

Centers for Disease Control and Prevention

# INTERNATIONAL ACTIVITIES REPORT

Fiscal Years 2016–2017



National Center for Immunization and Respiratory Diseases  
Influenza Division



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# Acknowledgements

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***NOTE: The information in this report was compiled by the Influenza Division and does not necessarily represent the official position of the Centers for Disease Control and Prevention.***

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## Cover Photo Credit

***Front Cover:***

Laboratory technicians in Cambodia's National Institute of Public Health Laboratory perform cell culture.

***Back Cover:***

Two laboratory technicians work in a biosafety cabinet in the influenza laboratory in Macedonia.

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# Influenza Division International Overview

# Background

The US Centers for Disease Control and Prevention's (CDC's) Influenza Division has a long history of supporting the World Health Organization (WHO) and its global network of National Influenza Centers (NICs). 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 outbreak investigations. The re-emergence of fatal human cases of avian influenza A(H5N1) in China in 2003 following the outbreak of severe acute respiratory syndrome (SARS), and subsequent 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 might emerge. These outbreaks highlighted several important gaps where work was needed to improve the ability to rapidly identify novel influenza viruses with pandemic potential. These gaps 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 US government (the Department of 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 existing support for WHO's Global Influenza Program 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; together, they formed the foundation for CDC's expanded role in international influenza prevention and control. The program accomplishes key goals by building on existing programs and infrastructure including WHO and its Regional Offices, CDC Global Disease Detection sites, US Department of Defense international program sites, and by utilizing the assistance of US Embassies.

In April 2009, the first case of pandemic 2009 H1N1 influenza virus (influenza A[H1N1]pdm09) infection in the United States was identified. Subsequent cases were quickly identified in other states and Mexico. 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 had made prior to the pandemic. 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 influenza A(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 14 years the program has undergone remarkable growth (see Maps, below) and has expanded to provide support to more than 50 countries, all WHO Regional Offices, and WHO Headquarters. Partnerships have been developed with the US Department of Defense, the United States Agency for International Development, the Biosecurity Engagement Program, universities, nongovernmental organizations, private industry, and other entities to enhance global surveillance and preparedness. More than 11 staff have been placed in the field (see Map) to provide on-the-ground assistance and support to countries and to WHO.

Recognizing that needs vary among 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, CDC 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 with the objective to expand prevention of global disease and improve health security through greater use of influenza vaccines worldwide.

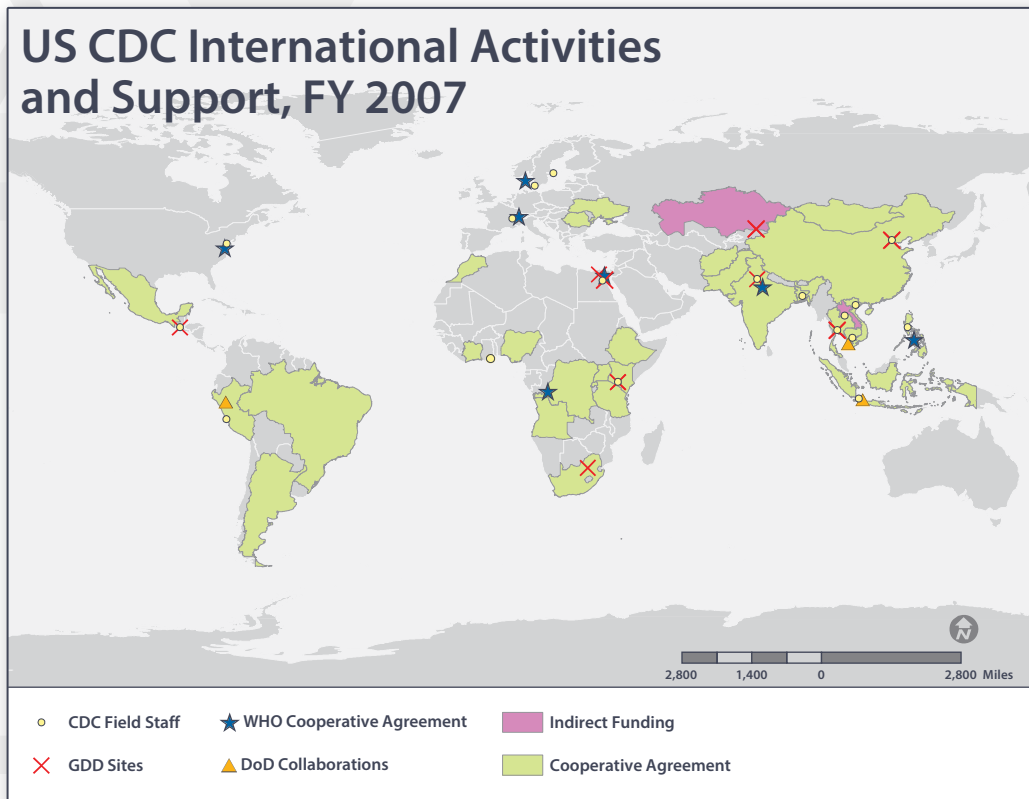
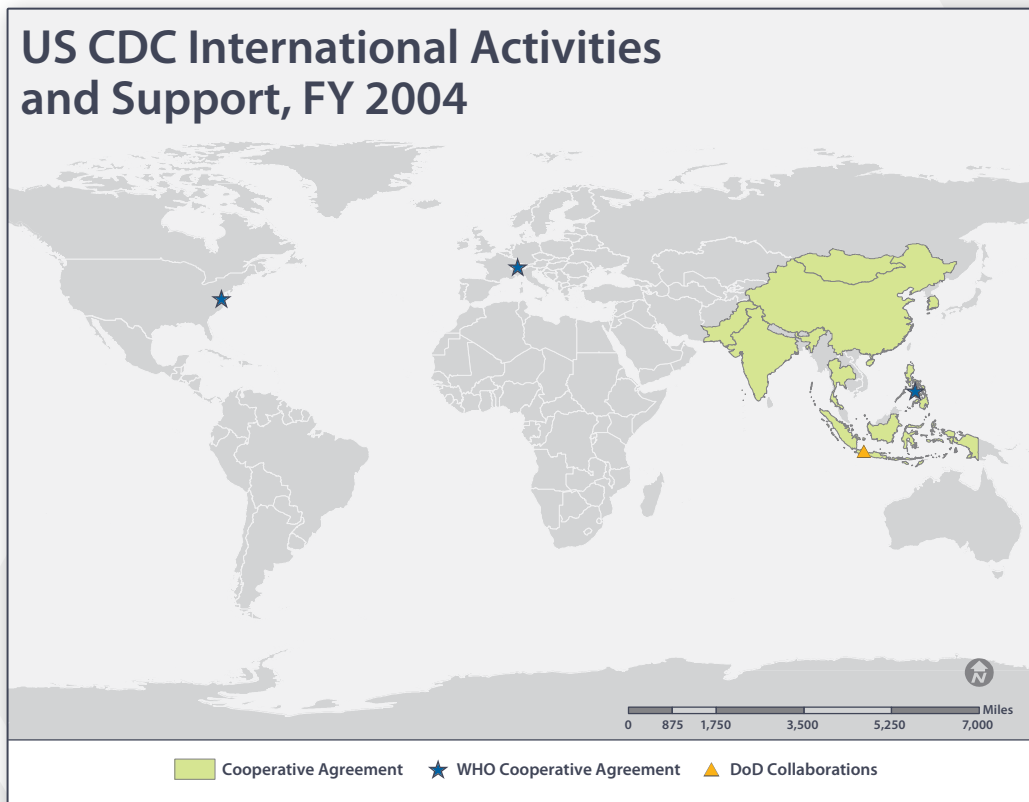
While the response to the 2009 influenza pandemic was an opportunity to show recent progress, human infections with highly pathogenic avian influenza viruses, including influenza A(H5N1) and A(H7N9), still pose a significant and ongoing global health threat and a threat to US security. To sustain the 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. CDC also envisions that each 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.

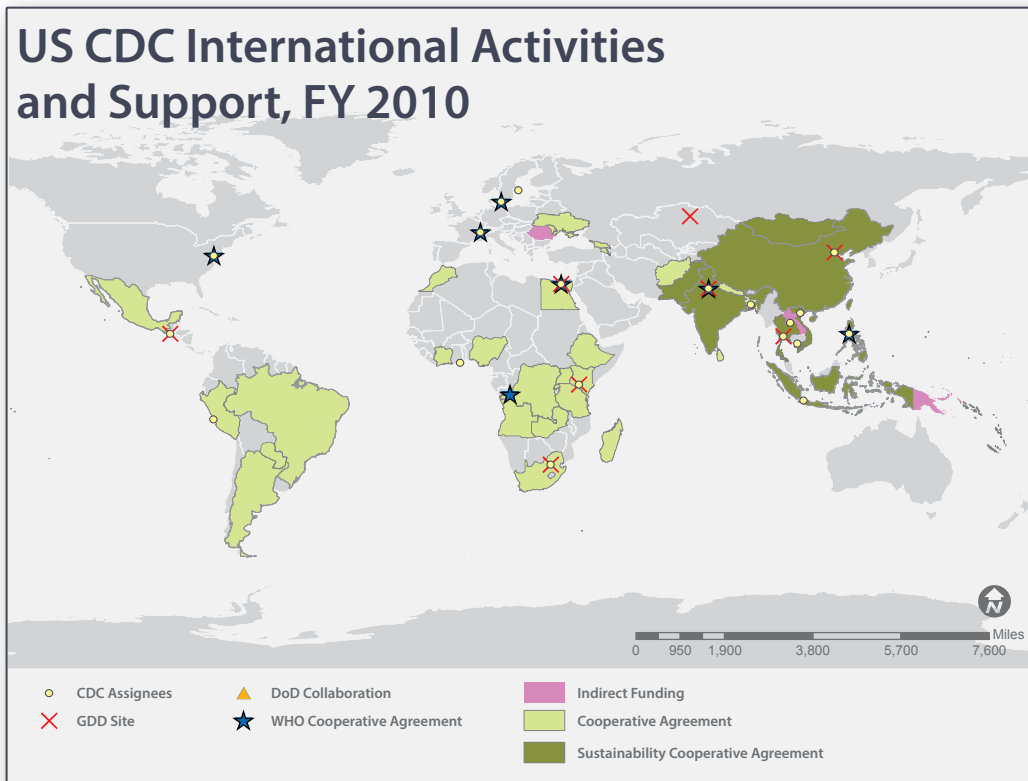
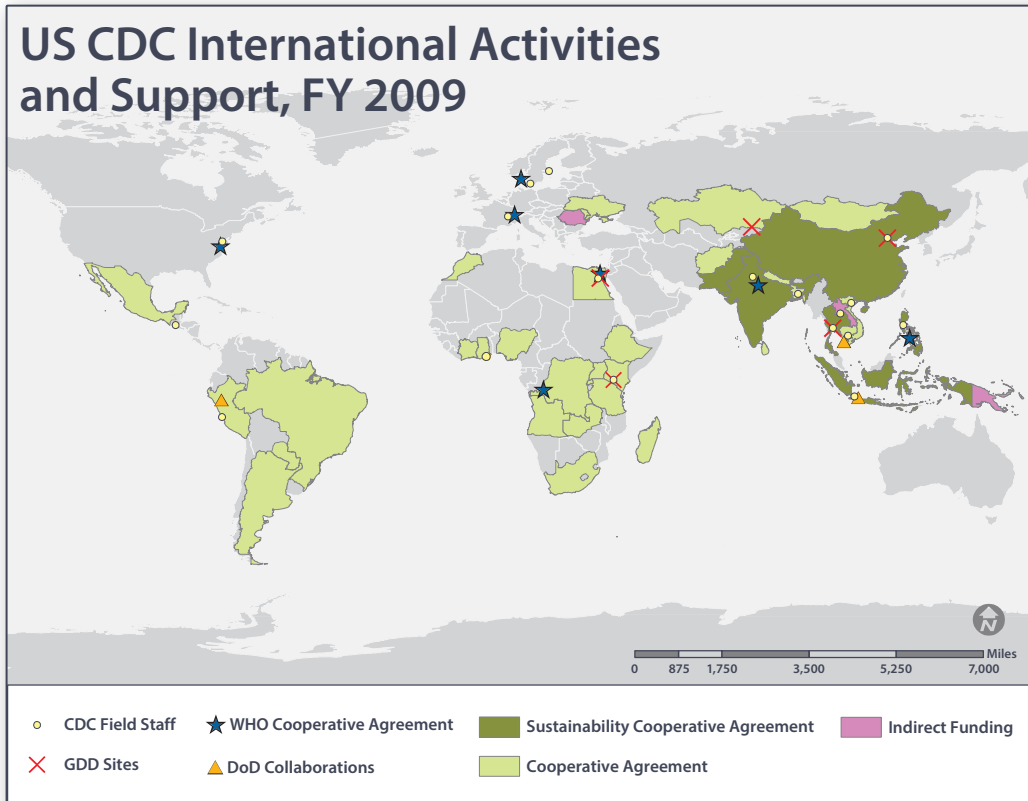
This program has shown substantial benefit beyond influenza. The capacity for laboratory and epidemiologic surveillance of severe respiratory disease has served as the basis for capacity for the diagnosis and investigation of other infectious diseases, particularly other respiratory pathogens like Middle East respiratory syndrome-coronavirus (MERS-CoV). Similarly, CDC has received reports from grantees describing the importance of the foundation built for influenza in the Ebola response. 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 not only in influenza outbreak response, but also to responses to outbreaks of other respiratory and non-respiratory pathogens including Rift Valley fever, dengue, cholera, Ebola, MERS-CoV, and rabies. Evidence shows that the technical assistance provided by the Influenza Division assists countries in increasing their capacity necessary for compliance with the International Health Regulations 2005 (IHR). The generic approach, with a focus on influenza and avian influenza, contributes to global capacity for laboratory, epidemiology, and overall preparedness for emerging and re-emerging infectious diseases.

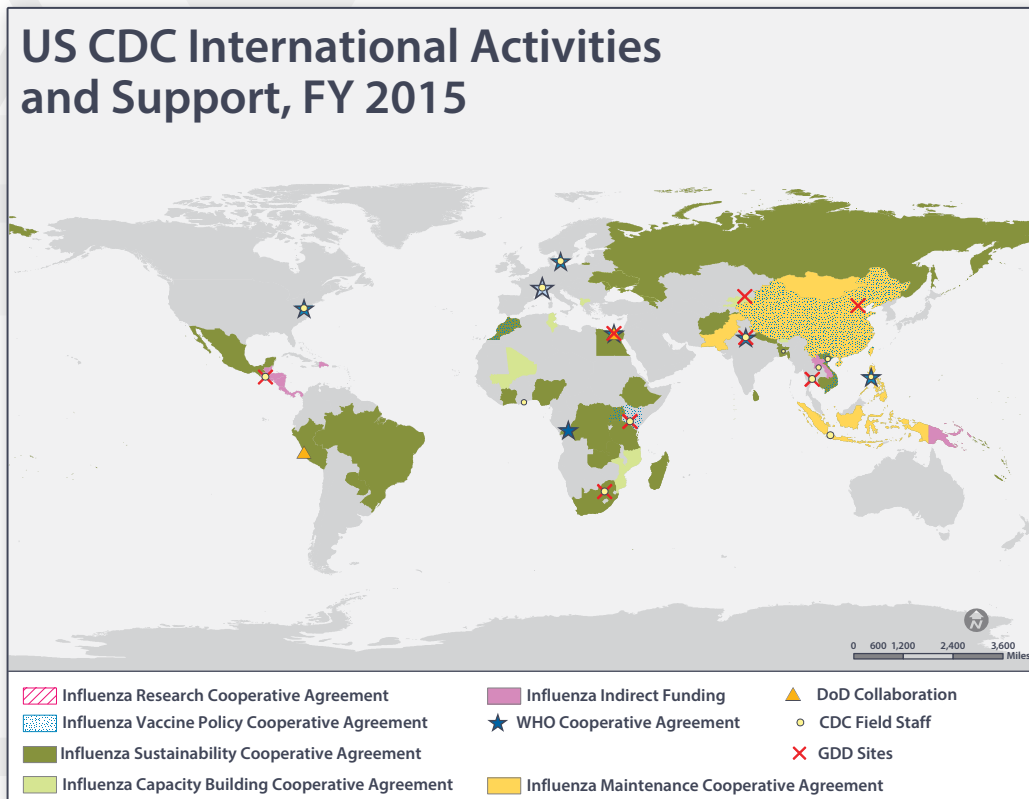
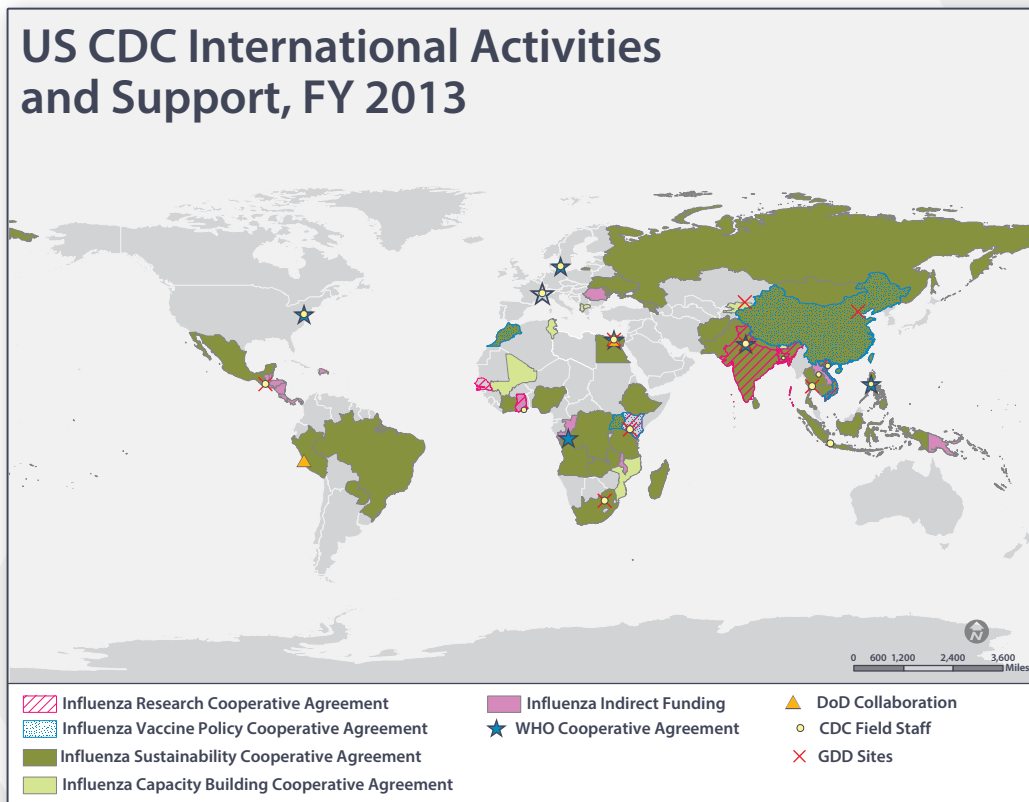
This report is the seventh update on the Influenza Division's international activities and encompasses Fiscal Years 2016 and 2017.

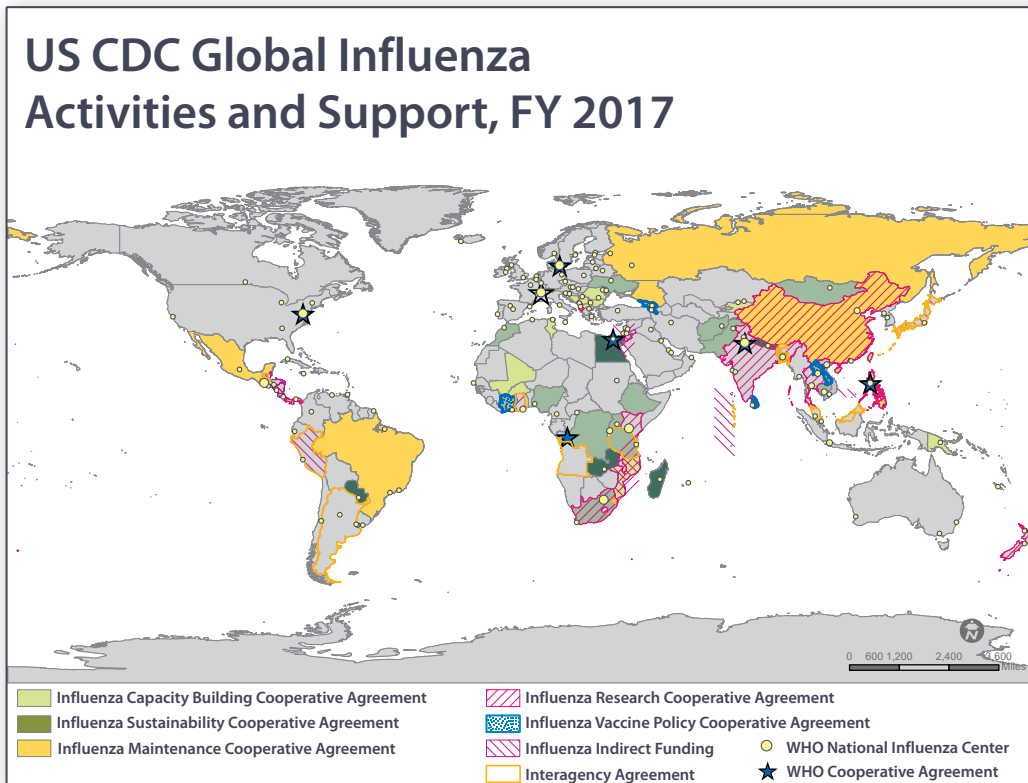
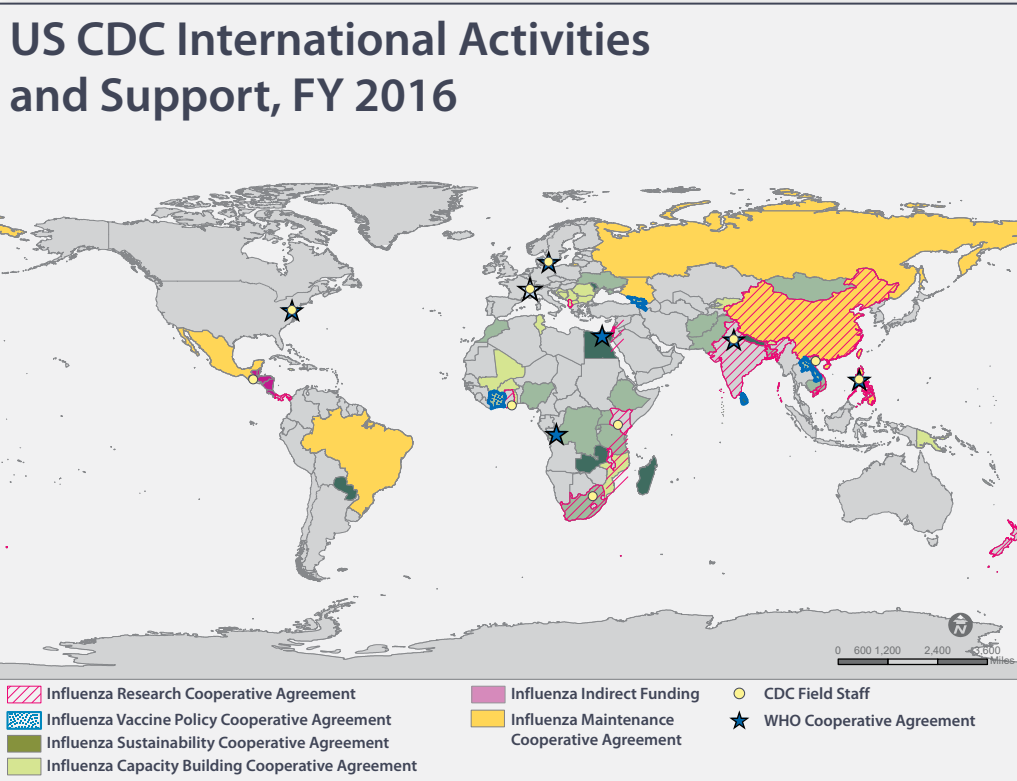
# Maps

For accessible explanations of the figures and maps in the section below, see the [Appendix](#), beginning on page 239.









# U.S. CDC & WHO Collaborations— Influenza

The US Department of Health and Human Services/CDC Influenza Division has maintained cooperative agreements with WHO Headquarters, the WHO Pan American Health Organization (PAHO), and the WHO Regional Office for the Western Pacific (WPRO) for many years to address seasonal and pandemic influenza. Since 2006, cooperative agreements have been maintained with all WHO Regional Offices. The main purpose of the cooperative agreements is to address global and regional preparedness for influenza—both human 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. Working with WHO expands the number of countries participating in the global system, and more importantly enhances early warning and communications capacities to improve the chance for early identification of a pandemic.

In recent years, CDC expanded its 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 provides a significantly expanded base of timely vaccine manufacturing to be used during a pandemic. Towards this goal, CDC has supported activities that will develop the evidence for use of vaccines globally, particularly 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 provides funding and technical support to WHO Headquarters annually 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 through provision of reagents and support of training
- Strengthening global coordination of and communication with GISRS by supporting periodic National Influenza Center (NIC) surveys
- Supporting NICs to attend the WHO vaccine composition consultations in September and February
- Supporting the adoption and implementation of the new 2017 WHO Terms of Reference for NICs of GISRS

### Influenza Epidemiology and Surveillance

- Strengthening influenza monitoring at the global level, including development of automated analysis and visual presentation tools
- Developing a risk 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 influenza A(H5N1) infection in collaboration with the World Organisation for Animal Health and the Food and Agriculture Organization (FAO) of the United Nations
- Supporting the development of goals and methods to inform efforts to determine the appropriate size and scope of the CDC International Influenza Surveillance Program

## Strengthening Influenza Pandemic Preparedness and Response Planning

- Reviewing national pandemic assessment and development of lessons learned to revise pandemic preparedness guidelines
- Reviewing:
  - » measures and indicators of severity during a pandemic
  - » the concept of pandemic phases for decision making
- Maintaining and improving the digital library

## Public Health Leadership and Global Coordination

- Providing 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 and compliance with the International Health Regulations (2005)

## Seasonal Influenza Vaccine Introduction

- Collecting and disseminating information on influenza vaccine availability and utilization
- Assuring quality and safety of influenza vaccines by visiting manufacturing sites and technical reviews of production procedures
- Supporting 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
- Conducting capacity development and facilitation of influenza vaccine policy in WHO Regions
- Supporting WHO's Strategic Advisory Group of Experts to update global vaccine recommendations
- Supporting WHO's Global Action Plan for Influenza Vaccines to expand the availability of influenza vaccines globally

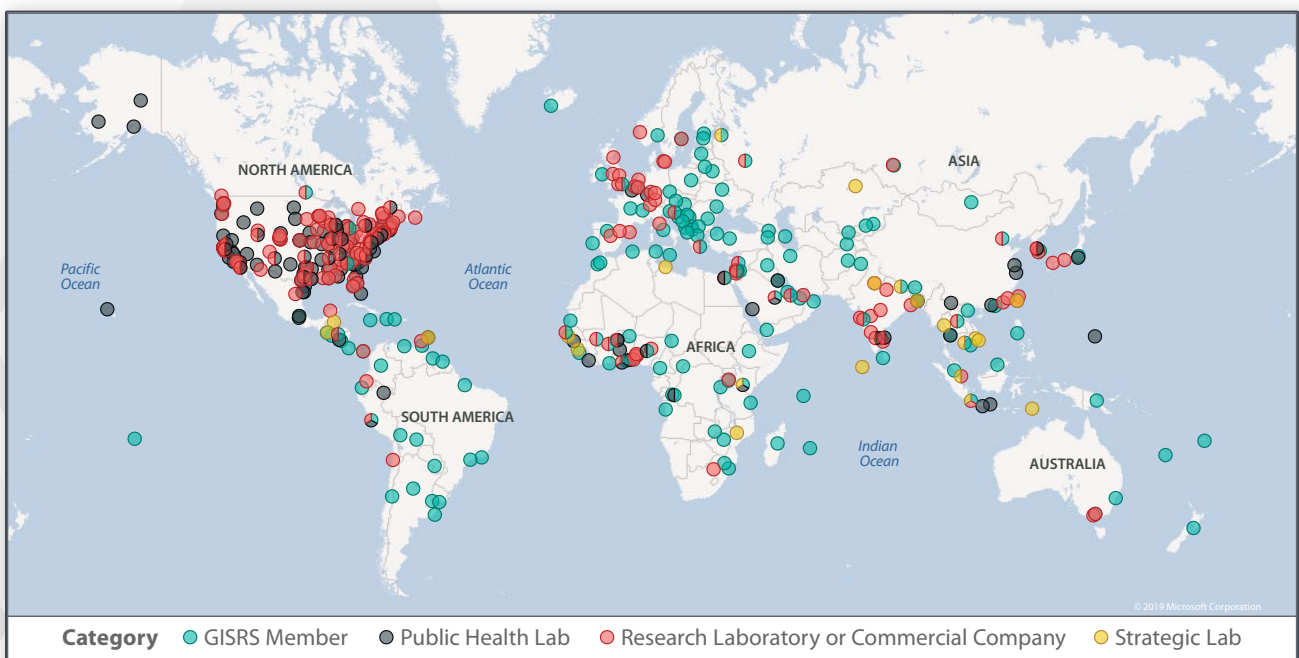
## Pandemic Influenza Preparedness (PIP) Framework

- Supporting PIP countries in accomplishing activities under their PIP work plan, including support for training and assessments
- Supporting and providing consultation to WHO HQ for monitoring & evaluation activities
- Serving as mentors for activities under burden of disease and other areas as needed

# International Reagent Resource (IRR)

The International Reagent Resource (IRR) was established in 2008 by CDC to provide influenza viruses, reagents, kits, and panels to researchers, public health laboratories, vaccine manufacturers, and diagnostic test developers in order to improve influenza diagnostics and vaccines and promote basic influenza research. On a global basis, the IRR acquires, manufactures, stores, and distributes free-of-charge quality influenza products via a web-based storefront to registered public health laboratories. The IRR also functions as a “warm base” for a potential pandemic response, with the ability to quickly ramp up its existing manufacturing and distribution activities to surge levels in the event of a major public health emergency. Centralizing these activities in the IRR ensures that the program can provide high-quality, standardized reagents to fulfill public health and pandemic preparedness needs.

Since 2008, IRR has built a catalog of more than 800 influenza reagents, including diagnostic kits, proficiency panels, positive controls, antigens, and antisera. From September 1, 2016–August 30, 2017, IRR distributed nearly 14,000 reagents for surveillance and research activities to 304 international laboratories in 154 countries. In addition to the US network of 122 public health laboratories in all 50 US states, Washington DC, Guam, and Puerto Rico that perform diagnostic testing for influenza, 83% of international labs participating in WHO’s Global Influenza Surveillance and Response System are currently registered with the IRR program.



**Figure 1—The IRR provides influenza reagents to 426 laboratories in 155 countries including the US to support year-round research and surveillance activities. For an accessible explanation of the figure, [click here to navigate to the Appendix](#).**

Since 2012, the IRR website at <https://www.internationalreagentresource.org/> has served as the program’s online hub for managing the ~1400 requests for influenza reagents that it receives each year. Laboratories can view the IRR’s catalog of 700+ influenza reagents and submit their requests electronically, as well as download product information sheets and certificate of analyses. Orders are triaged by CDC on a daily basis, with a team of customer service representatives on hand to coordinate shipping to recipient laboratories and facilitate navigation of international customs if needed.





**Figure 2—The IRR website provides registered laboratories with information about its large influenza reagent catalog and receives all online orders. For an accessible explanation of the figure, [click here to navigate to the Appendix](#).**

Due to increasing recognition of the success of the IRR model, CDC’s National Center for Immunization and Respiratory Diseases (NCIRD) expanded the program during 2015–2016 to include another 200 non-influenza viruses, bacteria, and other related reagents. Newly added reagents aid in the detection of:

- Adenovirus
- Respiratory syncytial virus infection (RSV)
- Human metapneumovirus
- Rhinoviruses
- Human parainfluenza viruses 1, 2, 3, 4
- Middle East respiratory syndrome–coronavirus (MERS-CoV)
- Human coronaviruses
- Streptococcus pneumoniae
- Neisseria meningitidis
- Haemophilus influenzae serotype b
- Bordetella pertussis

IRR will continue to add new influenza and non-influenza reagents to its catalog in order to support the important research activities of its strategic laboratory partners, the development of vaccines and diagnostics, and ongoing surveillance for influenza and other emerging infectious disease threats.



# WHO Region for Africa [AFR]



# WHO Region for Africa [AFR]

In Fiscal Year (FY) 2017, there were 15 bilateral cooperative agreements to build or enhance sustainable influenza surveillance in the sub-Saharan region of Africa. These agreements were with Ministries of Health (MOHs) or institutions designated by a country's MOH to work with CDC.

Direct country support through non-research cooperative agreements is established in the following 14 countries:

- Burkina Faso
- Republic of Côte d'Ivoire
- Democratic Republic of Congo
- Ethiopia
- Kenya
- Madagascar
- Mali
- Mozambique
- Nigeria
- Rwanda
- Tanzania
- Togo
- Uganda
- Zambia

In addition, CDC's direct assistance to the countries listed above supports capacity building in 4 partner West African countries—Mauritania, Niger, Senegal, and Sierra Leone—to enhance surveillance systems. CDC's direct assistance to WHO's Regional Office for Africa (AFRO) through a cooperative agreement allows for the enhancement and expansion of surveillance systems across Africa through AFRO member states. Currently CDC is working with Guinea-Conakry to set up an influenza surveillance system, also contributing to the goals of the Global Health Security Agenda (GHS) and WHO.

Core activities of CDC bilateral agreements and technical assistance include:

- Building sustainable national capacity for surveillance for seasonal influenza, pandemic influenza, and other emerging diseases and preparedness for implementation of the International Health Regulations (2005)

- Contributing surveillance data to WHO's Global Influenza Surveillance and Response System (GISRS)
- Increasing the geographic reach of WHO GISRS
- Providing early access to critical virus isolates from humans and birds for WHO GISRS
- Increasing the quantity of shipments and influenza isolates provided by African influenza laboratories for analysis by WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs)
- Developing sustainable epidemiologic and virologic surveillance systems for severe influenza to understand the burden of disease in the WHO AFR

CDC also partners with:

- Institut Pasteur in Paris, France to support activities in Cameroon, Central African Republic, and Senegal
- WHO in Geneva, Switzerland and the US Agency for International Development to support activities in Burkina Faso, Malawi, Mozambique, and the Democratic Republic of the Congo
- The Indian Ocean Commission in Port Louis, Mauritius to enhance surveillance in Mauritius and build surveillance capacity in the Seychelles

In FY 2013, CDC expanded its cooperative agreement portfolio to include a vaccine policy component and worked with Uganda and Kenya to move national vaccine policies forward. In FY 2016, CDC began working with Côte d'Ivoire through the same mechanism.

Core activities of these agreements include:

- Conducting a needs assessment to identify barriers to vaccine introduction
- Improving and interpreting the evidence base to make the case for vaccine use
- Strengthening National Immunization Technical Advisory Group to empower them to conduct evidence-based decision-making
- Developing a 3-year action plan to introduce vaccines
- Implementing the plan

- Introducing or expanding vaccine use to the target population through development of a national policy

In addition to the capacity building grants identified above, CDC's Influenza Division also supports surveillance of influenza-associated illness in sub-Saharan Africa and research collaborations with institutions in Ghana, Kenya, Malawi, Senegal, and South Africa. These collaborations focus on demonstrating the burden of disease and identifying risk factors for severe influenza, measuring influenza-associated morbidity and mortality, and documenting influenza vaccine effectiveness.

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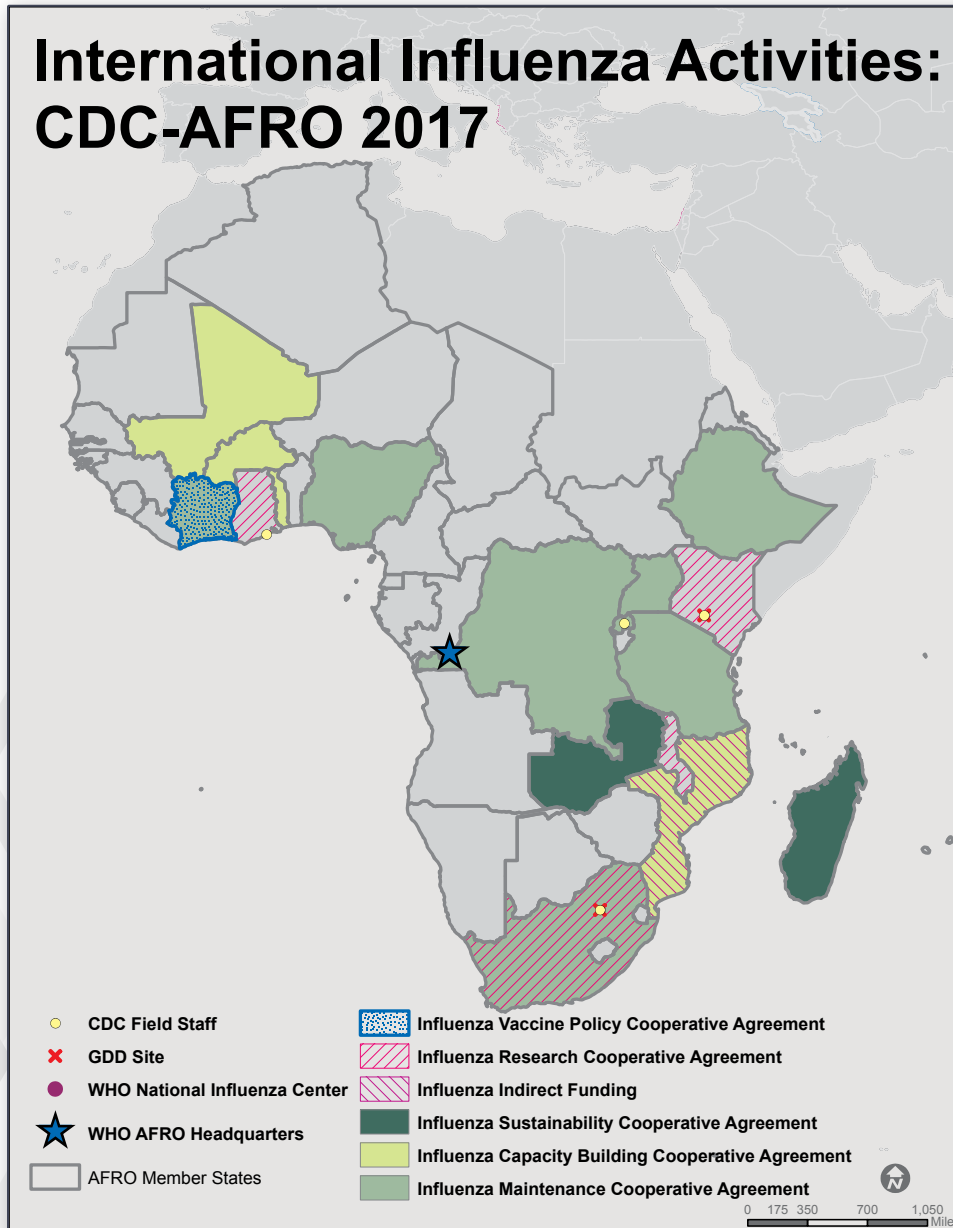
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# WHO Regional Office for Africa [AFRO]



### HIGHLIGHTS

- Disseminated weekly bulletins on virological surveillance of influenza through the WHO African Region (AFR) influenza laboratory network
- Provided strategic guidance, technical and financial support, and coordination to member states to strengthen the virological and epidemiological surveillance of influenza to better prepare against seasonal, zoonotic, and pandemic influenza threats in the WHO AFR

## U.S. CDC DIRECT SUPPORT

The WHO Regional Office for Africa (AFRO) commenced its initial 5-year cooperative agreement on surveillance and response to seasonal and pandemic influenza with CDC in September 2016. With support from CDC, 30 of 47 countries (64%) in the region have developed and maintained sentinel surveillance and laboratory capacity for the diagnosis of influenza. CDC support includes technical and financial assistance to member states to strengthen their national influenza surveillance systems, with a specific focus on influenza-like illness (ILI) and severe acute respiratory infection (SARI). Countries within the network are regularly supplied with laboratory equipment and reagents, enhancing and sustaining diagnostic capacity for detection of influenza viruses. This support has also enhanced laboratory capacity in the region to identify MERS-CoV and Ebola virus.

## SURVEILLANCE

The WHO AFRO influenza laboratory network was extended to establish sentinel surveillance for influenza for 5 countries (Chad, Gabon, Guinea, Malawi, and Mauritania).

### SURVEILLANCE ACTIVITIES

- Updated the *National Protocol for Sentinel Surveillance for Influenza, based on the WHO Global Epidemiological Surveillance Standards for Influenza*; this document was translated into 3 WHO AFRO languages and disseminated to all member states. The guide for adaptation of the generic protocol is also available for countries to modify the protocol to their own country context.
- Participated as a regional focal point and mentor in a workshop on monitoring and evaluation of surveillance systems with a specific emphasis on influenza sentinel surveillance in October 2015 in Abidjan and March 2016 in Kigali.

