INDIA

Addressing Emerging Infectious Diseases in the Republic of India: Influenza Disease

This HHS/CDC cooperative agreement was established five years ago (9/2008–9/2013) to estimate the burden of disease related to influenza virus infection in India, through a population-based longitudinal study at three sites with demographic surveillance systems.

Study Objectives:

- Estimate the incidence of laboratory-confirmed influenza among persons hospitalized with acute respiratory illnesses and acute exacerbations of chronic medical conditions.
- Determine risk factors for severe disease due to influenza, including underlying chronic conditions, demographics, smoking, and socio-economic status.
- Estimate the annual mortality rate due to severe respiratory disease and influenza in the population.

Approach: Persons living in the DSS areas in one of the three study areas (Ballabgarh, Vadu, and Vellore) that seek inpatient medical attention and meet the study enrollment criteria are enrolled, and clinical and epidemiologic information and respiratory specimens are collected from all consenting persons. Each site is also conducting a community-based survey, to gather health care utilization data as well as household risk factors and socioeconomic status. Additionally, two sites (Ballabgarh and Vadu) are conducting outpatient screening and enrollment to estimate the burden of non-hospitalized medically attended influenza disease.

Timeline: April 2009–September 2013.

Progress and Findings:

- The facility based surveillance for medically attended inpatients among 300k population has varied greatly both in enrollment and percent positivity for influenza from site to site. While Vadu/Pune revealed influenza positivity of 21% (699/3,325), Delhi had positivity of only 7% (62/923). Almost half of all influenza virus infections at each site are due to the A(H1N1)pdm09 virus.
- A preliminary estimate of influenza related hospitalization based on eligible cause hospitalization rate of 86/10,000 population/year and 8–10% influenza positivity has allowed extrapolation of total hospitalizations to approximately 1 million hospitalizations related to influenza.

Conclusion:

- >5,000 hospitalizations recorded with influenza positivity ranges from 7–21%.
- Rates of hospitalization vary significantly and almost 1/5 hospitalizations due to influenza occur during peak monsoon season.
- Incidence of influenza varied between sites (6-44/10,000).
- Annualized incidence rate in Vadu comparable to rates in U.S.
- Age specific differences from site to site.

Spectrum of Respiratory Virus Infections in Acute Respiratory Tract Infection (ARI) Among Children in India

This study has been carried out by utilizing the hospital based surveillance to estimate the incidence of influenza in Ballabgarh, Haryana.

Study Objectives: The main objectives of the study are to estimate burden of pneumonia, due to important viral (e.g., influenza, Respiratory Syncytial Virus (RSV)) and bacterial pathogens (*H. influenzae* and *streptococcus pneumoniae*), as well as drug sensitivity patterns of the causative agents in a rural community.

Approach: A subset of febrile acute respiratory illness (FARI) specimens collected from October–December 2010 were tested for various pathogens using a real-time RT-PCR.

Timeline: October 2010–to date.

Progress and Findings: Analysis of 137 specimens revealed 60 (44%) specimens were positive for one of the viruses tested: RSV (17%), rhinovirus (13%) and PIV3 (4%). Studies are underway to determine the incidence of each of these viruses in this population-based study.

Conclusion: This study provides evidence that respiratory viruses singly or in mixed infections are detected in >50% of medically attended hospitalized children from a rural community in India using sensitive detection methods like RT-PCR. These findings will help guide efforts to reduce the disease burden due to viral ARIs in developing countries.

Surveillance for Influenza and Infection with Other Respiratory Viruses Among Persons with Chronic Obstructive Pulmonary Disease, Kashmir, India

Surveillance data from other countries suggest that persons hospitalized with exacerbations of underlying chronic lung disease account for a substantial proportion of persons hospitalized with influenza. However, data are needed to establish the magnitude of acute exacerbations of COPD (AECOPD) due to severe influenza in India to inform local and national government response efforts to influenza epidemics, including targeting of influenza prevention efforts in areas with a high prevalence of COPD, and to guide local clinicians' management and treatment of persons hospitalized with AECOPD.

Study Objectives:

- Determine prevalence of influenza in hospitalized patients with acute exacerbation of COPD.
- Assess risk factors, spectrum of clinical illness, and case definitions.
- Determine prevalence of other respiratory viruses.

Approach: Sher-I-Kashmir Institute of Medical Sciences (SKIMS) is the main tertiary care hospital providing care for persons with COPD in Srinagar, the capital of Kashmir, and admits the majority of COPD patients with exacerbations requiring more than just supportive care. SKIMS will join the existing Indian Influenza Surveillance Network and begin conducting surveillance for influenza-like illness (ILI) among its outpatient population in September 2010, using Influenza Surveillance Network standard operating procedures. Additional surveillance for persons hospitalized with AECOPD will be conducted at this facility, due to the high burden of such patients, to better understand the contribution of influenza virus infections among persons hospitalized with AECOPD at SKIMS in Srinagar beginning in September 2010.

Timeline: September 2010–2013.

Progress and Findings: From the beginning of the project until September 2011, 318 patients of AECOPD were enrolled; two-thirds were aged 65 years or more. The influenza positivity rate is 8.2% (23) out of the 282 samples tested. Among the positive samples, 52.2% (12) were tested for influenza A/H1N1pdm09, 8.7% (2) for influenza A/H3N2 and 30.4% (7) for influenza B.

Conclusion: The preliminary data shows Influenza to be an important cause of hospitalization due to acute exacerbation of COPD among elderly population.

Direct and Indirect Protection by Influenza Vaccine Given to Children in India

Through collaboration between the All India Institute of Medical Sciences (AIIMS), CDC, and the University of Alabama, a study to determine whether immunization of young children with trivalent influenza virus vaccine (TIV) protects immunized children and older non-immunized household members is being conducted in three villages near New Delhi, India. Children aged 6 months–10 years are randomized at the household level to receive TIV or a control vaccine—Inactivated Polio Vaccine (IPV). Weekly household surveillance for febrile acute respiratory illness (FARI) is conducted among all study household members.

Study Objectives:

- Measure direct protection of children by influenza vaccine.
- Measure indirect protection against influenza among family members of influenza vaccine recipients.
- Define contribution of influenza virus to illness within three villages in rural Ballabgarh.
- Assess risk factors for more severe disease due to influenza virus.
- Establish surveillance system for influenza virus infections that will be used to assess outcomes in subsequent influenza virus vaccine study.

Approach: A prospective, household randomized, controlled, observer-blinded study is being conducted in 3 peri-urban villages outside of Delhi, India. The vaccination of children aged 6 months to 10 years with either Trivalent Influenza Vaccine (TIV) or the control vaccine (IPV) will be carried out for 3 years, followed by weekly household surveillance for febrile acute respiratory illness (FARI) to assess the efficacy of influenza vaccination. Additionally, a small subset of vaccinated children (n=200) will be enrolled to measure their immune response to vaccination and risk factors affecting immunogenicity.

Timeline: September 2008 to September 2011; extended till September 2014.

Progress and Findings:

- Enrollment, vaccination, and surveillance activities have been successfully implemented in October 2009 and 2010 with high rates of vaccine acceptance (91% of 3,700 eligible children received at least one dose of vaccine), and exceptionally high rates of community acceptance for surveillance enrollment (90% of 17,000 persons consented to participate in weekly surveillance).
- Influenza positivity was identified among 350 (17%) of the 2,030 FARI episodes during 2010 across all age groups. Pandemic H1N1 accounted for half of the influenza positivity.
- While the predominant circulating strain in 2009 was pandemic H1N1, co-circulation of both influenza B and pH1N1 was observed in 2010.
- Influenza seasonality in Delhi coincides with rainy season in July, plans underway to change the vaccination using SH vaccines resulting in policy changes.

Conclusion:

- Enrollment and immunization rates for influenza vaccine are high, reflecting high community acceptance.
- Likely no benefits of vaccination in first year (due to vaccine mismatch), need to continue three year vaccination.

- Emergence of pandemic H1N1 emphasized the importance of multi-year studies of influenza vaccine.
- Weekly FARI Surveillance in 18,000 villagers providing incidence data.
- Measurement of cell mediated immune response and nutritional factors in subset of the participants.
- Vaccine efficacy yet to be determined.

A similar vaccine effectiveness study is underway in Senegal.

Understanding Host Innate Immune Responses Against Influenza A Virus: An ICGEB-CDC Collaboration

Influenza virus has evolved complex translational control strategies as part of an innate defense mechanism exhibited by the infected cell. The influenza virus has evolved complex cap-dependent translation initiation mechanisms and involve the recruitment of both viral and host-cell proteins to preferentially synthesize viral proteins and prevent activation of antiviral responses.

Study Objectives:

- To explore cellular factors that are activated or involved with influenza virus (including H5N1) replication, assembly or release.
- Study viral-host factors associated with Influenza pathogenesis.

Approach: We undertook a comprehensive analysis of these virus-host interactions to better understand the viral drift resulting in a molecular evolution that results in its adaptability to infect different hosts. Discovering these new host-viral protein-protein interactions holds great promise for further research leading to new anti-viral targets.

Timeline: 2009–2014.

Progress and Findings:

- The NP protein of influenza A viruses (H1, H3, H1pdm09) down regulates the PKR pathway via interaction with HSP-40 (PLoS ONE published).
- The influenza A virus Neuraminidase protein via up regulation of Src signaling thereby enhancing cell survival through interaction with CEACAM6. (JBC, submitted).
- Influenza A virus Nucleoprotein interacts with Clusterin and inhibits its anti-apoptotic function, likely by preventing Bax movement into the mitochondria. This may lead to Cytochrome c release from mitochondria and subsequent induction of apoptosis.
- Role of Actinin-4, a cytoskeleton scaffolding protein postulated to be involved in viral trafficking within an infected cell. Actinin-4, being a cytoskeleton protein, can be hypothesized to facilitate transport of viral components during entry and exit of viral particles and can possibly have a role in intracellular trafficking of viral components thus controlling viral assembly and budding.

Conclusion: Complex interplay of viral proteins with innate host factors likely will uncover unique pathways that can be exploited for anti-viral approaches.

KENYA

Population-based Surveillance for Influenza and Other Respiratory Diseases in Nairobi and Kisumu, Kenya

The Influenza Program in collaboration with the International Emerging Infections Program (IEIP) under KEMRI/CDC currently conducts population-based disease surveillance (PBDS) for severe acute respiratory illness (SARI) and influenza-like illness (ILI) in two sites in Kenya; Kibera, an informal urban settlement in Nairobi, and Lwak, a rural community in western Kenya. Approximately 25,000 residents are enrolled in each of the two sites.

Study Objectives:

- Characterize etiologies of acute respiratory illness in a rural community and an urban community in Kenya.
- Evaluate the burden of medically attended and home-reported influenza and other respiratory diseases.
- Provide a platform to evaluate interventions such as vaccine.

Approach: Community interviewers visit each household bi-weekly to ask residents questions about illness symptoms in the past week. In addition, residents have access to a free clinic, where surveillance is conducted for respiratory illness, including influenza, and a number of other disease syndromes. Patients meeting the case definition for SARI and ILI have a nasopharyngeal and oropharyngeal specimen collected. Specimens for SARI and ILI are tested at the CDC/KEMRI laboratory in Nairobi for influenza and other viral pathogens using real-time RT-PCR. Data from weekly household visits, visits at the free clinics, and laboratory results are stored in a central database in CDC-Nairobi and at KEMRI/CDC, Kisumu.

Timeline: Surveillance for respiratory illness in the two sites began in 2006. A five year review of data is underway so that the seasonality, epidemiology and burden of influenza can be well-understood, and interventions such as vaccines can be evaluated.

Progress and Findings: Influenza virus has been shown to circulate year-round with a peak in activity between July and October of every year. From March 2007–February 2010 the adjusted rates of medically attended influenza-associated acute lower respiratory infections per 1,000 person-years in Kibera (urban informal settlement, Nairobi) and Lwak (rural western Kenya) were 13.7 and 23.0, respectively.

Conclusion: Influenza circulates throughout the year in Kenya with peaks during the cool and rainy seasons. Influenza constitutes a preventable fraction of the overall burden of respiratory illness in Kenya.

Hospital-based Surveillance for Multiple Respiratory Pathogens in Nyanza Province, Kenya

The Influenza Program in collaboration with the CDC Global Disease Detection program under KEMRI/CDC currently conducts comprehensive hospital-based surveillance for multiple respiratory pathogens at Siaya District Hospital, located within the Health and Demographic Surveillance System site in Nyanza Province, Kenya. This area has been under systematic health and demographic surveillance since May 2007.

Study Objectives:

- Characterize etiologies of hospitalized respiratory illness at Siaya District Hospital.
- Monitor the impact of influenza in the context of other respiratory viruses and underlying comorbidities.

Approach: Patients hospitalized with respiratory illness have a nasopharyngeal and oropharyngeal specimen collected. Specimens are tested at the CDC/KEMRI laboratories for influenza A and B, respiratory syncytial virus (RSV), parainfluenza (PIV)-1, -2 and -3, adenovirus (AdV) and human metapneumovirus (HMPV) by real time reverse transcriptase polymerase chain reaction. More recently Taqman Array Card (TAC) multiplex PCR technology has been used to test specimens for seven bacterial and 13 viral pathogens. Comprehensive clinical data are also collected.

Timeline: Surveillance is ongoing.

Progress and Findings: During 2009–2011 the respiratory viruses most commonly detected in hospitalizations using conventional PCR methods were AdV, PIV-3, RSV, HMPV and Flu A. Flu-associated hospitalization rates were highest in children 0<2 years old; similarly, other pathogen-associated rates remained high in this age group. Taqman array analyses have found *Streptococcus pneumonia*, rhinoviruses, respiratory syncytial viruses, adenoviruses, enteroviruses, and influenza viruses to be most commonly detected in hospitalized patients. Median CT values in patients with detectable *S. pneumoniae* were significantly lower in fatal compared to surviving patients, potentially suggesting a higher density of the pathogen. This is consistent with previously reported associations between high NP/OP density and pneumococcal pneumonia.

Conclusion: TAC Multiplex PCR technology identified one or more pathogens in 85% of respiratory hospitalizations in Western Kenya. Fatal outcomes are associated with multiple pathogens. In patients with *S. pneumonia* a greater pathogen density of *S. pneumoniae* was detected in the NP swabs of fatal as compared to non-fatal cases.

Seasonal Influenza Vaccine Effectiveness Study

Influenza vaccine has been shown to reduce influenza-associated acute respiratory illnesses (ARIs) in developed countries. However, little is known about the effectiveness of influenza vaccine in the developing world. KEMRI/CDC-Kenya, with support from the Kenya Ministry of Public Health and Sanitation, is conducting a three-year observational influenza vaccine effectiveness study using the commercially available Southern Hemisphere seasonal vaccine in two sites in Kenya; Lwak—a rural site in western Kenya, and Kibera—an informal urban settlement in Nairobi. The International Emerging Infections Program (IEIP) under KEMRI/CDC currently conducts population-based disease surveillance (PBDS) for severe acute respiratory illness (SARI) and influenza-like illness (ILI) in these two sites.

Study Objectives:

The objectives of the study are to evaluate the following:

- Effectiveness of the vaccine in preventing laboratory-confirmed disease.
- Effectiveness of the vaccine in preventing medically attended ILI and SARI, and symptomatic ILI and SARI reported in the community.
- Indirect effect of the vaccine in preventing laboratory-confirmed influenza, and ILI and SARI in non-immunized household members.
- Acceptability of influenza vaccination among community residents.

Approach: The vaccine is offered on a voluntary basis to infants from 6 months of age through children up to 10 years old enrolled in the IEIP study site. Sanofi Pasteur-France has donated Southern Hemisphere trivalent influenza vaccine for the study. Prior to the vaccination campaign a vaccination awareness campaign was conducted to sensitize the community to the benefits and availability of the influenza vaccine.

After vaccination, the study participants are followed up through the routine IEIP surveillance which includes weekly home visits where field workers ask household members questions about recent illnesses and deaths. The study participants also have free access to a medical clinic where free care is provided. At the clinic, specimens are collected from patients who have SARI or ILI. Samples are tested at the CDC laboratory using real-time RT-PCR for influenza virus. At the end of every year patients who received vaccine will be compared to patients who did not receive vaccine.

Timeline: Data from the past three years of influenza surveillance has shown that the influenza season in Kenya peaks July–October, and therefore most closely mirrors the Southern Hemisphere influenza season. The vaccine is available every year in Kenya beginning in March to coincide with the Southern Hemisphere influenza season. The study is entering its third and final year.

Progress and Findings: There has been over 40% uptake in both sites during the1st and 2nd year of vaccine campaign. A preliminary estimate of 43% vaccine effectiveness has been observed, which is consistent with the use of TIV at other sites. To date there has been a 100% match between locally grown viruses from existing surveillance and the Southern Hemisphere vaccine formulations. Children living more than 5km radius from the nearest vaccination facility have been significantly less likely to get vaccinated. Families with mothers aged 25–34, 35–44, >45 years have all been more likely to participate in the vaccination campaign than families with mothers aged <25 years. Mothers whose occupation requires them to be away from home have been less likely to participate than mothers who did not work or whose nature of work did not require that they be away from home. While formal evaluation of vaccine effectiveness will occur after year three, these findings also point to the essential role that mothers play in the vaccination of their children with seasonal influenza vaccine. Future campaigns will need to consider ways to adapt vaccination schedules to working mothers, and community mobilization efforts may need to target alternative family members who may bring children for vaccination if working mothers are unavailable. These findings also support the notion that future campaigns may need to consider opening additional vaccination centers if large portions of the targeted population will have to travel greater than 5km for vaccination.