Joint WHO AFRO/CDC missions were conducted in Chad, Gabon, and Sierra Leone in conjunction with the Sentinel Surveillance for Influenza Training Program to report on the status of surveillance systems in each of the countries so that corrective actions could be initiated if necessary.

## LABORATORY

As of June 2017, 24 of the 30 National Influenza Reference Laboratories within the Regional Laboratory Network were regularly contributing surveillance data to the global influenza surveillance platforms. More than 13,000 specimens have been tested for the presence of influenza viruses, with a positivity rate of 8.6%. In 2016, the laboratory network tested approximately 35,000 specimens, of which 16% were positive for influenza virus.

AFRO continues to support virological testing, providing equipment, reagents, and consumables necessary for influenza testing, and training regional laboratory personnel to build and sustain workforce capacity in regional laboratories.

### LABORATORY ACTIVITIES

- Disseminated weekly virological surveillance data through the AFR Influenza Laboratory Network.
- Provided essential reagents and supplies to Algeria, Burkina Faso, Central Africa Republic, Republic of the Congo, Senegal, and Togo for enhancing and sustaining laboratory testing of ILI and SARI clinical specimens.
- Provided financial support to the Democratic Republic of the Congo to strengthen the National Institute of Biomedical Research (INRB) to enhance virological influenza surveillance. This allowed the initiation of virus isolation at INRB.
- Strengthened 10 countries' national influenza reference laboratories with financial support.
- Supported 10 countries to strengthen virological surveillance by the purchase of virus transport media to help ensure high-quality specimens reach the lab for testing, and reagents for molecular testing of specimens for influenza.

## PREPAREDNESS

WHO AFRO, in collaboration with WHO Headquarters (HQ), is implementing the laboratory and surveillance component of the Pandemic Influenza Preparedness (PIP) framework in 9 countries: Burundi, Cameroon, Congo, Ghana, Mozambique, Madagascar, Sierra Leone, Tanzania, and Zambia. All countries are focusing on activities to strengthen their capacities to monitor trends in circulating influenza viruses. In addition, the PIP Framework focuses on preparedness and encourages countries to develop country preparedness plans and to coordinate with other sectors in preparedness for avian influenza.

To avoid duplication of efforts, the WHO staff's focal point on influenza ensures harmonization of the CDC influenza project and PIP.

### PREPAREDNESS ACTIVITIES

- **Ghana and Tanzania** conducted self-assessment surveys of their influenza laboratories using WHO standardized tools.
- **Ghana** established 24 sentinel sites for influenza surveillance in all regions between January and April 2015, as part of influenza preparedness. Ghana also sent samples from patients with ILI for assessment by its National Influenza Center (NIC).
- **Ghana's NIC** supported sub-regional influenza capacity by training 2 staff members from Nigeria and Côte d'Ivoire on influenza virus isolation (March 18–27, 2016).
- **Tanzania** conducted training on influenza specimen collection and shipment for staff in newly established influenza sentinel sites. Tanzania also procured information technology equipment for its Ministry of Health, laboratories, and sentinel sites to enhance data sharing and ensure monitoring and assessment of influenza events of international concern.

### TRAINING

- The Fourth Regional National Influenza Center Meeting was convened with more than 70 participants from member states, partners, and WHO.
- A train-the-trainer workshop with influenza sentinel surveillance training modules was conducted for 20 experts from 11 countries (Francophone and English-speaking). Presentations were delivered on developing and/or enhancing influenza surveillance systems and national protocols for sentinel surveillance for influenza.
- The train-the-trainer workshop resulted in the implementation of training of 30–40 health professionals from 10 African countries (Burundi, Chad, Congo, Ethiopia, Gabon, Guinea, Malawi, Mauritania, Niger, and Sierra Leone) between October and December 2016.

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# BURKINA FASO



## OVERVIEW

CDC provides financial and technical assistance to strengthen surveillance and control of influenza and a number of other diseases. CDC strengthened influenza surveillance through its cooperative agreement with the Ministry of Health (MOH) in Burkina Faso, Strengthening Human and Animal Influenza Surveillance and Response in Burkina Faso (September 2016–August 2021). This cooperative agreement provides technical assistance in many key areas, most notably project management, building capacity among local staff (epidemiologists and laboratory technicians), and in the field of research.

## SURVEILLANCE

Surveillance of influenza in Burkina Faso focuses on both epidemiologic and virological surveillance. Epidemiologic surveillance is under the management of the Epidemiologic Surveillance Service. All hospitals and health facilities in the country report all cases of disease and both maternal and neonatal mortalities weekly. These reporting requirements are monitored using weekly official letter telegrams to detect any potential outbreaks.

Virological surveillance started in 2010 with the support of the United States Naval Medical Research Unit Three (NAMRU-3), CDC, and the US Agency for International Development. NAMRU-3 allows for sentinel surveillance based on onsite clinical sample collection, in accordance with the WHO case definitions for influenza-like illness (ILI) and severe acute respiratory infection (SARI). Testing of all collected samples is performed in the NIRL by RT-PCR for influenza virus detection, and weekly results are shared with the Directorate of Disease Control (DDC)/Ministry of Health (MOH) and WHO. Clinical specimens are shipped twice per year to the WHO Collaborating Center for Reference and Research on Influenza at CDC for vaccine strain selection and for external quality control.

## SURVEILLANCE ACTIVITIES

- Two ILI sentinel sites are functional and samples are collected daily.
- Four SARI sentinel sites are operable through the Burkina RESPIRE project, and regular collection of SARI cases is conducted.

## HIGHLIGHTS

- The Directorate of Diseases Control/Ministry of Health and the National Influenza Research Laboratory (NIRL) began sentinel surveillance of influenza-like illness and severe acute respiratory infection (SARI) in 2010.
- The number of sentinel sites increased from 1 site (2010) to 6 sites (2017).
- Based on existing surveillance, CDC initiated and funded the Burkina RESPIRE project, which aims to strengthen surveillance of SARI and unusual respiratory events.
- A functional national specimen transport system has been established.
- NIRL capacity has been increased with staff training, equipment, and reagent and supplies acquisition (33 respiratory pathogens can be detected by the Fast Track Diagnosis–33 test).

- All Terms of Reference for implementation of new human and avian sentinel sites are available.
- Training for medical staff for influenza case detection and sample collection, packaging, and shipment was conducted.
- Approximately 50 epidemiologists from 16 districts and regions were trained in the front-line Field Epidemiology Training Program (FETP) with the financial support of the African Field Epidemiology Network.
- Thirteen familiarization meetings for prevention of and response to highly pathogenic avian influenza have been organized by the Ministry of Animal Resources in different regions, targeting political, administrative, religious, and traditional authorities and poultry farmers.
- One TV program for sensitization on prevention of highly pathogenic avian influenza has been organized by the Ministry of Animal Resources.
- A total of 2,500 sensitization posters and 2,200 leaflets on avian influenza prevention were shared with communities and veterinary services.
- A meeting of data managers and epidemiologists on data analysis was organized through the Burkina RESPIRE project.

- Training of 24 trainers of community-based health workers on unusual and unexpected respiratory events with the Burkina RESPIRE project was conducted in 3 districts.

## LABORATORY

Before the beginning of the cooperative agreement, the NIRL made efforts to work closely with national and international partners but needed additional funding and technical assistance. With the support of CDC, NAMRU-3, and the DDC, SARI and ILI surveillance was implemented. The main activities of the NIRL were to analyze samples collected by the sentinel sites using RT-PCR and to provide weekly results to DDC and WHO; this objective has been met following CDC's support. NIRL is involved in the Burkina RESPIRE pilot project, and approximately 50 specimens are tested each month.

### LABORATORY ACTIVITIES

- Approximately 60 specimens are collected per month from routine ILI surveillance performed by NIRL.
- Capacity building of data managers on laboratory data reporting was conducted through the Burkina RESPIRE project.
- The NIRL staff have been trained by a CDC/ Association of Public Health Laboratories specialist on biosafety and biosecurity.
- Approximately 50 SARI specimens from the Burkina RESPIRE project are tested each month.
- During the first quarter, 3,000 avian swabs were collected from 13 regions through the support of a project with the Ministry of Animal Resources.
- With the support of CDC, NAMRU-3, and WHO, the NIRL regularly sent 30–50 clinical specimens per year to the WHO Collaborating Center for Reference and Research on Influenza at CDC for influenza vaccine strain selection.

## PREPAREDNESS

The MOH, in collaboration with the Ministries of Animal Resources, Environment, and Defense developed a national action plan for preparedness and response to an influenza outbreak. Extensive work has been done aligning human and animal influenza surveillance activities. Burkina Faso has been selected as a pilot country to establish national surveillance of unusual respiratory events and strengthening of SARI surveillance for 2 years. These existing collaborations

from different levels of the MOH, Ministry of Animal Resources, and national laboratories (NIRL and Laboratoire National de L'Élevage) are a solid base for the implementation of the cooperative agreement and can give an opportunity to improve the surveillance system and strengthen the One Health concept.

### PREPAREDNESS ACTIVITIES

- A national action plan for preparedness and response was developed in the event of an influenza outbreak.
- The drafting of Terms of Reference for the biannual meeting of data managers and epidemiologists on data analysis was completed.
- The drafting of Terms of Reference to enhance data management of influenza at the district, hospital, regional, and national levels was completed.
- The drafting of Terms of Reference was completed for training 1 surveillance and laboratory data manager in the surveillance and response system and WHO FluNet data reporting.
- A meeting of data managers and epidemiologists on data analysis was held through the Burkina RESPIRE project.

## TRAINING

- Data managers were trained on laboratory data reporting.
- Trainings of trainers of 24 community-based health workers on unusual and unexpected events with the Burkina RESPIRE project were conducted in 3 districts.
- Training for community-based health workers on unusual and unexpected events with the Burkina RESPIRE project is active and ongoing.
- Forty-nine epidemiologists from 16 districts and regions were trained in FETP with the financial support of the African Field Epidemiology Network.
- Trainings for the sentinel sites' medical staff on influenza cases detection, sample collection, packaging, and shipment were funded by the Burkina RESPIRE project.
- Two members of NIRL staff were trained on influenza virus isolation and identification at the Ghana and Senegal National Influenza Centers.

# REPUBLIC OF CÔTE D'IVOIRE

## OVERVIEW

Fiscal Year (FY) 2016 marked the last year of CDC's cooperative agreement with the National Institute for Public Hygiene (INHP). The agreement was titled *Sustaining Influenza Surveillance Networks and Response to Seasonal and Pandemic Influenza by National Health Authorities*. A site visit was conducted to provide technical assistance and follow-up on surveillance activities by the CDC Regional Advisor based in Accra, Ghana on June 2016. The Association of Public Health Laboratories (APHL) in collaboration with CDC trained 2 virologists on a real-time PCR assay for non-influenza respiratory viruses in July 2016 in Atlanta. This training enabled the National Influenza Center (NIC) staff to set up the protocol and diagnostic system for non-influenza respiratory viruses.

CDC strengthened the capacities of INHP in the management and monitoring of national health systems during the Ebola virus epidemic in West Africa. CDC also supported INHP to develop strategic and operational procedures for the fight against Ebola virus disease, which allowed Côte d'Ivoire to obtain supplemental funds through the influenza project for the procurement of supplies. During this timeframe, the first meeting of the CDC and the Partnership for Influenza Vaccine Introduction (PIVI) kicked off in Tbilisi, Republic of Georgia, with 2 experts from Côte d'Ivoire in attendance.

## SURVEILLANCE

In December 2015, the influenza surveillance system was evaluated for effectiveness, in order to strengthen influenza surveillance indicators. The specific attributes assessed were simplicity, sustainability, acceptability, utility, timeliness, flexibility, representativeness, data quality, and stability. The results have been used to strengthen influenza surveillance, and the data have been published in scientific reviews.

### SURVEILLANCE ACTIVITIES

- Epidemiologists from INHP and biologists from the Institut Pasteur made 3 supervisory visits to the 9 influenza-like illness (ILI) and severe acute respiratory infection (SARI) sentinel sites.
- An annual review meeting of the influenza surveillance network was held to review

## HIGHLIGHTS

- Implementation of influenza surveillance based on electronic transmission of data via the Magpi application began in early 2017.
- The Partnership for Influenza Vaccine Introduction project was implemented in Côte d'Ivoire.

surveillance data from sites, share experiences, and discuss challenges to the improvement of the surveillance system.

- The head of the Department of Epidemiology of INHP and the lab supervisor participated in the fifth African Network for Influenza Surveillance and Epidemiology meeting in Kigali, Rwanda.
- The head of the Department of Epidemiology of INHP and 2 lab managers participated in the OPTIONS for the Control of Influenza IX meeting in Chicago, USA.
- The epidemiologists of INHP elaborated a new roadmap for the Epidemiology Surveillance Unit of INHP, which monitors influenza surveillance.
- The epidemiologists of INHP and lab managers updated the influenza surveillance protocol.
- The project conducted a Hospital Utilization Survey in 8 Health District housing sentinel sites for the estimation of influenza disease burden.

## LABORATORY

The Côte d'Ivoire NIC has worked closely with CDC and APHL to strengthen its capacities. NIC laboratorians (2) have been trained extensively with CDC and APHL scientists on virus typing, subtyping, PCR, RT-PCR, and reverse genetics techniques to diagnose influenza and non-influenza respiratory viruses. The NIC participated in the WHO External Quality Assessment Program project (EQAP) for influenza A detection by RT-PCR and CDC's Performance Evaluation Panels (15 and 16) for influenza testing by RT-PCR in 2016. The NIC collaborated with WHO's Global Influenza Surveillance and Response System (GISRS) by regularly sharing influenza viruses with WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs) in London and Atlanta.

## LABORATORY ACTIVITIES

- The National Influenza Laboratory (NIL) tested a total of 4,015 influenza specimens from sentinel hospitals, with 436 positives that included 112 influenza A(H1N1)pdm09, 142 influenza A(H3N2), 27 influenza A/untyped, 3 influenza B/Yamagata, 137 influenza B/Victoria, and 92 influenza B with lineage not determined types.
- NIL sent 2 sets of 2 specimen/untypable/influenza viruses to WHO GISRS via the WHO CCs in London and Atlanta in June 2016.
- NIL participated in a training on RT-PCR assay for non-influenza respiratory viruses in Atlanta organized by CDC and APHL. The lab supervisor and a lab engineer participated in the training, which enabled the staff to set up the protocol and diagnostic system for non-influenza respiratory viruses in the NIL.

## PREPAREDNESS

For preparedness against influenza epidemics and pandemics, the project team and INHP reproduced policies on influenza surveillance; organized sensitization and communication round trips targeting health care workers, poultry farmers and dealers, community leaders, and administrative and political authorities; trained rapid response teams for local epidemics and clusters; and made a stock of personal protective equipment (PPE) for investigations.

### PREPAREDNESS ACTIVITIES

- Four hundred posters, 3 kakemono (roll-up posters), and 4,600 forms on influenza surveillance policies for community awareness and preparedness against influenza outbreaks and pandemics were produced and distributed.
- Awareness meetings on influenza were held in 8 cities of Côte d'Ivoire (Ferké, Boudoukou, Bouna, Katiola, Tanda, Niakara, Agnibilékrou, and Ouangolo).
- A rapid response team was set up for local epidemics and clusters on influenza in a sentinel site. More than 283 health professionals from the health regions and districts of the country were trained by INHP and CDC.

- A provision of PPE was acquired by INHP through the Ministry of Health in the framework of the fight against potential epidemic diseases and influenza. Globally, more than 18,000 PPE items are available and stocked at INHP. These PPE can be used in response to epidemic or pandemic influenza and other acute respiratory infections.
- The PIVI project was presented at the National Immunization Technical Advisory Group meeting in Côte d'Ivoire. A Technical Working Group has been established to develop policies and recommendations on influenza vaccination.

## TRAINING

CDC continues to provide 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. From 2015 to 2017, the following trainings were organized in Côte d'Ivoire:

- Hosted training on Monitoring and Evaluation of Surveillance Systems with Emphasis on Influenza and Sentinel Surveillance for the following countries: Côte d'Ivoire, Ghana, Nigeria, DRC, Morocco, Rwanda, Tunisia, Uganda, and Zambia.
- A data manager from INHP was trained in management and analysis of influenza data in Amsterdam, the Netherlands.
- Fifteen health care workers from sentinel sites were trained on investigation of avian influenza outbreaks and the use of Magpi software for notification.
- Management unit staff were trained in the procedures for managing US funding.
- Management unit staff were trained in advanced Microsoft Excel use.

# DEMOCRATIC REPUBLIC OF CONGO (DRC)

## OVERVIEW

CDC provides financial and technical assistance to strengthen surveillance and control of influenza and a number of other diseases. CDC strengthened influenza surveillance through 3 cooperative agreements and provides technical assistance in many key areas, most notably in project management, capacity building among local staff (epidemiologists and laboratory technicians), and in the field of research.

## SURVEILLANCE

In the Democratic Republic of the Congo (DRC), the Fourth Directorate of the Ministry of Health (MOH) is the institution in charge of disease control. For influenza sentinel surveillance, this Directorate produces and disseminates standard weekly reports that include virological and epidemiological data, and organizes monthly meetings of the DRC Influenza National Technical Committee.

Influenza surveillance has been strengthened by improving the collection of samples by sentinel sites from patients with influenza-like illness (ILI) and severe acute respiratory infection (SARI) according to case definitions, by analysis of collected specimens at the national influenza laboratory, and by establishing a uniform method of sharing the laboratory report via WHO's reporting platform, FluNet. Additionally, sentinel site staff report suspected influenza cases, and when the criteria are met, take samples. The samples taken are sent to the National Institute of Biomedical Research within 48 hours. Sentinel site staff are regularly trained and supervised. Supervisory visits and trainings are conducted monthly at sentinel sites in Kinshasa and quarterly for sites located in the provinces.

## SURVEILLANCE ACTIVITIES

- Sentinel sites collected 2,084 specimens from ILI and SARI patients that were shipped to the national influenza laboratory.
- Specimens collected were analyzed and reports were shared, including with FluNet.

## HIGHLIGHTS

- Following the global pandemic outbreak in poultry caused by the influenza A(H5N1) virus in 2007, the Democratic Republic of the Congo set up its influenza sentinel surveillance system, which had 11 sites as of September 2016.
- From October 2015 through mid-2017, 2,084 specimens were taken from influenza-like illness/severe acute respiratory infection patients and sent to the National Influenza Laboratory for analysis.
- A total of 135 samples were positive for influenza: 91 for type A and 44 for type B.
- Epidemiologists and lab technicians were trained, and site staff received a refresher training and supervision.

- Epidemiological weekly reports were written and shared between stakeholders.
- Epidemiologists from the MOH made supervisory visits to influenza sentinel sites in Kinshasa, Matadi, and Lubumbashi.
- Training was provided to 2 epidemiologists and lab technicians during this period, improving their skills in virus isolation, data management, and estimating the burden of disease.
- Site staff including medical doctors, nurses, and lab technicians received an update on case definition and sample collection.
- Epidemiologists and site staff updated the influenza sentinel surveillance manual training.
- The Influenza National Committee participated in the writing of a roadmap for the Global Health Security Agenda.

## LABORATORY

Thanks to the first 5-year cooperative agreement, the DRC national laboratory was equipped and the capacity of staff to perform real-time PCR was built. Within the framework of partnership with CDC, lab technicians benefitted from many trainings. The lab is

evaluated regularly. To date, the national laboratory is working to become a National Influenza Center and to acquire genetic sequencing techniques.

### LABORATORY ACTIVITIES

- The National Influenza Laboratory tested a total of 2,084 influenza specimens (866 SARI and 1,218 ILI from 11 sentinel sites); among them, 135 were positive. Of these, 91 were type A (71 were H1N1; 15 were H3N2; 5 had no subtyped typed), and 44 were type B.
- The National Influenza Laboratory submitted 52 reports to FluNet and shared specimens with lab partners, sending a total of 110 positive samples to the WHO Collaborating Center for Reference and Research on Influenza at CDC.

### PREPAREDNESS

Following the influenza A(H1N1) pandemic in 2010, DRC developed a preparedness plan to deal with pandemics. Unfortunately, the resources mobilized did not allow the implementation of that plan. Since then, it has not been updated.

Within the framework of global health security, a 5-year roadmap has been developed taking into account control of zoonotic diseases through the One Health approach. Thus, a multi-sectorial zoonotic prevention committee was created. In total, 6 zoonotic diseases were identified as priorities; among them were influenza infections.

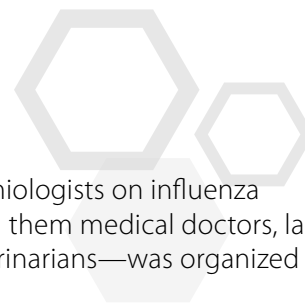
Detected through animal surveillance, an outbreak of avian influenza appeared in the province of Ituri at the boundary with Uganda, killing hundreds of poultry, though no human cases have been discovered to date. The influenza A(H5N8) virus was identified as the pathogen. In response to this situation, the routine surveillance system was reinforced, and care provider staff are on alert.

### PREPAREDNESS ACTIVITIES

- Epidemiologists were trained on influenza illness surveillance and response.
- A lab technician at the National Influenza Laboratory was trained.
- Refresher sessions were conducted for site sentinel staff.
- Influenza illness surveillance was integrated into routine surveillance.

### TRAINING

- Training of 50 epidemiologists on influenza surveillance—among them medical doctors, lab technicians, and veterinarians—was organized in May 2017.
- Eleven training workshops for 67 health staff involved in sentinel surveillance work were held in all 4 sites in 2015 and 2016.
- Two epidemiologists from the MOH attended influenza surveillance training in Ivory Coast.
- Two lab technicians attended training on influenza diagnosis techniques in Ghana.
- A lab technician attended the CDC/Association of Public Health Laboratories Virus Isolation Workshop in Dakar, Senegal.



# ETHIOPIA

## OVERVIEW

The implementation of cooperative agreements between the federal Ministry of Health/Ethiopian Public Health Institute (EPHI) and CDC has resulted in tremendous improvement in influenza surveillance activities. The *Maintenance of Influenza Surveillance Capacity* cooperative agreement (period of performance August 1, 2016–July 31, 2017) has strengthened existing influenza surveillance systems; maintained national capacity to detect, monitor, and respond to influenza virus changes; and mitigated transmission of novel influenza among humans in Ethiopia. Sentinel sites have also been equipped to carry out their surveillance functions via the purchase of laboratory equipment and reagents, by which lab capacity building was initiated. In the cooperative agreement, CDC provides financial support for maintaining and strengthening influenza surveillance activity. Technical support includes routine sharing of surveillance and laboratory findings with CDC in Atlanta for virus characterization and drug sensitivity testing. Furthermore, CDC involvement in nationally organized meetings, conferences, trainings, and document preparation enhanced the level of preparedness and response of the country.

## SURVEILLANCE

Ethiopia adopted the Integrated Disease Surveillance and Response strategy; per the recommendation in the strategy, Ethiopia conducted a comprehensive assessment of existing surveillance, epidemic preparedness, and the response system of the country. Avian influenza infections in humans, A(H1N1) pdm09, and severe acute respiratory syndrome (SARS) are included as immediately reportable diseases. The country has implemented a multi-component influenza surveillance system: sentinel surveillance, ambulatory health facility-based sentinel surveillance, and a laboratory-based surveillance system. Severe acute respiratory infection (SARI)/influenza-like illness (ILI) sentinel surveillance activities were started in September 2008. Currently, there are 8 sentinel surveillance sites (5 SARI and 3 ILI sites) located in 5 mega-regions. Illnesses that meet the case definitions for ILI and SARI are included in the surveillance system. The public health emergency management center supports the National Influenza Laboratory (NIL) by

## HIGHLIGHTS

- Surveillance data from sentinel sites were routinely collected and compiled, and descriptive data analysis was conducted.
- The severe acute respiratory infection/influenza-like illness/MERS-CoV implementation guideline was reviewed and distributed to all sentinel sites.
- Completeness and quality of the surveillance data were monitored and feedback was given to the reporting sentinel sites.
- A weekly bulletin was developed and shared with all concerned partners and government organizations.
- Supportive supervision and review meetings were routinely conducted.
- Laboratory supplies and a running costs budget were given for all sentinel sites.
- Laboratory specimens were collected and tested.
- Trainings and community awareness activities were conducted.

serving as a focal point for the generation, processing/analysis, and dissemination of scientific information for public health information and decision making.

## SURVEILLANCE ACTIVITIES

- The data from sentinel sites were compiled; descriptive data analysis was conducted by time, place, and person; and disease trends were visually depicted.
- Forty-two Public Health Emergency Management Center (PHEM) officers at the national and regional levels were trained on influenza sentinel surveillance and outbreak response.
- Ethiopian Field Epidemiology Training Program (FETP) residents actively engaged in conducting influenza data analysis to assess seasonality, risk, and disease burden in the country.
- Twenty-four sentinel sites' focal persons were trained on influenza sentinel surveillance and outbreak response.
- Needs assessments on meeting the needs of the surveillance network and laboratory capacity were conducted and the pre-requisites were identified.

- Supportive supervision was conducted at sentinel sites. The quality of surveillance data collected from sentinel sites (both case-based and aggregated data) was assessed and the data were compiled.
- Fifty-two reports were delivered through WHO FluNet and FluID data on a weekly basis to the WHO Global Influenza Surveillance and Response System (GISRS), the Ministry of Health, partners within the country, and CDC.
- Two members of the influenza technical working group participated in the fourth International Influenza Centers meeting in the African Region, conducted October 24–26, 2016 in Brazzaville, Republic of the Congo.

## LABORATORY

The Ethiopian NIL has been supported by CDC since the establishment of the laboratory in 2009. Through this support, NIL has acquired influenza typing and sub-typing RT-PCR reagents, RNA extraction kits, and more recently, RT-PCR reagents for testing of non-influenza viruses from the International Reagent Resource (IRR). In terms of training and capacity building, since October 2015, 2 NIL staff members were trained on respiratory sample collection and transportation at the Uganda Virus Research Institute and hence are certified as biological specimen shippers. One NIL staff member also received a 5-day training on influenza virus culture techniques at Institut Pasteur in Dakar, Senegal.

### LABORATORY ACTIVITIES

- NIL has tested 1,467 samples for ILI and SARI. Among the respiratory specimens from ILI and SARI, 340 (23.2%) samples were influenza positive: 152 (10.4%) for influenza A(H3N2), 77 (5.2%) for A(H1N1) pdm09, and 111 (7.6%) for influenza type B.
- NIL was involved in the laboratory investigation of ILI and SARI outbreaks. In the ILI outbreak, a total of 120 throat swab samples were collected, of which 75 (62.5%) were sub-typed as influenza A(H1N1)pdm09 and 4 (3.4%) as influenza A(H3N2). In the SARI outbreak, 20 samples were collected and 8 (35%) were found to be positive for A(H1N1) pdm09.
- NIL has provided trainings to influenza sentinel site focal persons on collection, handling, and transportation of samples from patients who fulfill the ILI and SARI case definitions, as well as from patients suspected to be infected with MERS-CoV.
- NIL has shipped a total of 100 positive samples to WHO's Collaborating Center for Reference and Research on Influenza at CDC in Atlanta for further characterization and antiviral testing.
- NIL participated in 2 WHO External Quality Assessment Project (EQAP) panels—15 and 16—and scored 100%.
- In collaboration with the surveillance wing of PHEM, NIL has conducted supportive supervision in all influenza sentinel sites.
- Two scientific posters on influenza laboratory testing were presented at an international conference by NIL staff.

## PREPAREDNESS

PHEM is responsible for implementing and monitoring national emergency preparedness and response planned activities, producing reports, and ensuring resource availability at a regional level, including the 24-hour operation of the Emergency Center, to guarantee that the country is prepared to respond to a pandemic. PHEM receives the necessary laboratory backing from the NIL and Emerging Infectious Diseases Laboratory located within NIL. CDC support through WHO has considerably advanced pandemic influenza preparedness and planning in Ethiopia. An influenza surveillance protocol and leaflets were adapted and distributed. Furthermore, ILI refresher trainings were delivered as preparedness activities.

### PREPAREDNESS ACTIVITIES

- The public health emergency management annual plan, which includes influenza, was implemented. Reporting formats for SARS, pandemic influenza, and avian influenza infections in humans were printed and distributed to all regions with other reporting formats for diseases under surveillance.
- The influenza sentinel surveillance sustainability plan was developed and aligned with public health emergency management activities.
- Two thousand SARI leaflets for health workers were printed and distributed to the sentinel sites.
- Two thousand ILI leaflets for health workers were printed and distributed at the sentinel sites.
- Two thousand Amharic-language ILI leaflets for health workers were printed and distributed at the sentinel sites.



## TRAINING

In collaboration with partners, PHEM continues to provide technical assistance and training to ensure the function of the sentinel surveillance system, quality of the surveillance data, prompt data analysis, and integration of the information into preparedness and response activities. In 2015–2017, the following trainings were organized in Ethiopia.

- Forty-two PHEM officers at national and regional level were trained on influenza sentinel surveillance and outbreak response.
- Twenty-four sentinel sites' focal persons were trained on influenza sentinel surveillance and outbreak response.
- Orientation/training on influenza sentinel surveillance was delivered to 40 Addis Ababa private and government hospital medical directors.
- More than 150 participants from sentinel sites, regional health bureaus, and different relevant sectors were trained on influenza.
- Onsite training and mentoring were delivered to all SARI/ILI sites.
- Experts from the epidemiology and lab units of EPHI and medical directors from 3 sentinel sites participated in a learning tour in Rwanda and Congo.

# KENYA



## OVERVIEW

In 2016, a new CDC cooperative agreement with the Henry Jackson Foundation, *Conducting Public Health Research in Kenya*, was established. In partnership with the Kenyan Medical Research Institute, it allowed the country to improve disease burden estimates, investigate causes of pediatric mortality, strengthen surveillance activities (integrated with malaria, HIV, and acute febrile illness surveillance), and establish a maternal-infant cohort platform to describe the impact of influenza during pregnancy in an area with high prevalence of HIV, malaria, and malnutrition to inform policy makers and stakeholders on the potential impact of an influenza vaccination program in the country.

CDC's cooperative agreement with the Kenyan Ministry of Health (MOH), named *Introducing or Expanding the Use of Influenza Vaccines in Public Health Programs Outside the United States*, was crucial in establishing and supporting the Kenyan National Immunization Technical Advisory Group (KENITAG) to review and deliberate the potential adoption of a national influenza program in the country.

The Influenza Program in Kenya, through CDC support, was also able to support the MOH with implementation of a National Influenza Center (NIC) created under the Public Health Laboratory System, in terms of infrastructure and capacity. Moreover, a cooperative agreement was established with the International Rescue Committee to establish surveillance for severe acute respiratory illness among refugees settling in Kakuma, a remote area in the northern part of the country.

## SURVEILLANCE

The influenza surveillance system in Kenya was established in 2006 and played an important role during the 2009 influenza pandemic. It allowed the country to monitor the introduction of the new viral strain and its impact on the population, creating greater awareness about influenza among the communities, health care providers, and stakeholders.

Surveillance is based on referral hospitals spread around the country and focuses on severe acute respiratory illness hospitalizations. This system

## HIGHLIGHTS

- The Influenza Program in Kenya has contributed to more than 30 publications since 2015, addressing characteristics and circulation of influenza viruses; influenza vaccine effectiveness; estimates of influenza disease burden domestically and globally; identification of risk groups; and various aspects of control and prevention strategies.
- The Kenyan government recognized the National Influenza Center as part of the Public Health Laboratory System in the country and an important reference for viral respiratory outbreak investigations.
- The Kenyan National Immunization Technical Advisory Group was established to make evidence-based recommendations for influenza vaccination in Kenya.
- A provisional recommendation was made to implement an influenza vaccination program for children 6–23 months of age in Kenya.
- Public health officials and fellows from the Field Epidemiology Training Program were trained on detection of and response to respiratory events.
- Event-based surveillance was initiated at the community level and integrated with the current activities established by the Kenyan Ministry of Health.
- A maternal-infant cohort was established in Western Kenya to document influenza-associated acute respiratory illness and its impact on pregnancy outcomes.

has facilitated detection and response to various respiratory outbreaks, locally and at the national level, as well as contributed data to global monitoring of influenza virus circulation and strains used to inform vaccine development.

Well-trained surveillance officers placed in each of the sites can coordinate sample collection and shipment to the national-level laboratory for respiratory event detection and investigation. Most recently, MOH officials were able to respond to a potential international event when a man from a neighboring country was admitted to one of the sentinel hospitals

in Nairobi with severe respiratory illness and died shortly after. The case was confirmed as associated with influenza A(H1N1)pdm09 virus and appropriate control measures were set in place.

### SURVEILLANCE ACTIVITIES

- Influenza surveillance data were analyzed to determine potential optimal timing of a possible seasonal influenza vaccine campaign..

### LABORATORY

The Kenyan NIC was established in 2017, as part of the Public Health Laboratory System within the MOH. The laboratory infrastructure was supported by CDC's cooperative agreement in place with the Henry Jackson Foundation and by resources available through Global Health Security Agenda (GHSA) funds. The Influenza Program, in partnership with CDC's Division of Global Health Protection in Kenya, provided support in terms of infrastructure, access to reagents and primers, and capacitation of laboratory staff. NIC staff participated with successful outcomes in a virus isolation external quality assessment that was organized through WHO's Global Influenza Program, and in November 2017, the Kenyan government applied for NIC recognition with WHO.

### PREPAREDNESS

CDC support through the Task Force for Global Health in 2016–2017 facilitated the update of the pandemic influenza vaccination chapter under the overall pandemic preparedness plans with the MOH. The Influenza Program in Kenya is also planning a knowledge, attitude, and practice survey among health care professionals to assess understanding and acceptability of influenza vaccination, in the context of a seasonal and pandemic influenza vaccination program. A full update of the preparedness plan is underway, and CDC Kenya will be supporting stakeholders on this process.

### TRAINING

The Influenza Program in Kenya provided technical assistance, financial support, and training to ensure the functioning of the sentinel surveillance system, quality of the surveillance data, laboratory proficiency, prompt data analysis, and integration of the information into preparedness and response activities in collaboration with various partners.

- The Diagnostic and Laboratory Systems Program, Division of Global Health Protection, trained 6 staff

from the NIC on technology transfer, molecular diagnostics, and virus culture, and assisted with development of 45 standard operational procedures and job aids.

- CDC's Division of Bacterial Diseases assisted with respiratory outbreak detection and response training among surveillance officers, public health officials, fellows from the Field Epidemiology Training Program, and clinicians from the hospital surveillance sites. Subject matter expertise on processing blood cultures within this division was also available to support training for county-level microbiologists on the process involved in a successful culture of blood specimens and determination of antibiotic resistance. These were all activities funded through the GHSA under the Detection and Response to Respiratory Events activities set up in Kenya with support of CDC's Division of Bacterial Diseases and Influenza Division.
- Annual training of surveillance officers was successfully conducted in collaboration with the Kenyan Medical Research Institute, MOH officials, experts from the Division of Bacterial Diseases, and experts from the Division of Global Health Protection, Kenya.



Collecting respiratory samples from child hospitalized with SARI in Mombasa Referral Hospital during a training session with surveillance officers.

# MADAGASCAR



## OVERVIEW

CDC provided substantial support to sustain the capacity of the Madagascar National Influenza Center (NIC) and health authorities for surveillance and diagnosis of influenza-like illness (ILI) and severe acute respiratory infection (SARI), including highly pathogenic avian influenza in Madagascar. CDC's cooperative agreement also increased the capacity of the Central, Regional, and District Authorities in Madagascar to provide rapid public health intervention in response to an outbreak and to implement appropriate disease containment measures.

Institut Pasteur Madagascar is currently funded through a 5-year cooperative agreement, Sustaining Surveillance Networks and Response to Seasonal and Pandemic Influenza in Madagascar. The project intends to:

- Establish and/or improve the ILI and/or SARI surveillance system in Mauritius and Seychelles to generate new data regarding influenza and other respiratory viruses' prevalence in these countries
- Improve and consolidate the ILI and SARI surveillance system in Madagascar to generate robust data to impact policy development for the country and potentially for the region, while working toward down-scaling and long-term sustainability of the ILI and SARI surveillance network in Madagascar
- Consolidate laboratory capacity to serve as a national and regional influenza reference center, to provide continuous diagnostic and training support to the country and to the region, and add additional laboratory capacity.

## SURVEILLANCE

To date, the ILI sentinel surveillance system encompasses 34 sites. All sites send daily epidemiological information regarding influenza. Seven collect respiratory specimens for analysis at the NIC on a weekly basis. SARI surveillance is performed at 18 hospitals. One hospital is selected to recruit all hospitalized SARI cases for testing.

## HIGHLIGHTS

- An evaluation was conducted of the Seychelles laboratory to assess its influenza surveillance and laboratory diagnostic capacity.
- In August 2016, discussions were held between WHO, the Malagasy Ministry of Health, and the National Influenza Center (NIC) to resume regional laboratory activities in the context of the Pandemic Influenza Preparedness framework.
- In December 2016, a team from Mozambique visited the laboratory and the sentinel sites to improve influenza surveillance in that country.
- In February 2017, 1 laboratory technician from the NIC participated in the CDC/Association of Public Health Laboratories international influenza virus workshop in Senegal.
- In February 2017, the director of the NIC participated as a trainer for a WHO Workshop on Sentinel Surveillance of Influenza in Mauritius.
- In March 2017, laboratory assessments in 3 regional hospitals were conducted within the context of the Pandemic Influenza Preparedness framework.
- In July 2017, the Director of the NIC was invited to be part of the organizing committee for the annual global NIC meeting.

## SURVEILLANCE ACTIVITIES

- Assembled a project focused on surveillance at three pig farms to explore the human-animal interface.
- Completed the influenza-specific SARI project in October 2013 and implemented a general SARI surveillance system.
- Managed ILI and SARI surveillance, including sampling and analysis.

## LABORATORY

All samples from ILI and SARI patients were tested for influenza. In addition, samples from SARI patients were also tested for RSV and rhinovirus. In order to strengthen the laboratory capacity of the NIC, new equipment and sampling materials were acquired to increase the number of specimens processed and to rapidly respond to an outbreak. In February 2017, a laboratory technician was trained on influenza virus isolation in Senegal. In order to control the emergence of oseltamivir-resistant strains of the pandemic A(H1N1)pdm09 influenza virus, the NIC implemented a diagnostic tool for detecting the H274Y oseltamivir resistance mutation in this virus subtype.

### LABORATORY ACTIVITIES

- The NIC tested 2,064 specimens (among them 353 from SARI patients and 1,711 from ILI patients).
- The NIC submitted 174 positive specimens to the WHO Collaborating Centers for Reference and Research on Influenza (WHO CC) (84 strains to CDC and 90 strains to the WHO CC in London) as part of the WHO Global Influenza Surveillance and Response System.
- The NIC participated in 2 WHO External Quality Assessment Project panels and scored 100% each time.
- The NIC conducted 4 laboratory site visits and provided logistic support to sentinel sites.
- The NIC hosted 2 laboratory staff from Mozambique to improve influenza surveillance activities.

## PREPAREDNESS

### PREPAREDNESS ACTIVITIES

- The national strategic plan for pandemic preparedness has been updated.
- The early warning system analyzes all data from sentinel surveillance of febrile illness in a timely manner.
- The transmission indicator of the WHO Pandemic Influenza Severity Assessment tools, designed to estimate the best indicators for influenza severity, is in active use.
- Three hospitals have been identified to implement influenza laboratory activities in the event of an outbreak of pandemic influenza.

## TRAINING

- The Epidemiology unit trained staff from sentinel sites upon demand.
- One laboratory technician from the NIC participated in the CDC/Association of Public Health Laboratories International Influenza Virus Workshop in Dakar, Senegal.
- Two staff from the NIC participated in the African Regional Biosafety Workshop organized in Ghana by CDC.
- The NIC provided technical assistance during a visit by Mozambique laboratory staff to improve Mozambique's influenza surveillance system.
- The NIC assisted the WHO Regional Office for Africa in training health workers on influenza surveillance in Brazzaville, the Republic of the Congo and in Mauritius to better support influenza capacity building in these 2 countries.
- The NIC and CDC team conducted a site visit at the Seychelles laboratory to evaluate its influenza surveillance and laboratory diagnostic capacity.

# MALI

## OVERVIEW

Fiscal Year 2015 is the second year of CDC's cooperative agreement with the Center for Vaccine Development/National of Influenza Center of Mali (CVD-Mali). The agreement is titled *Sentinel Surveillance of Influenza in Mali*. This cooperative agreement builds upon CVD-Mali's previous experience in influenza surveillance and influenza vaccine trial in 2009.

The cooperative agreement awarded by CDC in 2014 has strengthened influenza surveillance in Mali by fostering surveillance of influenza-like illness (ILI) and severe acute respiratory infection (SARI) in more sites, and has supported capacity building to enhance Mali's preparedness and response.

## SURVEILLANCE

The National Surveillance System was assessed to determine its strengths and weaknesses, and to improve and integrate an influenza surveillance system. As a result, the national influenza surveillance protocol was developed and validated. Five ILI and 3 SARI sites were selected in the country. Currently, weekly data from the 8 sentinel sites are submitted to the National Directorate of Health, WHO, and CDC.