Conclusions: To date the uptake of influenza vaccine has approached 50%, with 46% vaccine effectiveness against lab-confirmed influenza observed. There has been a 100% match between circulating and vaccine strains.

Surveillance for Avian Influenza Viruses in Live Bird Markets in Kenya

Influenza viruses circulating in poultry in Kenya have not been described. Influenza surveillance in live bird markets (LBM) has been recognized as an effective tool in detecting influenza subtypes circulating in the poultry population. Qualitative risk assessment studies carried out in Kenya in 2008 identified live bird markets as high-risk points, not only for virus introduction and circulation among birds, due to the practices employed, but also for introduction of virus to humans working with poultry. Conducting surveillance at LBMs is vital to early detection of the introduction of avian influenza to the poultry population in Kenya.

Study Objectives:

- To identify and characterize avian influenza viruses circulating in poultry traded in live bird markets in Kenya.
- Investigation of market practices that would contribute to mixing and transmission of virus within the market.

Approach: Between March 2009 and February 2011, we collected samples from birds presented for sale in the five live bird markets in Kenya. We visited each market once a month, and collected tracheal and cloacal samples from 25 birds per market visit. We also collected five environmental samples in each market at every visit. All the specimens were tested for influenza A matrix gene by real-time reverse transcription-polymerase chain reaction at the BSL-3 KEMRI/CDC laboratory in Kisumu. All influenza A positive samples were sent to CDC's Atlanta laboratory for virus isolation and subtyping.

Timeline: This field work was carried out from March 2009 through February 2011 but the project is ongoing.

Progress and Findings: From March 24, 2009 through February 28th, 2011, we collected a total of 5,221 cloacal and tracheal samples during 22 monthly visits to the five markets. Of these 4,176 (80%) were from chickens, 321 (6.1%) from ducks, 382 (7.3%) from turkeys, and 342 (6.6%) from geese. Of the 5,199 (99.6%) samples tested, influenza A virus was detected in 42 (0.8%) of the samples. Influenza A was detected in 35 of 4,166 (0.8%) swabs from chicken, three of 381 (0.8%) turkeys, four of 335 (1.2%) geese, and 0 of 317 (0%) ducks as shown in. Overall, influenza A was detected in 33 (1.3%) and nine (0.4 %) of oropharyngeal and cloacal swabs respectively. Virus isolation and subtyping of influenza A positive swabs is ongoing to determine the influenza subtypes circulating in poultry species in Kenya.

Conclusion: Current work suggests a relatively low prevalence of influenza circulating in poultry at live bird markets. However additional work has suggested higher prevalence in pigs, suggesting slaughterhouses as an important area for future monitoring of occupational exposures.

Evaluation of Length of Specimen Storage on Influenza PCR Test Results: An Analysis of Influenza Surveillance Specimens in Kenya, 2008–2010

Little is known about the optimal time specimens can be refrigerated before being tested for influenza by real time reverse transcription-polymerase chain reaction (rtRT-PCR). Existing guidelines recommend that samples be stored at 4°C for up to 96 hours.

Study Objectives:

- To determine the relationship between the numbers of days a specimen was in refrigeration and influenza positivity as well as the rRT-PCR Cycle Threshold (Ct) values for influenza specimens.

Approach: We collected nasopharyngeal and oropharyngeal specimens from patients with respiratory illness at influenza sentinel surveillance sites in Kenya. Specimens were stored in viral transport medium (VTM) at 2-8°C, transported to Nairobi, and tested for influenza A and B using rRT-PCR. We used multivariable logistic regression to determine the relationship between the number of days a specimen was refrigerated and influenza positivity influenza surveillance data from Kenya (2008–2010). We conducted ordinal logistic regression to evaluate the relationship between refrigeration days and the rRT-PCR Cycle Threshold (Ct) values of influenza-positive specimens.

Timeline: Analysis of sentinel surveillance data, 2008–2010.

Findings: Of the 7,833 samples included in the analysis, 940 (12.0%) were positive for influenza. In the multivariable analysis, there was a decline in positivity when samples were stored for six days or longer. We found that samples could remain in storage for at least five days without affecting the proportion-positive of samples. Ct values of influenza-positive specimens did not vary significantly by storage days.

Conclusion: These findings suggest that respiratory specimens can be refrigerated for up to five days in Kenya without substantially influencing the detection of influenza viruses.

A Comparison of Smart Phones and Paper-Based Questionnaires for Surveillance Data Collection using Influenza Sentinel Surveillance Sites in Kenya, 2011.

Manual data collection and data entry using paper-based questionnaires can be time consuming and prone to errors. Smartphones and other hand held electronic devices have potential to improve speed and accuracy of data collection, transmission, and entry. We introduced smartphones in four hospital-based influenza sentinel surveillance sites in Kenya. We compared smartphone-collected data to paper-based-collected data previously collected by the same surveillance officer.

Study Objectives:

- To compare the quality and timeliness of surveillance data collected using smart phones and paper-based questionnaires.

Approach: Since 2006, the Kenya Ministry of Health and the Kenya Medical Research Institute/CDC-Kenya have conducted sentinel influenza surveillance at 9 to 11 health facilities in Kenya. At each site, surveillance officers identify patients with respiratory illness and administer a brief (18 question) questionnaire that includes demographic and clinical information. From May–June 2011, we pilot-tested an electronic data collection system using Field Adapted Survey Toolkit (FAST) on HTC Touch Pro2 smartphones at four sentinel sites. For each site, we compared questionnaires collected using smartphones to an equal number of paper-based questionnaires collected by the same surveillance officer. We evaluated completeness of data collection, errors in data entry and time taken to enter collected data into the central database. We projected costs of running the two systems for a period of two years and compared them. In addition we sought the surveillance officers' experiences on using these data collection tools.

Timeline: Analysis of sentinel surveillance data, 2010–2011.

Findings: A total of 1,019 paper-based questionnaires were collected at the four sites from Dec 14, 2010–June 6, 2011 and 1,019 smartphone questionnaires were collected at the same four sites from May 3, 2011–Aug 26, 2011. In all, 5% (95% CI: 4.5%-5.0%) of paper-based questionnaires were determined to be incomplete compared to 3% (95% CI: 2.8%-3.2%) of smartphone questionnaires. Of the questions requiring mandatory responses in the smart phone questionnaire, 4% of them were unanswered in paper-based questionnaires. Seven paper-based questionnaires had duplicated patient identification numbers, while no duplication was seen in smartphone data. Smartphone data was uploaded into the database within 8 hours of collection, and paper-based data took an average of 24 days to be uploaded. For two years, costs of establishing and running paper-based data collection system is approximately $61,830 USD compared to approximately $45,546 USD for smart phone data collection system. Fixed costs incurred in establishing the two systems were estimated at $12,990 USD and $16,480 USD for paper and smartphone systems respectively. All surveillance officers reported that smartphones were much easier, faster and more convenient to use as data collection tools. Electronic data collection using smart phones has potential to improve data integrity and reduce resource costs.

Conclusion: Electronic data collection using smart phones has been demonstrated to improve the timeliness of data analysis, to improve data integrity and to reduce resource costs in Kenya.

MADAGASCAR

Viral Etiology of SARI in Madagascar

In order to describe epidemiology and etiology of various viruses known to be responsible for SARI cases, we selected two hospitals in the SARI surveillance system in Madagascar. Samples are analyzed at the NIC for influenza detection and characterization, but also for detection of other respiratory viruses, using a multiplex real-time PCR implemented at the NIC.

Study Objectives:

- Describe epidemiology of SARI cases.
- Study viral etiology of SARI cases.
- Identify risk factors for hospitalization.
- Estimate economic burden of SARI for Malagasy population.

Approach: Based on the SARI surveillance system implemented in 18 hospitals in Madagascar, we selected two hospitals for an active SARI surveillance (Antananarivo and Moramanga). Every hospitalized patient with clinical features of SARI syndromes is included in the study. Respiratory specimens are tested for a panel of 14 viruses developed at the NIC. Genetic studies are conducted to characterize Malagasy strains and see if there is a correlation between genotype and severity of the disease.

Timeline: The active survey begins in November 2010 and is ongoing.