### SURVEILLANCE ACTIVITIES

- A team of 60 medical doctors and laboratory technicians were selected and trained in Sikasso, Mopti, and Bamako by CVD-Mali and the Ministry of Health (MOH). Two immediate outcomes were observed in data accuracy and fewer missing data.
- The CVD-Mali and National Directorate of Health team conducted weekly supervisory visits to the Bamako sites and quarterly supervisory visits for regional sites to ensure protocol adherence.
- Lab supplies, consumables, and reagents were procured.
- A centralized database hosted in CVD-Mali was developed.
- Refresher trainings are conducted every year for the sentinel sites.
- Weekly and annual reports are developed and shared with the MOH, CDC, WHO, and other key stakeholders.

## HIGHLIGHTS

- **Refresher trainings-of-trainers were conducted for sentinel site staff. Fifty-five participants (medical doctors, nurses, lab technicians, and surveillance officers) were trained on the following topics:**
  - » Standard Operating Procedures
  - » Influenza epidemiology
  - » Case definitions
  - » Labelling and packaging
  - » Roles and responsibilities
  - » Personal protective equipment
  - » Sampling
  - » Data management
  - » Reporting
- **Lab supplies, consumables, and reagents were procured to build laboratory capacity.**
- **Case enrollment and sample testing were supervised and coordinated at all sentinel sites. Specimen collection quality was ensured through supervision visits.**

- The team participated in regional and international laboratory and epidemiology meetings and trainings influenza.

## LABORATORY

Prior to receiving a cooperative agreement, CVD-Mali successfully established capacity for influenza testing.

- The cooperative agreement provided support to the laboratory including:
  - » Logistic and technical support for sentinel sites
  - » Laboratory supplies received from CDC to strengthen surveillance activities
  - » A laboratory assessment conducted by a CDC laboratory expert
  - » Equipment for virus culture that was purchased and is ready to be installed
- From October 2015 to June 2017, the Influenza Reference Laboratory (CVD-Mali) participated in WHO External Quality Assessment Project panels

for the detection of influenza virus type by RT-PCR (panels 14 and 15).

- Laboratory staff participated in many workshops, such as virus isolation, and received International Air Transport Association training for dangerous goods shipment.

### **LABORATORY ACTIVITIES**

- The NIC tested 2,593 influenza specimens from ILLI and SARI sites.
- The NIC submitted a total of 251 (of 497 collected) positive samples to the WHO Collaborating Center for Reference and Research on Influenza in Atlanta as part of the WHO Global Influenza Surveillance Network.
- Many supervisory visits and refresher trainings were conducted in all the sentinel sites.

### **PREPAREDNESS**

The MOH implemented an integrated disease surveillance and response system, which now includes influenza. Mali developed a national strategic plan for influenza surveillance and response. Sentinel site staff were trained on suspected case detection, and CVD-Mali laboratory capacity has improved.

### **TRAINING**

- An influenza lab technician was trained on virus culture at the Institut Pasteur in Dakar, Senegal.
- Three training workshops for 60 health staff (physicians, pharmacists, and nurses) in sentinel surveillance work were held in all sites.
- Three representatives from the CVD-Mali participated in a workshop on strengthening surveillance of seasonal influenza and rapid response for pandemic influenza in the African region (held in Ghana in April 2017).
- Two influenza lab technicians were trained in Cameroon on diagnosis of respiratory viruses (April 2017).
- The deputy financial officer and deputy influenza coordinator participated in a grant management training in Dar es Salaam, Tanzania (May 2017).

# MOZAMBIQUE



## OVERVIEW

The National Institute of Health, Mozambique (INS) began a 5-year cooperative agreement with CDC in 2013 titled *Surveillance and Response to Avian and Pandemic Influenza by the National Institute of Health, Mozambique*. Since 2009, the INS has worked to establish sentinel surveillance for influenza and other acute respiratory illnesses to build national capacity for early detection and rapid response to threats posed by these pathogens. The cooperative agreement has accelerated influenza surveillance activities in Mozambique and has also enhanced preparedness and the INS's ability to respond to outbreaks and pandemic influenza.

## SURVEILLANCE

The first National Influenza Workshop in Mozambique was convened. Sentinel sites were assessed for surveillance of influenza-like illness (ILI) and severe acute respiratory infection (SARI) in adults.

### SURVEILLANCE ACTIVITIES

- An exploratory visit to Massingir District and training in Caia for the implementation of One Health sentinel surveillance was conducted.
- Regular weekly and monthly reporting of laboratory and epidemiologic data to FluNet was completed.
- Provincial surveillance and response teams were restructured and trained on influenza and other acute respiratory illness (ARI) case definitions and data collection in 7 of the 10 provinces.
- A 2-day training on outbreak investigation and response to influenza and other ARIs was held for epidemiologists and laboratorians from all provincial surveillance and response teams.
- The first round of collection of birds for screening of emerging avian virus was conducted and sample testing is ongoing.
- The first National Influenza Workshop was held in February 2017. This workshop was multi-sectorial, with participation from the Ministry of Agriculture and Food Security, Ministry of Health, Ministry of Defense, and other public and private national entities. The workshop addressed the challenges

## HIGHLIGHTS

- A routine surveillance system was developed and strengthened at 2 sentinel sites.
- National laboratory capacity to routinely test and detect influenza virus has improved.
- The nation's ability to respond to influenza outbreaks and to prepare for pandemic influenza has improved.
- The quality of epidemiologic and virologic data and data sharing with local and global influenza surveillance networks has been enhanced.

of national surveillance (sentinel and event-based) of and response to influenza and other ARIs in Mozambique and possible action plans and solutions, including sustainability of the system.

## LABORATORY

### LABORATORY ACTIVITIES

- Detection of influenza B virus strains (Yamagata and Victoria lineages) is now included in the detection protocol recently standardized at the national reference laboratory.
- A score of 100% was reached in 2016 in both WHO and CDC influenza EQAP panels. These demonstrate a high level of competence of the national reference laboratory for detection of seasonal (H3 and H1) and avian (H7 and H5) influenza A subtypes and both lineages of influenza B viruses.
- Characterizations of the antigenic and genetic profiles of influenza, which were performed in the Atlanta WHO Collaborating Center for Reference and Research on Influenza and the South African National Institute for Communicable Diseases, were made available to INS.

## PREPAREDNESS

CDC support through WHO has considerably advanced pandemic influenza preparedness and planning in Mozambique. The National Committee for Disaster Management, together with partnering ministries, has continued to work on a national pandemic plan while the Ministry of Health and WHO have led the development of a health sector response plan.



On an annual basis, refresher trainings are organized for public health staff (medical directors, focal points, and surveillance and laboratory technicians from sentinel sites) from provincial sentinel sites.

Every month the INS organizes a surveillance technical meeting to monitor data and trends in sentinel surveillance-based activities.

### *PREPAREDNESS ACTIVITIES*

- The first National Influenza Workshop was held.
- Provincial team trainings were held focusing on building surveillance for outbreaks of severe respiratory and febrile illnesses and enhancing rapid response and containment.

### **TRAINING**

- Epidemiologists, laboratorians, and veterinarians from all provinces were trained in ARI outbreak investigation.
- Training on epidemiology and leadership for outbreaks and emergency management was conducted.
- Staff from the 4 sentinel sites and laboratory and data management staff were trained on influenza burden estimates.
- Three INS staff from the Department of Surveillance and Laboratory Reference Services visited the Pasteur Institute of Madagascar for an exchange visit and training.

# NIGERIA

## OVERVIEW

The cooperative agreement (CoAg) between the Federal Ministry of Health (FMOH) and CDC has been implemented through 2 5-year cooperative agreements. The funding provided for implementation of the influenza project enabled the country to continue to build staff capacity, and assisted the project to transition its accounting system to fit into the Government's new Treasury Single Account (TSA) policy.

These 2 awards marked the establishment of the National Influenza Sentinel Surveillance (NISS) Project (Phase 1) and consolidation of the project (Phase 2). Its aim was to establish a surveillance system for influenza and monitor the role of and trends in cases of influenza-like illness (ILI) and severe acute respiratory infection (SARI) in humans. In addition, the project facilitated epidemiological linkage of cases to their causative influenza types and subtypes, detection of the most vulnerable age groups and co-morbidities, detection of unusual patterns of the disease, and prompt detection of novel influenza viruses and other viruses with epidemic potential.

## SURVEILLANCE

ILI and SARI samples were collected from the 4 influenza surveillance sites. Supportive supervisory visits were carried out in all sites, and the surveillance system was evaluated for parameters of quality. The project continued to report influenza surveillance and laboratory data to FluID and FluPrep, respectively, and shipped influenza positive specimens to WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs). An annual influenza surveillance review meeting was carried out to review performance for the immediate previous year. Investigations of influenza A(H5N1) among human contacts of birds involved in the outbreaks of influenza A(H5N1) were jointly conducted by Human and Animal Health components and the Nigeria Field Epidemiology and Laboratory Training Program (FELTP). FELTP investigated 5 hotspots for influenza in poultry in Nigeria and stocked oseltamivir in the hotspot states. A post-H5N1 outbreak review meeting was carried out to proffer solutions to the incessant

## HIGHLIGHTS

- Sustainability of the influenza program was achieved at the sentinel sites.
- The successful relocation of the National Influenza Reference Laboratory—from a pre-fabricated building in Asokoro to a permanent structure under the National Reference Laboratory, Gaduwa—provided a better environment for laboratory work.

poultry outbreaks and prevent the disease from spreading to humans using the One Health concept.

## SURVEILLANCE ACTIVITIES

- Supervision of the sites was conducted with a focus on enhanced sample collection, storage, and packaging.
- The Influenza Sentinel Surveillance system self-evaluated for performance attributes.
- Influenza data were actively reported to FluNet, FluID, and shared in forums and weekly meetings and publications of the Nigeria Centre for Disease Control (NCDC).
- Influenza-positive samples were shipped to WHO CCs, including CDC, for confirmation and inclusion in bi-annual vaccine formulation and production.
- A performance review of influenza by the NISS sentinel sites, laboratory, and epidemiologists was conducted and action plans were provided to ensure sustainability.
- The influenza protocol among participating NISS teams was updated, and teams were trained on sample collection, storage, packaging, and transportation.
- Active case search was conducted and samples were collected from human contacts of influenza A(H5N1)-infected poultry in outbreaks. Samples were tested for H5N1 and other influenza A subtypes as well as influenza B.
- Oseltamivir was supplied to 5 states considered hotspots of influenza A(H5N1) transmission in poultry in Nigeria (Kano, Bauchi, Kaduna, and Plateau states, and Federal Capital Territory) for management of cases.

- The influenza A(H5N1) post-outbreak situation and experiences with the animal health authorities and Nigeria FELTP were reviewed; this review provided sustainable solutions for preventive actions.

## LABORATORY

The laboratory has been actively involved in influenza surveillance, and attention has been given to ensuring a constant supply of reagents and materials for continuous diagnosis during the period. In-house training of staff on new procedures and internal quality controls was carried out. The laboratory participated in 3 WHO External Quality Assessment Program (EQAP) panels for influenza and also participated in a Zika proficiency test. One staff member was added to the laboratory team and 18 students undergoing the Students Industrial Working Experience Scheme from different higher education institutions in Nigeria were trained. Data from laboratory analysis of ILI and SARI cases were shared in FluNet. Influenza-positive samples were also shared with CDC and a WHO CC. The laboratory staff were trained by different organizations on PCR, quality assurance, biosafety and biosecurity, and cell culture. The laboratory was relocated in May 2017 from its temporary structure to a permanent structure for maximum output.

### LABORATORY ACTIVITIES

- The laboratory tested 693 and 90 samples received from ILI and SARI cases, respectively, from the sentinel sites.
- The National Influenza Research Laboratory (NIRL) shared virologic and epidemiologic data through the WHO Regional Office for Africa laboratory network and WHO FluID.
- The laboratory participated in the WHO EQAP for the detection of influenza viruses by PCR (Panel 16, 2017) and the CDC Influenza Molecular Diagnostic Performance evaluation panel.
- The laboratory was relocated from its pre-fabricated structure in Asokoro to a solid-constructed building housing the NCDC National Reference Laboratory in Gadaua in May 2017.
- In keeping with the sustainability of the program as provided in the NISS sustainability plan, the laboratory participated in various efforts to build skill and provide service for the diagnosis and confirmation of other national priority diseases, such as bacterial meningitis.

## PREPAREDNESS

The program has continued to align with the global Pandemic Influenza Preparedness (PIP) framework through the sharing of viruses with WHO Global Influenza Surveillance and Response System (WHO GISRS) and its ongoing efforts to determine the burden of disease due to influenza. In conjunction with NCDC, it has continued to be actively involved in pre-positioning oseltamivir in states identified by the Animal Health component as hotspots for avian influenza, and is constantly working with the animal health sector on influenza outbreak response consistent with the framework of One Health. The program will continue to carry out both internal and external self-evaluation—using indicators of the 12 core capacities of PIP—to refine strategies and pursue vigorously the ownership of the program by the country.

### PREPAREDNESS ACTIVITIES

- The 2013 edition of the Nigeria Influenza Pandemic Plan was shared with NCDC, to review it for consistency with global pandemic preparedness efforts.
- Oseltamivir was prepositioned in 5 states that recently experienced influenza outbreaks (Kano, Kaduna, Federal Capital Territory, Plateau, and Bauchi states).
- The Animal Health component collaborated with the Nigeria FELTP to carry out outbreak response with oro- and nasopharyngeal samples collected and tested.
- Preliminary work on influenza disease burden estimation was started.

## TRAINING

NIRL staff received training on different aspects of the diagnosis of priority diseases in Integrated Disease Surveillance and Response, including influenza. These included:

- African Regional Biosafety Workshop (October 26–30, 2015), Accra, Ghana, Noguchi Memorial Institute for Medical Research at the University of Ghana (2 staff)
- Enhancing Capacity for Diagnosis of Ebola Virus Disease by Molecular Methods (December 7–11, 2015) under the International Atomic Energy Agency in Entebbe, Uganda (2 staff)

- One World Accuracy External Quality Assurance and Training of Laboratory Trainers (July 20–22, 2016) West Africa Regional Disease Surveillance (WARDS) project, Ouagadougou, Burkina Faso (6 staff)
- Lassa Fever Enzyme-Linked Immunosorbent Assay Kit Validation and Training (August 3–6, 2016) organized by NCDC, Abuja, Nigeria (4 staff)
- Improvement of Clinical Laboratory Technology for Infectious Disease Control (September 27–December 2, 2016), Japan International Cooperation Agency (JICA), Tokyo, Japan (1 staff)
- CDC/Association of Public Health Laboratories Virus Isolation Workshop (March 28–31, 2017), Nairobi, Kenya (1 staff)
- Training on Tissue Culture (August 8–9, 2016), Accra, Ghana, NOGUCHI (1 staff)
- Strengthening Surveillance of Pandemic and Seasonal Outbreaks in the African Region (April 3–7, 2017), NOGUCHI, Accra, Ghana (2 staff)
- Grants Management Training for Global Health Security Agenda (GHSA) and Influenza Grantees (May 21–25, 2017), Dar es Salaam, Tanzania (2 staff)



# RWANDA

## OVERVIEW

In July 2008, the Influenza Sentinel Surveillance System (ISS) was established at 4 district and 2 referral hospitals to provide timely, high-quality epidemiologic and virologic data to help characterize and monitor trends in illnesses and deaths attributable to influenza and other respiratory diseases. These sentinel sites represent the country's 5 regions; selection of sites required the capacity of each site to collect and ship samples to the National Reference Laboratory (NRL) in Kigali for testing. Fiscal Year (FY) 2017 is the first year of CDC's cooperative agreement with the Rwanda Biomedical Center/Epidemic Surveillance and Response Division (RBC/ESR). The agreement is titled *Maintenance of Influenza Surveillance Capacity in Rwanda, 2016–2019*. Past cooperative agreements, *Preparedness and Response to Avian and Pandemic Influenza in Rwanda 2007–2011* and *Sustaining Influenza Surveillance Networks and Response to Seasonal, Avian and Pandemic Influenza Outside the United States of America 2011–2016*, awarded by CDC to the Ministry of Health, have strengthened influenza testing capacity at the national influenza laboratory and helped build epidemiology capacity in routine influenza surveillance and outbreak preparedness and response.

## SURVEILLANCE

A sentinel surveillance system for severe acute respiratory infection (SARI) and influenza-like illness (ILI) was established in 2008 by the Rwandan Ministry of Health with funding and technical support from CDC.

The surveillance system is implemented in pediatric, adult, and maternity inpatient and ambulatory wards at 2 referral hospitals and 4 district hospitals. Demographic, clinical, and epidemiological data along with respiratory specimens are collected and analyzed for influenza virus types and subtypes and other respiratory pathogens. From October 1, 2015 to September 30, 2017, 2,471 cases—including 2,329 (94%) SARI cases and 142 (6%) ILI cases—were enrolled. Of these, 131 (5%) tested positive for influenza, comprising of 101 (77%) cases of influenza type A and 30 (23%) cases of influenza type B. Among

## HIGHLIGHTS

- From March 9–11, 2016, Rwanda hosted the fifth African Network for Influenza Surveillance and Epidemiology Meeting with the theme “Influenza in Africa: From Data to Disease Prevention.”
- Estimates of the national burden of influenza-associated severe acute respiratory illness hospitalization in Rwanda during 2012–2014 were completed, and a manuscript titled “The national burden of influenza associated severe acute respiratory illness hospitalization in Rwanda, 2012–2014” was published in December 2017 in *Influenza and Other Respiratory Viruses* (<https://onlinelibrary.wiley.com/doi/abs/10.1111/irv.12494>).

influenza type A, 58 (57%) and 43 (43%) cases were subtyped A(H3) and A(H1N1)pdm09, respectively. The network reports weekly to WHO FluNet and to in-country stakeholders.

## SURVEILLANCE ACTIVITIES

- The case investigation questionnaire was revised to remove information that is rarely analyzed, specifically the sections related to travel history and exposure to sick poultry. Conversely, the section on underlying medical conditions/risk factors has been expanded.
- After the data collection form was updated, a 1-day training was provided to surveillance officers with a specific emphasis on how to accurately and completely collect information on underlying medical conditions.
- The influenza surveillance system was designed and integrated into the Health Management Information System electronic reporting system.
- Six quarterly formative and supervisory visits were conducted at each of the 6 sentinel sites.
- Two thousand four hundred and seventy-one case investigation forms were collected, entered into the database, and analyzed to produce weekly reports shared with stakeholders.
- Cleaned data were collected for medical burden of disease estimates.

- A protocol and data collection tools, data collection, data analysis, and manuscript writing were completed for the evaluation on influenza sentinel surveillance in Rwanda, 2013–2016.
- An epidemiology review led by a CDC team to assess the functionality of the influenza sentinel surveillance system was conducted March 14–16, 2016.
- Advocacy meetings were successfully conducted with hospital senior management to transition salaries of influenza surveillance staff from CDC funding to the ordinary budget of the Government of Rwanda by July 2016.
- A protocol and data collection tools were developed for assessment of risk factors for influenza associated–SARI hospitalization outcomes, pending clearance by the Rwanda National Ethics Committee and CDC.
- Program staff participated in the Global Health Security Agenda 5-year Rwanda roadmap development workshop, June 2017.
- Program staff participated in the One Health Zoonotic Disease Prioritization Workshop in Rwanda, June 2017.

## LABORATORY

The National Reference Laboratory (NRL) has been providing influenza PCR testing to support the national sentinel surveillance system for influenza since 2008. The laboratory tests for influenza year-round using CDC typing and subtyping assays obtained through the International Reagent Resource program at CDC. The NRL has developed real-time PCR assays for other respiratory viruses. A full influenza laboratory capacity assessment using the Laboratory Capacity Review Tool (v3) was completed by CDC and the Association of Public Health Laboratories representatives. The NRL successfully participated in CDC and WHO External Quality Assurance Project panels. The program is working to establish virus isolation capacity to achieve WHO National Influenza center (NIC) status.

### LABORATORY ACTIVITIES

- The NRL tested a total of 2,471 respiratory specimens (142 ILI and 2,329 SARI cases) for influenza with a detection rate of 5% (131/2471).

- The NRL tested 617 respiratory specimens for other respiratory pathogens with a detection rate of 85% (525/617) for at least 1 pathogen among the following: influenza A and B; human coronavirus NL63, 229E, and OC43; parainfluenza 1, 2, 3 and 4; human metapneumovirus A and B; adenovirus; enterovirus; RSV A and B; rhinovirus; parechovirus; bocavirus; *Mycoplasma pneumoniae*; *Streptococcus pneumoniae*; *Haemophilus influenzae*; and *Staphylococcus aureus* in tested specimens.

## PREPAREDNESS

The occurrence of disease outbreaks in neighboring countries (an outbreak of avian influenza A[H5N8] in wild birds and domestic poultry in Uganda in January 2017; an outbreak of yellow fever in Angola with cases reported in Kenya and the Democratic Republic of the Congo in February 2017; an outbreak of Ebola virus disease and an outbreak of avian influenza in the Democratic Republic of the Congo in May 2017) have triggered the maintenance of a high level of preparedness for emerging infectious disease outbreaks and other disease outbreaks of unknown origin. As part of preparedness measures and risk mitigation strategies, CDC-Rwanda supported the Government of Rwanda in the following:

- Surveillance among wild birds was increased.
- Awareness was raised among the general population.
- One Health Steering Committee and National Rapid Response Team meetings were convened to spearhead preparedness efforts.
- An update of the *National Avian Influenza Contingency Plan* was initiated.

### PREPAREDNESS ACTIVITIES

- The National Avian Influenza Contingency Plan was revised and updated.
- Technical support was provided to develop the Government of Rwanda's risk communication strategies.
- Technical support was provided in assessing the laboratory's capacity to test possible first cases of avian influenza in both animals and humans.
- Following the outbreak of avian influenza A(H5) in Uganda, staff participated in regular interagency avian influenza A(H5) updates and preparedness and response meetings.

## TRAINING

- A 5-day training was organized to involve more health care providers in conducting influenza surveillance activities so that within each hospital ward, there is a person responsible for identifying cases and collecting specimens. The objective is to sustain the influenza sentinel surveillance program and minimize the workload of the single fulltime surveillance officer who conducts surveillance activities in all hospital wards.
- Surveillance officers attended a 1-day training with a specific emphasis on how to accurately and completely collect information on underlying medical conditions.
- Surveillance officers attended a 3-day training on the electronic reporting system.
- One laboratory technologist participated in a 1-week training on cell culture and virus isolation organized by CDC's Influenza Division in Dakar, Senegal.

# SOUTH AFRICA



## OVERVIEW

Fiscal Years 2016–2017 marked the first years of the CDC cooperative agreement CDC-RFA-IP16-160502CONT17, *Maintenance of Influenza Surveillance Capacity by National Health Authorities Outside the United States*. This 5-year award began in 2016. South Africa has had influenza-like illness (ILI) surveillance since 1984. In 2009, severe acute respiratory infection (SARI) surveillance was established with the support of a cooperative agreement with CDC. In 2015, SARI surveillance was renamed the Pneumonia Surveillance Program and integrated into the Group for Enteric, Respiratory and Meningeal Diseases Surveillance in South Africa (GERMS)-SA program, which is sustained by the South African government. The surveillance program platform provides a base for specific projects to describe important aspects of pneumonia and influenza in the South African setting, specifically with respect to tuberculosis and HIV. The surveillance data and the data from a set of additional studies allow the Centre for Respiratory Diseases and Meningitis (CRDM) to inform policy makers on a number of issues, including the burden of influenza-associated disease. Support from CDC allows CRDM to provide support and training to southern African countries in both epidemiology and laboratory aspects of influenza surveillance.

## SURVEILLANCE

Over the reporting period, South Africa maintained the Viral Watch ILI surveillance program with >100 practitioners in 8 provinces, the pneumonia surveillance program with sites in 5 provinces, and systematic ILI surveillance in public health clinics in 3 provinces. In 2016, the pneumonia surveillance program was streamlined with testing for influenza, RSV, and *Bordetella pertussis* conducted at all surveillance sites. At enhanced surveillance sites, individuals are enrolled according to a broader case definition, and for a limited period patients were tested for a wider range of pathogens: RSV; influenza A and B; adenovirus; human metapneumovirus; parainfluenza 1, 2, and 3; rhinovirus; enterovirus; *Streptococcus pneumoniae*; *Bordetella pertussis*; *Haemophilus influenzae* type B; atypical bacterial

## HIGHLIGHTS

- An influenza vaccine policy for South Africa was approved in 2017.
- Active surveillance for human cases was established for influenza A(H5N8) following an outbreak in poultry.
- Recommendations for the diagnosis, prevention, and management of and public health response to influenza were published.
- Annual influenza meetings were held in 2015 and 2016.
- Seven peer-reviewed articles from influenza surveillance were published in 2016.
- A new site for systematic influenza-like illness surveillance was added in 2017.
- Annual estimates of influenza vaccine effectiveness were published.

causes of pneumonia (*Legionella* species, *Chlamydia pneumoniae*, and *Mycoplasma pneumoniae*); *Pneumocystis jirovecii*; and *Mycobacterium tuberculosis*.

## SURVEILLANCE ACTIVITIES

- Weekly reporting was made to the WHO Regional Office for Africa (WHO AFRO) and WHO Headquarters (WHO HQ), and an annual influenza season report was submitted to WHO HQ for the September 2016 Southern Hemisphere vaccine strain selection consultation meeting.
- A national influenza policy was published.
- Recommendations for the diagnosis, prevention, and management of and public health response to influenza were published.
- The SARI surveillance system was integrated into more comprehensive pneumonia surveillance and moved into the GERMS-SA program to allow more national representation.
- Active surveillance for human cases was established for influenza A(H5N8) following an outbreak in poultry.



## LABORATORY

In 2015, 6,071 specimens were received from all respiratory illness surveillance programs. The season was dominated by influenza A with influenza A(H1N1)pdm09 accounting for 49% and influenza A(H3N2) accounting for 37% of influenza infections. Influenza B/Yamagata strains dominated all influenza B virus detections. Influenza A(H1N1)pdm09 viruses were in the 6B genetic lineage and A(H3N2) viruses mainly in the 3C.2a lineage. Influenza B viruses were in clade 3 of the B/Yamagata lineage. In 2016, approximately 7,600 specimens were processed for respiratory illness surveillance. The 2016 influenza season was dominated by influenza B, accounting overall for 53% of influenza virus-positive cases, with influenza A(H3N2) as the dominant influenza A subtype, detected in 66% of influenza A positive cases. Influenza B/Victoria strains dominated all influenza B virus detections. All influenza A(H1N1)pdm09 viruses were in the 6B.1 genetic lineage and almost all influenza A(H3N2) viruses were in the 3C.2a genetic lineage.

### LABORATORY ACTIVITIES

- The Director for the WHO-designated National Influenza Center (NIC) attended the fourth WHO Informal Consultation on Improving Influenza Vaccine Virus Selection, November 18–20, 2015 and the Global Initiative on Sharing All Influenza Data/International Society for Influenza and Other Respiratory Virus Diseases Workshop on Genetic Analyses of Influenza Viruses, November 21–22, 2015, in Hong Kong.
- The NIC Director attended a CDC-led international influenza infant burden workshop, April 25–28, 2016, in Albania.
- The NIC and CRDM conducted an influenza A(H3N2) outbreak investigation in a school in Grahamstown in July 2016.
- The NIC Director attended a WHO workshop on the launch of the *Tool for Pandemic Influenza Risk Assessment*, May 4–5, 2016, Geneva, Switzerland.
- The NIC Director participated in a WHO Technical Meeting on Piloting RSV Surveillance based on the Global Influenza Surveillance and Response System, Geneva, Switzerland, June 28–30, 2016.
- The NIC Director participated in the fourth National Influenza Centers Meeting, Brazzaville, Republic of the Congo, October 24–26, 2016.

## PREPAREDNESS

Active surveillance for human infection with influenza A(H5N8) was established in response to an outbreak in poultry. This included active screening and testing of any symptomatic exposed individuals. An outbreak of influenza A(H3N2) in a school was investigated, an abstract was prepared for presentation at a conference, and a manuscript is in preparation.

### PREPAREDNESS ACTIVITIES

- Active surveillance for human cases was established for influenza A(H5N8) following an outbreak in poultry.
- An outbreak of influenza A(H3N2) in a school was investigated.

## TRAINING

The National Institute for Communicable Diseases (NICD) continues to provide training support to southern African countries and to the staff working at the surveillance sites. The following training sessions occurred:

- NICD hosted 5 members of the Ghana influenza surveillance team February 13–17, 2017. The purpose of the visit was to provide training and share experiences on conducting surveillance for respiratory diseases in order to enhance the influenza surveillance program in Ghana.
- Training was conducted for health care workers in support of the maternal influenza vaccination campaign in South Africa in 2016 and 2017.
- The co-head of the CRDM at the NICD in South Africa gave a presentation at the twelfth annual African Vaccinology Course, November 7–11, Cape Town, South Africa titled: *Updates on Influenza Vaccines* and taught at the Advanced Vaccinology Course in Africa (“Afro-ADVAC”), Muldersdrift, Gauteng, South Africa, September 19–28, 2016: Influenza vaccine in lower and middle income countries—is it needed?
- Two medical technologists attended an Influenza Sentinel Surveillance Training: Train the Trainer, Brazzaville, Republic of the Congo, September 5–9, 2016.
- NICD hosted the National Institutes of Health Mozambique team April 4–8, 2016. The purpose of the visit was to provide training and share experiences on conducting surveillance.



## RESEARCH

CDC's Influenza Division has collaborated with the South Africa NICD to conduct SARI surveillance at 5 hospitals and ILI surveillance at 2 sites. From this platform, South Africa has identified risk factors for influenza-associated hospitalization and death including HIV infection, pulmonary tuberculosis infection, age <2 years, and age ≥65 years. With data from health utilization surveys, South Africa has also estimated the burden of disease among children, adults, and pregnant women.

In addition, newer studies have assessed the duration of viral shedding in HIV-infected and HIV-uninfected adults and children. Likewise, household transmission of influenza viruses has been studied to assess the role of HIV and tuberculosis infection in disease transmission.

Research projects include studies to explore:

- Disease and economic burden of respiratory illness associated with influenza
- Transmission of influenza viruses among HIV-infected and HIV-uninfected household members
- A prospective cohort study of influenza viral shedding in HIV-infected and uninfected adults
- Attributable fraction and risk factors for influenza-associated SARI hospitalization in a high-HIV prevalence setting
- Effectiveness of trivalent inactivated influenza maternal vaccination among pregnant women and their newborns

# TANZANIA



Physician transfers patient information to the hospital's influenza surveillance log book.

## OVERVIEW

From 2007 to date, Tanzania has received 3 cooperative agreements (CoAg) to support influenza surveillance activities. The first 4-year CoAg (2007–2011), 1U51 IP000156, was titled *To Enhance Influenza Surveillance and Laboratory Capacity to Improve Capabilities to Respond to Avian and Pandemic Influenza Outbreaks in Tanzania*. This CoAg supported the country to initiate influenza surveillance system through 6 sentinel sites. The second CoAg was granted from August 2011 to July 2016 with the title *Sustaining the Influenza Surveillance Networks and Response to Seasonal and Pandemic Influenza in Tanzania*. The main objective of this second CoAg was to assist Tanzania to prepare to sustain the influenza surveillance established by the support from the previous CoAg. The third (and current) CoAg is titled *Maintenance of Influenza Surveillance Capacity by National Health Authorities Outside the United States*. This reporting period is for years 1 and 2 of the third CoAg.

## HIGHLIGHTS

- The 6 sentinel sites in the country have continued engaging in influenza surveillance and are equipped to serve nearby districts in the event of an outbreak.
- A virologic picture of influenza in the country was established; 12% of the tested samples were influenza positive.
- Viral specimens and information were shared with the international community for quality control and development of vaccines.
- Awareness of influenza was created among health care personnel and the community at large.
- Capacity to prevent and control influenza outbreaks and pandemics was developed.
- A system to transport samples using public buses as a means for sustainability was established.

## SURVEILLANCE

The influenza sentinel surveillance system is based on the laboratory confirmation of samples collected from patients meeting the influenza-like illness (ILI) standard case definition and all severe acute respiratory infection (SARI) cases submitted by the sentinel sites to the National Influenza Center (NIC). Six sentinel sites were financially supported to conduct influenza surveillance. Weekly SARI reports are sent from the sentinel sites to the Ministry of Health and Social Welfare (MOHSW), Preventive Services Department through the integrated disease surveillance and response (IDSR) system. Reports on aggregated data are shared with all stakeholders, including top management of MOHSW, the WHO Country Office, CDC Tanzania, sentinel sites, and other partners. Laboratory samples are collected at the sentinel sites and transported for testing at the NIC. Through this surveillance, Tanzania has been able to identify circulating influenza virus strains in the country, share the samples with the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in Atlanta, and build capacity in preparedness, early detection, and rapid response to influenza and other emerging and re-emerging viral diseases.

## SURVEILLANCE ACTIVITIES

- Influenza epidemiological data were collected from 6 sentinel sites where 2,552 patients were enrolled through surveillance.
- SARI data were shared through IDSR at the national level with WHO and CDC.
- Two biannual meetings were hosted with stakeholders to evaluate achievements and address challenges of influenza surveillance.
- Supportive supervision to 2 sentinel sites was delivered biennially. Topics discussed included surveillance implementation activities, mentorship/on-the-job training, inventory of project equipment/assets, feedback to the site authorities, and sustainability issues.
- Country representatives participated in national and international meetings.

## LABORATORY

The National Influenza Laboratory (NIL) is part of the National Health Laboratory Quality Assurance and Training Center and attained NIC status in November 2014. From October 1, 2015 to July 30, 2017, the NIC tested 2,552 specimens for influenza using RT-PCR. Of those specimens, 318 (12.5%) were influenza positive, of which 229 (71%) were type A; the remainder were type B. Among the influenza A subtypes, 152 (66%) were influenza A(H3) while the rest were A(H1N1) pdm09. Laboratory capacity has been strengthened not only for influenza, but also for other emerging and re-emerging diseases including dengue, Chikungunya, and Ebola.

## LABORATORY ACTIVITIES

- RT-PCR testing was conducted on 2,552 samples received from influenza sentinel sites.
- Weekly influenza surveillance information was submitted to the WHO Regional Office for Africa, CDC, and WHO's Global Influenza Surveillance and Response System via FluID.
- Sixty-eight positive samples for influenza were shared with the WHO CC at CDC.
- Influenza laboratory results of specimens sent from sentinel sites were shared with respective hospital management and clinicians.
- Capacity was expanded for diagnosis and surveillance of avian and human influenza and other emerging diseases like dengue

fever, novel influenza A(H7N9), MERS-CoV, Chikungunya, yellow fever, and Rift Valley fever.

- Testing was conducted for non-influenza respiratory viruses including RSV, human metapneumoviruses, human parainfluenza viruses, adenoviruses, and human rhinoviruses.

## PREPAREDNESS

The MOHSW collaborates with CDC, the United Nations, and other stakeholders on the implementation of the preparedness and response plan for avian and pandemic influenza and other emerging and re-emerging infectious diseases. The plan is multi-sectoral, involving key ministries and other stakeholders.

The Tanzania MOHSW collaborates with other sectors and partners in the implementation of the *National Preparedness and Response Plan for Avian and Pandemic Influenza*. The National Task Force is in place to deal with preparedness activities and will respond to any outbreaks that occur. The committee is divided into 5 subcommittees including coordination, surveillance plus lab, case management, logistics, and social mobilization and public awareness.

## PREPAREDNESS ACTIVITIES

- The National Task Force for Public Health Emergencies is in place and is activated from time to time; some members change depending on the nature of the outbreak or threat.
- The influenza preparedness plan was adopted for viral hemorrhagic fevers.
- Surveillance at the point of entry in collaboration with other stakeholders including immigration officers continues, but in a passive manner.
- The capacity that exists at the national and sentinel sites levels to control influenza pandemics will be utilized to combat any influenza infection/pandemic that arises in any area within the country.

## TRAINING

- Refresher and on-the-job training was provided to sentinel surveillance staff during on-site supportive supervision visits to 2 sentinel sites.

# TOGO



Laboratorians explaining the functionality and maintenance of the -80°C freezer.

## OVERVIEW

In 2016, a cooperative agreement (CoAg) between Togo and CDC, *Improve Capacity to Conduct Routine Influenza Surveillance and Detect and Respond to Pandemic Influenza*, was implemented. With the support of CDC and the United States Naval Medical Research Unit Three (NAMRU-3), influenza surveillance in Togo was initiated in April 2010 through the first cooperative agreement between the Ministry of Health (MOH), the Institut National d'Hygiene (INH), and CDC. INH and the Division of Surveillance improved the capacity of sentinel sites to collect more data and samples through training for surveillance officers. This CoAg strengthened influenza surveillance and supports capacity building in Togo by allowing for detection of and response to avian and potential pandemic influenza in real time. This CoAg provides the opportunity for Togo's National Influenza Laboratory (NIL) to achieve National Influenza Center (NIC) status.

## SURVEILLANCE

Influenza sentinel surveillance continues in 4 sentinel sites located in the Lomé Commune Region (Capital City), Maritime, and Savanes regions. Laboratory data of samples tested were managed and reported weekly to sentinel sites, the MOH, the Division of Surveillance, and WHO through FluMart and CDC/NAMRU-3.

## HIGHLIGHTS

- The National Influenza Laboratory (NIL) has made progress toward influenza viral isolation, and a new biosafety level 2 laboratory, constructed with funding from the Togo U.S Embassy and support of CDC, was inaugurated on June 17, 2016.
- The Institut National d'Hygiene (INH) obtained a cooperative agreement (CoAg) with the Global Health Security Agenda in September 2015.
- The INH obtained a CoAg with CDC's Influenza Division in September 2016.
- Influenza-positive samples were submitted to the WHO Collaborating Center for Reference and Research on Influenza in Atlanta for vaccine preparation purposes.

Review meetings with all stakeholders were organized up to 2 times per year as part of a strategy to improve the surveillance system by identifying strengths and areas of concern.

Trainings were also organized to refresh knowledge of the sentinel site personnel and provide skills for new staff involved in surveillance. Laboratory personnel and Division of Surveillance officers participated in international conferences and trainings organized by various partners.

## SURVEILLANCE ACTIVITIES

- The national protocol for influenza surveillance was updated on February 2017 according to the WHO Regional Office for Africa protocol of 2015.
- Sentinel site staff were trained.
- Influenza surveillance activities were monitored in sentinel sites.
- A monthly report bulletin was implemented.

## LABORATORY

The NIL continues to analyze samples collected and has worked with CDC/NAMRU-3 experts to update laboratory procedures and protocols. NIL technologists have updated their skills with partners (CDC scientists and Institut Pasteur in Yaoundé) on typing and subtyping in real-time PCR of non-influenza respiratory viruses.

Notable progress in laboratory surveillance capacity has been achieved toward influenza viral isolation through cell culture by training of the NIL staff at the Côte d'Ivoire NIC, Abidjan (2016) and Senegal NIC, Dakar (2017). The success of this partnership has led to a new biosafety level 2 laboratory. This laboratory will be used to analyze influenza viral isolates and will allow for continuous participation in sending sample selections for influenza vaccine preparation to WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs).

### LABORATORY ACTIVITIES

- NIL tested a total of 1,476 influenza specimens (of which 300 specimens were positive).
- NIL submitted a total of 20 positive samples to the WHO CC in Atlanta as part of the WHO Global Influenza Surveillance Network.
- NIL staff conducted 3 supervisory visits in 2 months and provided logistical support to laboratories in the influenza surveillance network.

### PREPAREDNESS

Staff training strengthened skills for the surveillance of seasonal and rapid response for pandemic influenza in the African Region in Accra.

A workshop was conducted on writing a protocol for building an early warning system that allows for identifying unusual cases or clusters of respiratory disease in humans or animals in communities, with rapid reporting of suspect cases or clusters of severe respiratory and febrile illnesses to national government authorities and WHO.

### TRAINING

- The NIL manager was trained on cell culturing and influenza viral isolation at the NICs in Abidjan and Dakar.
- NIL staff were trained on molecular diagnostics for non-influenza respiratory viruses.
- Global Health Security Agenda and influenza grantees were trained on grant management.
- INH staff attended the:
  - » Fourth Meeting of National Influenza Centers for the African Region in Brazzaville, Congo
  - » WHO meeting for influenza burden estimation in Geneva, Switzerland
  - » Strengthening Surveillance of Seasonal and Rapid Response to Pandemic Influenza in the African Region meeting in Accra, Ghana

# UGANDA

## OVERVIEW

Uganda's influenza surveillance program was reestablished and a diagnostic laboratory revived in 2007 at the Uganda Virus Research Institute with assistance from a cooperative agreement with CDC's Influenza Division. A sentinel surveillance program was established in the 4 geographical regions of Uganda in public health centers and hospital in- and outpatient units. Nasopharyngeal and oropharyngeal swabs were collected from patients meeting standard case definitions for influenza-like illness (ILI) and severe acute respiratory infection (SARI).

Later in 2010, following a program review, more emphasis was put on the collection of SARI specimens, with the introduction of SARI follow-up forms, to assist in the determination of the burden of influenza disease in Uganda.

## SURVEILLANCE

SARI and ILI specimens collected from the 10 sentinel surveillance sites are transported to the National Influenza Center (NIC) for testing for influenza type A and B viruses using real-time RT-PCR, and subtyped for seasonal influenza A(H1), A(H3), and A(H5).

### *SURVEILLANCE ACTIVITIES*

- In 2016, 2,454 samples were tested with a positivity rate of 16.5%; 6.8% were positive for influenza A(H3), 7.9% for influenza B, and 1.8% for influenza A(H1N1)pdm09. Prevalence was higher in children and slightly higher in males (50.9%) compared to females (49.1%).
- Samples were collected regularly and data were shared through the Ministry of Health's Weekly Epidemiology Newsletter, FluNet, and the WHO Regional Office for Africa's system to determine the burden of influenza disease in Uganda.

## LABORATORY

The laboratory carries out RT-PCR, hemagglutinin A/hemagglutinin inhibition assays, and virus isolation of respiratory pathogens. Uganda refers influenza viruses isolated to the CDC WHO Collaborating Center

## HIGHLIGHTS

- A National Symposium was hosted where data on influenza in Uganda were disseminated.
- Information booklets and brochures on influenza surveillance in Uganda have been produced and circulated.
- The National Influenza Center participated in a number of community cultural events to provide information on influenza surveillance.

for Reference and Research on Influenza (WHO CC) as part of WHO's Global Influenza Surveillance and Response System (GISRS) activities. Data are continuously shared with FluNet, the Regional Office, the WHO country office, and with the Ministry of Health, which includes compilation of laboratory data in the Weekly Epidemiology Bulletin. The NIC participated in the WHO Influenza External Quality Assessment Project panel with a score of 100%. The laboratory provided supportive supervision to the sentinel sites to ensure collection of quality samples.

### *LABORATORY ACTIVITIES*

- All samples from the sentinel sites were tested for influenza viruses.
- The data in the virological laboratory database were verified and maintained.
- Isolates were shipped to the WHO CC in Atlanta as part of WHO's GISRS.

## PREPAREDNESS

The NIC is part of the National Task Force for pandemic preparedness in the country. Data are reported to the Surveillance and Response committee of the National Task Force. The committee meets quarterly and the National Task Force meets twice a year; however, during outbreaks the committee meets more regularly, sometimes 3 to 4 times a week.



## TRAINING

- The NIC conducted refresher trainings for the sentinel site staff to ensure that case definitions for ILI and SARI are correctly followed during sample collection.
- NIC staff received and participated in a refresher training on influenza surveillance, data collection, sample transportation and storage, and both national and international data reporting.

## INFLUENZA VACCINE ACTIVITIES

The Uganda Virus Research Institute received three years of funding to fund work contributing to development of a national seasonal influenza vaccination policy. That funding concluded in 2016, and was followed by a small sub-award via the Task Force for Global Health to complete activities begun during that cooperative agreement. Prior to this period, Uganda did not have a National Immunization Technical Advisory Group; the development of a vaccine policy was an impetus to create the Uganda National Immunization Technical Advisory Group (UNITAG), along with an influenza sub-committee. UNITAG members received policy training, and as a result of these activities Uganda has written its first national immunization policy, which has been sent to parliament for ratification.

Key activities during this period include:

- A needs assessment was conducted to identify gaps and barriers to introduction of seasonal influenza vaccine.
- Stakeholders' workshops were held on introduction of seasonal influenza vaccine, providing information on flu vaccine. These activities were undertaken in collaboration with Sanofi Pasteur and country and regional representatives.
- Engagement was continued with UNITAG, the national Expanded Program for Immunization, and the National Drug Authority to understand the requirements of the national immunization authorities for the introduction of influenza vaccine.
- Materials were prepared for a knowledge, attitudes, and practices survey of pregnant women and health care workers.



# ZAMBIA

## OVERVIEW

Continuous progress is being made in the effort to achieve the overall goal of Zambia's influenza program: to strengthen influenza surveillance and the surveillance of other communicable diseases by bolstering public-sector laboratory and surveillance capacity for influenza-like illness (ILI) and severe acute respiratory infection (SARI). Reliable data gathering on both seasonal and pandemic influenza in Zambia is now possible as a result of the CDC-funded Influenza Sentinel Surveillance Program (ISS) through grants awarded to the Ministry of Health (MOH) and the University Teaching Hospital (UTH).

## SURVEILLANCE

The 6 existing sentinel sites in the 2 provinces continued sample collection and provided data to characterize the burden of disease. Staff at existing and new sites were also retrained on influenza surveillance and introduced to the Pandemic Influenza Preparedness framework through separate workshops. Updates on influenza surveillance were provided, especially the One Health approach. One previously problematic site, Ndola Central Hospital, was revamped and is now fully operational. A data management training for relevant site staff was also conducted to ensure good quality actionable data are collected. Three new sentinel sites with a human/animal interface were successfully identified and established. A staff training and orientation workshop was also conducted. Sites will become fully functional once logistics for sample storage and shipping are finalized.

## SURVEILLANCE ACTIVITIES

- Sample collection and processing from the existing 6 sentinel sites continued.
- New staff were recruited with the revamping of the Ndola Central Hospital site.
- The involvement of district Surveillance Officers in Lusaka and Ndola increased to assist with data needs of the program and the staff.
- Quality sample collection was sustained through staff retraining on influenza surveillance, including sample collection, packaging, and storage.

## HIGHLIGHTS

- The identification and establishment of 3 new sentinel sites with a human/animal interface allowed participation in the Pandemic Influenza Preparedness Framework.
- One previously problematic site, Ndola Central Hospital, was revamped and is now fully operational.
- A manuscript was written and is awaiting finalization: "An Evaluation of the Zambia Influenza Surveillance System, 2009–2015."
- Staff participated in the Training of Trainers on Influenza Surveillance in the WHO African Region, Brazzaville, Republic of the Congo, September 5–9, 2016, and 1 staff member later served as resource person in the establishment of influenza surveillance in Sierra Leone.

- Staff were trained on data management.
- Staff participated in a respiratory disease outbreak investigation in a Lusaka college, which was confirmed as influenza A(H3N2) by the National Influenza Center (NIC).

## LABORATORY

The UTH Virology Laboratory, which has been functioning as Zambia's NIC, worked closely with CDC; the National Institute for Communicable Diseases in Johannesburg, South Africa; and the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in London to strengthen influenza laboratories. Zambian scientists are now conducting various procedures routinely including typing, subtyping, PCR, real-time PCR, and sequencing techniques, as well as virus isolation and identification. The establishment of this capacity has led to significant enhancements benefiting both Zambia and GISRS.

The program continued to participate in the WHO External Quality Assessment Program (EQAP) panels with scores ranging from 98% to 100%. Weekly reporting of SARI/ILI results to stakeholders and to FluNET was maintained. Summary reports were shared annually with the MOH and program partners.

## LABORATORY ACTIVITIES

- Routine testing of samples from ILI and SARI cases continued, as well as virus isolation from RT-PCR positive samples. A total of 4,715 samples received and 4,191 (89%) were processed.
- Shipment of isolates to WHO CCs took place, consistent with global vaccine development guidelines. Isolates were sent to the WHO CCs at CDC and in London, UK.
- The NIC participated in the WHO EQAP and attained a full score on almost all assessments.
- Staff from the NIC and MOH made regular supervisory and training visits to sentinel sites to support surveillance activities, and in response to high staff turnover, to train and orient new staff as necessary.
- Measures were taken to establish performance metrics/indicators to monitor performance and make improvements as needed to ensure that surveillance requirements are met in an effective and efficient manner.

## PREPAREDNESS

Several training workshops were conducted. Of note was the introductory training workshop on pandemic influenza preparedness in Fall 2016 to orient all staff on the Pandemic Influenza Preparedness framework. Participants included NIC staff, sentinel staff, and representatives from stakeholder organizations. A refresher training on the Strengthening Pandemic Influenza Preparedness Workshop was conducted November–December 2016 for all program staff as well as partners. Beginning in 2017, monthly vaccine-preventable disease meetings with various stakeholders have been held regularly. These meetings provide a platform to exchange information and preparation for various vaccine-preventable diseases with pandemic potential.

## PREPAREDNESS ACTIVITIES

- The NIC was called upon to participate in the field investigation of a severe respiratory illness outbreak at the National Resource Development College in Lusaka, and the lab confirmed an influenza A(H3N2) outbreak.
- Site assessment was conducted, with eventual identification and establishment of 3 new pandemic influenza preparedness sites with a

human/animal interface, including staff training from these new sites and existing sites.

- Once-monthly meetings were held with the School of Medicine's Veterinary Lab to enhance the existing partnership.

## TRAINING

- In order to reduce systematic testing errors, and to provide uniformity, consistency, and reliability in each of the activities performed as part of ISS, there was a need to develop written standard operating procedures (SOPs). The program organized an SOP-writing workshop, at the end of which comprehensive SOPs were drafted.
- A data management workshop was organized in January 2016 to address incomplete questionnaires with missing information that were being received from sentinel sites.
- A staff retraining workshop for the ISS was held in Ndola in September 2016.
- An orientation workshop was provided for ISS and pandemic influenza preparedness in conjunction with WHO in November 2016.
- A laboratory scientist attended the WHO NIC global meeting in Geneva, Switzerland in July 2017.

# Partner Countries

## MAURITANIA

Mauritania is a country on the Atlantic (West) coast of Africa. The collaboration between the Ministry of Health (MOH)/Direction de la Lutte contre la Maladie (DLM), CDC, and the Institut National de Recherches en Santé Publique (INRSP)/National Public Health Research Institute of Nouakchott started in 2010. In 2011, with support from CDC and the United States Naval Medical Research Unit Three (NAMRU-3), Mauritania began influenza surveillance.

INRSP advocates to the MOH for strengthening epidemiological surveillance capabilities for influenza in order to determine seasonality and the burden of disease through sentinel site surveillance across Nouakchott.

CDC and NAMRU-3 helped strengthen the capacity of the influenza laboratory through the acquisition of a RT-PCR machine, a biosafety cabinet, and influenza reagents, in addition to coordinating multiple national and regional trainings. The US Embassy supported the influenza laboratory by donating refrigerators and an air conditioner.

Significant progress in laboratory surveillance capacity has been achieved over the past 6 years, and the success of this partnership has led to substantial improvements benefiting Mauritania. The influenza surveillance network in Mauritania has grown to include an influenza laboratory and 3 sentinel sites.

## MAURITIUS

In collaboration with the Institut Pasteur of Madagascar, the first cooperative agreement with Mauritius began in 2013. The cooperative agreement period is for 5 years. Additional funds were made available by CDC through a cooperative agreement for the purchase of a real-time PCR machine through the WHO Regional Office for Africa (WHO AFRO) and the local WHO Country Office.

A comprehensive influenza-like illness (ILI) and severe acute respiratory infection (SARI) surveillance system was established in January 2013. SARI and ILI surveillance occurs year-round, but illness peaks between the months of May through August.

Surveillance is also carried out yearly amongst pilgrims returning from the Hajj. They are screened for respiratory viruses including influenza, RSV, human metapneumovirus, and MERS-CoV. With the help of CDC, the laboratory achieved National Influenza Center (NIC) status. In an average week, the laboratory receives and processes 30 respiratory samples. The NIC provides support to all surveillance sites by providing viral transport media and sample collection kits through the laboratory transport system.

A pandemic preparedness plan has been drafted and circulated to all stakeholders at appropriate levels within the Ministry of Health and Quality of Life (MOHQL). Every year, the Ministry of Social Security in collaboration with the MOHQL provides 80,000 doses of influenza vaccine for the elderly. The MOHQL purchases another 20,000 doses for health care workers, vulnerable groups including immunocompromised patients (diabetics, HIV, and patients on immune suppressants), pregnant women, and children under the age of 2. Vaccination activities start the last week of April and end the last week of June or continue until the stock is depleted.

## NIGER

In May 2009, influenza surveillance was initiated in Niger by the Centre de Recherché Medicale et Sanitaire in collaboration with the Institut Pasteur of Paris, WHO, and CDC.

Niger's influenza surveillance system has 5 sentinel sites. Surveillance data are shared weekly with WHO AFRO and the MOH. In 2016, the CDC Influenza Division's Atlanta team conducted an assessment to evaluate influenza surveillance and laboratory systems in Niger.

The Niger Influenza Reference Laboratory will be participating in the CDC/Association of Public Health Laboratories laboratory mentorship program meeting to kick off a 2-year laboratory mentorship. The mentorship program is an opportunity for the Niger Influenza Reference Laboratory to reach biosecurity and quality standards and to work towards becoming a WHO NIC.

CDC has provided the following support to the influenza surveillance system in Niger:

- Capacity building support through participation in regional trainings and workshops
- Laboratory reagents and supplies support through the International Reagent Resource
- Technical expertise and counselling toward strengthening influenza surveillance nationally

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## SENEGAL

Since 2012, with the financial and technical support of the US Department of Health and Human Services and CDC, the Senegalese influenza surveillance system has been enhanced for detection of additional clinical syndromes and the laboratory identification of other respiratory pathogens. This improved system, now called the 4S Network, is based on reporting of nonspecific indicators as epidemiological data to health care authorities, and on random sampling for laboratory-based testing.

The network has been expanded from 3 ILI sentinel sites, all in Dakar, to 14 sentinel sites with 2 SARI sites. Weekly reports are prepared and transmitted by the Senegal MOH to regional and district public health staff, as well as national and international partners.

Notable progress in laboratory diagnostic capacity has been achieved over the past 4 years, and the success of this partnership has led to significant enhancements benefiting both Senegal and WHO's Global Influenza Surveillance and Response System. The 4S Network supports other laboratories on a regional level. Laboratorians from Guinea, Togo, and Mauritania have been trained on influenza detection and identification techniques.

The Institut Pasteur of Dakar, in collaboration with the Senegal MOH, continues to build laboratory and epidemiologic surveillance capacity to determine the burden of influenza disease.

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## SEYCHELLES

ILI and SARI surveillance in Seychelles both began in October 2013. ILI sentinel surveillance is conducted in 6 health care centers: 4 on the island of Mahe, 1 on the island of Praslin, and 1 on the island of La Digue. They send daily epidemiological information for several diseases including ILI.

SARI sentinel surveillance is conducted in 4 hospitals throughout the country; 2 are on the islands of Praslin and La Digue. The sentinel sites are monitored periodically by the Disease Surveillance and Response Unit to verify registers and entry of data. They use checklists and questionnaires as evaluation tools.

The Molecular Diagnostic Unit of the Seychelles Public Health Laboratory began analyzing samples from sentinel sites in October 2013, for the detection of influenza A (H1N1, H3N2, and H1N1pdm09 strains) and influenza B viruses. The Molecular Diagnostic Unit successfully participated in WHO's External Quality Assessment Project Panel 13.

- Testing of 269 specimens for influenza viruses was conducted.
- The MOH of Madagascar was supported in updating the National Contingency Plan for 2014–2016.

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## SIERRA LEONE

In 2011, WHO selected 8 countries in sub-Saharan Africa, including Sierra Leone, to strengthen sentinel surveillance efforts through the project Strengthening Influenza Sentinel Surveillance in Africa. Prior to this effort, Sierra Leone had no influenza surveillance activities. Sierra Leone had a surveillance program that began in 2011, however, this program was temporarily suspended during the Ebola virus outbreak. Following the 2014 Ebola outbreak, Sierra Leone resumed conducting routine surveillance for influenza A(H5N1), with sentinel surveillance for ILI and SARI in 4 sites throughout the country.

- Two laboratory scientists participated in a capacity building training geared towards developing knowledge and skills to implement sentinel surveillance activities for all sentinel sites.

# Research Activities in Partner Countries

## GHANA

CDC's Influenza Division developed a research cooperative agreement with the Noguchi Memorial Institute for Medical Research in 2012 to establish a respiratory disease surveillance platform in the Shai-Osudoku and Ningo-Prampram Districts in the Greater Accra Region of Ghana. Patients with influenza-like illness (ILI) and those hospitalized with severe acute respiratory infection (SARI) were enrolled in 9 surveillance health facilities. Other health facilities within the districts provided weekly aggregate data on incidence of respiratory diseases and patients meeting the ILI and SARI case definitions. Additional studies included the incidence of influenza in HIV-infected and HIV-uninfected adults and the impact of influenza infection on pregnancy.

## KENYA

CDC's Influenza Division collaborates closely with the Ministry of Health (MOH) and other partners to explore strategies for sustainable influenza surveillance, the timing of influenza activity in Kenya, optimal times to vaccinate against influenza, the disease and economic burden of influenza illness among WHO target groups, and the potential impact of influenza vaccination programs.

Research activities include studies to:

- Compare the quality, cost, and timeliness of data collection between a smartphone data collection system and a paper-based system for routine influenza surveillance in Kenya 2011–2012
- Compare SARI and clinical pneumonia case definitions for the detection of influenza virus infections among hospitalized patients, Western Kenya, 2009–2013
- Determine whether the duration of specimen storage affects influenza testing results by real-time RT-PCR through the analysis of influenza surveillance specimens, 2008 to 2010
- Conduct point-of-care evaluation of the BD Veritor™ Rapid Diagnostic Test for Influenza in Kenya
- Explore the etiology of pediatric fever in Western Kenya: a case-control study of falciparum malaria, respiratory viruses, and streptococcal pharyngitis
- Understand the etiology and epidemiology of SARI in children aged less than 5 years in Kibera, an urban slum in Nairobi, during 2007–2011
- Identify young infants and children at higher risk of dying from respiratory infections within the hospital setting
- Explore the role of HIV in the household introduction and transmission of influenza in a slum, Nairobi 2008–2011
- Review existing data on the influenza-associated disease burden in Kenya, 2006–2013
- Estimate the burden of influenza and RSV among inpatient and outpatient facilities in rural Western Kenya, 2009–2012
- Describe the demographic, socioeconomic, and geographic determinants of seasonal influenza vaccine uptake in rural western Kenya, 2011
- Describe the etiology of pediatric respiratory disease mortality at Kenyatta National Hospital
- Explore what influenza vaccine formulation should be used in Kenya through a comparison of influenza isolates from Kenya to vaccine formulations, 2007–2013
- Describe the uptake and effectiveness of a trivalent inactivated influenza vaccine in urban and rural Kenya, 2010–2012
- Describe influenza activity in Kenya, 2007–2013: timing, association with climatic factors, and implications for vaccination campaigns
- Quantify the economic burden of influenza in Kenya
- Conduct a cohort study of ILI among pregnant women in Western Kenya
- Explore which maternal influenza vaccine strategies have the greatest impact on disease burden among pregnant women and young infants



## MALAWI

CDC's Influenza Division has partnered with the Malawi-Liverpool Wellcome Trust Clinical Research Programme located at Queen Elizabeth's Central Hospital (QECH) in Blantyre, Malawi since 2011. Influenza surveillance is conducted among children and adults seeking care at QECH. In addition, the Malawi-Liverpool Wellcome Trust Clinical Research Programme partners have collaborated to assess nosocomial transmission of influenza and RSV in the pediatric high-dependency unit, the impact of HIV and malaria on transplacental transfer of influenza antibodies, the incidence and severity of influenza among HIV-infected and HIV-uninfected adults, and changes in influenza genomics that may impact the severity or transmissibility of influenza viruses.

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## SENEGAL

Research activities are being conducted through a partnership with PATH, the Institut de Recherche pour le Développement, and Institut Pasteur de Dakar. These activities include 3 separate but related vaccine trials:

- A large-scale randomized controlled trial to evaluate the impact of inactivated influenza vaccine (IIV) among vaccinated children and their communities, via indirect effects or herd immunity
- A second randomized controlled trial of the safety and immunogenicity of an influenza vaccine containing an immune response-boosting adjuvant (MF59-adjuvanted IIV)
- A third randomized controlled trial of the efficacy of live-attenuated influenza vaccine (LAIV) in reducing influenza among LAIV-vaccinated children, as compared to those receiving placebo

Vaccination and follow-up activities have been completed for all 3 trials, and analyses are underway with manuscripts anticipated in 2015–2017.

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# WHO Eastern Mediterranean Region [EMR]



# WHO Eastern Mediterranean Region [EMR]

CDC's Influenza Division has 5 bilateral influenza cooperative agreements in the WHO EMR. These agreements are with Ministries of Health (MOHs) or institutions designated by MOHs to work with CDC to build capacity to routinely identify, diagnose, and respond to seasonal and pandemic influenza across the Eastern Mediterranean Region.

ID provides direct support through these agreements to the following five countries:

- Afghanistan
- Egypt
- Morocco
- Pakistan
- Tunisia

Additional influenza work in the region includes a bilateral cooperative agreement for the development of influenza vaccine policy in Morocco.

CDC also supports the WHO Regional Office for the Eastern Mediterranean (EMRO) through a bilateral cooperative agreement. Funding through this regional agreement helps to build capacity in countries throughout the region.

The core activities of cooperative agreements and technical assistance between WHO EMRO and CDC are

- To enhance the quality, sensitivity, and effectiveness of surveillance systems for influenza and severe acute respiratory infection, as well as sustaining and further enhancing the laboratory capacities of National Influenza Centers for timely detection of novel influenza viruses;
- To develop the capacities of the countries to use routinely collected surveillance data to improve their understanding of influenza epidemiology to better inform the national health authorities on appropriate preventive and control strategies for influenza; and
- To support the development of appropriate public health policies that will promote the introduction and increased use of seasonal influenza vaccines in at-risk population groups in the region.

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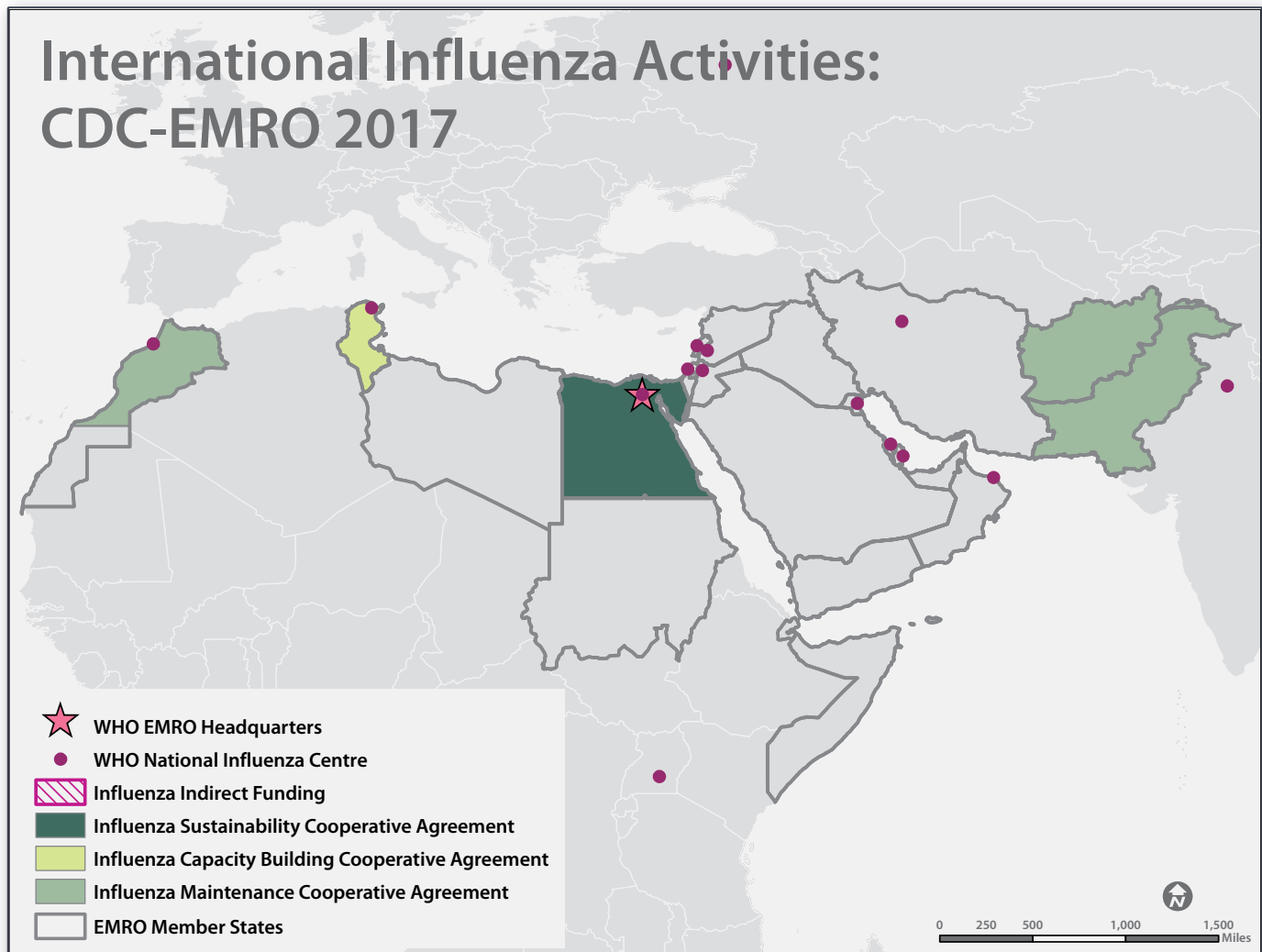
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# WHO Regional Office for the Eastern Mediterranean [EMRO]



## HIGHLIGHTS

- Guidance was developed for severe acute respiratory infection (SARI)/influenza-like illness (ILI) sentinel surveillance in the region in collaboration with member states.
- The number of countries implementing SARI and ILI surveillance was expanded.
- A regional stockpile of influenza-specific antiviral drugs was established that ensures timely access for all 22 countries in the region in the event of an influenza pandemic.
- The use of the Regional Office's online platform for influenza surveillance, Eastern Mediterranean Flu Surveillance (EMFLU), was expanded to 12 countries.
- Information and communication materials were developed promoting the use of seasonal influenza vaccines in the region.
- An assessment was conducted on seasonal influenza vaccine use, access, and national policies in the region.

## U.S. CDC DIRECT SUPPORT

The current 5-year cooperative agreement on strengthening surveillance and response for seasonal and pandemic influenza in the WHO Eastern Mediterranean Region began in September 2016.

The WHO Eastern Mediterranean Regional Office (WHO EMRO), based in Cairo, Egypt, serves 21 member states and 1 territory with an overall regional population of more than 583 million. Member countries include Afghanistan, Bahrain, Djibouti, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates, Yemen, and the occupied Palestinian territory.

Technical and financial support are provided to the countries through 4 main work streams: (1) enhancing the quality of the surveillance systems for influenza-like illness (ILI) and severe acute respiratory infections (SARI), (2) developing the capacities of countries to use routinely collected surveillance data to improve their understanding of influenza epidemiology, (3) developing the capacities of the countries for early detection and rapid response to influenza outbreaks, and (4) supporting the development of appropriate public health policies that will promote introduction and increased use of seasonal influenza vaccines in at-risk population groups in the region. Guidance, standards, and tools are regularly developed and shared with the countries for this purpose.

## SURVEILLANCE

In order to address and remedy gaps identified during the 2009 influenza pandemic, support to WHO EMRO is used to strengthen national surveillance and response capacities in the region through the establishment and enhancement of sentinel surveillance systems for SARI and ILI.

This support has enabled countries in the region to collect quality epidemiological and virological surveillance data on influenza and ILI in a timely and reliable fashion. This information is being used to better understand the circulation patterns of seasonal influenza viruses in the region, including types and sub-types, as well as the epidemiology of influenza and risk factors for severe disease. This information serves as an evidence base to inform

national prevention and control strategies and associated policy decisions.

## SURVEILLANCE ACTIVITIES

- An online regional influenza surveillance data collection platform, Eastern Mediterranean Flu Network (EMFLU), was developed for both epidemiologic and laboratory data. Twelve countries are currently submitting influenza data to the system on a regular basis.
- Weekly reports epidemiologic and laboratory reports were disseminated to countries in the region that highlighted regional data collected in EMFLU.
- Technical missions were conducted to Egypt, Jordan, Kuwait, the occupied Palestinian territories, Qatar, the Kingdom of Saudi Arabia, and the United Arab Emirates to establish or enhance sentinel surveillance systems for SARI and ILI.
- Technical support was provided to Egypt, Iraq, Jordan, Kuwait, Oman, the occupied Palestinian territories, Syria, and Tunisia after a rapid increase of seasonal influenza A(H1N1)pdm09 cases.

## LABORATORY

There are 16 functional National Influenza Centers (NICs) in the region. WHO EMRO, in close collaboration with the US Naval Medical Research Unit-3 (NAMRU-3), conducts periodic visits to these NICs to assess their capacity to perform influenza virus sequencing, detect novel or unsubtypeable viruses, and test for antiviral susceptibility. Fifteen of the 16 NICs regularly participate in the WHO External Quality Assessment Project (EQAP) panels. As a result of the support, 8 NICs currently have full capacity for influenza virus sequencing and 4 NICs have full capacity for antiviral susceptibility testing. Work is currently underway to fully integrate activities of the NICs with SARI surveillance, especially focusing on integration of epidemiological and virological data.

## LABORATORY ACTIVITIES

- Five field missions were conducted to assess and strengthen the influenza laboratory capacities of the NICs in Jordan, Qatar, Saudi Arabia, Sudan, and the United Arab Emirates.
- New guidance was developed to improve and increase the timely sharing of seasonal influenza viruses with WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs)

for vaccine strain selection. The guidance highlights the selection criteria for influenza specimens, the appropriate time to share specimens, and the shipping process.

- Reactivation of the NIC in Sudan—one of the oldest NICs in the region—was supported after a 5-year gap. Influenza reagents and consumables were provided to the laboratory, resulting in the ability to test clinical specimens from 2 sentinel sites in Khartoum using RT-PCR.
- More than 2,000 samples from the Eastern Mediterranean Region were submitted to the WHO CC in Atlanta for characterization.

## PREPAREDNESS

Public health preparedness for epidemic and pandemic influenza has been strengthened in the region through technical and financial support from CDC. In-country rapid response teams have been established in all 22 countries in the region. These teams have been trained to conduct field investigations and to respond to outbreaks of influenza.

A mechanism for regional country coordination and rapid information sharing was established, linking the work streams supported by the cooperative agreement with national emergency operations centers and Ministries of Health.

Guidance, best practice documents, and tools have been developed to assess and measure the severity of influenza, estimate the burden of influenza-associated hospitalizations, and develop supportive policies for introduction and increased use of seasonal influenza vaccines in the region.

### PREPAREDNESS ACTIVITIES

- A 5-year regional plan was drafted to promote the use of seasonal influenza vaccines among high-risk groups in the region.
- Standardized communication materials were developed promoting the use of seasonal influenza vaccines.
- A regional training workshop on estimating influenza burden of disease was conducted, attended by participants from Egypt, Pakistan, Morocco, Oman, Iran, and Jordan.

- The outbreak response capacity of rapid response teams at the national and sub-national level was enhanced through mentorship.
- Disease burden was estimated, and a series of studies were published on the burden of disease due to influenza-associated illness in the region using surveillance data from Egypt, Iran, Oman, and Tunisia. These study reports were published in a special volume of the Eastern Mediterranean Health Journal in 2016.

## TRAINING

WHO EMRO in collaboration with member states organized the following sub-regional and national training courses:

- **Rapid Response Training** in Somalia focused on field investigations and response to outbreaks, which was attended by forty health professionals from 12 regions
- **Training Workshops** focused on standardizing clinical case management of patients with SARI/viral pneumonia in Kuwait, Qatar, and Syria
- **Hands-on Influenza Sample Management Training** focused on supporting the NICS and influenza laboratories in Jordan, Qatar, Saudi Arabia, Sudan, and the United Arab Emirates during field missions

## RESEARCH ACTIVITIES

A CDC-funded Influenza and Respiratory Syncytial Virus in Infants Study (IRIS) was conducted among hospitalized and non-ill infants aged <1 year from 2015–2017, with local sponsorship by the Eastern Mediterranean Public Health Network at Al-Basheer Hospital, Maternal and Pediatric Buildings in Amman, Jordan.

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# AFGHANISTAN



The Baba Mountain range of the Hindu Kush between Kabul and Kandahar.

## OVERVIEW

The Islamic Republic of Afghanistan's Ministry of Public Health (MOPH) received their first cooperative agreement funding from CDC for capacity building in 2006. Fiscal Year 2011 was the last year of the initial cooperative agreement funding. These funds supported the Afghan Public Health Institute (APHI), a division of 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 infection (SARI), building laboratory capacity for testing specimens for influenza viruses, health education, and training activities. After successful completion of the first cooperative agreement, a second agreement for sustainability was awarded; that agreement ended in September 2016.

## HIGHLIGHTS

- Began regular submission of data to WHO FluID and the WHO Eastern Mediterranean Flu (EMFLU) online reporting system.
- The first National Conference on Respiratory Infections was held in April 2016 in Kabul, which brought together professionals from many sectors—including health care, academia, and provincial leaders—to share new findings, lessons learned, and explore new strategies to improve the nation's health.
- Sharing of influenza virus isolates with the WHO Collaborating Center for Reference and Research on Influenza at CDC was resumed; 20 virus isolates were shared in 2016 for virus characterization and vaccine strain selection.
- Influenza surveillance activities were presented at the OPTIONS for the Control of Influenza IX Conference in Chicago, USA in August 2016.

## SURVEILLANCE

The primary disease surveillance system in Afghanistan is the National Disease Surveillance and Response (NDSR, formerly the Disease Early Warning System), established in 2006 with technical support from WHO and financial support from the US Agency for International Development. It is a sentinel site-based syndromic surveillance system for weekly reporting of infectious disease morbidity and mortality, operating in public and private health facilities and in the community. NDSR collects data for 15 reportable diseases including influenza. NDSR receives data from 548 sentinel sites located throughout the 34 provinces of the country. The system is being upgraded to establish surveillance sites in all public health facilities nationwide; to introduce community-based surveillance reporting through community health workers; to cover more private health facilities; and to work toward implementation of the International Health Regulations 2005 (IHR) in Afghanistan. In December 2016, an IHR Joint External Evaluation was conducted by WHO, and the Afghanistan surveillance system obtained the highest score among all countries in the WHO Regional Office for the Eastern Mediterranean (EMRO) region.

## SURVEILLANCE ACTIVITIES

- ILI and SARI epidemiologic data and laboratory specimens were collected from 9 sentinel sites in 9 provinces; specimens were sent for testing to the National Influenza Center (NIC) at the Central Public Health Laboratory (CPHL).
- Epidemiologic data were collected on 12,757 SARI cases; 311 mortality cases associated with SARIs; and 29,757 ILI cases in 2016.
- A total of 544 sentinel sites were established by the end of 2016 that operate in regional, provincial, and district hospitals; private hospitals; health centers; and clinics.
- Influenza epidemiologic surveillance data were reported on a weekly basis to the WHO global online database, FluID, and the WHO EMRO regional platform, Eastern Mediterranean Flu Surveillance (EMFLU).
- Seven influenza outbreaks were detected, investigated, and responded to.
- A number of events associated with poultry deaths were reported and coordinated with the Animal Health Department.

## LABORATORY

The virology laboratory of the CPHL was designated as a NIC in 2009. The NIC has worked closely with the NDSR and MOPH to establish state-of-the-art laboratories, and supports the NDSR surveillance program via confirmation of suspected outbreaks and testing for routine disease surveillance. NIC staff have been trained extensively through the support of international partners including WHO, the United States Naval Medical Research Unit Three (NAMRU-3), and the US Department of Defense on typing, subtyping, PCR, real-time PCR, and other techniques. Notable progress in laboratory surveillance capacity has been achieved over the past 5 years. The NIC is currently able to conduct real-time PCR testing and virus isolation, and identify influenza subtypes.

### LABORATORY ACTIVITIES

- In 2016, the laboratory received 1,318 samples from ILI sites and 1,802 samples from SARI sites.
- More than 20 samples were shared with the WHO Collaborating Center for Reference and Research on Influenza in Atlanta.
- Influenza virological surveillance data were reported on a weekly basis to the WHO global

online database, FluNet, and the WHO EMRO regional platform, EMFLU.

- Results from influenza virological surveillance were reported on a weekly basis to the MOPH and Surveillance Directorate.
- The RT-PCR machine for the NIC was calibrated, resuming the capacity of the NIC to perform influenza virus isolation in December 2015 after a long interruption (since 2012).

## PREPAREDNESS

The national surveillance system in Afghanistan captured data on both indicator-based surveillance and event-based surveillance. The system shares information on new circulating viruses and outbreaks with all stakeholders. When required, the system sends and receives alerts for situations of concern.

### PREPAREDNESS ACTIVITIES

- Three coordination meetings were conducted among NDSR coordinators and provincial officers to enhance surveillance activities and improve on outbreak detection and response.
- An inter-sectorial IHR coordination meeting was conducted.
- Three rounds of Provincial Rapid Response Training were conducted for NDSR and CDC officers.
- All influenza surveillance sentinel sites were assessed based on the approved checklist from WHO.
- Staff participated in 3 National Zoonotic Committee meetings.

## TRAINING

- More than 500 surveillance focal points were trained on priority disease detection, investigation, and response with a focus on influenza surveillance, sample collection, and emerging and re-emerging infections.
- A refresher training was conducted for surveillance assistants on SARI/ILI sample collection, storage, shipping, and labeling, lab algorithm, and standard operating procedures.
- A refresher training was conducted on data management and use of global databases on influenza such as FluID and EMFLU.

# ARAB REPUBLIC OF EGYPT



Pandemic plan update meeting in Egypt.

## OVERVIEW

A cooperative agreement with the Ministry of Health and Population (MOHP) provides support to conduct epidemiologic and laboratory surveillance for influenza and to build capacity in Egypt's National Influenza Center (NIC) to detect and isolate seasonal and novel influenza viruses.

## SURVEILLANCE

Influenza surveillance was introduced in Egypt in 1999 through the establishment of influenza-like illness (ILI) sentinel sites. There are a total of 6 complementary disease surveillance programs managed by the MOHP; of note are the National Notifiable Disease Surveillance System, which includes acute respiratory infection (ARI) syndromic surveillance, the severe acute respiratory infection (SARI) and ILI sentinel surveillance systems, and the avian influenza surveillance system. The influenza surveillance system as a whole involves a collaborative approach between the MOHP, Directorates of Health, district health authorities, sentinel sites, and other stakeholders such as WHO, the United States Naval Medical Research Unit Three (NAMRU-3), CDC, the US Agency for International Development, and the Egyptian Veterinary and Animal Health Authority.

## HIGHLIGHTS

- The influenza surveillance system provided quality data to estimate the risk factors, seasonality, baseline and threshold, trend, burden, and severity of influenza-associated illnesses in the country.
- Influenza data have been used in local pandemic planning and to guide decision makers on appropriate prevention and control strategies for influenza, including consideration of introduction and use of seasonal influenza vaccines for high-risk groups.
- Capacity of the subnational influenza laboratories has been enhanced, including capacity for detection of unsubtypeable strains.

## SURVEILLANCE ACTIVITIES

- Sixteen site visits were conducted to monitor the status, performance, and challenges of the SARI and ILI sentinel surveillance programs and to provide technical assistance.
- Two workshops were held to share and discuss assessment results and recommendations with sentinel site surveillance teams.
- Screening was conducted for influenza and other novel viruses among returning Hajj pilgrims in 2016; samples were collected from more than 1,000 pilgrims.
- Staff participated in WHO's Pandemic Influenza Severity Assessment.
- Surveillance, diagnosis, and reporting methods were improved, such as utilizing the correct case definition, timeliness, completeness, and data validation.
- Reporting among sectors who previously did not routinely report to the MOHP, such as universities and private hospitals, increased.
- Two task force meetings were held to assess the risk of influenza A(H5N1) virus using the Tool for Influenza Pandemic Risk Assessment and included experts from the human and animal epidemiology and laboratory sectors.

- Sentinel surveillance sites for pneumonia were established.
- Staff participated in the global risk assessment of influenza A(H9N2) virus, providing the Egyptian virus profile.
- Thirteen thousand posters on ARI surveillance and handling were designed, printed, and disseminated.

## LABORATORY

To support International Health Regulations (IHR 2005) requirements, the MOHP and other stakeholders have aimed to enhance the capacity of the Central Public Health Laboratory (CPHL) and the regional laboratories. The virology laboratory in the CPHL serves as a National Influenza Center (NIC) and provides laboratory support for influenza surveillance systems. Additionally, the CPHL has provided training for 10 sub-national virology laboratory staff. The lab has a dedicated biosafety level 2 laboratory and has begun the certification process for establishing a biosafety level 3 laboratory.

### LABORATORY ACTIVITIES

- CPHL participated in the WHO External Quality Assessment Project panel and achieved a score of 100% in 2015, demonstrating competency in performing influenza PCR testing.
- Fourteen field visits were conducted to the sub-national laboratories to review and assess the use of the standard guidelines for obtaining laboratory specimens for emerging respiratory diseases.
- More than 150 samples were submitted to WHO Collaborating Centers for Reference and Research on Influenza for genetic characterization during 2015–2017.
- A biological risk management training for the national influenza laboratory team was conducted.