Progress and Findings: From October 1, 2010 to September 30, 2011, the NIC tested 222 samples of SARI cases for 14 respiratory viruses (influenza A and B; respiratory syncitial virus; human Coronaviruses HKU1, OC43, NL63 and 229E; human Metapneumovirus; human Rhinovirus; Parainfluenza Virus type 1, 2 and 3; Adenovirus, Bocavirus). Among them, 20.7% (46/222) were negative for all respiratory viruses tested. Influenza A was the most common virus detected with 34.2% of positivity rate, followed by RSV (27.5%), HRV (18.5%) and influenza B (10.8%). Most patients included were less than five years old (>50%).

Conclusion: The part of viral infection in SARI hospitalized patients is important. Some viruses may have a role in the severity of disease, particularly in the younger (<5 years old).

Excess Mortality Associated with the 2009 A(H1N1)v Influenza Pandemic in Antananarivo, Madagascar

Assessing the burden of influenza epidemics on mortality is difficult in tropical countries. In Africa, until recently, the burden of influenza was believed to be negligible. The purpose of this study was to assess the impact of 2009 influenza epidemic on mortality in Madagascar.

Study Objectives:

- Evaluate the impact of the recent pandemic A(H1N1) 2009 virus on mortality among inhabitants in Antananarivo.

Approach: The study was carried out in Antananarivo, the capital city of Madagascar. We obtained death certificate data from 2007 to 2009 from the three urban centers in Antananarivo, where all deaths are reported in paper-based registers. Death certificates in Antananarivo and its suburbs must be obtained before casketing. In hospital, few cases of acute respiratory disease were laboratory-confirmed as influenza infection, but no deaths. Furthermore, there is no routine analysis of mortality data in Madagascar. Each death certificate, including the decedent's date of birth, sex, date of death, address and the cause of death declared, was classified according to the International Classification of Diseases (10th revision). Data were entered using Microsoft Access and were analyzed using the statistical package R. Mortality was measured by the number of deaths per month or per year, for the total population or each subpopulation, distinguished according to age.

Timeline: We analyzed all deaths reported in 2009 and compared them with the expected number of deaths calculated from the average rate of deaths of the two preceding years (2007, 2008).

Progress and Findings: We observed 20% more deaths than expected among people in Antananarivo, Madagascar, during the influenza pandemic in November 2009 with an excess of mortality for age group ≥50 years (RR=1.41). Statistical analyses showed that pulmonary diseases were more frequent than other causes of deaths.

Conclusion: These results suggest that the pandemic A(H1N1) 2009 virus may have been accompanied by increased mortality.

NEW ZEALAND

Southern Hemisphere Influenza and Vaccine Effectiveness Research and Surveillance Study (SHIVERS)

The Influenza Division is cooperating with New Zealand public health laboratories and universities to conduct a five year study in the southern hemisphere on influenza and other respiratory diseases; their burden, epidemiology, transmission, risk factors, and the effectiveness of vaccination.

Study Objectives:

The SHIVERS study has two Primary Objectives:

- Severe disease: Estimate the incidence rate, prevalence, clinical spectrum, pathogenesis and outcomes of severe pneumonia and severe acute respiratory infection (SARI) caused by influenza and other respiratory pathogens in the Auckland population, including the Maori and other indigenous groups.
- Vaccine effectiveness: Assess the annual effectiveness and/or efficacy of influenza vaccines in preventing laboratory confirmed influenza in the population of Auckland and targeted subpopulations.

Approach: At the end of September 2011, the U.S. Department of Health and Human Services awarded the Institute of Environmental Science and Research (ESR) with a five year research grant, *Southern Hemisphere Influenza Vaccine Effectiveness Research and Surveillance (SHIVERS).* It is a multi-centre and multi-disciplinary collaboration amongst ESR, Auckland District Health Boards, University of Otago, University of Auckland, the U.S. Centers for Disease Control and Prevention and the WHO Collaborating Centre at St. Jude Children's Hospital in Memphis, USA.

Timeline: The research cooperative agreement was awarded in September 2011 and the first few months of work focused on establishing the platform to conduct the study.

Progress and Findings: The cooperative agreement was awarded at the end of FY 2011.

Conclusion: The SHIVERS study is expected to answer many questions related to the epidemiology of influenza in a southern hemisphere setting through enhanced real-time surveillance in sentinel practices and hospitals.

The SHIVERS Project Team meet in Upper Hutt, New Zealand.

PERU

Influenza Seasonality and Incidence in Four Ecologically Diverse Regions of Peru

Most influenza burden estimates are based on passive surveillance data in temperate countries. These estimates lack population denominators necessary for the determination of disease incidence. Population-based epidemiologic and laboratory data on influenza would be useful for describing the impact of this disease and formulating effective public health strategies for prevention and control. We therefore implemented a multisite, prospective cohort study with active community-based household surveillance in four ecologically distinct regions of Peru.

Study Objectives:

- To estimate the incidence of human influenza in four distinct ecological regions of Peru.
- To estimate the economic burden of influenza in the study population in the four locations.

Approach: A total of 8,000 persons (2,000 per site) representing approximately 2,000 households from four distinct geographic locations of Peru (Lima: desert valley, Puerto Maldonado: rainforest, Cuzco: highlands, and Tumbes: tropical coast) are participating. Field workers enroll household members and perform active prospective surveillance to identify ILI cases through household screening visits three times per week. Once an ILI case is identified, field workers administer a questionnaire about influenza risk factors and economic burden. Nasal and throat swabs are obtained for viral diagnostic testing by PCR. All ILI cases are followed for 15 days to allow for adequate data collection to optimize disease burden estimation.

Timeline: This study is ongoing.

Progress and Findings: A total of 5,457 ILI cases were identified in all four sites between June 2009 and March 2012. The percentage of ILI episodes positive for influenza A(H1N1)pdm09 was 15.3%, 12.6%, 9.3%, and 7.3% in Lima, Tumbes, Puerto Maldonado, and Cusco, respectively. From 5,432 samples processed to date, 626 (11.5%) were positive for influenza A (H1N1)pdm09, 4 (0.1%) for A (H1N1), 661 (12.2%) for A (H3N2), 329 (6.1%) for influenza B, and 3,812 (70.2%) were negative for influenza virus (testing of these samples for other pathogens is underway). Preliminary results from June 2009 and December 2010 show an overall influenza incidence rate of 140/1000 person years (py). Of these, 66/1000py sought care and 1.1/1000py required hospitalization. The incidence of influenza was higher during 2009 (160/1000py, 95% CI 150–180) than during 2010 (130/1000py, 95% CI 120–140). During 2010, when influenza A (H3N2) and influenza B were predominant, incidence of influenza was highest among children aged 12–23months (31/100py, 95% CI 23–43). Tumbes consistently had the highest incidence of influenza (19/100py, 95% CI 17–21), followed by Lima (17/100 py, 95% CI 15–18), Madre de Dios (12/100 py, 95% CI 11–13) and Cuzco (8/100 py, 95% CI 8–10).

Conclusion: Our findings show that children had higher influenza incidence rates than adults. This may be explained by a lower cumulative immunity to influenza than other age groups, stressing the importance of a targeted vaccination strategy among children. Incidences rates were different in all sites, suggesting an influence of environmental or cultural variables on virus transmission.

Incidence and Prevalence of Exposure to Influenza Virus in Peru

Despite the many studies on influenza A(H1N1) pdm09 virus since the 2009 pandemic, there are few data on the incidence or prevalence of infection with this virus in the general population of Peru. Sero-epidemiological data are important to estimate true infection rates and to determine which strains are prevalent. Moreover, such data will allow calculation of rates of asymptomatic infection and vaccine effectiveness when combined with existing clinical and vaccination data.

Study Objectives:

- To estimate the incidence and prevalence of exposure to various influenza virus strains in humans at four study sites in Peru.

Approach: This study is nested in the influenza cohort study described in Entry One. Blood samples were taken from the cohort study participants in June 2011 and again in April 2012 and are being tested for evidence of exposure to influenza virus by hemagglutination inhibition assay.

Timeline: Samples collection is completed. Laboratory testing has been performed on 30% of the samples to date.

Progress and Findings: A total of 5,936 serum samples have been collected in the four sites in the two cross-sectional samplings. Results from the first sampling in 2011 show that 40.6%, 35.4%, 24.1%, and 15.4% tested positive for antibody to influenza A(H1N1)pdm09 virus in Lima, Tumbes, Cusco, and Puerto Maldonado, respectively. With regard to antibody to influenza A H3N2 virus, preliminary results show 46% of the study population is positive in Lima and 32.1% in Cusco. Results for H3N2 from Tumbes and Puerto Maldonado, as well as all results from the second sampling, are pending.

Conclusion: The prevalence of exposure to influenza virus varies significantly between the four study sites in Peru. Calculations on the incidence of exposure will be conducted when the laboratory analyses are complete.

Influenza Virus Transmission between Humans and Animals in Backyard Farms in Peru

Domestic animals, especially swine and fowl, play an important role in the evolution and ecology of influenza A virus. Pandemic influenza A(H1N1)pdm09 virus is thought to have been first introduced into humans from pigs. Transmission from humans to swine has also been reported by the World Organisation for Animal Health (OIE) in more than 15 countries. Recently our group, in collaboration with the San Marcos University Veterinary School, has found serologic evidence of influenza A(H1N1)pdm09 virus infection in 9.1% of pigs in backyard farms in Tumbes, Peru, with virus isolated from 1% of the animals. These findings highlight the potential risks of influenza virus transmission between humans and backyard animals.

Study Objectives:

- Describe epidemiology of influenza virus transmission between humans and backyard animals (poultry, swine and guinea pigs) in Tumbes, Peru.
- Determine potential risk factors for influenza virus infection associated with animal contact.

Approach: This study is nested in two of the study sites, Tumbes and Cusco, included in the influenza cohort study described in Entry One. A large percentage of the population of these areas lives in close proximity/contact with domestic pigs, poultry and guinea pigs, often in unsanitary conditions. A questionnaire regarding animal living conditions, diseases, and interaction with humans was administered and nasopharyngeal swabs taken from persons meeting a standard case definition for ILI as well as an age and sex-matched household control. Nasal swabs for pigs/guinea pigs and cloacal/pharyngeal swabs for poultry were collected when a human case of ILI was identified. Swab specimens were tested for evidence of influenza A virus by RT-PCR. Serum samples were also taken from animals to test for IgG antibody by hemagglutination inhibition to assess from previous exposure to influenza virus.

Timeline: Sample collection is completed. Data entry and laboratory testing are ongoing.

Progress and Findings: We have enrolled 141 cases of ILI and their matched controls. Swabs from 282 humans and 565 animals have been obtained, as well as 1,164 serum samples. Laboratory testing on the human cases shows 22% to be positive for influenza A H3N2 virus and 1.8% positive for influenza

A(H1N1)pdm09 virus. Only one animal sample, collected from a guinea pig, is positive for influenza A (sub-typing pending). Results from the swabs from human controls and serologic results from animals are pending.

Conclusion: During the period of study, exposure to domestic animals in backyard farms did not appear to increase risk of influenza A virus infection to humans, primarily because very few animals were infected. It is likely that the one infection detected in a guinea pig was acquired from a human. Serologic testing of the animals will give an indication of the risk of influenza A infection in animals over a broader period of time.

Serological Correlates of 2009 Pandemic H1N1 Influenza A Virus Immunity and Cross-Protection in a Neotropical Zone

Population-based data on the incidence of influenza A virus infection and the infection-to-disease ratio in the Amazon region of South America are limited. To address this knowledge gap, we conducted a prospective community-based cohort study to estimate the incidence of influenza A infection, antibody prevalence, and seroconversion rate (i.e. seroincidence) in Iquitos, a city in the Peruvian Amazon.

Study Objectives:

- Determine the age-specific prevalence of antibody to influenza A virus following the 2009 pandemic in Iquitos, Peru.
- Determine the extent of mild or asymptomatic infection and the effect of previous influenza virus infection on diseases severity.

Approach: We capitalized on an existing cohort study of dengue fever in Iquitos, Peru in which participants are monitored three times per week for acute febrile illness, including influenza-like illness. Serum was taken from a subset of these participants every six months, timed to represent the periods prior to, during, and following the first wave of pH1N1 transmission. Samples were tested by hemagglutination inhibition (HI) for evidence of antibodies to pH1N1, seasonal H1N1 (sH1N1), and H3N2 influenza A viruses.

Timeline: Samples were collected between early 2009 and mid-2010, and laboratory testing was conducted between January and June 2011.

Progress and Findings: A total of 3,375 samples from 1,606 participants were collected and screened for antibodies. Between the baseline and the end of the first pandemic wave, the highest proportion of seroconversion against pH1N1 was observed among younger participants: 39.8% of participants younger than 15 years seroconverted compared with 20.5% overall. Another 9.9% of the population seroconverted against pH1N1 during a second smaller wave. The overall ratio of subclinical: symptomatic infections was approximately 5:1, with subclinical infection more frequent in older age groups. We did not observe a clear effect of pre-pandemic pH1N1, sH1N1, or H3N2 antibodies on the odds of experiencing symptomatic infection.

Conclusion: Seroincidence rates of pH1N1 in Iquitos 2009 were similar to those reported for other countries. The attack rate was elevated in younger populations, suggesting that observed increased incidence of disease in this group is the result of increased exposure as opposed to a reflection of pre-existing immunity in older populations. The ratio of subclinical: symptomatic infection was 5:1. The prevalence of exposure to sH1N1 and H3N2 was low.

Occupational Exposure to Zoonotic Influenza Virus in Peru

As pandemic influenza A H1N1 virus continues to circulate, more questions arise about how this and other novel influenza viruses appear and are introduced into human populations. We have implemented an active surveillance cohort study to explore the frequency and epidemiology of zoonotic influenza virus transmission in humans with occupational risk of infection with swine and avian influenza viruses. We are also conducting surveillance in birds and swine.

Study Objectives:

- Determine the prevalence of antibodies against avian and swine influenza among humans regularly exposed to swine and birds.
- Estimate the incidence of zoonotic influenza in the exposed humans.
- Determine risk factors for zoonotic influenza infection in the exposed humans.
- Determine the prevalence of influenza virus infection in birds and swine.

Approach: Although this project leverages CDC-funded activities, it is primarily funded by NIH. Active and passive surveillance was established in three cities in Peru (Pucallpa, Tumbes, and Lima) to monitor humans with occupational exposure to poultry and swine through exposures in backyard farms, slaughterhouses, live bird markets, game bird breeding, and through clinical veterinary medicine. Subjects are followed weekly by phone to report ILI cases in the humans and animals. A monthly follow-up visit is also made. When human or animal ILI is reported trained personnel visit the site to collect nasal and oropharyngeal swabs from the humans and animals. Swabs are tested for influenza virus by RT-PCR. Blood samples are also collected every six months from each participant and tested for anti-influenza antibody by ELISA, with positive samples tested by hemagglutination inhibition assay against specific swine and avian influenza virus strains. Lastly, regular blood collections and serologic testing is conducted on pigs arriving at a slaughterhouse in Lima from various areas of Peru.

Timeline: Enrollment, sample collection, and testing are ongoing.

Progress and Findings: To date 415 human participants have been enrolled from whom 38 swabs and approximately 650 sera samples have been collected. Thirty-four (89.5%) of the swabs have been tested, of which 2.9 % are positive for influenza A(H1N1) pdm09, 8.8 % for influenza A H3N2, and 5.9 % for influenza B. Of the 650 serum samples, 345 (53%) have been tested, with 25%, 18% and 12% positive for antibody to influenza A(H1N1) pdm09 virus in Tumbes, Pucallpa and Lima respectively. None of 44 swabs collected from animals are positive for influenza virus, but 22% are positive for New Castle disease virus. The Ministry of Agriculture was notified. Serological testing on the animals is pending.

Conclusion: All evidence of influenza virus infection in the human population to date appears to be related to human-to-human or human-to-animal transmission. To date we have not identified episodes of novel zoonotic influenza virus infection in humans or animals, but surveillance is ongoing.

The Economic Cost of SARI in Hospitals in Peru

According to the World Health Report, the disease burden of respiratory tract infections is estimated at 94 million DALYs and 3.9 million deaths. However, there is limited information on the economic cost of severe acute respiratory illness (SARI) in Peru and the factors that influence this cost. We propose a prospective hospital-based study to assess the direct and indirect costs of influenza-associated SARI in hospitals in Peru.

Study Objectives:

- Calculate the health care costs associated with SARI using an incidence-based approach.
- Describe the characteristics affecting the health care costs of influenza-associated SARI in Peru.

Approach: We will collect information from randomly selected SARI cases admitted to three hospitals in Lima, Peru (one private, one from the Ministry of Health, and one from the Social Security system). Study staff will record the information for all direct and indirect costs associated with the SARI episode through daily monitoring. Sources of information will include interviews with patients or their relatives, medical records, accounting records, and daily interviews with hospital staff. Data collection will include patient demographic information and information related to the disease, previous and current therapy, time of onset, duration of illness, and symptoms. In addition to clinical information, the use of health care resources to manage the event will be collected. When known, the biological etiology of the SARI case will be noted.

Timeline: The study protocol was designed in 2011 and will be implemented in 2012.

Progress and Findings: Pending.