## PREPAREDNESS

There is strong commitment by the MOHP to continue to invest and support influenza preparedness and response activities. Influenza surveillance guidelines, standard operating procedures, reporting tools, case management protocols, and all other relevant protocols are updated and in line with global standards. Capacity building activities to strengthen the laboratory and epidemiological surveillance system were carried out regularly. There is strong

collaboration and information sharing between the human and animal health sectors. Data management capacity was improved among influenza surveillance personnel at all levels with linkage between epidemiological and virological data. These data may be used to advocate for the introduction of seasonal influenza vaccine to high-risk groups.

### PREPAREDNESS ACTIVITIES

- The pandemic influenza preparedness plan was updated.
- Five meetings between human and animal health sectors were led under the Food and Agriculture Organization of the United Nations/World Organisation for Animal Health/WHO Four-Way Linking project for assessing health risks at the human-animal interface.

## TRAINING

- Training workshops were conducted for health care workers in hospital intensive care units, emergency departments, and infection control units on ILI/SARI surveillance, case management, and guidelines for obtaining respiratory specimens, among other topics.
- Refresher training sessions were conducted for surveillance staff to increase awareness of standard operating procedures for ARI and avian influenza surveillance.
- Workshops were conducted for surveillance officers on data collection and management, monitoring and evaluation, and notifiable disease procedures.
- Influenza surveillance officers were trained on communication and exchange of information between stakeholders and laboratory staff to better prepare for outbreak response.
- Workshops on risk communication were conducted for physicians.
- Training of trainers sessions were conducted for central and governorate level staff to enhance early detection of MERS-CoV.
- Health care facility technicians were trained on proper sample collection, handling, storage, and transportation.



# MOROCCO



## OVERVIEW

The Influenza Division at CDC has worked collaboratively with Morocco's National Institute of Hygiene (NIH), home to the country's National Influenza Center (NIC), since 2006.

Morocco's NIC has conducted virological surveillance using a network of volunteer private practitioners from 8 large cities since 1996. In 2007, extension of the existing influenza surveillance network began with new sentinel sites opening across the country. CDC funding has helped to strengthen influenza surveillance in Morocco by building capacity for integrated laboratory and epidemiologic surveillance for influenza-like illness (ILI) and severe acute respiratory infection (SARI). As a result, the level of preparedness and response for epidemic and pandemic influenza has been elevated.

The current cooperative agreement aims to support and strengthen existing influenza surveillance systems; maintain capacity to detect, monitor, and respond to changes in influenza viruses; and mitigate the transmission of novel influenza among humans.

## SURVEILLANCE

Morocco's Ministry of Health (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 8 regional hospitals where syndromic and virologic data are collected. ILI is tracked through a network of 380 health units and a network of 110 private physicians reporting syndromic ILI. Eight of the 380 health units collect both syndromic and virologic data.

### *SURVEILLANCE ACTIVITIES*

- Routine SARI surveillance was systematically conducted year-round in the pediatric, pulmonology, and internal medicine wards in hospitals in 7 regions of the country.
- Routine ILI surveillance was systematically conducted year-round in the Public Health Centre Network, which includes more than 375 public clinics, and the Private Practitioners Network, which includes more than 50 physicians.

## HIGHLIGHTS

- RT-PCR multiplex diagnosis of influenza and other respiratory viruses was introduced in 4 regional laboratories.
- The flu laboratory network was empowered by decentralizing the virological diagnosis of influenza-like illness and severe acute respiratory illness to all the sentinel sites for flu surveillance (8 sites).
- The National Influenza Center became certified by the Spanish Association for Standardisation and Certification, in accordance with International Organization for Standardization (ISO) 9001 requirements for a quality management system.

## LABORATORY

Morocco's virological influenza surveillance network includes one NIC and eight regional laboratories. The NIC has the capacity to conduct RT-PCR testing for influenza viruses and fifteen other respiratory viruses, virus culturing, hemagglutinin inhibition assay testing, direct immunofluorescence testing, sequencing, and phenotypic analysis of drug susceptibility. The eight regional laboratories are also equipped with PCR machines.

Recently, new technology was procured for regional and peripheral laboratories. Multiplex RT-PCR technology was introduced in four regional laboratories to expand diagnostic capacity for influenza and other respiratory viruses, as well as bacterial etiologies of ILI and SARI. Additionally, new molecular biology equipment was purchased by the MOH for ten new peripheral laboratories. A training was planned to launch the involvement of these laboratories in the influenza laboratory network.

### *LABORATORY ACTIVITIES*

- A total of 2,404 specimens were tested for influenza viruses (October 2015–May 2017).
- A total of 20 influenza-positive samples were sent to WHO Collaborating Centers for Reference and Research on Influenza for consideration in vaccine strain selection.

- Certification was acquired for the quality management system of the NIC (ISO 9001, version 2008).
- Molecular biology equipment was purchased for the diagnosis of influenza and other respiratory viruses.

## PREPAREDNESS

The continuing development of a national seasonal influenza vaccine program bolsters preparedness via the capacity for rapid deployment of pandemic vaccines through a well-established mechanism in the event that they are needed.

## TRAINING

The Department of Epidemiology and Disease Prevention at the MOH and the NIC continue to provide technical assistance and training to ensure the function of the sentinel surveillance system, quality of the surveillance data, prompt data analysis, and integration of the information into preparedness and response activities. The following trainings were held between 2015 and 2017:

- Sample management and transportation (International Air Transport Association certification of NIC staff)
- Training of the regional laboratories on multiplex RT-PCR to investigate ILI and SARI cases
- Training on molecular investigation of MERS-CoV
- Training on molecular investigation of Zika virus

## INFLUENZA VACCINE ACTIVITIES

An annual seasonal influenza vaccination campaign runs from September through February, coinciding with Morocco's influenza season. Morocco uses the northern hemisphere formulation. Health care workers in public health facilities are vaccinated free of charge, and in the Fiscal Year (FY) 2015 and FY 2016 periods, 120,000 doses were purchased for this purpose. Private market vaccine purchases typically number ~300,000 doses annually. More than 30,000 doses a year were provided by the MOH for Hajj pilgrims, while approximately 50,000 additional doses were provided by international donors.

Significant achievements during the FY 2015 and 2016 period included:

- Identification of a vendor from which to purchase vaccine.
- The development and dissemination of information on influenza, influenza vaccines, and the vaccination campaign.
- Use of mass media communication tools, including television, radio, social media, and print outlets to generate awareness of the annual vaccination campaign and to promote acceptability of the vaccine.
- Leveraging of existing communication and health education infrastructure with non-governmental organizations focusing on diabetes to promote seasonal influenza vaccine and influenza prevention annually (via incorporation of vaccine days with the World Diabetes Day events and media announcements).

# PAKISTAN

## OVERVIEW

Pakistan has had a cooperative agreement with CDC since 2006 that supports development of state-of-the-art laboratories at designated sentinel sites in Pakistan for rapid confirmation of human and novel influenza viruses. Significant progress has been made despite continuing social and political challenges.

A total of 8 sentinel sites are located in the outpatient departments of major provincial tertiary care hospitals, as well as 1 hospital in the federal capital, Islamabad. Sites were selected on the basis of representative geographic distribution, high population density, and patient turnover rate.

## SURVEILLANCE

Sentinel sites support both influenza-like illness (ILI) and severe acute respiratory infection (SARI) surveillance activities on a year-round basis, providing both epidemiologic data and representative respiratory samples to the Pakistan National Institute of Health (NIH). Data from this system are shared with the Ministry of National Health Services, Regulation, and Coordination on a regular basis.

This sentinel lab-based influenza surveillance network has served as a model for the development of a Public Health Laboratories Network in the country under the Global Health Security Agenda (GHS) initiative and for International Health Regulations (IHR) implementation.

### *SURVEILLANCE ACTIVITIES*

- A series of influenza awareness seminars were held ahead of influenza season to further build the capacity of site-level technical staff and to share information and data with health professionals.
- Monitoring and review visits of sentinel sites were conducted at 6 of 8 sentinel sites: Multan (Punjab), Peshawar (KP), Quetta (Balochistan), King Edwards Medical University (Lahore), Azad Jammu and Kashmir (Muzafarabad), and Gilgit (Baltistan).
- Specimen collection supplies were provided not only to sentinel sites but also to districts and institutes.

## HIGHLIGHTS

- The National Institute of Health of Pakistan has continued with influenza surveillance activities.
- Pakistan's influenza-related activities also complement those in the Global Health Security Agenda Action Package framework, and are intended to build and strengthen capacity in early detection of health threats and build a rapid and effective response to disease outbreaks and other public health emergencies.
- GHSA funding has supported pandemic preparedness activities complementing influenza surveillance work.

- Support was provided to provincial health departments, high-risk districts for influenza and other respiratory pathogen surveillance, including surveillance for Middle East respiratory syndrome-related coronavirus (MERS-CoV).
- Periodic/seasonal alerts and guidelines were shared with provincial health departments and hospitals.

## LABORATORY

The majority of the influenza sentinel sites continued to collect epidemiological data and specimens from ILI and SARI cases. At least 4 sites continued to perform onsite molecular testing by real-time polymerase chain reaction (RT-PCR). The National Influenza Center (NIC) provides reagent support, updated guidelines, confirmatory testing, and quality control support to the laboratories.

From October 2015 to May 2017, 3,597 respiratory samples were collected, of which 598 were positive for influenza viruses. Virological data are uploaded to FluNet on weekly basis. Samples collected during outbreaks throughout the country are received at the NIC and tested for influenza in addition to all specimens received through routine surveillance. Sentinel sites were equipped with surveillance forms, laboratory reagents, and supplies for continued sample collection and laboratory testing onsite.



## LABORATORY ACTIVITIES

- An annual coordination and review meeting was held with sentinel site staff to review the status of laboratory-based influenza surveillance and future needs.
- Three laboratory technical staff were hired to support the molecular biology and sequencing teams and to focus on influenza viral culture and typing.
- More than 80 samples were submitted to WHO Collaborating Centers for Reference and Research on Influenza for detailed characterization.
- Monitoring and reviews were conducted at 7 sentinel surveillance sites.
- Essential laboratory equipment and supplies were supplied to various provincial sentinel sites.

## TRAINING

- Rapid response training was held for 25 federal and provincial public health personnel in November 2015.
- A 3-day onsite laboratory training was given on the use of influenza real-time PCR at the NIH in Islamabad.
- Statistical Package for the Social Sciences (SPSS) software workshops were held in Peshawar, Karachi, Multan, and Quetta.
- Influenza laboratory personnel provided technical support for a Laboratory Quality Assurance and Control course in Karachi in July 2016.

# TUNISIA

## OVERVIEW

CDC's 5-year capacity building cooperative agreement with Institut Pasteur de Tunis (IPT) began in September 2013. The project aims to gradually address all gaps in influenza surveillance in Tunisia, building on the previous strengths of the system. The main objective is to build an appropriate and effective surveillance and control system compliant with international standards of quality and sustainability. Specifically, it aims to conceive and implement an integrated plan for influenza surveillance and control;

- develop an information management system for the automatic achievement of needed tasks and functions; develop a training plan for all actors in influenza surveillance and control,
- prepare for effective interventions in a sustainable manner; to develop a quality plan to foster good practices,
- to enhance the preparedness for a potential pandemic, and
- develop a communication plan to increase awareness and improve behaviors in order to reduce the risk of transmission.

## SURVEILLANCE

In 2014, severe acute respiratory infection (SARI) surveillance was formally started and 7 SARI sites were established, enabling identification of circulating influenza strains. Prior to this period, influenza surveillance in Tunisia was limited to influenza-like illness (ILI). The Ministry of Health implemented an electronic surveillance system to improve the quality and completeness of surveillance data related to acute respiratory infection (ILI and SARI cases related to influenza and other pathogens). This project integrates epidemiologic and laboratory data and allows for improved surveillance of influenza and other respiratory viruses, including emerging and novel agents.

Over the 2 seasons during which the improved surveillance has been functioning, the identification of epidemiologic and viral differences between the seasons was illustrated. These data were reported to WHO and can be viewed on FluNet.

## HIGHLIGHTS

- **New guidelines and procedures were implemented, including new reporting forms for the nationwide influenza surveillance system.**
- **Cascade training was performed to ensure appropriate use of tools at different levels.**
- **Two papers were published: 1 on the influenza burden of disease and 1 on evaluation of the surveillance system.**
- **A new version of the electronic Information management system was developed.**

## SURVEILLANCE ACTIVITIES

- Six SARI sites were established and began collecting epidemiologic data and specimens.
- The ILI system was reduced from 268 to 104 sites in order to better the quality of surveillance.
- A new surveillance guide was developed containing the theoretical basis, methodology, and procedures for surveillance. The guide was implemented at regional ILI and SARI sites, as well as those at the local level.
- An evaluation plan for the surveillance system was developed and piloted.
- Monthly meetings were conducted with the steering committee and principal investigator of the CDC cooperative agreement to focus on the monitoring and evaluation of the surveillance system.

## LABORATORY

Since 1980, the National Influenza Center (NIC) in Tunisia has operated as part of the virology unit of the microbiology laboratory of Charles Nicolle Hospital in Tunis. Samples are collected from the sentinel surveillance network covering the 24 governorates and state or private hospitals and the laboratory for analysis. Since 2008, the first-line technology used is real-time PCR, following protocols validated by WHO and CDC. Collaboration with different teams from world-renowned laboratories (WHO Collaborating Centers for Reference and Research on Influenza

[WHO CCs] in London and Atlanta, and the NIC of Madrid) has enabled the laboratory to ensure reliability of results and mastery of molecular biology techniques applied to surveillance. Typing, subtyping, RT-PCR, and sequencing are routinely performed.

### LABORATORY ACTIVITIES

- The capacity of the laboratory was enhanced by obtaining a new PCR machine.
- A total of 1,647 specimens were processed and tested in the 2015–2016 influenza season, and 1,237 specimens were processed and tested in 2016–2017.
- NIC participated in WHO's External Quality Assessment Project (EQAP) panels with a score of 100%.
- Twenty-six samples were submitted to WHO CCs for characterization between 2015 and 2017.

### PREPAREDNESS

Preparedness activities focused on improving performance of the surveillance system in Tunisia. The steering committee met and decided to update the preparedness plan during the next year.

### PREPAREDNESS ACTIVITIES

- Data were collected to produce an estimate of the burden of influenza-associated SARI.
- Capacity to type and subtype circulating viruses causing acute respiratory infections was improved.
- Capacity for antiviral testing was improved.

### TRAINING

- Two train-the-trainer workshops focused on the new surveillance guide for health professionals were conducted. The workshops were followed by a cascade training for personnel working in the field, covering 24 governorates.
- Two 3-day training seminars were conducted on incorporating Global Positioning System/ Geographical Information System tools into influenza surveillance. The seminars were attended by 25 representatives of ILI and SARI sites, the National Program of Influenza Control at the Ministry of Health, and IPT.
- Training workshops were conducted to enhance the skills of health professionals in epidemiology, sampling techniques, and quality data management.
- A train-the-trainer approach has been adopted to decentralize training activities, and electronic training materials have been provided as a complement.

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# WHO European Region [EUR]



# WHO European Region [EUR]

Currently, there are 9 bilateral influenza cooperative agreements that support influenza activity in the WHO European Region. These cooperative agreements are with Ministries of Health or other institutions that work with CDC to build capacity in order to routinely identify, diagnose, and respond to seasonal and pandemic influenza.

CDC supports the following countries and/or entities via cooperative agreements:

- Armenia
- Bosnia and Herzegovina
- Georgia
- Kyrgyz Republic
- Republic of Macedonia
- Republic of Moldova
- Russian Federation
- SECID: the Southeast European Center for Surveillance and Control of Infectious Diseases (*Priority countries—Albania, Bosnia and Herzegovina, Kosovo,\* Macedonia, and Montenegro*)
- Ukraine

Armenia and Georgia were awarded vaccine policy cooperative agreements in 2016. These agreements are designed to assist the countries in reviewing current vaccine status within their countries, developing a vaccine program, and implementing the program. Additionally, the Republic of Moldova is participating in the Partnership for Influenza Vaccine Introduction with the Task Force for Global Health with the intent of introducing a vaccine program in their country.

In addition, CDC supports the WHO Regional Office for Europe via a cooperative agreement to provide technical and coordination support to member states.

The core activities of these bilateral agreements are:

- Build sustainable national capacity for the detection and identification of and response to seasonal, avian, and novel influenza
- Develop interagency pandemic preparedness plans
- Strengthen capacity for integrated laboratory and epidemiologic surveillance for influenza-like illness and severe acute respiratory infections, which

includes making routine contributions to WHO's Global Influenza Surveillance and Response System and implementing the International Health Regulations (2005)

- Develop and train local rapid response and containment teams

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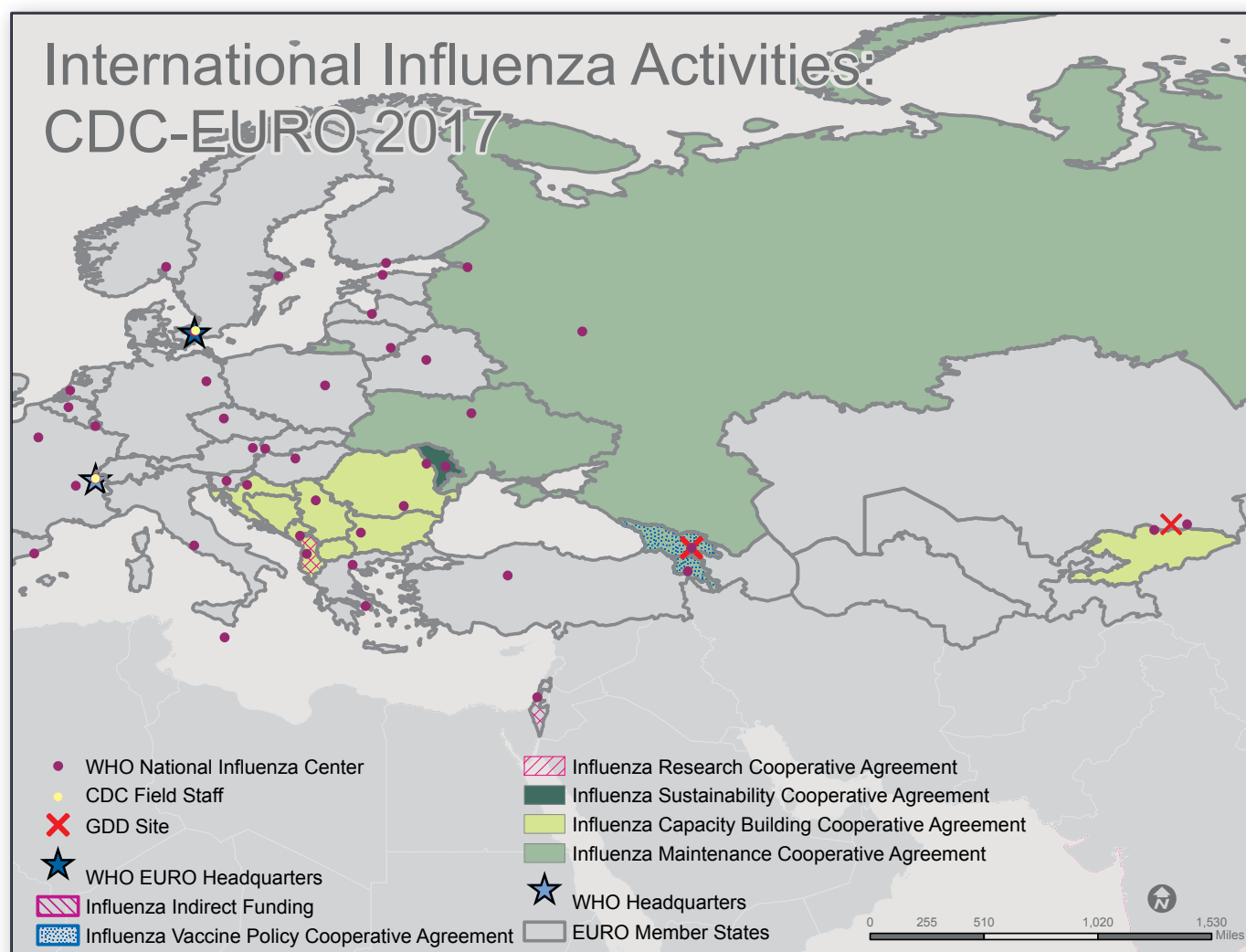
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*\*This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo declaration of independence.*

# WHO Regional Office for Europe [EURO]



## HIGHLIGHTS

- The fifth joint WHO Europe/European Centre for Disease Prevention and Control (ECDC) Meeting on Influenza Surveillance was held for all 53 member states in June, 2016.
- The joint ECDC–WHO Europe *Flu News Europe* bulletin and a rapid risk assessment were published in English and Russian.
- Montenegro’s National Influenza Center became formally recognized by WHO as part of the Global Influenza Surveillance and Response System (GISRS) and 48 of 53 member states shared influenza virus specimens with WHO.
- A guidance document, *Prevention and Control of Outbreaks of Seasonal Influenza in Long-term Care Facilities* (<http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/publications/2017/prevention-and-control-of-outbreaks-of-seasonal-influenza-in-long-term-care-facilities-a-review-of-the-evidence-and-best-practice-guidance-january-2017>), and the *Influenza Sentinel Site Assessment Tool* were published.

## HIGHLIGHTS cont'd

- The Flu Awareness Campaign (<http://www.euro.who.int/en/media-centre/events/events/2014/10/launch-of-flu-awareness-campaign>), a multimedia event, was held with 8 member states participating in the 2015 campaign (Albania, Croatia, Estonia, Latvia, Poland, Lithuania, Romania, and Serbia) and 12 in 2016 (Bulgaria, Croatia, Estonia, Georgia, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, Ukraine).
- Following a 2-year pilot of the Tailoring Immunization Programme in Kaunas, Lithuania (initiated in 2015), influenza vaccination coverage among pregnant women increased from <0.5% to an average of 4.5%, with some pilot sites reaching >20% in 2017.

## U.S. CDC DIRECT SUPPORT

The WHO Regional Office for Europe (WHO EURO) in Copenhagen, Denmark, serves 53 member states with a population exceeding 900 million. Since 2006, WHO Europe has collaborated with CDC on the *Cooperative Agreement for Surveillance and Response to Pandemic and Avian Influenza*. This cooperative agreement (CoAg) has been administered by the High Threat Pathogen team (PAT). Along with its collaboration with CDC, PAT works closely with WHO Headquarters, WHO Country Offices, the European Centre for Disease Prevention and Control (ECDC), the WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs) and for Pandemic and Epidemic Research, as well as regional surveillance organizations and technical bodies.

The third 5-year CoAg with CDC focuses on the following areas: improving the quality of epidemiological and virological surveillance, strengthening early warning and risk assessment, estimating the disease and economic burdens due to influenza, increasing uptake of seasonal influenza vaccine, and communication and advocacy. PAT also collaborates with CDC on developing training (e.g., on data management and surveillance system assessment) and tools (e.g., the *Influenza Sentinel Surveillance Assessment Tool*), and providing mentoring for laboratory quality.

In addition to CDC's financial support, since 2009, a senior epidemiologist has been detailed from CDC to strengthen WHO Europe's activities.

In order to make most efficient use of resources, activities are complementary to those funded through the Partnership Contribution of the Pandemic Influenza Preparedness Framework ([http://www.who.int/influenza/resources/pip\\_framework/en/](http://www.who.int/influenza/resources/pip_framework/en/)).

## SURVEILLANCE

Pandemic, zoonotic, and seasonal influenza cause significant morbidity and mortality as well as a high economic burden. As influenza is often insufficiently prioritized in countries with limited resources, in order to justify surveillance activities and prioritize national influenza vaccination programs, PAT's activities include developing capacity to generate and use influenza surveillance data to evaluate seasonal trends and to estimate disease and economic burden. These data, in turn, inform influenza control and prevention programs.

PAT supports strengthening of the International Health Regulations' national core capacities for early warning and response, through both outpatient and hospital-based sentinel surveillance for influenza.

Countries of the Newly Independent States and selected countries in south-eastern Europe continued to be the main focus for work at the national level in 2015–2017.

Since October 2014, PAT and ECDC have published the Flu News Europe (<http://flunewseurope.org>) bulletin weekly during the influenza season in both English and Russian.

## SURVEILLANCE ACTIVITIES

- The fifth joint WHO Europe/ECDC Meeting on Influenza Surveillance for 50 countries in the region was held in 2016. The third and fourth meetings were held for countries of the Newly Independent States in 2015 and 2017, and these states participated in the ECDC Annual Influenza Meeting in 2017.
- Data from 50 member states were analyzed, summarized, and published weekly in English and Russian in the Flu News Europe bulletin during the influenza season and monthly during the summer.

- A summary of epidemiological and virological data was provided for the 2017 northern hemisphere vaccine composition report developed by the WHO CC in London.
- Tools were developed to support reviewing, monitoring, and strengthening of national surveillance systems, including an electronic surveillance assessment tool and a feasibility tool for selection of severe acute respiratory infection (SARI) sentinel sites.
- Country profiles of the national influenza surveillance systems of all member states in the region were created and published on the WHO website (<http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/surveillance-and-lab-network/influenza-surveillance-country-profiles/influenza-surveillance-country-profiles-of-who-european-region-member-states>).
- Technical assistance was provided to 5 member states (Belarus, Kazakhstan, Romania, the Russian Federation, and Ukraine) to obtain estimates of the burden of influenza in their nations.
- The Flu Awareness Campaign (<http://www.euro.who.int/en/media-centre/events/events/2014/10/launch-of-flu-awareness-campaign>), a multimedia event, was held with 8 member states participating in the 2015 campaign (Albania, Croatia, Estonia, Latvia, Poland, Lithuania, Romania, and Serbia) and 12 in 2016 (Bulgaria, Croatia, Estonia, Georgia, Latvia, Lithuania, Poland, Portugal, Romania, Slovakia, Slovenia, and Ukraine).
- Development of guidelines to increase influenza vaccine uptake in targeted populations (pregnant women and health care workers), based on Tailoring Immunization Programmes for Influenza guidance (<http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/news/news/2013/11/developing-tailored-solutions-to-increase-influenza-vaccination-uptake-among-health-care-workers>), continued.
- Prevention and control of outbreaks of seasonal influenza in long-term care facilities: a review of best-practice guidance (<http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/publications/2017/prevention-and-control-of-outbreaks-of-seasonal-influenza-in-long-term-care-facilities-a-review-of-the-evidence-and-best-practice-guidance-january-2017>) was published in English and Russian.
- The PAT website was redesigned to better address user needs, based on analyses of users' website activity.

## LABORATORY

Through the CoAg, PAT provides National Influenza Centers (NICs) in the WHO European Region with technical assistance and capacity building on influenza laboratory surveillance, preparedness, and response; training in influenza laboratory techniques; support to improve laboratory management and quality; assistance with shipment of viruses to WHO CCs; and reagents for influenza testing—all with a view to achieve and maintain recognition by WHO of NICs in all member states. Activities are tailored to the specific capacities and needs of the individual NICs and national influenza laboratories in the region.

### LABORATORY ACTIVITIES

- PAT's ongoing support in this area resulted in Montenegro's NIC achieving WHO formal recognition in 2017; only 8 member states in the region have an influenza surveillance system, but do not yet have a WHO-recognized NIC.
- A total of 48 member states in the WHO European Region shared influenza viruses with the WHO Global Influenza Surveillance and Response System.
- A total of 21 member states reported antigenic or genetic characterization data to WHO. Nineteen countries reported preliminary antigenic characterizations and 21 reported genetic characterizations, while 14 of these countries reported both. Twelve countries monitor and report weekly on antiviral susceptibility of influenza viruses.
- The number of laboratories in the WHO European Region participating in the WHO External Quality Assessment Program increased from 34 in 29 countries in 2007 to 65 in 50 countries in 2017.
- NICs in 5 countries of south-eastern Europe (one of which is recognized by WHO; another is in the process of obtaining recognition through the program) were mentored in laboratory quality in collaboration with CDC and Association of Public Health Laboratories.

## PREPAREDNESS

In response to numerous outbreaks of zoonotic influenza in the region, including human cases of variant influenza (i.e., human infections with viruses that normally circulate in swine) and outbreaks of avian influenza in birds, PAT provided technical assistance to countries and assisted in risk assessments by ECDC and WHO Headquarters on influenza at the human-animal interface. The WHO Risk Assessment on Zoonotic Influenza is now routinely translated into Russian and posted on the WHO Europe website. In addition, PAT assisted in the development and piloting of the WHO Tool for Influenza Pandemic Risk Assessment.

Due to a severe and early start to the influenza season in late 2015, a rapid risk assessment was conducted and published in February 2016 as a peer-reviewed publication. During this influenza season, PAT also conducted emergency missions to support responses in Armenia and Ukraine.

Guidance for the control of influenza in long-term care facilities was developed together with the WHO CC for Pandemic Influenza and Research, University of Nottingham, United Kingdom, with input from experts from the influenza network and ECDC.

### PREPAREDNESS ACTIVITIES

- Twelve countries have published revised pandemic preparedness plans since the 2009 pandemic, up from 8 in 2015 (<http://www.euro.who.int/en/health-topics/communicable-diseases/influenza/pandemic-influenza/pandemic-preparedness/national-preparedness-plans2/publicly-available-plans-prepared-after-2009-pandemic>).
- The translation into Russian of WHO Europe's influenza website (<http://www.euro.who.int/ru/health-topics/communicable-diseases/influenza/zoonotic-influenza/ru-monthly-global-risk-assessment-for-human-illness-from-avian-and-swine-influenza>) was completed.
- A survey was conducted among member states on public health measures implemented in response to outbreaks of avian influenza A(H5), and a report describing strengths and weaknesses was published.
- The third meeting of the joint WHO Europe and ECDC working group on influenza surveillance characterization data was held in October 2015 in Greece.

- The 1-year milestone meeting of the south-eastern Europe quality assurance mentor program for national influenza laboratories was held in May 2016.
- A peer-reviewed paper on global influenza vaccine policies was co-authored with WHO Headquarters.
- Technical assistance was provided to Armenia and Georgia in connection with a grant from CDC for the implementation of influenza vaccine policies, in association with WHO's Pandemic Influenza Preparedness (PIP) Framework.
- A facilitator at the WHO Eastern Mediterranean Region Office was provided to organize a training on pandemic management and leadership, held in April 2016.

## TRAINING

- A CDC training course on sentinel surveillance evaluation for countries of south-eastern Europe was co-facilitated in Sarajevo in February 2017.
- A training in antiviral susceptibility assays was held by the WHO CC for Portugal's NIC in December 2016.
- A visit was conducted to assess the capacity of the national influenza laboratory in the former Yugoslav Republic of Macedonia, November–December 2016.
- A webinar for virologists from NICs was offered in January 2016.
- A workshop was held to assist Belarus, Kazakhstan, the Russian Federation, and Ukraine in estimating national disease burden from seasonal influenza.
- Seventeen virologists from the European Region were trained on laboratory preparedness for emerging respiratory pathogens.
- A training in Introduction to Laboratory Quality Management and the Laboratory Quality Stepwise Implementation (LQSI) tool was held for all South Eastern Europe countries and for all Newly Independent States.
- The WHO Strengthening Capacities of Influenza Laboratory Experts training was held for NICs.
- Critical care training for 140 intensive care clinicians was held in 5 countries.

In addition to the above courses, CDC-funded personnel have provided support in 17 training courses held under WHO's PIP Framework.

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# ARMENIA



Van displaying message regarding vaccine and health in Armenia.

## OVERVIEW

In 2006, the State Hygiene and Anti-Epidemic Inspectorate (SHAEI) of the Ministry of Health (MOH) in Armenia began a cooperative agreement with CDC to develop and enhance influenza surveillance and laboratory capacity. Since 2010, Armenia has conducted surveillance for both influenza-like illness (ILI) and severe acute respiratory infection (SARI) in the cities of Yerevan, Kapan (Syunik marz [region]), and Vanadzor (Lori marz), and the sentinel surveillance system now includes a fully functioning PCR laboratory in each city. With a focus on avian and human influenza, Armenia's epidemiological surveillance capacity has been enhanced since the beginning of its partnership with CDC. In Fiscal Year 2016, Armenia progressed to a maintenance phase and is incorporating all activities under the control of the recently formed National Center for Disease Control and Prevention.

## SURVEILLANCE

The operation of the Influenza Sentinel Surveillance System in 5 sentinel sites with good geographic and demographic representation was sustained and maintained. Sentinel site data were collected, combined, and analyzed and a standard report was produced weekly. Reporting included information on ILI. Surveillance data were submitted on a weekly basis and included in the joint European Center for Disease Prevention and Control (ECDC)–WHO

## HIGHLIGHTS

- Samples were shipped to the WHO Collaborating Center for Reference and Research on Influenza in London on an annual basis.
- Surveillance data were regularly submitted to and included in the joint European Center for Disease Prevention and Control–WHO Europe Flu News Europe bulletin and the European Surveillance System (TESSy), as well as being published weekly on FluNet and FluID.
- An influenza awareness campaign and awareness raising workshops were conducted in all marzes (regions) of Armenia. School personnel and kindergarten teachers, caretakers, and nurses were included. These campaigns reached a total of 624 people. Additionally, the campaign targeted medical personnel from both hospitals and polyclinics (doctors—pediatricians, family doctors, general physicians, etc.), reaching 950 people overall.

Europe *Flu News Europe* bulletin and the European Surveillance System (TESSy), a regional database for influenza data storage. FluNet and FluID are the main data storage systems for influenza data for WHO, and Armenia continues to contribute data to both these systems on a regular basis. Trainings for country epidemiologists (55 people) were conducted throughout the reporting period. Influenza awareness campaigns were also performed, as were awareness-raising workshops throughout the country.

## SURVEILLANCE ACTIVITIES

- The Influenza Sentinel Surveillance System operated as planned in 5 sentinel sites with good geographic and demographic representation (Yerevan, Vanadzor, Kapan, Nairi, and Ijevan).
- Surveillance data were submitted weekly to all electronic systems including the joint ECDC–WHO Europe *Flu News Europe* and TESSy, FluNet, and FluID.
- An influenza awareness campaign with awareness-raising workshops was conducted in all marzes of Armenia with school personnel; 624 people were trained.



- A training was conducted for medical personnel in hospitals and polyclinics (doctors—pediatricians, family doctors, general physicians, etc.) that reached 950 people.
- Training was conducted for 55 epidemiologists throughout the country.
- The information management system was reviewed to ensure coordination among the sentinel sites and that national and WHO (including FluNet and FluID) reporting requirements are met.
- Sentinel site data were combined and analyzed, and a standard weekly report including information on ILI cases was produced.

## LABORATORY

Routine and ongoing influenza testing from ILI and severe acute respiratory infection (SARI) sites in sentinel laboratories was performed as planned. Samples were shipped on an annual basis to the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in London. As a part of external quality control testing, Armenia participated in CDC's Performance Evaluation Panels for influenza testing by RT-PCR, with the result of 100% detected correctly. To increase laboratory capacity and prepare for influenza virus isolation and typing, the laboratorians were trained using current WHO reagents and techniques after the necessary reagents were identified and procured.

After implementing virus isolation, the laboratory has begun the process for formal recognition as a National Influenza Center by WHO.

### LABORATORY ACTIVITIES

- Routine and ongoing influenza testing from ILI and SARI sites in sentinel laboratories was performed as planned (825 and 1,399 samples were collected, respectively).
- Samples were shipped to the WHO CC in London (40 and 70 samples) on an annual basis.
- CDC's Performance Evaluation Panels for influenza testing by RT-PCR were completed, with a score of 100% detected correctly.
- The biosafety and biosecurity of laboratories was maintained according to national and international standards.

- Training was conducted for laboratorians in preparation for influenza virus isolation and typing using current WHO reagents and techniques after necessary reagents were identified and procured.

## PREPAREDNESS

Surveillance for outbreaks of severe respiratory and febrile illnesses was maintained. An event-based surveillance system was developed to identify potential outbreaks of severe respiratory diseases. Communication materials for use during pandemic situations were maintained.

### PREPAREDNESS ACTIVITIES

- Health care workers and clinicians were trained on recognizing, treating, and reporting respiratory diseases.

## TRAINING

- Trainings are continuously provided under the cooperative agreements. Fifty-five epidemiologists were trained to maintain capacity in routine influenza surveillance, analysis, and outbreak preparedness and response.
- Trainings were conducted to improve the capacity of laboratory staff in molecular techniques for influenza detection (5 people).
- Training was also provided to health care workers and clinicians on how to identify and test for influenza and other respiratory diseases.

## INFLUENZA VACCINE ACTIVITIES

- Armenia expanded vaccine coverage from 15,000 doses in the 2015–2016 season to 60,000 doses in the 2016–2017 season; 50% of the uptake was among the military population.
- A knowledge, attitudes, practices, and behavior survey was implemented to identify the facilitators and barriers to influenza vaccine acceptance among key risk groups, including health care workers, pregnant women, and children under the age of 5.
- Several training and communication campaigns were designed and implemented to improve awareness and understanding of seasonal flu and flu vaccine benefits and risks among the general public, journalists, and health care providers.
- Consultations on influenza vaccination strategy were conducted with decision makers, professional associations, and public health organizations.

# BOSNIA AND HERZEGOVINA



## OVERVIEW

Fiscal Year 2016 marks the beginning of a direct partnership between CDC and the Ministry of Civil Affairs (MoCA) in Bosnia and Herzegovina (BiH). As a member of the South East European Center for Infectious Diseases Surveillance and Control (SECID), BiH began work to improve influenza surveillance and laboratory testing under the SECID cooperative agreement and with assistance from SECID. They continue this work with their new direct funding opportunity, and are in the initial years of capacity building. They will work to provide a country-level view of influenza, bringing together several distinct political entities. The capacity building project period continues through 2021.

## SURVEILLANCE

BiH, in collaboration with SECID, has been building surveillance capacity within their country for several years. In 2016, BiH applied for their own CDC grant to improve surveillance capacity and expand on the work begun with the assistance of SECID. The Institute for Public Health of the Federation of BiH (FBiH) participated in an evaluation training course and developed a plan to review the surveillance system currently in place, and to build in measures to maintain an effective system in the future. Surveillance activities in both entities continue and will be revised to ensure an accurate view of influenza in BiH.

## SURVEILLANCE ACTIVITIES

- Participants in the surveillance evaluation course reviewed their surveillance systems and current plans, and developed a protocol for ongoing evaluation and measurement of the quality of the surveillance systems. The protocol for FBiH was finalized and implemented through the remainder of 2017. Republika Srpska participated in the course as well and will be reviewing their system in 2017.
- FBiH plans to expand the number of surveillance sites in order to increase population coverage and gain more insight into influenza in their region.
- As a member of the SECID network, both the FBiH and the Republika Srpska reviewed procedures and processes to improve overall surveillance activities.

## HIGHLIGHTS

- The Ministry of Civil Affairs of Bosnia and Herzegovina (BiH) applied to a CDC request for proposals and received an award in Fall 2016.
- Necessary administrative requirements (both internal to BiH and external CDC/US government requirements) were met to open banking accounts and begin the project.
- The BiH-level coordination team was established, as were Institute for Public Health of the Federation of BiH (FBiH) and Republika Srpska entity-level implementation teams, as well as Brčko district and Veterinary office teams.
- The first Steering Committee meeting of the project was organized.
- The surveillance team from FBiH participated in a training session to develop a protocol for evaluation of the influenza surveillance system.
- Laboratory teams from both Sarajevo and Banja Luka continued participation in a laboratory mentoring program.
- Based on successful completion of Year 1 activities, each laboratory developed a set of Year 2 activities. In Year 2, the laboratory staff assumed leadership of processes from their Association of Public Health Laboratories (APHL) mentors, and were increasingly responsible for completion and implementation of activities. A monthly status report was completed for APHL in order to monitor forward progress.
- Both laboratories completed Year 2 activities and were invited to participate in a week-long training course at the mentor's US laboratory. Staff attended the training in May 2017 and successfully completed training, obtaining knowledge and procedures to implement in their own facilities.
- Banja Luka laboratory participated in the CDC Quality Panel in February 2017, scoring a 90% accuracy rate.
- Both laboratories participated in the WHO External Quality Assessment Project panels, and both received a 100% proficiency score.
- Both laboratories continue to implement training and purchasing equipment to implement virus isolation and apply for National Influenza Center recognition from WHO.

- Activities continue, and with the support from the CDC cooperative agreement, a review of the systems in each entity is planned in successive years.

## LABORATORY ACTIVITIES

- Laboratory teams from both Sarajevo and Banja Luka participated in laboratory mentoring program, successfully completing Year 2 activities. Together with their mentor, each laboratory staff developed a training plan for each year. Via monthly calls and email exchanges, the laboratories completed the activities in Year 1.

## PREPAREDNESS

Activities during the first year of the project focused on administrative tasks necessary to implement and successfully complete the project over the next 5 years. Therefore, the project has completed limited activities in the area of preparedness. Activities were planned to begin in late 2017 and continue into the second year of the project. Preparation of an overview of the existing surveillance systems and revising the pandemic preparedness plans was planned for Fall 2017, continuing into Spring 2018. Planning has begun and communication with relevant health care institutions has been initiated.

### *PREPAREDNESS ACTIVITIES*

- An overview of the existing surveillance system was conducted September–December 2017.
- Revisions of pandemic preparedness plans were implemented from November 2017–March 2018.