Conclusion: Pending.

The Effect of Micronutrient Deficiencies on Frequency, Severity, and Outcome of Influenza-like Illnesses

Micronutrient deficiencies have been associated with increased infectious disease morbidity rates, particularly diarrheal and respiratory infections. Children under the age of 5, who are anemic and who have previously developed diarrhea, are three times more likely to develop pneumonia. In general, there is a clear dose-response pattern between malnutrition and increased morbidity and mortality rates due to acute lower respiratory infections (ALRI)/pneumonia. However, data demonstrating decreased nutritional status as risk factor for acquiring an ILI or as a predictor of severity of illness is limited.

Study Objectives:

- Estimate the effect of micronutrient deficiencies on severity, frequency and outcome of an influenza-like illness (ILI) infection among individuals living in semirural communities of Peru.

Approach: All enrolled participants will be asked to join the nested study and provide a blood sample and a stool sample after giving their consent. Hemoglobin tests will be performed to address health status. Levels of Vitamins A, C, D, and the minerals Iron and Zinc will be detected from sera. Parasitological status will be assessed from analyzing the stool samples. This study aims to determine whether or not abnormal levels of micronutrients are associated with increased frequency, severity and outcome due to an ILI infection.

Timeline: On hold, awaiting funding.

Progress and Findings: Protocol approved by IRB.

Conclusion: None yet.

SENEGAL

Assessment of the Effectiveness of Seasonal Trivalent Influenza Vaccine (TIV) Among Children in Senegal

Effective influenza vaccines have been available for decades, but they have neither been studied nor used in tropical developing countries. A number of reports from developed countries indicate that influenza vaccine, when given to a limited number of persons most responsible for transmission, usually children, has the potential to interrupt transmission and reduce the overall influenza burden of a community. This study will determine whether immunization of young children (6 months to 9 years) with influenza vaccine will protect not only the immunized children but also the infants, older children and adults who are around them.

Study Objectives:

- Evaluate the total effectiveness of TIV in reducing rates of laboratory-confirmed symptomatic influenza among vaccinated children from villages where TIV is introduced, compared to rates among vaccinated children from villages where inactivated polio vaccine (IPV) is introduced.
- Evaluate the age-specific indirect effectiveness of TIV in reducing rates of laboratory-confirmed symptomatic influenza among unvaccinated persons, as well as the total (population) effectiveness in reducing community-wide rates of influenza in villages where TIV is introduced, compared to compared to rates in villages where inactivated polio vaccine (IPV) is introduced.
- Evaluate age-specific post-vaccination immune responses and describe the safety profile of TIV among a subset of vaccinated children.

Approach: This research is a partnership with PATH, the Institut de Recherché pour le Développement (IRD), and Institute Pasteur Dakar. The study is an observer-blinded Phase IV cluster-randomized trial with villages randomized into two groups. Children aged 6 months to 9 years in these villages receive either TIV or a control, inactivated polio vaccine (IPV). In addition, some of the vaccinated children will be enrolled into an immunogenicity and safety subset which will measure the immune response to vaccination and assess reactions to the study vaccines among Senegalese children. A combined approach of active and passive influenza surveillance will be used to assess laboratory-confirmed influenza among vaccinated children and consenting unvaccinated persons in order to evaluate the effects of the vaccines in this population.

Timeline: July 2008 to June 2014.

Progress and Findings: From 2009 to 2011, three vaccination rounds have taken place, with full vaccination of between 7,600 and 9,500 eligible children each spring. Surveillance activities, including administration of health questionnaires and nasopharyngeal specimen collection, are ongoing. As of 2011, over 20,000 febrile respiratory episodes have been identified and tested for influenza through community surveillance. Influenza A(H1N1)pdm was first detected in the study villages in February 2010, and preliminary findings were shared at the International Conference on Emerging Infectious Diseases (July 2010) and Options for the Prevention and Control of Influenza (September 2010). Data on the vaccination status of participants remain blinded; analyses of direct, indirect, and total effectiveness are pending unblinded analysis.

Conclusion: Vaccination rates are high among eligible children in this community, and influenza viruses are a major cause of febrile respiratory illness in the population.

SOUTH AFRICA

Respiratory Viral Co-infections Identified by a 10-plex Real-time Polymerase Chain Reaction Assay in Patients Hospitalised with Severe Acute Respiratory Illness—South Africa, 2009–2010

Use a newly developed multiplex assay to investigate 10 respiratory viruses including influenza (INF) A and B, parainfluenza (PIV1-3), respiratory syncytial virus (RSV), enterovirus (EV), human metapneumovirus (hMPV), adenovirus (AdV) and rhinovirus (RV) as causes of SARI during 2009–2010.

Study Objectives:

- Develop a real-time multiplex reverse transcriptase PCR assay to detect the most common respiratory viruses (influenza A and B, RSV, EV, hMPV, AdV, RV, PIV 1, 2 and 3) in nasopharyngeal aspirates and nose and throat swabs.
- Use the developed test assay to investigate the role of the most common viral agents as aetiological agents in patients hospitalised with SARI in South Africa.

Approach: The multiplex assay was developed to detect 10 respiratory viruses including influenza (INF) A and B, parainfluenza (PIV1-3), respiratory syncytial virus (RSV), enterovirus (EV), human metapneumovirus (hMPV), adenovirus (AdV) and rhinovirus (RV), followed by influenza subtyping. Nasopharyngeal and oropharyngeal specimens were collected from patients hospitalized with pneumonia at six hospitals during 2009–2010.

Timeline: From February 2009 up to December 2010.

Progress and Findings: Out of the 8,173 patients tested in this period 3,240 (40%) had single-infections, 1,426 (17%) co-infections and 3,507 (43%) were negative. The most common viruses were: RV (2,034, 25%), RSV (1,169, 14%), (1,083, 13%), influenza A (704, 9%). RSV, hPMV and influenza had seasonal patterns while AdV and RV were detected throughout the year. RV and RSV were associated with most single infections in children 0–1 years.

Conclusion: The data provide a better understanding of the viral aetiology of hospitalized cases of pneumonia and demonstrate the usefulness of this multiplex assay in respiratory disease surveillance in South Africa.

Evolutionary Dynamics of 2009 Pandemic Influenza A(H1N1) in South Africa from 2009-2010

Genotypic characterization of A(H1N1)pdm09 strains from influenza-like illness (ILI) and severe acute respiratory illness (SARI) cases from South Africa during 2009–2010.

Study Objectives:

- To investigate the evolution pandemic H1N1 in South Africa from July 2009 to December 2010.
- To describe the effect of hosting the FIFA Soccer World Cup in 2010 on the circulation of specific lineages.
- To describe the geographic and temporal distribution of strains, genetic and antigenic drift in HA genes and investigate genotypic markers of mild and severe disease and the presence drug resistant strains.

Approach: Amplify and sequence the HA1 region of the HA gene. Perform hemagglutination inhibition assays on viral isolates and sequence of the PB2 and NA genes to investigate pathogenicity and resistance mutations.

Timeline: September 2009–July 2011.

Progress and Findings: We investigated 9,792 and 6,915 specimens from patients with influenza-like illness (ILI) or severe acute respiratory infection (SARI) symptoms across South Africa for 2009 Pandemic Influenza A(H1N1) in 2009 and 2010 and conduct a molecular epidemiological investigations of 96 strains. The pandemic strain occurred as a second epidemic peak following seasonal H3N2 cases in 2009 and in 2010. Progressive drift away from the A/California/7/2009 vaccine strain was observed at both the nucleotide and amino acid level with 2010 strains clustering separate to 2009 strains although antigenically these strains were still similar to the vaccine strain. No resistance or known pathogenicity mutations were detected.

Conclusion: Pandemic H1N1 cases occurred in both 2009 and 2010 as a second wave following seasonal H3N2 cases in South Africa. Molecular epidemiological analyses suggest multiple introductions of the pandemic H1N1 strain in 2009 and at least two clusters in 2010 that are distinctly separate from 2009 strains. Progressive genetic drift away from the original vaccine strain is apparent; however antigenic investigations showed that these strains are still similar enough to A/California/07/2009 vaccine strain.

Risk of Death Amongst TB patients Hospitalised with Influenza in South Africa 2009–2010

This is an analysis of influenza surveillance data to assess the relationship between influenza and tuberculosis.

Study Objectives:

There are limited published data on influenza in patients with pulmonary tuberculosis (TB). We aimed to compare the characteristics of patients admitted with TB to those without TB and to determine whether influenza virus co-infection was a risk factor for in-hospital death among patients with suspected or laboratory-confirmed TB.

Approach: Hospitalised patients presenting with severe acute respiratory infection (SARI) were enrolled prospectively at public hospitals in four provinces of South Africa. TB cases were defined as patients with either a laboratory-confirmed diagnosis of TB, or currently receiving or started on TB treatment at the current admission.