## TRAINING

- Laboratory staff from both FBiH and Republika Srpska attended a Biosafety Training in May 2016 in Zagreb, Croatia.
- Laboratory staff attended a virus isolation training in May 2016 in California, USA.
- Surveillance staff (1 from MoCA, 3 from FBiH, and 2 from Republika Srpska) attended a surveillance evaluation training course in Sarajevo, BiH in February 2017.
- The Project Coordinator participated in the grants management training organized by CDC/ Training Programs in Epidemiology and Health Interventions Network (TEPHINET) in Tanzania in May of 2017.
- Training of trainers for laboratory staff was conducted in June 2017. The training involved experts from BiH as well as foreign experts to equip participating laboratory staff with necessary skills to disseminate good practices within their laboratories in accordance with international laboratory standards and scientific best practice.

# GEORGIA



## OVERVIEW

The partnership between CDC and the National Center for Disease Control and Public Health of Georgia (NCDC) began in 2006. Fiscal Year (FY) 2016 was the fifth year of funding for NCDC's second cooperative agreement with CDC, with an implementation period from 2011 to 2016. The purpose of the agreement was to sustain improvements made during the capacity building phase. In 2017, NCDC received a third cooperative agreement designed to help maintain the gains made during the previous 2 project periods and provide a transition period for the NCDC to take full control of all functions necessary to maintain influenza surveillance in their country. The transition period is from 2016 to 2021.

## SURVEILLANCE

Activities conducted from October 1, 2015 to September 30, 2017 focused on support and maintenance of the influenza-like illness (ILI) and severe acute respiratory infection (SARI) sentinel surveillance systems in Georgia. Sentinel sites and the National Influenza Center (NIC) were provided with all the necessary supplies to monitor viruses within the country. Additionally, Georgia worked to increase awareness and knowledge of health care providers and the staff of NCDC through trainings and attendance at various workshops and international conferences (including the OPTIONS for the Control of Influenza IX conference, August 24–28, 2016, and the Influenza Annual Meeting in Hungary, Budapest). Staff attended a workshop on advanced data management designed to improve knowledge of data analysis for reporting and identifying potential pandemics (held in Amsterdam, the Netherlands, in 2016).

### SURVEILLANCE ACTIVITIES

- The NIC obtained all reagents and supplies necessary for permanent and appropriate functioning. All the supplies procured ensured maintenance of the biosafety level required for working on influenza specimens and isolates according to national and international standards.
- All 6 sentinel sites obtained supplies necessary for their efficient operation.

## HIGHLIGHTS

- Georgia maintains an influenza surveillance system providing epidemiological and laboratory data of both local and international importance.
- Due to a transition period, the Government of Georgia covered expenses incurred between the previous and current cooperative agreements. This represents the first official support of the program from the government.
- The WHO National Influenza Center has qualified personnel and successfully participated in the WHO External Quality Assessment Project and CDC External Quality Assessment panels with 100% scores.
- Progress in laboratory surveillance capacity led to significant enhancements benefiting both Georgia and the Global Influenza Surveillance and Response System (GIS). Sequencing capacity was implemented—beneficial for Georgia as well as network members—and sequence data were uploaded to the Global Initiative on Sharing All Influenza Data website.
- The WHO Collaborating Center for Reference and Research on Influenza in London selected one of Georgia's collected isolates as an A(H3N2) reference virus in 2015.
- The NIC received specimens collected by those sites on a weekly basis.
- Standard reports on influenza, including analysis of SARI and ILI data, were uploaded to the NCDC website on a weekly basis.
- The Project Management Unit visited sentinel sites to evaluate whether all procedures were being followed according to standard protocols, and made corrections as needed.
- Virological and epidemiological data were submitted electronically to the European Surveillance System (TESSy) on a weekly basis.
- All documents and procedures developed and undertaken during the reporting period were reviewed and agreed to by local experts in order to meet Georgian legislative and international requirements.

- The NCDC team has collected and analyzed data from medical records of all confirmed lethal influenza cases (influenza season 2015–2016) and provided a report to the Ministry of Health.
- NCDC staff conducted trainings for health care providers on various aspects of influenza.

## LABORATORY

The NIC remains the only laboratory responsible for testing human influenza specimens throughout the country. The NIC worked closely with WHO and CDC to improve its capacity for influenza laboratory testing by participating in several training programs on validation and verification of molecular methods, virus isolation, hemagglutination inhibition assays, sequencing, and bioinformatics. The NIC of Georgia provided technical advice to a regional laboratory working on avian influenza specimens and assisted in testing when needed.

Progress in laboratory surveillance capacity has led to significant enhancements benefiting both Georgia and the GIS. The WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in London selected 1 of the Georgian isolates as an A(H3) reference virus in 2015.

### LABORATORY ACTIVITIES

- The NIC tested a total of 2,856 influenza specimens (1,002 from sentinel ILI sites; 1,538 from sentinel SARI hospitals; and 316 from non-sentinel hospitals).
- The NIC submitted 55 positive samples to the WHO CCs: 45 samples to the WHO CC in London and 10 to the WHO CC Atlanta as part of the WHO Global Influenza Surveillance Network.
- The NIC successfully participated in External Quality Assessment programs organized by WHO and CDC.
- NIC personnel attended various trainings on PCR validation/verification, virus isolation/subtyping by hemagglutinin inhibition assay, and bioinformatics trainings provided by WHO and CDC (in St. Petersburg, Russia and Hong Kong, respectively).
- NIC staff provided training to the Imereti Zonal diagnostic laboratory in influenza real-time PCR assay performance.
- On several occasions, the NIC assisted the regional laboratory in timely testing of avian influenza specimens obtained from wild birds.

- NIC staff conducted 2 poster presentations at the European Scientific Working Group on Influenza (ESWI) conference in Riga, Latvia, September 10–13, 2017.

## PREPAREDNESS

During the last 10 years, the national preparedness plan for influenza was finalized with support from a World Bank project. The plan was developed and reviewed by public health experts and representatives from other relevant sectors of the government. Portions of the plan have been tested through tabletop exercises. The preparedness plan was utilized during the 2009 influenza A(H1N1) pandemic. The *National Preparedness Influenza (NPI) Operational Plan* is updated annually in accordance with epidemiological situation and needs. In November 2016, representatives from the Ministry of Health and NCDC of Georgia participated in the Inter-Country Workshop on Pandemic Preparedness for Newly Independent States conducted by the WHO Regional Office for Europe in Tbilisi, Georgia.

### PREPAREDNESS ACTIVITIES

- The NPI Operational Plan was updated during influenza seasons 2015–2016 and 2016–2017.
- Trainings including topics on pandemic preparedness were conducted by NCDC staff throughout the country for health care providers.

## INFLUENZA VACCINE ACTIVITIES

As a result of the National Preparedness Plan, for the first time in Georgia, high-risk groups were identified and vaccinated with seasonal influenza vaccine, and immunization awareness campaigns were organized for the general population and regional public health center specialists. Eight thousand doses of vaccine were purchased with government funds and administered to high-risk groups, with 500 doses of vaccine used for vaccinating NIC personnel, sentinel site staff, and epidemiologists involved in the ILI and SARI surveillance systems. Additionally, 2,000 doses of vaccine were purchased through a Global Fund project for vaccination of HIV-infected individuals.

NCDC began a new cooperative agreement with CDC's Influenza Division in FY 2016 focused on the development of influenza vaccine policy. Activities focused on creation of an evidence base for seasonal influenza vaccine policy and expansion of vaccination programs. Highlights of those activities include:



- A review of existing data on costs of influenza immunization programs, coverage levels, adverse events, acceptability, and effectiveness was completed by a working group made up of key Ministry of Health, NCDC, and medical regulation agency members, as well as national immunization experts.
- A knowledge, attitudes, and practices survey was conducted exploring gaps, barriers, knowledge, attitudes, and reasons for unacceptability of seasonal influenza immunization among medical providers and pregnant women.
- Focus group discussions focusing on vaccination were carried out in 3 sites: Tbilisi, Kutaisi, and Batumi.
- Enhanced surveillance of SARI admissions in pregnant women was established in 2 large referral hospitals in Tbilisi.
- Data from NCDC surveillance as well as from non-routine surveillance systems were collected and analyzed to establish both disease incidence and prevalence and the economic burden of influenza in Georgia.
- The Georgian National Immunization Technical Advisory Group was provided with materials on seasonal influenza and influenza vaccination in order to conduct an evidence-based review and elaborate recommendations for influenza vaccination policy.

# KYRGYSTAN

## OVERVIEW

Fiscal Year (FY) 2017 is the fifth year of CDC's capacity building cooperative agreement with the Department of Disease Prevention and State Sanitary and Epidemiological Supervision of the Ministry of Health (MOH) of the Kyrgyz Republic. During the first 5 years of the collaboration, the MOH conducted trainings, identified and purchased needed equipment, and developed surveillance guidelines to strengthen capacity for surveillance of influenza and other diseases, which had been previously established in the country. Additionally, several evaluations of sites and processes were conducted to identify areas of improvement and aid in designing overall project plans. As FY 2017 and the capacity building cooperative agreement moved to an end, the Department of Disease Prevention and State Sanitary and Epidemiological Supervision of the Kyrgyz Republic MOH were well positioned to move into a more sustainable model for surveillance.

## SURVEILLANCE

Epidemiologic control in Kyrgyzstan covers 38 infectious diseases including influenza and acute respiratory viral infection (ARVI). Activities are targeted to prevent and identify hotspots at early stages. Reports with data about infectious diseases (influenza and ARVI-focused) are communicated by 53 offices of State Sanitary Control (SSC) on a weekly and monthly basis. Due to support provided since 2013 by CDC, there are ongoing epidemiologic surveillance activities for severe acute respiratory infection (SARI) and influenza-like illness (ILI).

In order to define influenza episodes, epidemiological thresholds were developed for 7 regions and 2 cities. Surveillance sites were provided with desktop and laptop computers.

### *SURVEILLANCE ACTIVITIES*

- To share experience and improve epidemiological control in the surveillance sites, epidemiologists from Bishkek city and Tokmok town visited surveillance sites in Osh city.
- Two monitoring and evaluation missions were conducted to inspect ongoing surveillance

## HIGHLIGHTS

- Epidemiologists, infectious disease specialists, and virologists were trained in strengthening of epidemiological influenza control; implementation of infectious control related activities within medical centers and hospitals during epidemiological influenza and acute respiratory infection season; and preparedness for an influenza pandemic.
- Overall, 220 health providers were trained.
- Fifteen PCs with printers and 5 laptops were purchased for the Disease Prevention Centers and local offices of the State Sanitary Control to setup a database for influenza analytics.
- Forty-eight rayon (district) and municipal (town) Disease Prevention Centers and local offices of State Sanitary Control were provided with Internet connections.
- A social media video regarding influenza and acute respiratory viral infection prevention was produced to inform the general population.
- Virologic laboratories obtained test systems to diagnose influenza.
- Personal protection equipment sets (585 sets) were purchased for working in hotspots in of the event of an influenza pandemic.
- Influenza prevention information materials (handouts) were developed, replicated, and distributed among school children, pregnant women, and the general population.

activities along with a study of case records kept at the surveillance sites in Bishkek, Osh, and Tokmok towns.

- National recommendations on influenza infection control have been supported by local experts in accordance with WHO and CDC recommendations.
- A Guide on Infectious Disease Episode Response was developed, where influenza-related topics were included in support of the International Health Regulations (IHR 2005). The guide covers collection and transportation of samples taken from patients with SARI.

- The national influenza team, regional disease prevention offices, and SSC offices (48 offices in total) were provided with Internet connections.

## LABORATORY

Virologic laboratories have improved their access to test systems and reagents for influenza diagnostics. Samples (isolates and patient specimens) are forwarded annually to the partner influenza centers including both CDC in Atlanta and the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in London, where samples are confirmed and the viruses' nucleotide sequences are identified. The national laboratory participates annually in professional testing through WHO's External Quality Assessment Project (EQAP) panels and every 2 years in the CDC-sponsored External Quality Assessment Panel. Proficiency testing results to date have been 100%.

### LABORATORY ACTIVITIES

- Samples (isolates and native samples) are forwarded annually to partner influenza centers—CDC in Atlanta and the WHO CC in London—to confirm and identify the viruses' nucleotide sequences.
- The national laboratory participates annually in the WHO EQAP testing for molecular/genetic approaches, and every 2 years in the CDC-sponsored panel. Confirmation results are 100%.
- Virologic laboratories in Bishkek and Osh cities, and in Issyk Ata district (Chui region) were provided with on-the-job training on laboratory diagnostics for influenza and laboratory assessment.
- Virologic laboratories now have improved access to test systems and reagents for influenza diagnostics.
- Laboratory assessment was conducted with CDC and the Association of Public Health Laboratories in April 2017.
- The Directive issued by the Kyrgyz MOH for routine epidemiologic control of influenza was revised and updated for laboratory diagnostics of influenza and ARVI.
- Two laboratory staff were trained at the Influenza Research Institute in St. Petersburg (Russia) on isolation techniques and definition of influenza viruses.

- Three staff from the State Sanitary and Epidemiological Surveillance Center were trained at the Influenza Research Institute in St. Petersburg (Russia) on influenza molecular diagnostics.
- Laboratory equipment—a steam sterilizer, incubator, refrigerator, freezer, Dewar flask, automatic pipettes and other needed equipment—was purchased.
- In total, 37 health providers and laboratory staff were provided with training on sampling, storing, transportation, and laboratory diagnostics of influenza by staff of surveillance sites.

## PREPAREDNESS

Urgent response training was delivered for pandemic influenza case registration among the population of Chui region. The training included interactions between health facilities (a territorial hospital, Family Medicine Center, Diseases Prevention Department [DPD], and the SSC office).

The training was provided with participation from managers of health facilities, representatives of veterinary service, Ministry of Emergency Situations, and local state administrations, followed up by discussions of the training findings. In total, 40 health providers took part in this training.

### PREPAREDNESS ACTIVITIES

- To assess the capacity of health facilities in case of an influenza pandemic, their preparedness level was assessed with the use of questionnaires developed to assess preparedness of Family Medicine Centers, hospitals, and Diseases Prevention Centers (Offices). The assessment covered 7 regions with 21 health facilities.
- Workshops were held that were dedicated to pandemic preparedness where issues of clinical and laboratory diagnosis of SARI were discussed. Infectious disease specialists, epidemiologists, and laboratory experts participated.

## TRAINING

- Health providers of surveillance sites attended relevant annual trainings at the beginning of every epidemiologic season. Trainings topics included SARI, ILI, use of standard case definitions, and reporting.
- By the end of the epidemiologic season, the database for SARI and ILI was managed by surveillance sites. They use EpiInfo software to



analyze data to further identify gaps and possible errors, and provide relevant items for discussion to improve epidemiologic control activities in the next season.

- Kyrgyzstan organized the following trainings in 2016: one for epidemiologists to improve epidemiologic surveillance of routine influenza; one for epidemiologists and health providers of Family Medicine Centers to improve infection control activities in health facilities during influenza and ARVI season; and one for infectious disease specialists and epidemiologists in influenza pandemic preparedness.
- Representatives of DPD and SSC took part in sessions of conferences with CDC and WHO on influenza in Budapest, St. Petersburg, and Tblisi.

# REPUBLIC OF MACEDONIA



## OVERVIEW

In 2013, CDC began work with the South East European Center of Infectious Diseases Surveillance and Control (SECID) Foundation, Albania, to build capacity for pandemic preparedness, communication, surveillance, monitoring, early response, and infection control. As a member of the Foundation, Macedonia participated in all capacity building activities, making significant progress during the first 3 years. In 2016, the Institute of Public Health, Republic of Macedonia, was awarded direct funding to continue efforts to build capacity and improve the surveillance system in the country. Fiscal Year 2016 was the first year of a 5-year cooperative agreement.

## SURVEILLANCE

The primary influenza surveillance system in Macedonia relies on mandatory notification for communicable diseases; all physicians are obliged to report 64 diseases, including influenza. In the 2014–2015 season, with support from SECID, a pilot project was initiated for sentinel surveillance of influenza-like illness (ILI), acute respiratory illness (ARI), and severe acute respiratory infection (SARI). The objectives were to obtain more precise data on the burden of disease and disease intensity as well as circulating viruses. The sentinel surveillance system started with 6 sites, expanding to 13 in 2015/2016, and covering 1.7% of the population. In the 3 influenza seasons, 181 sentinel samples were collected from ILI patients; 64 (35.4%) were positive for influenza. Additionally, 294 non-sentinel specimens were collected, 92 (31.3%) of which were positive. Influenza B predominated in the 2014–2015 season, influenza A(H1N1)pdm09 and B/Victoria viruses co-dominated in the 2015–2016 season, and influenza A(H3) was predominant in the 2016–2017 season.

## SURVEILLANCE ACTIVITIES

- Epidemiologists from the Institute of Public Health (IPH) made regular visits to each of 13 sentinel sites across the country.
- A team from IPH (epidemiologists and virologists) prepared and updated protocols for sentinel surveillance of influenza; the case definitions in use are in accordance with WHO recommendations.

## HIGHLIGHTS

- Laboratory capacity was increased, with the goal of eventual recognition as a National Influenza Center according to WHO standards.
- Estimation and use of thresholds for baseline activity, a typical epidemic curve, and an alert threshold were implemented using WHO Global Influenza Surveillance Standards from 2013.
- Estimation and use of influenza activity levels were carried out using the Moving Epidemic Method .
- Evaluation of the influenza sentinel surveillance system will be conducted in 2017.
- Surveillance data were submitted on a weekly basis to the European Influenza Surveillance System (TESSy), a regional database for influenza data storage used by the European Center for Disease Prevention and Control and the WHO European Region.
- Weekly feedback reports, available at [www.iph.mk](http://www.iph.mk), were distributed to the Ministry of Health, Centers for Public Health, and data providers.
- In 2015, seasonal thresholds, a typical epidemic curve, and an alert threshold were established using WHO Global Influenza Surveillance Standards from 2013.
- For the 2015/2016 season, influenza activity levels (low, medium, high, and very high) were calculated using the Moving Epidemic Method from the European Centre for Disease Prevention and Control (ECDC).
- Weekly influenza reports were produced with information for the country and region. These reports were shared with data providers, epidemiologists at the regional and local levels, and decision makers, and were made available online at [www.iph.mk](http://www.iph.mk).
- Laptops for ILI and SARI sentinel sites were provided as an incentive and a tool to report epidemiological data.
- In 2017, an evaluation of the sentinel influenza surveillance system was performed using a protocol and tools developed during a workshop

on influenza surveillance evaluation in Sarajevo in 2017.

- The epidemiologic team is in the process of analyzing data from the evaluation with an emphasis on improving the system, making it more acceptable and less complicated for the participants, and a further emphasis on finding sustainable ways to increase the number of specimens collected.

## LABORATORY

During the period September 2016 to June 2017 the following activities were performed: existing standard operating procedures (SOPs) for molecular diagnosis and cell cultivation of influenza were revised; internal trainings of laboratory staff were held on cleaning biosafety cabinets (BSCs), transporting infectious materials, and responding to biological and chemical spillages; a biosafety officer, equipment officer, and quality assurance officer were nominated; and a draft biosafety manual and quality manual were in preparation, as well as laboratory inventory and a plan for equipment maintenance.

Positive samples were shared with WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs) in London and at CDC in Atlanta. Lab results were reported in a timely manner to the sentinel sites, Ministry of Health, and EuroFlu. The annual number of specimens tested for influenza increased. Laboratory staff were involved in the sentinel site visits to provide training and information to site staff on proper sample retrieval, storage and transport. Purchases of equipment, reagents, and supplies for cell culture and PCR, as well as regular service and maintenance of lab equipment, were initiated.

### LABORATORY ACTIVITIES

- The number of specimens collected and analyzed increased from 119 in the 2015–2016 season to 176 in 2016–2017 season: 71 samples were from ILI/ARI sites, 15 samples were from SARI sites, and 90 samples were from routine surveillance. Sixty-five of 176 samples were influenza positive; 62 were influenza A and 3 were influenza B. Influenza A(H3) was dominant.
- New SOPs were developed for use of personal protective equipment, for prevention of contamination, for entering results in the lab information system, and for documentation and reporting.

- Internal trainings of the laboratory staff were conducted on cleaning the BSC in September 2016; transport of infectious materials in October 2016; and responding to biological and chemical spillages in October 2016.
- In January 2017, 20 samples were sent to the WHO CC in London. In March 2017, 25 samples from the 2016–2017 season were sent for further characterization to CDC in Atlanta.
- Laboratory staff were involved in sentinel ILI/ARI/SARI site visits to 13 ILI/ARI sites and 5 SARI sites.
- Training was conducted for ILI/SARI site personnel in October 2016.
- Both epidemiologic and virological data were reported to the European Surveillance System (TESSy) on a weekly basis.
- Two individuals participated in the grants management training for Global Health Security Agenda and Influenza Grantees in May 2017 in Dar es Salaam, Tanzania.
- One epidemiologist participated in the ECDC Influenza Annual Meeting in Stockholm on June 20–22, 2017.

## PREPAREDNESS

An operational plan and guide for managing risk during an influenza pandemic in Macedonia was adopted in 2013; revisions were planned for 2017–2018. Experts from the IPH worked on developing outbreak investigation protocols and SOPs for influenza, with the goal of establishing an outbreak response team by the end of October 2017.

Collaboration between IPH and the Food and Veterinary Agency (FVA) was improved; a successful coordination meeting was held in July 2016. During winter 2017, 2 intersectoral meetings were organized with avian influenza as a main topic, with representatives from the veterinary sector, public health, the Ministry of Agriculture, Ministry of Finance, the Center for Crisis Management, the Ministry for Transport, the Association of Local Governments, and the Protection and Rescue Directorate.

A cross-border meeting between the public health and veterinary sectors from Macedonia and Albania was held in July 2017 in Ohrid, Macedonia. An agreement was made to develop guidelines and protocols for cross-border collaboration and rapid response teams for use in cases of outbreaks using CDC guidelines for rapid response teams, with the

eventual goal to foster sharing and collaboration with other neighboring countries in the region.

### PREPAREDNESS ACTIVITIES

- A coordination meeting was held with representatives from the FVA, Department for Health Protection and Animal Welfare, Veterinary Institute, Faculty of Veterinary Medicine in Skopje (FVM)—Department of Avian Diseases, Ministry of Health, and IPH—Sector for Prevention and Control of Communicable Diseases and Laboratory for Virology and Molecular Diagnostics. The meeting was organized in July 2016. The importance of continuous cooperation between these sectors was key emphasis of the meeting.
- Intersectoral meetings were held with representatives from the veterinary sector, public health, the Ministry of Agriculture, Ministry of Finance, the Center for Crisis Management, the Ministry for Transport, the Association of Local Governments, and the Protection and Rescue Directorate. The January 2017 meeting was dedicated to discussion of the threat of introduction of avian influenza A(H5N8) detected in neighboring countries and the preparedness and capacity of the country to detect and respond.
- A venue was booked and organization started for the next cross-border meeting between the public health and veterinary sectors from Macedonia and Albania.

### TRAINING

- In September 2015, a team of epidemiologists and virologists for IPH provided training for medical staff and members of ILI/ARI sites on use of case definitions and reporting, and sampling, storage, and transport of lab specimens.
- In January 2016, training was provided for SARI sites on use of case definitions, reporting requirements, and preparation of weekly reports and reporting.
- In 2015, 2 trainings were provided for epidemiologists at the regional level for sentinel ILI surveillance.
- In October 2016, refresher trainings were provided for the staff from ILI/ARI sites on the use of case definitions and reporting, and sampling, storage, and transport of lab specimens.
- In November 2016, an epidemiologist from IPH participated in the CDC/Council of State and Territorial Epidemiologists training course for Advanced Management Analysis of Influenza Surveillance Data Training Course, in Amsterdam, the Netherlands.
- In March 2016, 2 staff members from IPH participated in a workshop for measuring the success of influenza sentinel surveillance in Tirana, Albania.
- In February 2017, 3 staff members from IPH attended a training for sentinel influenza surveillance evaluation, and 2 staff members participated in a 1-day meeting on improving influenza surveillance and pandemic response in South Eastern European countries, organized by SECID/CDC.

# REPUBLIC OF MOLDOVA



## OVERVIEW

Since 2009, CDC has worked with the Ministry of Health (MOH), National Center of Public Health of the Republic of Moldova (NCPH) to build capacity for pandemic preparedness, communication, surveillance, monitoring, early response, and infection control. Fiscal Year 2017 is the last year of CDC's sustainability cooperative agreement with NCPH. The purpose of the award is to maintain the capacity built during the first project period, including laboratory, epidemiological, and preparedness capacity for surveillance and response to pandemic influenza. The work conducted during the past 10 years has positioned Moldova well to continue surveillance of influenza and identification of a potential pandemic.

## SURVEILLANCE

Between October 1, 2015 and September 30, 2017, 180 reports were developed for influenza monitoring of acute respiratory illness (ARI) and severe acute respiratory infection (SARI) in sentinel sites. Concurrently, 48 information communications were developed for the media, which were published on the NCPH website. NCPH specialists participated in 22 TV and 21 radio shows.

Visits and assessments were also conducted to the sentinel sites regarding influenza, ARI, and SARI, and the level of preparation in case of the epidemiological situation worsened.

On February 16, 2017, a workshop was organized for epidemiologists, family doctors, and infectious disease doctors from sentinel sites to participate to discuss and learn about influenza.

In February 2017, a training session was held to develop a plan for evaluating the entire surveillance system in the country. A protocol and plan were developed, and implementation was planned for the remainder of 2017 and into 2018. Measures to monitor site performance will be instituted for ongoing monitoring of system sites.

## SURVEILLANCE ACTIVITIES

- Weekly and monthly reports on the epidemiological situation of influenza, ARI, and SARI in Moldova (75 reports) were developed.

## HIGHLIGHTS

- The influenza sentinel surveillance system was improved through strengthening hospital, polyclinic, and laboratory surveillance for influenza-like illness (ILI), acute respiratory illness (ARI), and severe acute respiratory infection (SARI).
  - During the influenza season, the laboratory performed diagnosis of ILI, ARI, and SARI cases.
  - Quality assurance measures were monitored and updated, including development of weekly reports on the epidemiological situation regarding influenza, ARI, and SARI in sentinel sites, and for other territories of the Republic of Moldova.
  - Improvements to the influenza surveillance system were implemented by developing structured reporting methods for influenza epidemiology, surveillance, and laboratory diagnosis.
- Weekly reports on influenza, ARI, and SARI in 9 sentinel sites (105 reports) were created.
  - Weekly information was communicated to the media on influenza, ARI, and SARI.
  - Visits were conducted at sentinel sites (Balti, Cahul, Causeni, Chisinau, Comrat, Edinet, Rezina, Soroca, and Ungheni) and evaluation was conducted of the epidemiological situation regarding influenza, ARI, and SARI in the 2015–2016 and 2016–2017 seasons.
  - Epidemiological staff participated in radio and TV programs to inform the population about influenza, ARI, and SARI, with an emphasis on ways to prevent the illnesses.
  - Explanations and surveillance information was provided to the Ministry of Health to support the development and issuance of MoH orders for influenza vaccination and epidemiological surveillance for both acute respiratory (ARI) and severe acute respiratory illness (SARI).
  - An organizing workshop was held involving epidemiologists, family doctors, and the infectious disease doctors from sentinel sites.

- An evaluation protocol was developed to review sentinel site performance and to implement measures for ongoing monitoring of the system.
- With the assistance of CDC and the Council of State and Territorial Epidemiologists, a week-long review of the national surveillance system was conducted in June 2017, including site visits to 2 sites.

## LABORATORY

The Viral Infections Laboratory is part of the NCPH within the MOH with the principal purpose of influenza diagnosis and surveillance. The laboratory supports national and international influenza surveillance through routine testing of influenza like illness (ILI) and SARI specimens collected from 9 sentinel sites located throughout the country and following a geographic pattern. The Laboratory collaborates with the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in London through sample submission and reports surveillance data to the European Centre for Disease Prevention and Control (ECDC) through the European Surveillance System (TESSy), an electronic data collection system. The Viral Infections Laboratory was designated a National Influenza Center (NIC) in 2013. Influenza testing by rRT-PCR is provided for all samples submitted, and viral isolation is attempted on a subset of positive specimens to allow for further characterization. Two additional regional laboratories with PCR capabilities will join the national surveillance system.

### LABORATORY ACTIVITIES

- During the period from the 40th week of 2015 through the 20th week of 2016, 666 nasopharyngeal exudation specimens from patients with presumptive diagnoses of influenza, ARI, and SARI were investigated using molecular biology techniques. Among the samples, influenza viruses were detected in 188 cases (28.2%): 160 were positive for influenza A(H1N1), 24 were positive for influenza A(H3N2), and 4 were positive for influenza B. During the same period, investigation for viruses other than influenza using PCR demonstrated that among 406 tested samples, 107 were positive for other viruses: 11 for bovirus, 52 for rhinovirus, 3 for metapneumovirus, 15 for coronavirus, 5 for parainfluenza types 1–4, and 21 for adenovirus.
- In 2015, 36 strains of influenza viruses were isolated and identified in Madin-Darby Canine Kidney cell cultures, including 1 strain of influenza A(H3N2), similar to the A/Texas/50/2012 H3N2 vaccine strain (genetic group 3C.2a); 15 strains of influenza A(H1N1)pdm, similar to strain A/California/7/2009 H1N1pdm09 (genetic group 6B); and 20 strains of influenza B virus (1 strain B/Florida/60/2008—B line/Victoria, and 19 strains of B/Massachusetts/02/2012—B line/Yamagata, genetic group 3).
- During the period from the 40th week of 2016 through the 20th week of 2017, 667 nasopharyngeal exudation specimens from patients with presumptive diagnoses of influenza, ARI, and SARI were investigated using molecular biology techniques. Among the samples, influenza viruses were detected in 219 cases (32.8%): 136 were positive for influenza A(H3N2), and 83 were positive for influenza B.
- In 2016, 14 strains of influenza A(H1N1)pdm09 similar to the vaccine strain A/California/7/2009, 6B.1 genetic groups (13 strains) and 6b.2 (1 strain) were isolated and identified, as was 1 strain of influenza B, similar to strain B/Brisbane/60/2008, genetic group 1.A.
- 20 samples were sent for confirmation and sequencing to the WHO CC in London in the 2015–2016 season, and 30 samples were sent in 2016–2017.
- The laboratory, which was accredited by WHO as an NIC on March 18, 2013, achieved re-accreditation on March 16, 2016, conducted by the WHO European Regional Office.

## PREPAREDNESS

Between October 1, 2015 and September 30, 2017, a few regulations were drafted and adopted: Ministry of Health disposition No. 543-d of September 16, 2016, *Regarding epidemiological surveillance of influenza, acute respiratory infections ARI and SARI, and required weekly submission of information by the territorial local public health centers in the epidemiological surveillance system*; Ministry of Health Order No. 29 of January 22, 2016, *Regarding ensuring the care of patients with acute respiratory infections and flu, including severe forms and thereof complications*; and Ministry of Health Order No. 974 of December 17, 2015, *Regarding vaccination against seasonal influenza for season 2015–2016*.

## *PREPAREDNESS ACTIVITIES*

- With CDC assistance, a review of the surveillance system was conducted, and a plan was developed to sustain the system after the end of the CDC project.

## **TRAINING**

- In February 2017, a workshop was organized where epidemiologists, family doctors, and infectious disease doctors from 9 sentinel sites participated to discuss and learn about influenza.
- Epidemiologists participated in 3 influenza surveillance workshops through WHO in 2015–2016, in Denmark, Copenhagen; Switzerland, Geneva; and Chicago, USA.
- Laboratorians participated in a laboratory safety and biosafety training held in Croatia, Zagreb by WHO and CDC in May 2016.
- Epidemiologists participated in the Workshop on Monitoring and Evaluation of Surveillance Systems with Emphasis on Influenza Sentinel Surveillance held in Sarajevo, Bosnia and Herzegovina by CDC and the WHO Regional Office for Europe in 2017.

# RUSSIAN FEDERATION



Artem Fadeev (Scientist of the Laboratory of Molecular Virology) responsible for implementation of full genome NGS as a part of molecular surveillance for circulating influenza viruses.

## OVERVIEW

The longstanding cooperation between CDC and the Russian Federation has resulted in the establishment of a well-functioning surveillance system in the country. In Fiscal Year (FY) 2016, CDC awarded the Russian Federation a third cooperative agreement to maintain the system developed. Recognized as WHO National Influenza Centers (NICs), the Research Institute of Influenza (RII) in St. Petersburg and the D.I. Ivanovsky Research Institute of Virology (IIV) in Moscow provide regional assistance, training, and expertise to neighboring countries in addition to monitoring influenza within their own country.

## SURVEILLANCE

In FY 2016 and 2017, cooperative agreements for RII enhanced and improved both routine and sentinel influenza surveillance systems that collect, analyze, and report epidemiologic and laboratory data from 59 Regional Based Laboratories (RBLs), collaborating with the 2 NICs. Both NICs in Moscow and St. Petersburg have continuously increased the number of influenza viruses isolated. Antigenic, genetic, and phylogenetic analysis of influenza viruses circulating in Russia was expanded, including determination of their susceptibility to antivirals. Sentinel surveillance for severe acute respiratory infection (SARI) and influenza-

## HIGHLIGHTS

- Capacity for virus isolation in Regional Base Laboratories (RBLs) and National Influenza Centers was increased. Early influenza isolates were presented in a timely manner to CDC.
- The number of individuals whose specimens were tested with PCR increased by 54% in the 2015–2016 flu season compared to the 2014–2015 season.
- Next-generation sequencing technology for whole genome analysis was introduced for surveillance in the Research Institute of Influenza (RII).
- A WHO External Quality Assessment Program (EQAP) panel to determine capacity to recognize potentially pandemic viruses via rRT-PCR was prepared by RII and directed to 10 RBLs for testing. Results are under analysis and will be presented in the Annual Report.
- The Laboratory of Molecular Virology participated in EQAP and successfully tested 2 panels: CDC Influenza Molecular Diagnostic Performance Evaluation-International (2016), received on March 17, 2017, and WHO Influenza EQAP Panel 16 (2017), received on April 20, 2017. Each panel contained 10 inactivated influenza virus samples, and all 10 samples were identified.
- Additional criteria for determination of the start of an influenza epidemic were developed.
- Influenza surveillance data were presented in a timely manner to the WHO Global Influenza Surveillance and Response System, CDC, the Ministry of Healthcare of Russia, and RBLs.

like illness/acute respiratory illness (ILI/ARI) was improved, allowing for identification of the main risk groups, and the most commonly circulating influenza and other respiratory viruses. Data were presented on a weekly basis to the Ministry of Healthcare of Russia (MOH), Rospotrebnadzor, as well as to the RBLs through weekly surveillance reports and website summaries. Data on influenza activity in Russia was also reported on a regular basis to WHO's Global Influenza Surveillance and Response System (GISRS); the WHO Regional Office for Europe's new electronic



system, the European Surveillance System (TESSy); and WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs).

### SURVEILLANCE ACTIVITIES

- Epidemiology capacity to recognize an epidemic start was enhanced by estimation of epidemic thresholds and baselines specific for each Federal District.
- Age-specific baselines were calculated for the first time in order to compare increases in influenza activity and duration of the epidemic in different population age groups.
- Incidence rates, hospitalizations, and deaths were analyzed by Federal Districts and the country as a whole for both the total population and certain age groups.
- The geography of epidemic spread through the country was tracked using epidemiological and laboratory data.
- In sentinel surveillance for SARI, a low rate of vaccination coverage in SARI patients was confirmed.
- The main risk groups for SARI development were individuals identified with diabetes and/or with chronic cardiovascular pathology, and pregnant women.
- Weekly epidemiological data were presented regularly to the MOH, Rospotrebnadzor, and back to RBLs.
- Surveillance findings were regularly reported to GISRS through WHO as well as WHO Regional Office for Europe electronic systems.

### LABORATORY

The laboratory surveillance network in Russia currently includes 59 RBLs. Influenza virus isolation is conducted in 31 laboratories. Antigenic and genetic analysis of viruses circulating in Russia is conducted on a regular basis, including determination of susceptibility to antivirals. The etiology of SARI and ILI/ARI cases reported from sentinel sites varies, depending on the geography of the site and seasonal patterns. Influenza viruses were detected more often among SARI patients, and other respiratory viruses more often in ILI/ARI patients.

### LABORATORY ACTIVITIES

- Antigenic cartography and microneutralization tests were implemented for antigenic analysis of influenza isolates.
- Monoclonal cell–enzyme-linked immunosorbent assay tests were used for virus identification in addition to hemagglutination inhibition tests.
- Full-genome analysis of influenza viruses using next-generation sequencing technology was implemented in the RII NIC; full genome sequencing results of tested influenza viruses were presented in the Global Initiative on Sharing All Influenza Data database.
- Influenza virus collections were replenished by new isolates in both NICs.
- The Low Temperature Biobank for PCR-influenza positive clinical samples was established in RII NIC during the 2016–2017 season.
- Laboratory and epidemiological data were integrated.
- Automatically generated cartographic, graphic, and tabular data on influenza activity in Russia were presented in weekly epidemiological reports (WERs) in a timely manner; data entered into the system by RBLs were processed automatically with immediate generation of graphical outputs (figures, maps, tables) for WER issues.
- Results of influenza surveillance in Russia for the period from the 2011–2012 to 2015–2016 seasons were presented in a manuscript prepared for publication by RII NIC.
- The viruses isolated in the beginning and at the peak of the epidemic season were sent to 2 WHO CCs in a timely manner.

### PREPAREDNESS

The draft *Pandemic Preparedness Plan for Russia* was amended, updated, and submitted to the MOH. The capacity to identify novel influenza A viruses of H2, H5, H7, and H9 subtypes as potential pandemic agents was increased by preparing rRT-PCR reagent kits and developing immunological methods for identification of potential novel pandemic influenza A viruses. Antigens to potentially pandemic influenza viruses (PPIVs) were prepared in the RII NIC. Full genome sequencing was introduced for analysis of seasonal and potentially pandemic influenza viruses in the RII NIC.



## PREPAREDNESS ACTIVITIES

- The draft of a Pandemic Preparedness Plan for Russia was updated and amended.
- An external quality panel (EQP) was prepared by RII NIC. It contained inactivated seasonal influenza A(H1N1)pdm09, influenza A(H3N2), influenza B (both lineages) and PPIV subtypes H9N2, H5N1, H7N9.
- Antigens to PPIVs were prepared for the study of population immunity.
- Specific antisera and monoclonal antibodies to PPIV were prepared for pandemic virus identification.
- A questionnaire for the examination of patients involved in the outbreak was prepared in RII NIC. A scheme for outbreak investigation was developed.
- Full genome sequencing was introduced for analysis of seasonal viruses and PPIVs in the RII NIC.

## TRAINING

The RII NIC continues to provide technical assistance and training to RBLs to maintain routine and sentinel surveillance systems, quality of surveillance data, prompt data analysis, and integration of the information into preparedness and response activities.

A workshop was organized with the support of Rospotrebnadzor, RII, and 59 RBLs of 2 NICs, with participation of 120 specialists; the workshop was held in St. Petersburg on October 26, 2016. Five training reports were presented by NICs specialists for RBLs virologists and epidemiologists.

In 2016 NIC representatives also participated in the WHO and CDC trainings on advanced management analysis of influenza surveillance data, shipment of infectious substances, laboratory quality management, rapid risk assessment of public health events, influenza burden, and influenza pandemic preparedness, as well as a biosafety workshop.

Three guidelines on virus isolation, identification, cell–enzyme-linked immunosorbent assays, and population immunity testing were prepared for RBL virologists by RII.

# SECID



## OVERVIEW

The South East European Center for Infectious Diseases Surveillance and Control (SECID) was established in 2013 at the Institute of Public Health in Tirana, Albania to support Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Macedonia, Montenegro, Romania, Serbia, and Kosovo\* in the field of surveillance and control of infectious diseases, including influenza and International Health Regulations (IHR) implementation. Within this network Albania, Bosnia and Herzegovina, Macedonia, Montenegro, and Kosovo\* have been identified as priority countries. Through SECID's work and support, the WHO officially recognized the laboratory in Montenegro as a National Influenza Center (NIC). Several other countries have made improvements to their laboratory capacity, and several more are expected to achieve WHO recognition in the near future. Fiscal Year (FY) 2017 is the fifth year of the capacity building agreement, and it is expected that SECID will move to a sustainable project plan in FY 2018, to continue the work begun during the initial project.