Timeline: 2009–2011.

Progress and Findings: The influenza detection rate was similar in patients with (8% (94/1,162) and without (9% (618/6,935) TB (p=0.36). 76% of the 862 TB patients tested HIV positive compared to 50% (2257/4,512) of those without TB, (p<0.001).The case-fatality ratio was 10% (114/1,175) in TB cases as compared to 5% (319/7,004) non TB cases (p<0.001). On multivariable analysis amongst TB cases, patients who were co-infected with influenza were more likely to die than patients who tested influenza negative (odds ratio 2.59, 95% confidence interval 1.26-5.33, p=0.009).

Conclusion: Preliminary data suggest influenza co-infection may be associated with increased mortality amongst patients with TB. Patients with TB are a potential risk group that may be targeted for influenza vaccination.

Increased Risk of Death amongst HIV-infected Persons Hospitalised with Influenza-Confirmed Illness

This is an analysis of influenza surveillance data to assess the relationship between influenza and HIV.

Study Objectives:

- We aimed to compare the clinical and epidemiologic characteristics of HIV-infected and -uninfected patients with influenza infection.

Approach: Hospitalised patients presenting with severe acute respiratory infection (SARI) were enrolled prospectively at public hospitals in four provinces of South Africa. Clinical and epidemiologic data were collected. Upper respiratory samples were tested for the presence of influenza virus by real time RT-PCR and blood samples tested for pneumococcal DNA using real time PCR. The study was a cohort study including all patients testing influenza-positive. Characteristics of patients testing HIV-positive were compared to those testing HIV-negative.

Timeline: 2009–2011.

Progress and Findings: Amongst 1,022 patients hospitalised with influenza-associated SARI, HIV infection status was available for 731 (72%). On multivariable analysis controlling for age-group and sex, HIV-infected patients were more likely to have confirmed pneumococcal (36/323, 11% vs. 16/379, 4%, odds ratio (OR) 2.6, 95% confidence interval [1.2-5.6]) or tuberculosis (52/325, 16% vs. 14/393, 4% OR 7.3 [3.0-17.4]) co-infection, be infected with influenza type B (vs. A) (131/331, 40% vs. 108/400, 27%, OR 1.7 [1.1-2.6]) and have prolonged duration of hospitalisation. On multivariable analysis controlling for receipt of mechanical ventilation and other underlying conditions; HIV-infection (OR 4.0 [1.4-11.2]) and tuberculosis co-infection (OR 3.7 [1.3-10.3]) were independent risk factors for death. HIV-infected individuals experienced a 4–5 times greater age-adjusted incidence of hospitalisation than HIV-uninfected individuals.

Conclusion: HIV-infected patients have increased incidence of influenza hospitalization and experience increased mortality as compared to HIV-negative individuals. HIV-infected patients should receive early antiviral therapy and should receive preventive measures such as annual influenza vaccination.

HIV Infection and Influenza Co-infection Increase the Risk of Elevated Blood Pneumococcal Loads and Associated Mortality in Hospitalised Pneumonia Patients

This is an analysis of influenza surveillance data to assess the relationship between influenza and HIV.

Study Objectives:

- There is a lack of sensitive assays for making an etiologic-specific diagnosis of pneumococcal pneumonia. We determined the prevalence of pneumococcal DNA in blood and factors associated with high bacterial load and death in patients with hospitalised pneumonia.

Approach: Hospitalised patients presenting with severe acute respiratory infection (SARI) were enrolled prospectively at public hospitals in four provinces of South Africa.

Timeline: 2009–2011.

Progress and Findings: We determined the prevalence of pneumococcal DNA in blood and factors associated with high bacterial load and death in patients with hospitalised pneumonia. Overall 7% (372/5130) tested lytA positive. On multivariable analysis the lytA-positive patients with higher blood pneumococcal loads had a higher prevalence of HIV [adjusted odds ratio (AOR): 2.5, 95% confidence interval (CI): 1.6-3.8], influenza co-infection [AOR: 1.4, CI: 1.2-1.7] and were more likely to be treated with supplemental oxygen [AOR: 1.6, CI: 1.1-2.4]. Amongst lytA-positive patients increased risk of death was associated with pneumococcal loads of ≥10,000 DNA copies/ml [AOR: 3.9, CI: 1.9-8.1], controlling for oxygen treatment and late presentation to the hospital.

Conclusion: HIV and influenza infections are significant risk factors for elevated pneumococcal loads in blood, which was also associated with an increased risk of death. High pneumococcal loads at time of diagnosis may have a role in future as a prognostic marker for pneumococcal pneumonia.

THAILAND

Randomized Controlled Trial to Compare the Immunogenicity of Intramuscular versus Intradermal Trivalent Inactivated Split Virion Influenza Vaccine in HIV-infected Men who have Sex with Men in Bangkok, Thailand

This study will assess the efficacy of a new intradermal formulation of the trivalent inactivated influenza vaccine (TIV) compared to standard intramuscular TIV in HIV-infected men who have sex with men (MSM) in Bangkok, Thailand.

Study Objectives:

- Primary Objective: To assess humoral antibody responses to intramuscular versus intradermal TIV in HIV-infected MSM prior to vaccination and at 1 month, 6 months, and 12 months post vaccination. We will further characterize humoral antibody responses by low versus high CD4 cell count.
- Secondary Objective: In a subset of participants, we will characterize cell-mediated immune responses to intramuscular versus intradermal TIV in HIV-infected MSM prior to vaccination and at 1 week, 1 month and 6 months post-vaccination. We will further characterize cell-mediated immune responses by low versus high CD4 cell count.

Approach: Randomized controlled trial.

Timeline: Enrollment started November 2011, participants followed for one year.

Progress and Findings: Enrollment ongoing, investigators remain blinded.

Conclusion: None yet.

Pediatric Respiratory Infections Cohort Evaluation (PRICE)

This is a longitudinal study to follow children aged 0–36 months for two years; we will follow children with underlying disease and age and time-matched healthy children.

Study Objectives:

Primary Objectives:

- To measure the rate of influenza acquisition and duration influenza illness in a cohort of healthy children and children with underlying disease.
- To evaluate the difference in the rate of influenza acquisition and duration of influenza illness between healthy children and children with underlying disease.

Secondary Objectives:

To repeat the first two Primary Objectives for RSV.

- To assess and compare disease severity between healthy children and children with underlying disease.
- To assess the medical costs (direct and indirect) associated with influenza and RSV infections and the difference in costs between healthy children and children with underlying disease.
- To evaluate the predictive value of markers of nutrition and inflammation, particularly vitamin D, for the incidence, duration and severity of influenza virus and RSV infections, as well as how these differ between healthy children and children with underlying disease.

- To investigate the relationship between environmental tobacco smoke exposure and occurrence of lower respiratory track disease and influenza virus and RSV infections.

Approach: Prospective, observational cohort study.

Timeline: Enrollment started August 2011, participants followed for two years.

Progress and Findings: Enrollment ongoing.

Conclusion: None yet.

Etiology of Pneumonia and Influenza-like Illness in Sa Kaeo and Nakhon Phanom Provinces, Thailand

This is a prospective study to describe the etiology and epidemiology of respiratory pathogens in Sa Kaeo and Nakhon Phanom provinces of Thailand.

Study Objectives:

- To perform population-based surveillance to determine the etiology and burden of acute respiratory diseases among patients hospitalized with community acquired pneumonia

Approach: Prospective, population-based.

Timeline: Enrollment started in 2003 in Sa Kaeo and 2004 in Nakhon Phanom.

Progress and Findings: Enrollment ongoing.

Conclusion: Established incidence, cost, seasonality and risk factors for influenza; data informed vaccine policy.

VIETNAM

Burden of Influenza-related SARI in 3 District Hospitals in Vietnam

Seasonal influenza viruses circulate in Vietnam throughout the year, however the understanding of influenza burden in Vietnam remains limited, especially the burden associated with hospitalized severe acute respiratory infection. Surveillance is carried out to detect severe acute respiratory infections (SARI) in three district hospitals from north, central and south Vietnam over a 12 month period. These data will be used to estimate disease burden of seasonal influenza virus in hospitalized severe acute respiratory infections (SARI).

Study Objectives:

- To describe morbidity and mortality of influenza-related SARI in hospitalized patients in district hospital in Vietnam over a 12 month period.
- To describe clinical, virological and epidemiologic characteristics of influenza-related hospitalized SARI cases in Vietnam.
- To compare influenza-related SARI to other hospitalized SARI at district hospital level in Vietnam.
- To evaluate the socioeconomic impacts of SARI for patients.

Approach: Data were collected to describe epidemiologic and clinical features at the district hospital level in Vietnam. Adults and children admitted to general medical wards of 3 selected district hospitals with SARI will be asked to participate in this surveillance. It is estimated that about 900 patients will be systematically sampled for evidence of influenza infection by RT-PCR testing of throat swabs taken at time of hospital admission. Epidemiologic, virological and clinical information from these patients will also be collected to estimate disease burden of hospitalized SARI in Vietnam.

Timeline: April 2011–March 2012.

Progress and Findings: Training sessions on burden study procedures, data collection, specimen collection and shipment were conducted for 63 field staffs at 3 selected district hospitals at the start of the study. After four months of field implementation, a total of 564 SARI patients were enrolled into the study and swabbed for RT-PCR testing. Thirty-two of the 564 tested specimens (6%) were positive for influenza infection (11 positive for influenza B virus and 21 positive for pA/H1N1/2009). A data entry system has been developed based on EpiData Version 3.1. The data on burden of influenza will be cleaned and analyzed at the end of the 12 month of data collection.

Conclusion: Interim results show that influenza viruses contribute to the burden of severe acute respiratory disease in district hospitals in Vietnam. Full analysis of the entire 12 month time period is forthcoming. Further studies looking at more severe respiratory disease in provincial hospitals is planned.

Animal Human Interface Studies: Pilot Extension Project for Influenza Viruses Infecting Humans and Animals in Vietnam

Vietnam has one of the highest densities of avian reservoirs of influenza A in the world, along with susceptible swine and human populations, all living in close contact. In domestic animals in Vietnam, influenza A is endemic. Avian strains circulating in fowl in Vietnam include H4N6, H5N2, H5N1, and H9N3. There is limited serological evidence of H5N1, H3N2, and H1N1 in swine in Vietnam. In humans, Vietnam has sporadic cases of avian influenza A/H5N1, and year-round transmission of seasonal strains, including H1N1 2009, H3N2, and B. Influenza virus isolates of H5N1 in humans and animals in Vietnam have varied genetically, producing a number of different clades, and suggesting a complex virus co-evolution. Given population densities, biosecurity practices, and close geographic proximity of animals and humans, opportunities for influenza virus genetic mutation and for cross-species transmission may be prevalent in Vietnam.

Study Objectives:

- To identify and characterize the circulating influenza viruses in humans, swine and poultry living in close proximity in a rural community in Vietnam.
- To determine the dynamics of animal-human interface transmission of influenza viruses in a rural community.
- To determine the phylogenetic relationships and genomic characteristics of virus isolates.

Approach: Participating households in a commune of the Red River delta area of north Vietnam with swine and poultry farming were surveyed to determine the relation by time and place of infections with influenza viruses in humans and animals. The households were visited every two days for three months to observe for human influenza-like-illness (ILI), and for sick pigs or poultry with respiratory symptoms. Blood samples and swabs from humans with self-reported ILI, and from poultry and pigs with reported respiratory illness, were tested for influenza infection. If influenza A was found in any species, humans and animals in the same households were followed up with blood and swab collection at the time of the first influenza confirmation and two weeks (for household members) and four weeks (for household animals) later. Paired human serum samples were also collected at the baseline of the study and three months after follow-up. RT-PCR was performed to identify influenza viruses in human and animal swab samples. HI was employed for testing human paired sera for H1N1 2009 or H5N1 antibodies; and ELISA and HI were used to test for immunity against influenza viruses from blood samples from pigs and poultry. Isolated influenza viruses from humans and animals will be further serologically and genetically analyzed in a subsequent study.

Timeline: April–July 2011.

Progress and Findings: A total of 446 people from 186 households had baseline serum samples collected and were observed for ILI and for pig and poultry respiratory illness. There were 220 serum samples collected three months later. The incidence rate of ILI was 28 episodes per 1,000 person-weeks (95% CI 17-45). From the follow-up, 27 episodes of ILI were observed in humans, seven respiratory episodes in poultry, and no illness in pigs. Of two sick pigs and 13 sick poultry, none were positive with influenza. Of the 27 human swabs, influenza pA/H1N1/2009 accounted for two cases (7%) and influenza B was found in three cases (11%). Of household and animal contacts of two H1N1 2009 positive persons, none of seven humans, one pig, and four poultry were positive for influenza after two weeks. Further virological and serological testing and genetic analyses are being done.

Conclusion: There was limited ILI in humans, and little respiratory illness in poultry and pigs, during this pilot study. Preliminary findings suggest that multiple strains of influenza viruses were identified in people and animals in a rural community. Sub-clinical human infection with H5N1 from poultry, and reverse zoonotic transmission of H1N1 2009 from humans to swine, are two of many animal-human interface variables that potentially may lead to continued genetic changes in influenza viruses, and uncertainties of the next pandemic strain in Vietnam or globally.

Acronyms and References

Acronyms

2009 H1N1	2009 Pandemic Influenza A (H1N1)
AFR	WHO African Region
AFRO	WHO Africa Regional Office
AI	Avian Influenza
AHI	Animal-Human Interface
AMR	WHO Region of the Americas
APHL	Association of Public Health Laboratories
ARI	Acute Respiratory Illness
BEP	Biosecurity Engagement Program
BSL	Biosafety level
CARE	Cooperative for Assistance and Relief Everywhere
CDC	Centers for Disease Control and Prevention
CDC-CAP	CDC Central America and Panama
CoAg	Cooperative Agreement
DFA	Direct Immunofluorescence
DoD	Department of Defense
DVM	Doctor of Veterinary Medicine
ECDC	European Centers for Disease Control
EMR	WHO Eastern Mediterranean Region
EMRO	WHO Eastern Mediterranean Regional Office
EOC	Emergency Operations Center
EPT	Emerging Pandemic Threats
EQAP	WHO External Quality Assessment Project
EUR	WHO European Region
EURO	WHO European Regional Office
FAO	Food and Agriculture Organization
FDA	United States Food and Drug Administration
FETP	Field Epidemiology Training Program
FELTP	Field Epidemiology and Laboratory Training Program
FY	Fiscal Year
FMOH	Federal Ministry of Health
GDD	Global Disease Detection
GDP	Gross Domestic Product
GIP	WHO Global Influenza Program
GISRS	WHO Global Influenza Surveillance and Response System
HA	Hemagglutinin (a protein on the surface of the influenza virus)
HAI (or HI)	Hemagglutination Inhibition Assay
HAI	Health care-associated Infection
HHS	United States Department of Health and Human Services
HPAI	High Pathogenic Avian Influenza
IATA	International Air Transport Association
ICEID	International Conference on Emerging Infectious Disease
ID	Influenza Division
IDSR	Integrated Disease Surveillance and Response
IHR	International Health Regulations
IFA	Immunofluorescence, Indirect Antibody Staining

IEIP	International Emerging Infections Program
ILI	Influenza-like Illness
IRR	Influenza Reagent Resource
LPAI	Low Pathogenic Avian Influenza
MD	Medical Doctor
MDCK	Madin-Darby Canine Kidney Cells
MOH	Ministry of Health
MPA	Master of Public Administration
MPH	Master of Public Health
MSc	Master of Science
NA	Neuraminidase (a protein on the surface of the influenza virus)
NAI	Neuraminidase Inhibitors
NAMRU	United States Naval Medical Research Unit
NCIRD	National Center for Immunization and Respiratory Diseases
NGO	Non-Government Organization
NI	Neuraminidase Inhibition Assay
NIC	National Influenza Center
NP	Nasopharyngeal swab
OIE	World Organisation for Animal Health (Office International des Épizooties)
OP	Oropharyngeal swab
PAHO	Pan American Health Organization
PATH	Program Appropriate Technology in Health
PCR	Polymerase Chain Reaction
PPE	Personal Protective Equipment
QA	Quality Assurance
QC	Quality Control
QMS	Quality Management System
RRT	Rapid Response Team
RSV	Respiratory Syncytial Virus
RT-PCR	Reverse Transcriptase Polymerase Chain Reaction
SADC	South African Development Community
SARI	Severe Acute Respiratory Infection
SARS	Severe Acute Respiratory Syndrome
SEAR	WHO South-East Asia Region
SEARO	WHO South-East Asia Regional Office
SMS	Short Messaging Service
SOP	Standard Operating Procedure
SPC	Secretariat of the Pacific Community
TB	Tuberculosis
TLDA	TaqMan Low Density Array
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USB	Universal Serial Bus
USDA	United States Department of Agriculture
VTM	Viral Transport Media
WPRO	WHO Western Pacific Regional Office
WPR	WHO Western Pacific Region
WHO	World Health Organization
WHO CC	World Health Organization Collaborating Center for Reference and Research on Influenza

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