## SURVEILLANCE

After influenza surveillance self-review, based on the WHO Regional Office for Europe (WHO EURO) guidance for sentinel influenza surveillance and the CDC international influenza assessment tool, and establishment of influenza-like illness (ILI) and severe acute respiratory infection (SARI) sentinel surveillance in every country, a new protocol has been prepared to evaluate effectiveness of different influenza surveillance systems. A mentoring system has been established to support evaluation and improve performance. Influenza surveillance field assessments were organized in most of the countries to evaluate and improve the performance of ILI/acute respiratory illness (ARI) and SARI sentinel surveillance. Specimen collection from ILI and SARI sentinel sites is mandatory and has been increasing in every country. Influenza databases have been established in each country and database management has been improved. Web-based and electronic databases have been established in some countries. Every country produced a national influenza profile and influenza

## HIGHLIGHTS

- National Influenza Center (NIC) evaluation missions were performed in Macedonia and Montenegro.
- An NIC has been established in Montenegro.
- All countries reported to WHO's Flu News reporting system in coordination with the European Centre for Disease Prevention and Control.
- Influenza-like illness and severe acute respiratory infection sentinel surveillance was established and strengthened in all countries, and the number of submitted samples continues to increase.
- A protocol for the evaluation of influenza surveillance systems has been developed based on CDC guidelines.
- A mentoring program has been established with CDC and the WHO Regional Office for Europe to evaluate and improve the quality of influenza surveillance systems and data quality.
- All NICs and laboratories have provided samples to WHO Collaborating Centers for Reference and Research on Influenza in London and at CDC.
- All countries have established and improved quality assurance of influenza diagnosis with the help of a mentoring program with the Association of Public Health Laboratories and CDC.
- Influenza virus isolation activities have started in Macedonia, Bosnia and Herzegovina, and Kosovo.\*
- Pandemic preparedness plans have been revised in Romania, Croatia, Serbia, Montenegro, and Bulgaria.
- Two countries within the network have been able to achieve advancement and management and have successfully applied for and received direct funding from CDC to continue to build and strengthen surveillance capacity in their own countries: Bosnia and Herzegovina and Macedonia.

bulletin, as well as sent the data to the Flu News platform of WHO and the European Centre for Disease Prevention and Control.

### *SURVEILLANCE ACTIVITIES*

- SARI surveillance protocols were implemented in all countries with the exception of Bulgaria, where there is currently a lack of SARI surveillance (although establishment is in progress).
- ILI surveillance protocols were implemented in all countries.
- Field assessments of influenza surveillance were organized in Albania, Montenegro, Croatia, Serbia, Bulgaria and Kosovo.\*
- All sentinel sites in all countries were equipped with all necessary sample collection and transportation materials.
- Virological and epidemiological data were submitted electronically to the European Surveillance System (TESSy) on a weekly basis by all countries.
- Surveillance reports were prepared and disseminated among health care professionals at sentinel sites and all health care providers in throughout the region.
- Sentinel sites were monitored in each country through site visits—once per month for the new sites during the influenza season, and twice per year for all sites.
- Influenza surveillance coordinators from Serbia, Kosovo,\* and Albania conducted reciprocal exchange visits to improve their database system and learn more about sentinel SARI and ILI surveillance and database management.
- A protocol for the evaluation of influenza surveillance systems has been developed based on CDC guidelines. All countries were trained and started the process of evaluation of their existing or recently established (sentinel ILI/SARI) influenza surveillance systems.
- A mentoring program has been established with CDC and WHO EURO to evaluate and improve the performance of influenza surveillance systems and data quality.

### **LABORATORY**

All activities were targeted to strengthen the capacities of molecular influenza diagnosis (RT-PCR) in all influenza laboratories, and to establish capacity for influenza virus isolation in Montenegro and Kosovo.\* SECID worked with Association of Public Health Laboratories (APHL) and CDC to develop and pilot a mentoring program to improve quality assurance and establish quality assurance protocols and standard operating procedures (SOPs); the program is being used as a model for implementation in other WHO Regions.

Essential kits for RT-PCR testing were procured for all countries, and RT-PCR machines were procured for Albania and Montenegro based on mentor recommendations. Training on RT-PCR testing and quality assurance as well as biosafety was provided in all countries. Essential equipment for virus isolation was procured for Kosovo.\*

WHO evaluation missions related to NIC recognition were organized for Montenegro and Macedonia, and WHO EURO recognized the Montenegro Influenza Laboratory near the Institute of Public Health in Podgorica as an NIC.

### *LABORATORY ACTIVITIES*

- WHO NIC assessment missions were organized for Montenegro and Macedonia.
- An NIC was established at the Influenza Laboratory near the Institute of Public Health in Podgorica, Montenegro, and recognized by WHO EURO.
- An increased number of samples were tested by influenza laboratories in all countries.
- Improved quality assurance procedures and sample positivity were implemented for influenza in all countries.
- Sample collection and transportation SOPs were implemented in all countries.
- RT-PCR equipment was procured for Albania and Montenegro.
- Influenza laboratory specialists from Kosovo\* visited Albania.
- Influenza laboratory specialists from Montenegro participated in an Influenza Virus Isolation Workshop, held on May 17–20, 2016 in Richmond, California, USA.

- RT-PCR essential kits were procured and provided based on country needs.
- Essential equipment to conduct virus isolation was procured for Kosovo.\*
- All NICs provided samples to WHO Collaborating Centers for Reference and Research on Influenza in London and at CDC.
- All countries established and improved the quality assurance of their influenza diagnostics with the help of the mentoring program coordinated by APHL and CDC.
- Influenza diagnostics improved by 40% in Albania and in all countries.

## PREPAREDNESS

All countries prepared legal acts to enact pandemic plans, performed training, and established structures to coordinate pandemic preparedness and response. Pandemic preparedness committees were established in all countries. All countries, apart from Albania, have revised their pandemic preparedness plans. Albania has been working with its veterinary system on the contingency plan for avian influenza and is in the process of finalizing its pandemic preparedness plan.

Joint human and veterinary workshops were organized to discuss integrated human and veterinary surveillance and pandemic preparedness in all countries.

Respiratory virus outbreak response protocols and guidelines have been prepared in all countries, and joint tabletop exercises and a regional meeting were organized. Infection control procedures improved and exercises were organized in some countries.

### PREPAREDNESS ACTIVITIES

- Influenza pandemic preparedness planning workshops were organized in all countries apart from Albania.
- Pandemic preparedness committees were established in all countries.
- Influenza pandemic plans were revised in all countries except Albania.

## RESEARCH ACTIVITIES

CDC funded an Influenza and Respiratory Syncytial Virus in Infants Study (IRIS) of hospitalized and non-ill infants aged <1 year from 2015–2017, with local sponsorship by SECID, at the Pediatric Department of the Mother Theresa University Hospital and the Queen Geraldine Maternity Hospital Neonatology Unit, in Tirana, Albania.

*\*This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo declaration of independence.*

# UKRAINE

## OVERVIEW

In 2016, CDC awarded the L.V. Gromashevsky Institute of Epidemiology and Infectious Diseases National Academy of Medical Science of Ukraine a third 5-year cooperative agreement designed to assist in maintaining gains and capacity built during the previous 10 years. The Institute has continued working on surveillance activities and participating in submitting information for vaccine strain selection. Additionally, a link with a veterinary group has been established and is expected to be strengthened in future years. The Ministry of Health (MOH) has formally adopted regulation of the surveillance system in the country.

## SURVEILLANCE

During the 2016–2017 influenza season, 283 influenza viruses were isolated; 236 of them were influenza A(H3N2), 3 were identified as influenza A(H1N1) pdm09, and 44 were influenza B virus (predominantly B/Victoria lineage). Fifty isolates were prepared and will be sent to CDC and 50 to the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in London. Influenza-like illness (ILI) and severe acute respiratory infection (SARI) surveillance in the 4 sentinel centers has shown that the percentage of influenza positive samples varies from 31% to 70%.

## SURVEILLANCE ACTIVITIES

- A team from the National Influenza Center (NIC) updated the [www.ukrinfluenza.com.ua](http://www.ukrinfluenza.com.ua) website. As a result of these changes, the website provided additional information, helping to identify more data about background diseases and the pre-existing conditions of influenza patients, and aiding in analysis of epidemiological data.
- Epidemiologists from the NIC made supervisory visits to influenza sentinel sites in Dnipro in April 2015 and Khmelnytsky in November 2016.

## LABORATORY

Funding from CDC continued to support the NIC in Kyiv and 4 regional virology laboratories in the sentinel sites with reagents, consumables, and other items to maintain optimal function of the laboratories. These

## HIGHLIGHTS

- The influenza surveillance system has been sustained.
- In the beginning of the 2015–2016 and the 2016–2017 seasons, the first isolates were sent to the WHO Collaborating Center for Reference and Research on Influenza for inclusion in the meeting to determine the vaccine composition for the Northern hemisphere.
- A Certificate of Conformity for participating in External Quality Assessment Project panel organized by WHO was received.
- With support from the CDC cooperative agreement, 1 person from the National Influenza Center (NIC) participated in the theory of influenza training for young scientists held in Siena, Italy; the course included a series of lectures from world-renowned experts on influenza.
- CDC's cooperative agreement supported participation of 3 persons from the NIC at an influenza conference held in Chicago, USA.

laboratories can perform PCR and virus isolation in cell culture. Samples from Ukraine are routinely submitted to the WHO CCs in Atlanta and London.

## LABORATORY ACTIVITIES

- Four sentinel site virologists were trained in influenza virus isolation and identification techniques, as well as real-time PCR investigation. One epidemiologist was trained how to work with the [www.ukrinfluenza.com.ua](http://www.ukrinfluenza.com.ua) website.
- PCR was used to investigate 1,938 samples from ILI and SARI patients in the 2015–2016 season. The laboratory confirmed 651 (33.6%) were positive for influenza viruses: 146 (22.4%) influenza A, 53 (8.0%) A(H3), 448 (69.0%) A(H1)pdm09, and 4 (0.6%) influenza B.
- Similarly, 1,254 samples from ILI and SARI patients were investigated in the 2016–2017 season, and the laboratory confirmed 539 (43.0%) were positive for influenza viruses: 202 (37.5%) influenza A, 281 (52.1%) A(H3), 1 (0.2%) A(H1)

pdm09, and 55 (10.2%) influenza B. Influenza B viruses predominantly belonged to B/Victoria genetic lineage (detected by the hemagglutinin inhibition assay method).

- Support of laboratories with consumables continued.
- Participation continued in the WHO Global Influenza Surveillance and Response System (GISRS), and the NIC submitted a total of 90 isolates to the WHO CC in Atlanta as part of WHO GISRS.
- The NIC conducted 3 supervisory site visits to 2 sentinel cities (October 2016 in Kiev and November 2016 in Khmelnytsky).

## PREPAREDNESS

Guidelines were developed for medical service personnel for pandemic preparedness; these were used for simulation exercises during annual meetings. Some guideline items are represented in the MOH of Ukraine order #732.

A cooperative study was initiated with the veterinary service and planning for a joint research project to conduct a serological examination of staff caring for poultry was begun.

## TRAINING

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

In 2015–2017 the following trainings were organized in Ukraine:

- Training workshops were held for 50 health staff from clinics involved in sentinel surveillance in 2015 and 2016.
- Virologists from the Dnipro and Khmelnytsky virology laboratories were trained on isolation of influenza viruses and in cell culture in December 2015 and February 2016.

As the result of the CDC project, and following an invitation from the International Society for Influenza and other Respiratory Virus Diseases, a young scientist from the Institute–Oksana Smutko attended training on influenza in Siena, Italy April 11–15, 2016, and received the appropriate certificate.



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# Region of the Americas [AMR]

# WHO Region of the Americas [AMR]

As of Fiscal Year 2017, CDC has 7 bilateral influenza cooperative agreements in the WHO Region of the Americas. These agreements with agencies, ministries of health (MOHs), or institutions designated by the MOHs facilitate work with the Pan American Health Organization (PAHO), WHO, and CDC to build capacity to routinely identify and respond to seasonal and novel influenza strains across the Americas. Additionally, these agreements assist countries to conduct activities that inform policies on introduction and increased use of influenza vaccines in the region.

Direct country support through non-research cooperative agreements are established in the following 5 countries, with the number of years of cooperative agreements in parentheses:

- Brazil
- Jamaica
- Mexico
- Paraguay
- Peru

In addition, CDC supports the Caribbean Public Health Agency and PAHO through cooperative agreements. CDC also supports activities at CDC-Central America and Panama's (CDC-CAP) Global Disease Detection site in Guatemala. These activities support programs in 8 Central American/Caribbean countries, including Belize, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.

The PAHO office is located in Washington, DC, USA. The office serves 35 member states; together their population exceeds 600 million people. Member countries include Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Dominica, the Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, the United States, Uruguay, and Venezuela. Between 2015 and 2017, WHO PAHO staff provided training, support, and technical assistance to member countries to strengthen preparedness, surveillance, and response, and laboratory capacity for influenza and other respiratory diseases.

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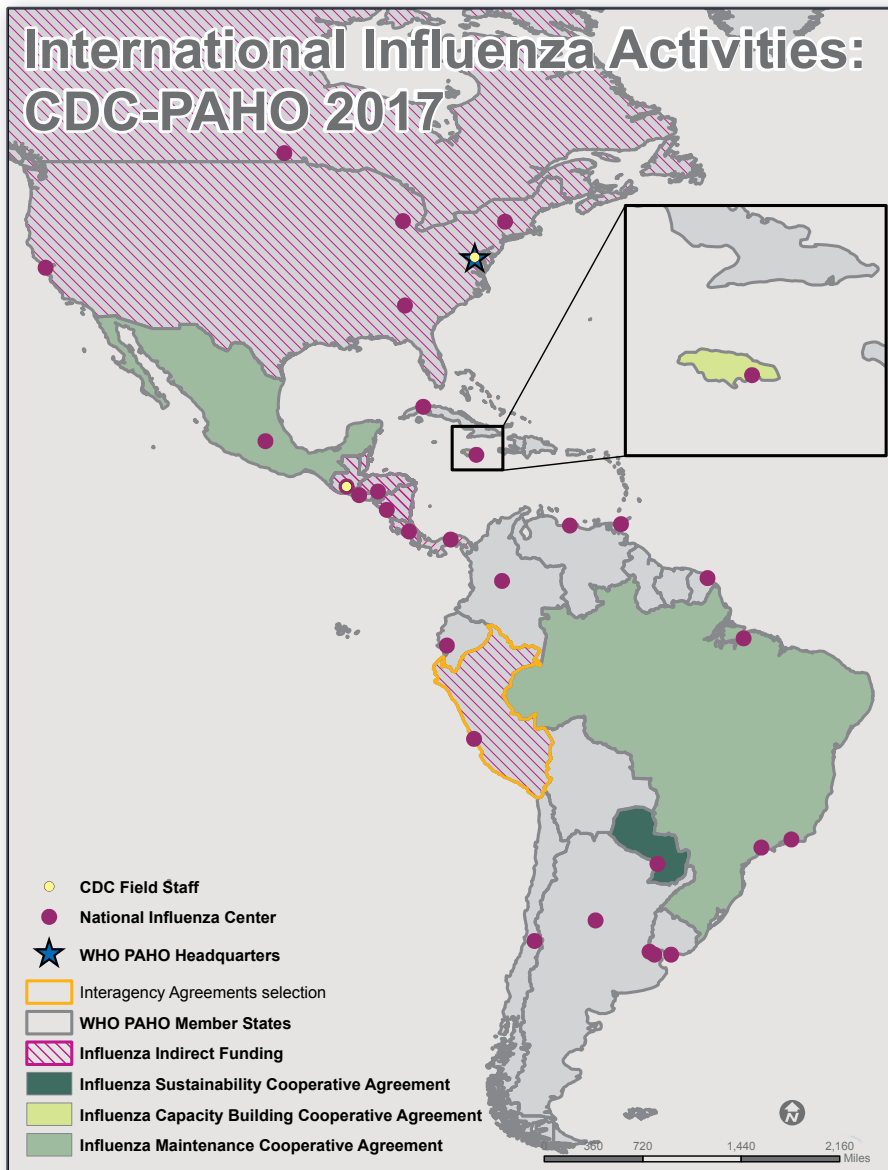
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# Pan American Health Organization [PAHO]



## HIGHLIGHTS

- The Pan American Health Organization (PAHO) strengthened influenza surveillance in the Americas. Efforts have included a focus on surveillance of hospital-based severe respiratory disease cases (i.e., severe acute respiratory infection [SARI]); integration of laboratory and epidemiologic data; timely, frequent analysis and dissemination of integrated data; strengthening of laboratory capacity; development of influenza burden of disease estimates; and launching of the regional influenza network, SARInet.
- PAHO countries also introduced or expanded influenza vaccination among high-risk groups in 40 countries and territories.
- PAHO countries improved data collection for better estimates of vaccine coverage, conducted field visits for effectiveness evaluations, and developed the Network for Evaluation of Influenza Vaccine Effectiveness (REVELAC-i) webpage for sharing of information.

## U.S. CDC DIRECT SUPPORT

The current 5-year cooperative agreement, *Surveillance and Response to Seasonal and Pandemic Influenza by Regional Offices of the WHO*, began in September 2016 and is now in its second year. The Pan American Health Organization (PAHO) is the WHO Regional Office for the Americas and is located in Washington, DC, USA. The Office serves 35 member states, 4 associate members, and 3 participating states.

In 2014–2015, technical cooperation activities centered on influenza and pandemic influenza preparedness through strengthening of 3 pillars: epidemiology, laboratory, and analyses to estimate influenza disease burden. In 2015–2016, PAHO focused on supporting epidemiologic and laboratory capacity in countries and developing influenza burden of disease estimates. Technical cooperation in strengthening epidemiologic capacity included

training in severe acute respiratory infection (SARI) surveillance and developing data-sharing bridges.

Laboratory activities continue to support immunofluorescence and real-time RT-PCR, including the detection of other respiratory viruses and building laboratory networks, such as the National Influenza Center (NIC) network and participation in WHO External Quality Assessment Project (EQAP) and CDC External Quality Assessment Panel.

## SURVEILLANCE

Since 2006, sentinel SARI surveillance has been implemented in hospitals and laboratories throughout the Americas. SARI-net, a network of PAHO member states that conduct SARI surveillance, was created in 2013 to facilitate sharing of ideas and access to resources, and to strategically address SARI surveillance. Five regional network meetings have taken place since 2013, with the most recent 3-day meeting in May 2018 bringing together more than 100 participants from 28 countries, 20 NICs, 9 national laboratories, and several collaborating institutions.

Between 2015 and 2017, PAHO continued the development and implementation of the PAHO/WHO *SARI Surveillance Protocol*, emphasizing that in resource-limited settings, surveillance should focus on severe cases. As a measure of the uptake of this guidance, almost all countries in the Americas currently have SARI or hospital-based influenza surveillance, and 17 countries routinely report surveillance data on a weekly basis to PAHO.

### SURVEILLANCE ACTIVITIES

- A landscape analysis was developed and disseminated to better understand the surveillance and laboratory capabilities and capacities in the Americas Region through assessment of the number of active SARI surveillance sites in the member states; the number of active influenza-like illness (ILI) surveillance sites in member states; the number of NICs in member states; identification of activities performed by NICs; and quarterly monitoring of shipments and sharing of influenza viruses and/or specimens with WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs).
- Weekly epidemiologic and laboratory data were shared through FluNet/FluID under the SARI-net umbrella (20 countries).

- Technical cooperation was provided to more than 15 countries by conducting surveillance site and laboratory assessments using CDC, PAHO, and American Public Health Laboratory (APHL) tools.
- Evaluation of 22 sentinel sites was provided, and assessment reports were produced for 10 countries including Antigua and Barbuda, Belize, Bolivia, Ecuador, Haiti, Mexico, Suriname, Paraguay, and Uruguay.
- Development/implementation of the PAHO/WHO *SARI Surveillance Protocol* continued, emphasizing that in resource-limited settings, surveillance should focus on severe (i.e., hospitalized) cases.
- Case-based software, PAHOflu, was developed to be used at the local level to capture laboratory and epidemiologic surveillance, and systems were implemented in 5 countries (Bolivia, Chile, Costa Rica, St. Lucia, and Suriname).
- In collaboration with PANAFTOSA (Pan American Foot and Mouth Disease Center), a landscape analysis was conducted of Ministries of Health (MOHs) and Agriculture in the region to assess their surveillance capabilities for influenza at the human-animal interface.
- The regional country guide entitled *Influenza and Other Respiratory Virus Surveillance Systems in the Americas 2016* was updated and published.

## LABORATORY

Between 2015–2017, PAHO continued to support the strengthening of laboratory capacity for the diagnosis of influenza and other respiratory viruses—including limited decentralization of real-time RT-PCR for influenza—through refresher courses for real-time RT-PCR and immunofluorescence, and through participation in WHO's EQAP. In 2015, 97% of NICs/national laboratories in the region attained 100% concordance on the panel. These activities allowed PAHO to continue to strengthen the regional laboratory network, which now consists of 28 NICs in Latin America and the Caribbean.

### LABORATORY ACTIVITIES

- Work plans were developed with the majority of NICs/national laboratories in the region based upon the needs and recent surveillance assessments. These plans included requests for purchases of reagents and bench training (e.g., phylogenetics, viral culture, and isolation).



- Funds were provided to member states, in order to integrate influenza surveillance into their national budgets and allow support of unfunded activities.
- More than 850 samples from Latin America and the Caribbean were submitted to the WHO CC in Atlanta for characterization.
- A course was developed to improve the process of sample identification for characterization and timing of shipment. During 2015–2016, the course was used to train more than 100 laboratorians from 20 countries, including 2 national courses to train large sub-regional networks in Argentina and Brazil. As a result, between 2012 and 2015, there was a 24% decrease in the number of Latin American and Caribbean countries that submitted samples more than 3 months old and a 36% increase in the number of member states that submitted samples at least twice per year to the WHO CC in Atlanta for additional characterization.

## PREPAREDNESS

Between 2015 and 2017, PAHO responded to various disease outbreaks both inside and outside the region including Ebola (West Africa), Cholera (Haiti), and Zika (South America and the Caribbean). PAHO activated their emergency operation center (EOC) in Washington, DC to coordinate preparedness activities in the region and provide support in the deployment of rapid response teams. The EOC served as the point of contact for communication between technical areas and MOHs. PAHO continued to support all countries in creating situation rooms and EOCs to centralize data and coordinate preparedness activities.

To successfully justify investments in prevention and control strategies, such as influenza vaccine, PAHO supported countries to use their surveillance and other national data sources to establish estimates of medical and economic disease burdens for influenza. PAHO also developed regional, sub-regional, and country estimates for influenza vaccine effectiveness using the SARI-net platform sentinel sites.

### PREPAREDNESS ACTIVITIES

- Country missions were conducted to help detect gaps and provide an opportunity to prioritize essential public health functions.
- Five countries (Bolivia, Colombia, Costa Rica, Ecuador, and Honduras) received assistance to generate estimates of influenza-associated hospitalizations and deaths using SARI surveillance data.

- Sixteen countries (Argentina, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Honduras, Mexico, Panama, Paraguay, Peru, the United States, and Uruguay) collaborated in participation in a regional analysis to estimate influenza-associated hospitalizations using International Classification of Diseases 10 (ICD-10) hospital discharge codes.
- As of 2016, 15 countries had joined the Network for Evaluation of Influenza Vaccine Effectiveness (REVELAC-i), which is led by PAHO, and 13 countries participated in the vaccine effectiveness evaluation.

## TRAINING

- SARI training workshops were conducted in at least 15 countries to support the implementation and strengthening of SARI surveillance in Latin America and Caribbean.
- SARI training workshops were conducted in at least 15 countries to assist in the detection and identification of unusual respiratory events in the region of the Americas.
- Country trainings were used to target local-level health professionals in the region for education about unusual respiratory event detection, as well as to teach the difference between indicator and event-based surveillance.
- Training in data analysis was provided to more than 90 public health professionals from 25 countries in the Americas to help them better understand development of baselines to look at influenza seasonality.
- In-country workshops were conducted to evaluate country results and lessons learned from the implementation of the influenza vaccine effectiveness protocols.

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# BRAZIL

## OVERVIEW

Fiscal Year (FY) 2017 marks the eleventh year of CDC's cooperative agreement with Unidade Técnica de Vigilância de Doenças de Transmissão Respiratória e Imunopreveníveis, in Brasilia, Brazil. As of FY 2017, Brazil was in its second year of a 5-year agreement titled *Maintenance of Influenza Surveillance Capacity by National Health Authorities Outside the United States*. This agreement was designed to continue to support and strengthen Brazil's existing influenza surveillance systems, as well as maintain its capacity to detect, monitor, and respond to changes in influenza viruses, and mitigate transmission of novel influenza among humans.

## SURVEILLANCE

Brazil's sentinel surveillance is based on a network of health units distributed in all geographic regions of the country. The principal objective is to identify circulating respiratory viruses in order to provide data to support seasonal influenza vaccine composition recommendations. In addition, the surveillance system—which consists of both sentinel surveillance for influenza-like illness (ILI) and severe acute respiratory infection (SARI) in hospital intensive care unit inpatients and universal surveillance for SARI—allows tracking of health system needs due to these respiratory viruses. As of 2017, Brazil has 76 municipalities with sentinel sites participating in its network. In total, there are 115 sentinel sites for SARI and 137 sentinel sites for ILI, with samples collected and sent to National Influenza Centers (NICs) or laboratories on a daily basis, from 100% of clinical cases. Data are collected through standardized forms and entered into electronic health surveillance systems, Sivep-Gripe and SINAN influenza web, for timely analysis.

### SURVEILLANCE ACTIVITIES

- Between 2015 and 2016, a total of 39,858 samples were collected from ILI sentinel sites and 4,753 samples were collected from SARI sites, resulting in a total of 7,349 (18.43%) and 1,265 (26.6%) positive for influenza or other respiratory viruses among ILI and SARI cases, respectively.

## HIGHLIGHTS

- Influenza surveillance was strengthened with the deployment of more influenza-like illness sentinel units and the incorporation of sentinel severe acute respiratory infection (SARI) in hospital intensive care units and by universal surveillance for SARI.
- Weekly epidemiological and technical reports were provided.
- National (epidemiology and laboratory) influenza meetings were conducted.
- The protocol for treatment of influenza was updated.
- An annual Influenza Vaccination Campaign was conducted that included new priority groups for influenza vaccination.
- An effectiveness study of the influenza vaccine in Brazil was conducted.
- Molecular biology for diagnostics was decentralized.
- A contingency plan for influenza was developed.
- Online courses for clinical diagnostics and surveillance of influenza were established.

- Regional and supervisory meetings of the sentinel sites were conducted to increase the quality of data and sample collection.
- The Ministry of Health (MOH) acquired and distributed oseltamivir.
- Weekly technical reports were provided to internal and external organizations including CDC and the WHO Pan American Health Organization (PAHO), and made available electronically via web.

## LABORATORY

Brazil has 3 WHO NICs. They are located in Belém/Pará State (Evandro Chagas Institute), São Paulo (Adolfo Lutz Institute), and Rio de Janeiro (Oswaldo Cruz Foundation), which also serves as the National Reference laboratory for the MOH. Each NIC receives subsets of positive/negative samples, as well as inconclusive samples from state-designated laboratories. NICs are responsible for additional

analyses including viral isolation and antigenic and genomic characterizations of viruses. All 3 NICs have the technical capacity to perform immunofluorescence and real-time PCR (rt-PCR). Central Laboratories in 22 states are also able to perform influenza detection by rt-PCR using CDC primers and probes. Notable progress in laboratory surveillance capacity has been achieved over the past 11 years. Data are included in national databases, Sivep-Gripe and SINAN, for sentinel surveillance. The success of this partnership has led to significant enhancements benefiting both Brazil and the WHO Global Influenza Surveillance and Response System (GISRS) program.

### LABORATORY ACTIVITIES

- Between October 1, 2015 and September 30, 2017, Brazil submitted a total of 254 samples to the WHO Collaborating Center for Reference and Research on Influenza in Atlanta as part of the WHO GISRS.
- Workshops were conducted with laboratory technicians focusing on laboratory diagnosis of seasonal and pandemic influenza viruses.
- Regional meetings and supervision/monitoring of influenza lab surveillance were conducted in the states.

### PREPAREDNESS

The MOH of Brazil has a *Contingency Plan for Influenza* (2010) which was developed after the 2009 influenza pandemic. The plan is updated as needed and WHO information on the circulation of animal influenza around the world is included. All recommendations of the plan follow the guidelines of CDC and WHO.

### PREPAREDNESS ACTIVITIES

- Training was conducted for leaders in health surveillance of federal units of Brazil for training in responsibilities under the Contingency Plan Matrix.
- Regional training seminars were conducted for the development of Contingency Plan for Influenza and other diseases in the federal units.
- Meetings were conducted with the Ministry of Agriculture for discussions and actions on avian influenza.

- The Ministry of Agriculture of Brazil developed a work plan for the monitoring of influenza viruses in migratory birds.
- There is an inter-ministerial technical group for discussion of actions and preparation for a possible influenza pandemic.

### TRAINING

Training and meetings for supervision/monitoring of influenza surveillance were held in the North, Northeast, South, East, and West regions. The following trainings were held:

- Training and meetings to estimate the burden of influenza
- Training for development of the Contingency Plan for Influenza
- An online training for clinical and surveillance of influenza
- Training for the Sivep-Gripe and SINAN Web Influenza systems
- Training for influenza data analysis

### RESEARCH

In partnership with the MOH and state health departments, CDC provided technical assistance to generate data for the design of influenza prevention and control strategies in the country. Ongoing projects evaluated the impact of influenza vaccination, burden of influenza disease, influenza A(H1N1) preparedness, and influenza vaccine effectiveness.

Primary activities included studies on the impact of seasonal influenza vaccination among persons 60 years and older on rates of influenza-associated mortality and hospitalization from 1994 to 2009 in São Paulo State, Brazil, and on reemergence of influenza A(H1N1)pdm09 in 2013, São Paulo, Brazil.

Additionally, Brazil is part of a multi-country evaluation of seasonal influenza vaccine effectiveness among high-risk groups targeted for vaccination, which is a PAHO-sponsored initiative through REVELAC-i (the Network for Evaluation of Influenza Vaccine Effectiveness).

# CENTRAL AMERICA (CDC-CAR)

## OVERVIEW

CDC's Regional Office for Central America's (CDC-CAR) influenza program activities provide support to 8 countries: Belize, Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama. The focus is to strengthen capacity to respond to pandemic influenza and to prevent and control seasonal influenza. This includes improving influenza surveillance and laboratory capabilities, promoting the development of local pandemic plans, supporting targeted research projects, and building the evidence base for decisions on influenza vaccine program expansion.

## SURVEILLANCE

Based on results of repeated in-depth evaluations of influenza sentinel surveillance, some countries in the region continued to update their national guidelines to implement the new influenza surveillance standards developed by WHO. The main strategy to optimize the surveillance system was to focus CDC resources on a limited number of sentinel sites in each country. The goal for sentinel hospitals was to increase the number and quality of respiratory samples from severe acute respiratory infection (SARI) cases, and to decrease bias. Some sentinel hospitals collect respiratory samples from 100% of SARI cases. Surveillance activities were further strengthened by ongoing training, updating of standardized procedures, and implementation of an essential indicators-based monitoring plan. All activities are being coordinated with the WHO Pan American Health Organization (PAHO) and Ministries of Health (MOHs).

### SURVEILLANCE ACTIVITIES

- Rigorous, in-depth standardized evaluations of influenza surveillance systems were conducted in 6 of 8 countries during 2017.
- Technical assistance was provided to local experts and epidemiologists in order to update national guidelines for influenza surveillance according to new WHO influenza surveillance standards.

## HIGHLIGHTS

- Surveillance for influenza and other respiratory viruses, laboratory capabilities, and pandemic influenza preparedness were strengthened in Central American countries.
- The abilities of national surveillance laboratories to identify and characterize circulating influenza viruses and other respiratory viruses were improved.
- In collaboration with CDC's Division of Global Health Protection and the WHO Pan American Health Organization, equipment and supplies were purchased, and training and technical assistance were provided to begin molecular testing for influenza at the national laboratory of Belize.
- The collection and processing of more than 20,000 samples annually at 6 National Influenza Centers and 2 influenza reference laboratories in the region was supported.

- Standardized operating procedures (SOPs) for surveillance were revised and updated in some countries.
- Support was provided for national decision-making on influenza vaccine formulation and timing in Guatemala.

## LABORATORY

Public health institutions in Central America have continued to improve laboratory-based surveillance for respiratory viruses. These gains have involved establishing numerous laboratories and sentinel sites to process clinical specimens. Currently, there are 6 National Influenza Centers (NIC), 2 National Influenza Reference Laboratories, and 16 decentralized influenza laboratories in the region. These efforts have resulted in expanded diagnostic capabilities and improved data quality. These laboratories now process approximately 20,000 respiratory samples per year. Personnel at the NICs have also updated algorithms, SOPs, and biosafety guidelines. Some countries in

the region have developed or updated laboratory contingency plans.

The support provided by CDC-CAR has improved the abilities of the MOH surveillance laboratories to identify and characterize the viruses that cause influenza and other acute respiratory infections. Laboratories in all 8 countries are registered with CDC's International Reagent Resource and receive reagents and control materials for molecular methods as well as cell lines.

### LABORATORY ACTIVITIES

- Rigorous, in-depth standardized evaluations were conducted of influenza laboratory capabilities in 6 of 8 countries with the CDC/Association of Public Health Laboratories review tool.
- Technical assistance was provided to the NICs and decentralized influenza laboratories to update algorithms, SOPs, biosafety guidelines, and contingency plans.
- Electronic laboratory information systems were strengthened.
- The collection and processing of approximately 20,000 respiratory samples yearly (from all influenza laboratories combined) was supported.
- In collaboration with CDC's Division of Global Health Protection and PAHO, equipment and supplies were purchased, and training and technical assistance were provided to begin molecular testing for influenza at the national laboratory of Belize.
- Emergency supplies and reagents were provided to NICs during unanticipated shortages.
- Technical assistance was provided to improve quality of cell culture, influenza virus isolation, and selection of isolates and specimens.

### PREPAREDNESS

All countries in the Central American region received recommendations to strengthen their Pandemic Influenza Preparedness plans based on the results from a core capacity assessment for influenza pandemic preparedness and response conducted in 2014. These recommendations have been useful to help countries prioritize their activities and identify the necessary resources for implementation.

Additionally, CDC-CAR worked with the Council of Ministers of Health of Central America (COMISCA) to support influenza programs throughout the region.

Planning for renewed focus on support for pandemic preparedness in Central America is underway. As a regional body, COMISCA focuses on integration across the nations of Central America and the Dominican Republic.

### PREPAREDNESS ACTIVITIES

- A core capabilities inventory to respond to influenza pandemic was conducted in all 8 Central American countries.
- Planning was begun for a renewed effort to improve pandemic preparedness, highlighting regional integration and efficiency.

### TRAINING

- Laboratory staff participated in a regional training on biosafety.
- Several hands-on trainings were conducted at the NICs and decentralized laboratories.

### INFLUENZA VACCINE ACTIVITIES

The CDC-CAR Influenza Program has supported influenza vaccination research and decision-making in order to optimize influenza prevention in the Central American region and the Dominican Republic. In 2013, CDC-CAR collaborated with PAHO to update the description of influenza seasonality in the Central American region and create a network for influenza vaccine evaluations in Latin America and the Caribbean, called REVELAC-i for its acronym in Spanish: Red para la Evaluación de Vacunas En Latino América y el Caribe–influenza.

Most recently, CDC-CAR has worked with PAHO and other partners to support decision-making regarding the timing and formulation of influenza vaccine in Guatemala. Recent and ongoing research studies are assessing influenza vaccine policy and practices in the public and private sector in Costa Rica, Guatemala, and Honduras. These studies and one in Panama and El Salvador are also assessing knowledge and practices regarding influenza and the influenza vaccine among health care workers and pregnant women. With improved understanding of the barriers to vaccination, influenza programs in these countries can develop plans to improve coverage among high-risk populations.

## RESEARCH

CDC's Influenza Division works closely with CDC Global Disease Detection and other CDC programs in Guatemala; COMISCA; the Gorgas Institute; PAHO; Universidad del Valle; and MOHs in Belize, Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama to explore the timing of influenza in the American tropics, optimal times to vaccinate, the disease and economic burden of influenza and influenza-like illness, the effectiveness of influenza vaccination programs, and illnesses averted through vaccination, especially among WHO's Strategic Advisory Group of Experts' target groups.

Research activities include the conduct of a CDC-funded Influenza and Respiratory Syncytial Virus in Infants Study (IRIS) of hospitalized and non-ill infants aged <1 year from 2015–2017, with local sponsorship by Sustainable Sciences at Institute Hospital Infantil, Manuel de Jesus Rivera "La Mascota," Managua, Nicaragua.

# JAMAICA



A porter at Bustamante Hospital for Children transports samples from the hospital ward to the hospital laboratory.

## OVERVIEW

In Fiscal Year (FY) 2016, the Ministry of Health (MOH), Jamaica, received a grant from CDC entitled *Surveillance and Response to Avian and Pandemic Influenza* to support routine influenza surveillance, and build capacity within the surveillance system of Jamaica to detect, respond to, and monitor changes in influenza viruses with special emphasis on capacity building and sustainability. FY 2017 marked the second year out of 5 of CDC's cooperative agreement with the MOH in Jamaica. This agreement was designed to continue to support and strengthen Jamaica's existing influenza surveillance systems, as well as maintain its capacity to detect, monitor, and respond to changes in influenza viruses, and mitigate transmission of novel influenza among humans.

## HIGHLIGHTS

- The Jamaican influenza and severe respiratory diseases surveillance system was instituted prior to 2000. The national surveillance system provides monitoring of trends in respiratory disease and timely investigation of suspicious cases.
- In 2009, surveillance of severe acute respiratory infections at 6 sentinel sites was instituted.
- In 2016, the country received a grant (CDC-RFA-IP16-1603) from CDC for surveillance and response to influenza in Jamaica. The project seeks to support routine influenza surveillance and build capacity and sustainability of the system to detect, respond to, and monitor changes in influenza viruses.

## SURVEILLANCE

In Jamaica, sentinel surveillance is performed through regular monitoring of severe acute respiratory infection (SARI), which continues in 6 sentinel sites. The sites send weekly reports of SARI and acute respiratory illness (ARI) cases and are required to sample 100% of SARI cases and 10% of ARI cases. Samples collected are sent to the National Influenza Center (NIC) for testing. The MOH reports on influenza activities and disseminates information to the field on a weekly basis.

The MOH hosts monthly meetings with the national surveillance team (which includes the 6 sentinel sites). In these meetings, discussions include strengths and weaknesses of the surveillance system, including SARI, and recommendations for improvement of case detection, sample collection, and feedback of information to sites.

Additionally, regions and parishes have monthly surveillance meetings where they evaluate and address the needs of their specific sites. The MOH also participates in these meetings and presents on SARI surveillance performance.

## SURVEILLANCE ACTIVITIES

- Between 2015 and 2017, more than 150 cases of influenza were identified and confirmed through laboratory tests. Additionally, more than 6 deaths were associated with influenza disease.



- Workshops and regional and supervisory meetings were conducted with the sentinel sites to increase the quality of data and sample collection.
  - » Monthly national surveillance meetings were held with the regional team.
  - » Regional and parish quarterly/monthly surveillance meetings were held.
  - » SARI sentinel site stakeholder site meetings were held, with formal dissemination of evaluation findings to all sites; follow-up visits were conducted to 5 of 6 sites to review the findings, and to discuss progress and the way forward. This included sensitization and reminders on the current SARI case definition and reporting requirements to persons in the field.
  - » Country representatives participated in CDC/WHO Pan American Health Organization (PAHO) collaborative workshops and meetings:
    - An influenza workshop held in Jamaica in December 2015
    - The third and fourth annual SARInet meetings, held in Puerto Rico in 2016 and the Dominican Republic in 2017
- Routine technical reports were provided to internal and external organizations, including CDC and WHO PAHO, and made available electronically via web.
- Respiratory and serum samples from patients presenting at different health care facilities throughout Jamaica were investigated for influenza and other viruses and reported.
- Samples were shipped to CDC for influenza virus detection and subtyping.
- NIC and MOH staff participated in influenza and other virus proficiency testing programs from 3 different providers (WHO, CDC, UKNEQAS- One World Accuracy).
- ISO:15189 accreditation for influenza–PCR and HI testing was applied for and received.
- A clerk/assistant participated in RT-PCR training by BioAnalytical Instruments in April 2017.
- An additional medical technologist was appointed to the NIC.
- Surveillance personnel participated in a training course in laboratory assessment in 2017.
- The director of the NIC-Jamaica visited the Gastrointestinal and Respiratory Division at CDC in August 2016 for updates on laboratory and other aspects of influenza surveillance and response.
- The director of the NIC-Jamaica participated in the SARInet Annual Meeting in the Dominican Republic in 2017.

## LABORATORY

The NIC is located at the Department of Microbiology at the University Hospital of the West Indies. The department offers full diagnostic laboratory services in bacteriology, virology, mycology, parasitology, and immunology. The NIC is an integral component of the virology laboratory services. The laboratory tests performed for influenza and other respiratory virus diagnosis and surveillance include viral isolation, immunofluorescence, hemagglutination inhibition (HI) assays, and nucleic acid tests.

### LABORATORY ACTIVITIES

- On average, the NIC was able to process approximately 1,000 samples per year.
- Between October 1, 2015 and September 30, 2017, Jamaica submitted a total of 33 samples to the WHO Collaborating Center for Reference and Research on Influenza in Atlanta as part of the WHO Global Influenza Surveillance and Response System (GISRS).

## PREPAREDNESS

In 2017, Jamaica completed the first draft of their Strategic Plan for National Influenza.

The country continues to maintain its rapid response and containment team, which was deployed within hours to the Cornwall Regional Hospital during an outbreak of respiratory illness in 2016 and is still operational.

### PREPAREDNESS ACTIVITIES

- Although the MOH of Jamaica does not routinely conduct surveillance of unusual respiratory cases with animal exposure, their policy includes considering any unusual event as a class 1 disease, and thus immediate notification must take place.
- Between 2016 and 2017, national responses to Zika, dengue, and influenza took place. In addition, in 2016, the Jamaica MOH responded to an outbreak of a respiratory illness at a large hospital, Cornwall Regional (a SARI sentinel site), which had to be partially evacuated.

- Activities to have the existing National Pandemic Preparedness and Response Plan reviewed and revised commenced.

## TRAINING

- An influenza workshop was held in Jamaica in December 2015.
- The third annual SARInet Meeting was held in Puerto Rico in 2016.
- A grant management training for grantees funded by the Global Health Security Agenda and CDC Influenza Division was held in Dar es Salaam, Tanzania, May 21–25, 2017; 2 participants from the MOH attended.
- Participants from the MOH and NIC attended the fourth annual SARInet Meeting in the Dominican Republic, May 22–26, 2017.
- A project management sensitization was held by the Jamaican MOH on May 31, 2017; National Epidemiology Unit and MOH staff were sensitized.
- One participant from the NIC attended the 65th anniversary of GISRS global NIC meeting in Geneva, Switzerland on July 17–19, 2017.



# MEXICO



Laboratory technician performing virus isolation procedure using MDCK cell lines.

## OVERVIEW

Fiscal Year (FY) 2017 marks the eleventh year of CDC's cooperative agreement with the General Directorate of Epidemiology of the Secretariat of Health of Mexico (DGE) in Mexico City, Mexico. As of FY 2017, Mexico is in its second year of a 5-year agreement titled *Maintenance of Influenza Surveillance Capacity by National Health Authorities Outside the United States*. This agreement was designed to continue to support and strengthen Mexico's existing influenza surveillance systems, as well as maintain its capacity to detect, monitor, and respond to changes in influenza viruses, and mitigate transmission of novel influenza among humans.

## HIGHLIGHTS

- Since 2001, the General Directorate of Epidemiology of the Secretariat of Health of Mexico has coordinated influenza epidemiological surveillance through the platform of the Epidemiological Surveillance System of Influenza.
- In 2006, Mexico developed activities to strengthen their influenza surveillance by reporting their data through FluNET. Epidemiology data, comprising of identification and registration of cases, as well as laboratory data, comprising of diagnostics, viral isolation, and influenza strain subtyping, are compiled and analyzed through Mexico's influenza surveillance electronic platform, SISVEFLU.
- As of 2017, the national influenza network includes 565 sentinel sites distributed throughout Mexico's 32 states.

## SURVEILLANCE

In Mexico, influenza represents a priority health problem: it is 1 of the top 10 causes of death among all age groups. Sentinel surveillance is performed through the Influenza Monitoring Units (USMIs), which are distributed across Mexico's 32 states. USMIs report occurrence of new suspected cases of influenza within the first 24 hours of detection through the Influenza Epidemiological Surveillance System (SISVEFLU) platform. The main objective of Mexico's influenza surveillance is to maintain an active and dynamic system to evaluate circulating viral strains capable of producing severe acute respiratory infection (SARI) with the intention of preventing outbreaks and/or epidemics. Surveillance allows the monitoring of epidemiological behavior of the disease to guide effective prevention and control measures. Mexico uses the data to identify risk groups and areas to promote dissemination and use of epidemiological information for decision-making and to form multisectoral groups to evaluate the control measures for influenza.



Sentinel site for the surveillance of influenza activity in Mexico.

## SURVEILLANCE ACTIVITIES

- Between 2015 and 2017, more than 17,000 cases of influenza were identified and confirmed through laboratory tests. Additionally, more than 1,200 deaths were associated with influenza. Over 72% of mortality cases were associated with influenza A(H1N1) pandemic virus.
- Workshops and regional and supervisory meetings were held with sentinel sites to increase data quality and improve sample collection.
- Weekly technical reports were provided to internal and external organizations including CDC and the WHO Pan American Health Organization (PAHO), and made available electronically via web.

## LABORATORY

InDRE is the Public Health National Reference Laboratory of the Secretariat of Health of Mexico, and its Laboratory of Respiratory Viruses has acted as the National Influenza Center for Mexico since 1964. This laboratory performs surveillance for influenza and other viruses including RSV, adenovirus, and parainfluenza, among others. In 2014, InDRE moved to a new building within the same campus as DGE, with the capability to house state-of-the-art technology and with suitable biosafety levels (BSL2 and BSL3). InDRE leads the National Laboratory Network for

influenza in the country, which consists of 31 Public Health State Laboratories and 5 additional laboratories for influenza surveillance. InDRE has the technical capacity to perform immunofluorescence, real-time PCR (rt-PCR), viral isolation, and sequencing. Notable progress in laboratory surveillance capacity has been achieved over the past 11 years, including the expansion of virologic surveillance to more states in Mexico and acquisition of biosafety infrastructure.

## LABORATORY ACTIVITIES

- On average, InDRE was able to process approximately 16,328 samples per year.
- Between October 1, 2015 and September 30, 2017, Mexico submitted a total of 176 samples to the WHO Collaborating Center for Reference and Research on Influenza in Atlanta as part of the WHO GISRS.
- Workshops were conducted with laboratory technicians to share developed work plans to ensure that all laboratory surveillance related processes were carried out in optimal conditions, including a suitable algorithm for rt-PCR and viral isolation.
- Training programs were conducted to update laboratory staff on bio-risk management and quality assurance/control issues.

## PREPAREDNESS

Through a series of meetings with representatives of the 3 countries (Mexico, USA, and Canada) involved in the North American Plan for Animal and Pandemic Influenza (NAPAPI), the Work Plan for 2014–2015 was revised. Among the activities to be undertaken are maintaining communication through the National Focal Points of the 3 countries and updating emergency protocols in case of an influenza epidemic for immediate response.

Potential areas of collaboration are being considered in case of an emergency event. The activities also include investigating outbreaks, sharing laboratory samples and medical countermeasures, and sharing information in a trilateral way.

### PREPAREDNESS ACTIVITIES

- The Ministry of Health (MOH) of Mexico routinely conducts surveillance of unusual respiratory cases with animal exposure. In addition, the DGE maintains a close relationship with the National Service of Sanity, Safety and Agri-food quality (SENASICA).
- In April 2017, after isolation of avian influenza A(H7N3) in bird embryos from a commercial farm in Jalisco, the Secretariat of Health in Mexico (through the DGE) began an operation of intentional searches for cases in humans exposed to birds at the farm. DGE collected information from exposed humans through the application of a case study for influenza and biological sampling of possible suspected cases. Pharyngeal exudates, conjunctival exudates, and serum samples were collected; all were analyzed for influenza A(H7N3).
- The MOH of Mexico is in the process of developing a burden of disease study for influenza to better assess the impact of disease in the country.

## TRAINING

- The *Manual for SISVEFLU* was updated.
- The SISVEFLU platform was updated to identify deaths with or through influenza, and a section to include evidence from the death certificate was also added.
- Federal entities received continuous supervision.
- Technical advice from CDC and PAHO to improve epidemiological surveillance of influenza was received.
- Information related to the influenza surveillance system, including update of weekly data that reflected the distribution of cases and deaths, was continually published.
- Continuous communication occurred between states and the epidemiologists responsible for influenza surveillance.

# PARAGUAY

## OVERVIEW

Fiscal Year (FY) 2017 marked the tenth year of CDC's cooperative agreement with the Dirección General de Vigilancia de la Salud in Asunción, Paraguay. As of FY 2017, Paraguay had entered its last year of a 5-year agreement titled *Sustaining Influenza Surveillance Networks and Response to Seasonal and Pandemic Influenza by National Authorities outside the United States*. This agreement was designed to provide support to Paraguay to continue enhancing their influenza surveillance networks and the systematic collection of virological and epidemiological influenza information. This agreement allowed for the rapid detection of and response to potential pandemic influenza, as well as the monitoring and assessment of the impact that seasonal influenza has in the country.

## SURVEILLANCE

Paraguay has 10 severe acute respiratory infection (SARI) and 5 influenza-like illness (ILI) surveillance sites that perform influenza surveillance throughout the country. Current data collected from this surveillance network are comparable with data from the region and are regularly incorporated and disseminated through a national epidemiological bulletin and the weekly Pan American Health Organization (PAHO) influenza report. Further, in 2015, Paraguay also implemented reporting to the FluID system, led by PAHO. Paraguay collects samples from 100% of the clinical cases associated with SARI surveillance and approximately 3–5 samples per week for ILI. Starting in 2016, Paraguay implemented a monitoring dashboard to track the process and results indicators of the surveillance system.

## SURVEILLANCE ACTIVITIES

- Between 2015 and 2017, more than 1,000 cases of influenza were identified and confirmed through laboratory tests. Additionally, more than 200 deaths were associated with influenza.
- Workshops and regional and supervisory meetings of the sentinel sites were conducted to increase the quality of data and sample collection. An interactive dashboard was implemented in order to visualize the process and results indicators by sentinel sites.

## HIGHLIGHTS

- Following the 2009 pandemic, the Ministry of Health began developing activities to strengthen influenza surveillance in country.
- Hospital-based and systematic surveillance focusing on severe acute respiratory infection (SARI) was established in Paraguay, and covers all age groups. Paraguay's surveillance data highlights variations in respiratory viruses that circulate all year round.
- As of 2017, Paraguay's surveillance network consists of 10 SARI sentinel hospitals (mostly located in Asunción, the capital city), and 5 influenza-like illness sites.
- Routine technical reports were provided to internal and external organizations including CDC and WHO PAHO, and made available electronically via web. The monitoring dashboard was developed to make automatic graphics with epidemiological and laboratory information, and is available on the Ministry of Health (MOH) web page.

## LABORATORY

Paraguay's National Influenza Center (NIC) capacity was strengthened in response to year-round demand for testing, and this was supported in large part by the cooperative agreement. Following the pandemic in 2009, the NIC reinforced the capacity for laboratory diagnosis of influenza, and implemented RT-PCR, viral isolation, and immunofluorescence techniques at the national level.

Additionally, Paraguay decentralized immunofluorescence techniques to 2 regional laboratories. As of FY 2016, in addition to performing influenza B lineage analyses on a routine basis, the NIC also tested viruses for other pathogens including RSV, adenovirus, and human metapneumovirus, among others. The NIC has established an external quality assessment program for sentinel laboratories, and the NIC itself participates in external evaluations coordinated by WHO and CDC, with excellent scores.

## LABORATORY ACTIVITIES

- On average, the NIC is able to process approximately 5,460 samples per year.
- Between October 1, 2015 and September 30, 2017, Paraguay submitted a total of 79 samples to the WHO Collaborating Center for Reference and Research on Influenza in Atlanta as part of the WHO Global Influenza Surveillance and Response System.
- The NIC plans to develop and implement bioinformatics techniques for influenza virus characterization.
- NIC professionals were trained in the use of Tableau software.
- A NIC professional was trained in influenza data management and epidemiological analysis in Quito, Ecuador.
- A NIC professional was trained in transport of infectious substances in Guayaquil, Ecuador.
- A NIC professional participated in the OPTIONS for the Control of Influenza IX meeting.
- A NIC professional participated in the eighth WHO meeting on development of influenza vaccines that induce broadly protective and long-lasting immune responses.
- A NIC professional was trained in bioinformatics by CDC subject matter experts.

## PREPAREDNESS

CDC support helped evaluate the ability of the surveillance system, and these results were used to update the national pandemic preparedness and response plan. The cooperative agreement strengthened surveillance capabilities, and the country continued the work by committing its own budget, increasing support of the NIC, and incorporating human resources at both the national level and the sentinel sites. It has also expanded and improved the infrastructure of the buildings and equipment. Human resources dedicated to surveillance both centrally and locally have been trained.

Paraguay is a member of the Network for Evaluation of Influenza Vaccine Effectiveness (REVELAC-i), led by PAHO. In 2015, the National Surveillance Guidelines were updated and the list of the mandatory events for notification were made available on the web at [www.vigisalud.gov.py](http://www.vigisalud.gov.py).

## PREPAREDNESS ACTIVITIES

- The MOH of Paraguay routinely conducts surveillance of unusual respiratory cases.
- The MOH of Paraguay developed a burden of disease study for influenza to better assess the impact of disease in the country. This work is in process for peer-review publication.
- A protocol for detection of unusual SARI events was included in the plan with actions to be taken by the rapid response team.
- Detection capacities for entry points and borders of the country was improved. The staff of the epidemiological units were trained.

## TRAINING

- A workshop was held on analysis of the information collected via sentinel surveillance of influenza and other alert systems in August 2015.
- Training was conducted in the use of the surveillance monitoring dashboard in December 2015.
- Training in operational guides for ILI and SARI surveillance and sampling was provided to staff of the Encarnación sentinel site in June 2016.
- Sentinel centers developed baselines in April–June, 2017.
- A talk was given at Advances in the Virological Surveillance of Influenza and Other Respiratory Viruses in Paraguay, at the tenth Paraguayan Congress of Infectology in November 2015.
- Sentinel center health personnel were trained in virological surveillance; collection, storage, and transportation of respiratory specimens; and interpretation of results.
- A Local Experience, National Virological Influenza Data conference was held for the Paraguayan Societies of Pediatrics and Infectious Diseases in March 2016.
- A workshop on laboratory diagnosis of respiratory viruses was held at the Paraguayan Society of Biochemistry in April 2017.

## PERU



Laboratorio de Referencia Regional en Salud Pública—DIRESA in Cusco, Peru which serves as a regional laboratory that tests samples in this tourist region, then sends them to the NIC for confirmatory and subtyping or lineage determination.

## OVERVIEW

Fiscal Year (FY) 2016 marked the tenth year of CDC's cooperative agreement with the Directorate General of Epidemiology (DGE) in Lima, Peru. As of FY 2016, Peru entered its last year of a 5-year agreement titled *Sustaining Influenza Surveillance Networks and Response to Seasonal and Pandemic Influenza*. This agreement was designed to provide support to Peru to continue enhancing their influenza surveillance networks and the systematic collection of virological and epidemiological influenza information. This agreement allowed for the rapid detection of and

## HIGHLIGHTS

- Peru developed preparedness/response plans against avian influenza in 2005. The Ministry of Health (MOH) initiated advocacy to increase the awareness of authorities, and encourage multi-sectorial work to prepare for potential influenza pandemics.
- Additionally, the Directorate General of Epidemiology implemented the *Sentinel Surveillance of Influenza and other Respiratory Viruses initiative* to regulate virological/influenza surveillance.
- Following the 2009 pandemic, the MOH implemented an intensified surveillance of severe acute respiratory infections (SARI) and deaths from SARI.

response to potential pandemic influenza, as well as the monitoring and assessment of the impact that seasonal influenza had in the country.

## SURVEILLANCE

Peru has 7 severe acute respiratory infection (SARI) and 21 influenza-like illness (ILI) surveillance sites that perform influenza surveillance throughout the country. In 2006, the implementation of the *National Plan for Preparedness and Response to Potential Influenza Pandemic* initiative increased the coverage of influenza surveillance because it allowed support of the National Medical Research Center Detachment (NMRCD, now the United States Naval Medical Research Unit 6 [NAMRU-6]), which increased the number of surveillance sites in the country.

## SURVEILLANCE ACTIVITIES

- Between 2015 and 2017, more than 1,805 cases of influenza were identified and confirmed through laboratory tests. Additionally, more than 60 deaths were associated with influenza.
- Workshops and regional and supervisory meetings of the sentinel sites were conducted to increase the quality of data and sample collection.
- Communication material has been developed and distributed to health establishments in the country, where it details flows and surveillance processes, with an emphasis on unusual SARI.



- Routine technical reports were provided to internal and external organizations including CDC, WHO, and the Pan American Health Organization (PAHO), and made available electronically via web.

## LABORATORY

Since 1999, Peru's National Influenza Center (NIC), located in the laboratories of the National Health Institute (NIH) in Lima, has participated in WHO's Global Influenza Surveillance and Response System (GISRS) by sharing information through FluNet and by sending isolated and typed viruses strains to the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in Atlanta. Following the pandemic in 2009, the NIC reinforced laboratory diagnosis of influenza, and implemented RT-PCR, viral isolation, and direct immunofluorescence techniques at the national level. Additionally, Peru decentralized immunofluorescence techniques to 18 regional laboratories and RT-PCR techniques to laboratories in Cusco and Loreto. Testing at the NIC is done on the same day samples are received and results are generally returned within 72 hours.

### LABORATORY ACTIVITIES

- On average, NIH is able to process approximately 4,420 samples per year.
- Between October 1, 2015 and September 30, 2017, Peru submitted a total of 116 samples to the WHO CC in Atlanta as part of the WHO GISRS.
- As of 2017, the national influenza network was comprised of 7 SARI sentinel sites and 21 ILI sentinel sites, distributed throughout Peru's 25 states.

## PREPAREDNESS

In 2017, DGE developed technical guidelines related to influenza surveillance and outbreak research; developed a thematic group that works specifically on surveillance, preparedness and response; and was in the process of updating technical guidelines.

In 2014, Peru revised their National Plan of Preparedness and Response to a potential pandemic of influenza and other emerging respiratory viruses, which was approved in December 2014. The plan was under budget review in 2017–2018.

In 2017, Peru MOH scheduled a meeting with the Ministry of Agriculture to improve flu surveillance, with emphasis on the human-animal interface.

## RESEARCH

CDC's Influenza Division has partnered with the MOH, PAHO, and NAMRU-6 to explore the timing of influenza in different macro-regions of Peru, the optimal time for influenza vaccination, the disease and economic burden associated with influenza, and vaccine effectiveness among potential target groups.

Research activities include a CDC-funded Influenza Illness and Influenza Vaccine Effectiveness Healthcare Personnel Cohort Study underway through 2020, sponsored by NAMRU-6 at 5 hospitals in Lima, Peru.

# Research Activities

## ARGENTINA

During the past 5 years, CDC's Influenza Division has worked closely with Ministries of Health, academic partners, and the Pan American Health Organization (PAHO) to explore the disease and economic burden of influenza illness, as well as the effectiveness of influenza vaccination among children and older adults. This latter effort is anticipated to help Argentina assess how many illnesses and costs could be averted through its vaccination program. Research activities include:

- A study to quantify the incidence of viral respiratory infections among outpatient and hospitalized children aged  $\leq 5$  years and the associated cost in Buenos Aires, Argentina
- A cohort study to quantify rates of laboratory-confirmed influenza among pregnant women
- A study to describe the timing of respiratory virus epidemics in sub-regions of Argentina over 30 years
- Participation in program evaluation to estimate influenza vaccine effectiveness among young children and older adults during 2012–2015 through the PAHO-led Network for Evaluation of Influenza Vaccine Effectiveness (REVELAC-i)

## AMERICAS

CDC's Influenza Division and PAHO are collaborating to strengthen surveillance systems in the region and leverage the data generated from these activities to answer questions of public health importance. Activities have focused on estimating medical and economic influenza disease burden, estimating influenza vaccine effectiveness, and determining seasonality of influenza circulation to optimize vaccine timing. Ongoing research findings include:

- Influenza peak activity in the American tropics, as reported to SARINet ([www.sarinet.org](http://www.sarinet.org)), appears to occur during May through September, and countries in this region should consider timing influenza vaccine accordingly.
- Efforts to estimate the burden of influenza-associated hospitalizations throughout the region are ongoing.

- Most countries (88%) in the Americas have seasonal influenza vaccination policies.
- On average, annually, ~85,000 people appear to die from influenza in the Americas.
- Regional efforts are ongoing to estimate influenza-associated mortality among pregnant women, a priority group recommended to receive influenza vaccine by WHO.
- Preliminarily, 2013 influenza trivalent vaccine effectiveness to prevent hospitalization in 9 Latin American countries was estimated to be 49% (95% confidence interval: 32–61%) for children aged  $< 5$  years and 48% (95% confidence interval: 33–59%) for adults aged  $\geq 60$  years.

## BRAZIL

In partnership with the Brazilian Ministry of Health and state health departments, CDC provides technical assistance to generate data for the design of influenza prevention and control strategies in the country. Ongoing projects evaluate the impact of influenza vaccination, burden of influenza disease, influenza A(H1N1) preparedness, and influenza vaccine effectiveness. Primary activities include:

- A study on the impact of seasonal influenza vaccination among persons 60 years and older on rates of influenza-associated mortality and hospitalization from 1994 to 2009 in São Paulo State, Brazil
- A study on the reemergence of influenza A(H1N1) pdm09 in 2013, in São Paulo, Brazil
- Additionally, Brazil is part of a multi-country evaluation of seasonal influenza vaccine effectiveness among high-risk groups targeted for vaccination, which is a PAHO-sponsored initiative through REVELAC-i.

## CENTRAL AMERICA

CDC's Influenza Division works closely with CDC Global Disease Detection and other CDC programs in Guatemala; the Council of Ministers of Health of Central America; the Gorgas Institute; PAHO; Universidad del Valle; and Ministries of Health in

Belize, Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and Panama to explore the timing of influenza in the American tropics, optimal times to vaccinate, the influenza-associated disease and economic burden, the effectiveness of influenza vaccination programs, and illnesses averted through vaccination, especially among WHO Strategic Advisory Group of Experts (SAGE) target groups.

Ongoing research activities include studies to explore:

- Associations between seasonal influenza and meteorological parameters in Costa Rica, Honduras, and Nicaragua
- Prevalence of influenza A in swine and duck populations in rural backyards within tropical wetlands in Guatemala, 2013
- Demographics and clinical characteristics of influenza A(H1N1)pdm09 deaths in Central America and the Dominican Republic, 2009–2010
- Influenza illness among case-patients hospitalized for suspected dengue, El Salvador, 2012
- Incidence of influenza-associated severe acute respiratory infection among pregnant women in El Salvador
- Medical and economic burden of influenza-like illnesses and influenza-associated medically-attended cases
- Burden of influenza and influenza-associated pneumonia in the first year of life in a prospective cohort in Managua, Nicaragua
- Influenza-associated hospitalizations and deaths in Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua
- Direct and indirect costs associated with laboratory-confirmed hospitalized influenza cases in Honduras, Panama, and Guatemala
- Impact of maternal acute respiratory infection and laboratory-confirmed influenza illness on neonates
- Pilot to evaluate the feasibility of measuring seasonal influenza vaccine effectiveness using surveillance platforms in Central America, 2012
- Public health policies and practices of the use of influenza vaccine, oseltamivir, and palivizumab in Costa Rica, El Salvador, Guatemala, and Panama
- Knowledge, attitudes, and practices for influenza vaccination in Costa Rica, El Salvador, Honduras, and Panama

## ECUADOR

CDC is working through SARINet, the PAHO regional surveillance network, to help Ecuador's National Influenza Center (NIC) explore the timing of influenza epidemics in different provinces within the country. In addition, CDC is exploring a collaboration between the NIC, the Universidad Catolica, and the University of Liverpool to estimate the influenza burden of acute respiratory illness among very young children in Ecuador. Research activities include:

- An analysis to determine the timing of historical influenza seasons in different provinces within Ecuador and the optimal time for influenza vaccination
- A cohort study to quantify rates of laboratory-confirmed influenza acute respiratory illness among very young children in the highlands of Ecuador

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## NICARAGUA

CDC's Influenza Division is collaborating with the Ministry of Health, PAHO, and the University of Michigan to explore the timing of influenza season in Nicaragua, verify the optimal timing of influenza vaccination, and quantify the burden of influenza illness among SAGE target groups. CDC is also partnering with the Ministry of Health, PAHO, and the Alliance for Influenza Vaccine Introduction to explore vaccine effectiveness and the value of maternal immunization to prevent illness among pregnant women and their babies. Research activities include:

- Describing the timing of influenza epidemics and optimal time to vaccinate using seven years of National Influenza Centre and WHO Collaborating Centre data.
- Quantifying the burden of influenza and influenza-associated pneumonia in the first year of life in a prospective cohort study in Managua, Nicaragua.
- Estimating influenza-associated hospitalizations and deaths in Central America (Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua) among various key age groups.
- Estimating, through REVELAC-i, the efficacy of inactivated influenza vaccine to prevent influenza among children and older adults in the region.
- Assessing the effect of seasonal vaccination in pregnant women on birth outcomes.



## PERU

CDC's Influenza Division has partnered with the Ministry of Health, PAHO, and the United States Naval Medical Research Unit 6 to explore the timing of influenza in different macro-regions of Peru, the optimal time for influenza vaccination, the disease and economic burden associated with influenza, and the effectiveness of vaccination among target groups. Research activities include:

- Describing the timing of influenza epidemics and optimal time to vaccinate using 7 years of NIC and WHO CC data
- Estimating the incidence burden of influenza in 4 ecologically distinct regions in Peru through a household-based community cohort study
- Estimating the economic burden of influenza in Peru, 2009–2010
- Exploring inactivated trivalent influenza vaccine effectiveness among health care workers in Lima, Peru

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# WHO South-East Asia Region (SEAR)

# WHO South-East Asia Region [SEAR]

WHO's Regional Office for South-East Asia (SEARO) is located in New Delhi, India. The office serves the following 11 member countries: Bangladesh, Bhutan, the Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand, and Timor-Leste. Seven of the 11 countries also received bilateral cooperative agreement funds from CDC's Influenza Division in Fiscal Year 2017.

WHO SEARO focuses on further strengthening capacity development in influenza disease surveillance, developing burden of influenza assessments, enhancing International Health Regulations preparedness, and scaling-up and refining laboratory capacity in influenza diagnostics.

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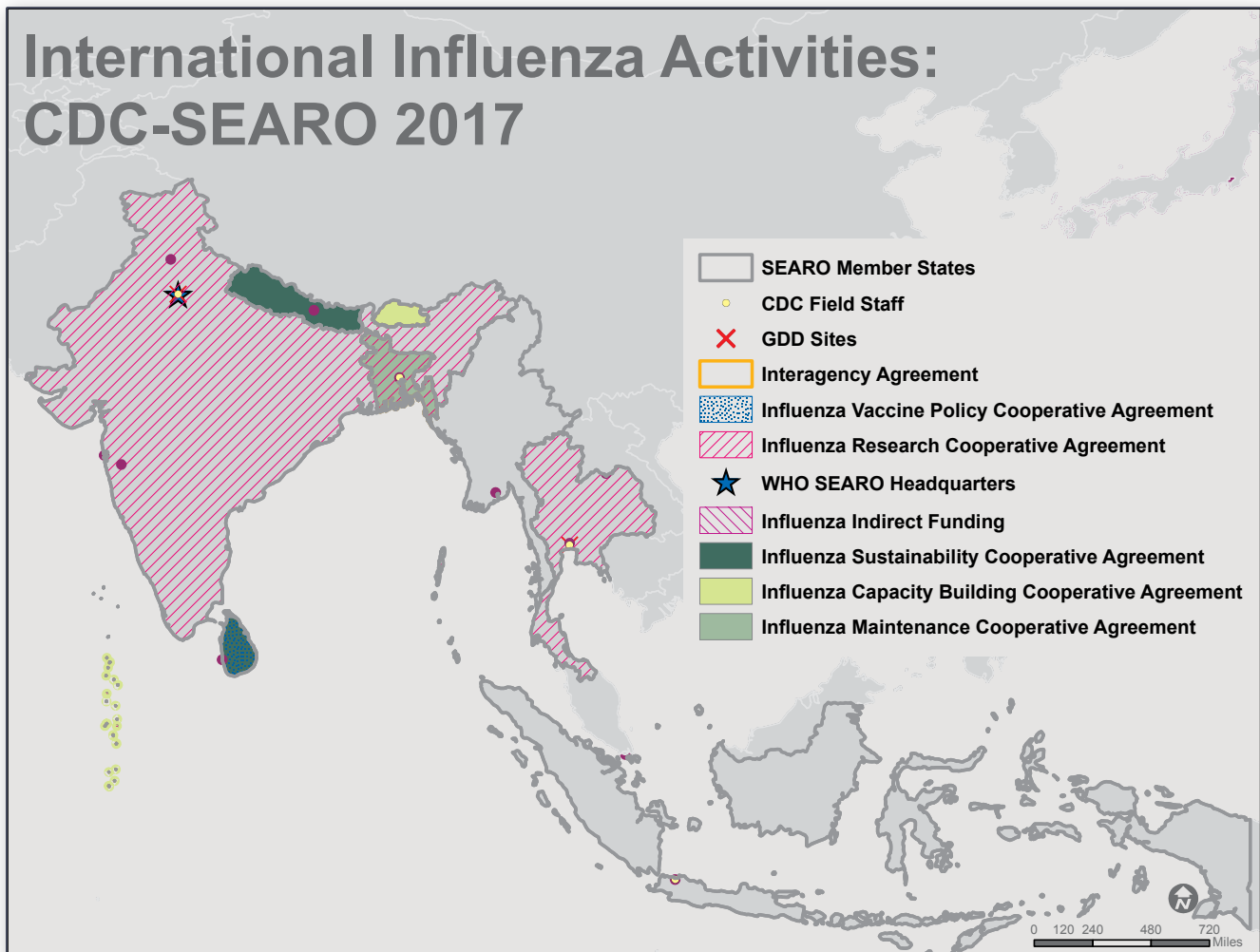
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# WHO Regional Office For South-East Asia [SEARO]



## HIGHLIGHTS

- The WHO Regional Office for South East Asia (SEARO) developed a web dashboard that incorporates enhanced reporting, including virologic data, from 9 countries; 5 of the 9 countries also provided epidemiologic data.
- The tenth Bi-Regional Meeting of the National Influenza Centers and National Influenza Programs was held in Bangkok, Thailand in July 2016, bringing in staff from more than 18 countries; 5 of 6 WHO Collaborating Centers for Reference and Research on Influenza; CDC; the US Agency for International Development; the Food and Agriculture Organization; the World Organization for Animal Health; and others. This was the second time that SEARO has hosted this meeting.
- SEARO held their first severe acute respiratory illness training for district-level hospitals that do not have intensive care unit capability, with teams from 15 hospitals in Nepal and a team from 1 hospital from the Maldives.
- Progress in the region was made on developing and encouraging burden of influenza assessments in Bhutan, Indonesia, Nepal, and Maldives.

## U.S. CDC DIRECT SUPPORT

Since 2006, WHO SEARO has received funding from a CDC cooperative agreement to support enhancing the capacity of member states to build and maintain influenza surveillance systems. Influenza surveillance systems support the routine identification, investigation, and containment of novel influenza viruses, some of which may have pandemic potential.

WHO SEARO is located in New Delhi, India. The office serves the following 11 member countries: Bangladesh, Bhutan, the Democratic People's Republic of Korea, India, Indonesia, Maldives, Myanmar, Nepal, Sri Lanka, Thailand and Timor-Leste. Seven of the 11 countries also received bilateral cooperative agreement funds from CDC's Influenza Division in Fiscal Year 2017.

In 2015–2017, WHO SEARO staff provided training, support, and technical assistance to member countries to strengthen preparedness and response, surveillance, and laboratory capacity.

## SURVEILLANCE

SEARO has utilized both CDC and WHO pandemic influenza preparedness (PIP) funds to conduct trainings and laboratory activities to improve influenza surveillance in the region. Trainings in data management for 10 of 11 countries improved reporting and encouraged countries to begin submitting data through the WHO internet platform for laboratory and epidemiologic data. Two additional countries, Myanmar and Maldives, now regularly submit virologic data, and 3 additional countries—Bangladesh, Maldives, and Bhutan—have begun reporting epidemiologic data. Epidemiologic and virologic data are now incorporated into a new web dashboard developed in partnership with the Health Systems Development team within SEARO.

### SURVEILLANCE ACTIVITIES

- SEARO developed a dashboard with several tabs showing climatic regions, sentinel site locations, dates of last reported data, and graphs of virologic and epidemiologic data by country and year, as selected by the user.
- SEARO produced a landscape analysis of SEARO as well as each of the 11 member countries. This product is currently being tailored to be more web readable.

- Nine countries now report to FluNet (virologic surveillance), an increase from 2015 when only 7 reported; of these 9 countries, 5 also report epidemiologic data, up from only 2 in 2015.
- SEARO staff have also supported CDC-organized lab and surveillance assessments within Bhutan, Nepal, and Sri Lanka.
- Laboratory and epidemiology staff from 10 countries and WHO staff from 10 country offices attended the data management trainings SEARO held.
- Burden of influenza studies have been encouraged within several countries of SEARO, including Nepal, Maldives, and Sri Lanka. Indonesia has published its burden estimate; Bhutan's paper on the estimated burden of influenza has been accepted for publication.

## LABORATORY

The financial support provided to SEARO through the cooperative agreement was used to enhance the capacity of the influenza public health laboratories in the region. Reviews of the emerging infectious disease testing and preparedness activities were conducted in the virology sections of the national health laboratories in both Thailand and Myanmar in 2016. In addition, CDC cooperative agreement funds were used to support the participation of laboratory focal points from the National Influenza Centers (NICs) and public health laboratories in the tenth and eleventh NIC meetings held in Bangkok in 2016 and in Kuala Lumpur in 2017.

### LABORATORY ACTIVITIES

#### WHO SEARO

- With CDC support, laboratory experts from countries in the WHO South-east Asia region participated in a training program on biosafety and infectious substances shipping conducted in April 2016 in Singapore.

## PREPAREDNESS

SEARO has worked towards improving overall International Health Regulations (2005) capacity, which includes supporting member states to revise and update their existing pandemic influenza preparedness plans. SEARO countries have been early adopters of the new Joint External Evaluations (JEE). Bangladesh, Bhutan, Indonesia, Maldives, Myanmar, Sri Lanka, and Thailand all completed their JEEs by the end of 2017.

## PREPAREDNESS ACTIVITIES

- A preparedness training was conducted by the infectious substance shipping trainer of the WHO along with the Temasek Life Sciences Laboratory, Singapore on the following areas: biosafety containment facilities and principles of biosafety containment, bio-risk assessment and management, development and implementation of bio-risk management systems, and proper and safe packaging and transport of infectious substances.
- In Bhutan, laboratory support for the newly opened Royal Centers for Disease Control national laboratory was provided by purchasing needed equipment and providing technical guidance for the development of a biosafety level 3 laboratory.
- In the Maldives, a review was conducted of the National Influenza Laboratory in Malé, the capital. Laboratory staff were trained on sample collection, reagent preparation, genetic material extraction, PCR testing, interpretation of results, documentation, and PCR quality control. SEARO also supported the purchase of requested lab supplies.

### SEARO

- A checklist was developed for revising pandemic preparedness plans in collaboration with the National University of Singapore. This checklist, reviewed during a workshop after the tenth Bi-Regional NIC Meeting, was sent to all of the member countries.
- Two editors from SEARO assisted in developing the global guideline titled *How To Implement Influenza Vaccination of Pregnant Women: An Introduction Manual for National Immunization Programme Managers and Policy Makers*.

### Bhutan

- A workshop to revise Bhutan's pandemic influenza preparedness plan to reflect a more all-hazards approach was held involving multiple stakeholders including animal health, emergency response, and the Ministry of Health. A specific pandemic influenza annex to the all-hazards plan is anticipated.

### Indonesia

- Indonesia held an extensive review of their pandemic preparedness plan which addresses the full range of IHR, including ports of entry and capacity for detection at clinic, hospital, and laboratory levels.
- Indonesia conducted a pandemic exercise in September 2017, including personnel from SEARO, WHO headquarters, and other Association of Southeast Asian Nations countries.

### Nepal and Maldives

- A 5-day training was conducted in Nepal on management of severe respiratory illness for hospitals without intensive care unit capability. The training was part of the WHO's program for Integrated Management of Adult/Adolescent Illnesses. Five district hospitals across Nepal and 1 district hospital from Maldives participated.

## TRAINING

- Data management training was provided to laboratory and epidemiology staff from 10 countries, as well as staff from 11 WHO Country Offices.
- Training was held for communicable disease recognition and management at points of entry to India.
- Laboratory experts from all countries in SEARO participated in a training program on biosafety and infectious substances shipping.
- A bi-regional meeting was held on the Asia Pacific Strategy for Emerging Infectious Diseases to introduce the newest iteration, which incorporates some of the all-hazards approach.
- Myanmar held an infection prevention and control training during their heavy influenza season, bringing together hospitals throughout the Yangon area.

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# BANGLADESH



## OVERVIEW

The Institute of Epidemiology, Disease Control, and Research (IEDCR) and Family Welfare has been a recipient of CDC cooperative agreements since 2006 and are now in their first year of a 5-year maintenance agreement. IEDCR is the national focal point for conducting disease surveillance and outbreak investigations and has led the country in identifying and responding to influenza A(H1N1) and other outbreaks of influenza. They oversee both hospital-based surveillance and epidemiology and the National Influenza Center (NIC) where samples are tested for influenza. IEDCR is capable of typing and subtyping of specimens for influenza; when necessary, IEDCR sends unsubtypable samples to a WHO Collaborating Center for Reference and Research on Influenza (WHO CC).

## SURVEILLANCE

CDC and icddr,b (the International Centre for Diarrhoeal Disease Research, Bangladesh), in partnership with IEDCR, conduct surveillance for emerging and zoonotic strains of influenza and for severe acute respiratory infection (SARI) and influenza-like illness (ILI) in the general population and in hospitals across Bangladesh. In addition, they conduct outbreak investigations of respiratory illness and participate in research studies on seasonal and avian influenza and other respiratory viruses.

National Influenza Surveillance Bangladesh (NISB) is ongoing in 10 sentinel sites. Nine sites are district hospitals that are secondary care facilities, and one is Dhaka Medical College, a tertiary care hospital. These sites represent the key geographic areas of Bangladesh.

## SURVEILLANCE ACTIVITIES

- NISB standard operating procedures (SOPs) were revised, standardized, published, and distributed.
- Hospital influenza surveillance included specimen collection from 10 ILI cases and all SARI cases; specimens were shipped every 2 weeks to the NIC.

## HIGHLIGHTS

- The Institute of Epidemiology, Disease Control, and Research's (IEDCR) National Influenza Center submits data to WHO FluNet PLUS and FluID platforms on a weekly basis.
- Since October 2016, IEDCR has sent several shipments of influenza positive samples to the Collaborating Center for Reference and Research on Influenza (WHO CC) at CDC. Samples from the human/animal interface were also sent in February 2017 to a WHO CC.
- In 2016, IEDCR started publishing quarterly newsletters highlighting national influenza surveillance in Bangladesh. These newsletters depict the geographical and seasonal distribution of influenza in the country and are intended to keep health managers abreast of ongoing influenza surveillance activity in Bangladesh.
- IEDCR participates regularly in WHO and external quality assessment programs, and has scored 100% correct results.

- IEDCR staff conducted periodical monitoring visits to NISB sites to review surveillance protocol and performance and to suggest improvements where needed.
- Monthly surveillance reports were regularly uploaded in IEDCR's website. These included the number of samples tested, the percent positive by type and subtype, and data by sentinel site and by age. The website is an open access source and the reports are accessible to the public.
- NISB activities are included in the 5-year (2015–2020) *IEDCR/NIC National Action Plan*.
- To keep policy makers abreast of ongoing influenza surveillance activities, IEDCR invited the honorable secretary of Ministry of Health and Family Welfare of Bangladesh, divisional directors, and civil surgeons to NISB surveillance data dissemination workshops.

## LABORATORY

IEDCR has several fully equipped biosafety level 2 (BSL-2) laboratories, and maintains strict biosafety and biosecurity according to national and international standards. Specimens are tested by real-time PCR for seasonal influenza strains (A[H1N1]pdm, A[H3], and influenza B) and as needed for subtypes H5, H7, and H9 as well as MERS-CoV. IEDCR is also capable of testing for multiple respiratory pathogens during outbreaks of unusual respiratory events. In 2007, IEDCR was certified as an NIC by WHO and has routinely contributed specimens to WHO's Global Influenza Surveillance and Response System.

### LABORATORY ACTIVITIES

- IEDCR/NIC participated in both the WHO External Quality Assessment Project and CDC External Quality Assessment Panel with 100% correct results.
- The NIC regularly orders and receives laboratory reagents from CDC's International Reagent Resource.
- From October 2016 to March 2017, a total of 1,411 influenza samples were collected and tested at the IEDCR lab.
- The SOP for NISB has been revised to meet global standards on collection, storage, packaging, and transport of specimens.

## PREPAREDNESS

Avian influenza outbreaks and the spread of pandemic influenza are of great concern for a country like Bangladesh because of its high population density and frequent interaction between humans and poultry. Bangladesh is a country with more than 180 million poultry, 50% of which are raised in backyards. Collaborations on human and animal health include the Bangladesh Department of Livestock Services (DLS), the Food and Agriculture Organization, WHO, the United Nations Children's Fund, the US Agency for International Development, and academic institutions in Bangladesh and overseas.

### PREPAREDNESS ACTIVITIES

- National influenza surveillance platforms were developed to detect potential circulation of novel influenza A(H7N9)/influenza A(H9N2) viruses among poultry and suspected human cases of influenza A(H7N9)/influenza A(H9N2) or MERS-CoV.

- Avian influenza surveillance was conducted among poultry workers in live bird markets in Dhaka City.
- IEDCR provided training to the District Rapid Response Team and Upazilla Rapid Response Team members with technical support from WHO. More than 400 physicians received training on outbreak investigation and response to influenza and other respiratory and emerging infectious diseases in November and December 2016.

## TRAINING

- To collect the necessary data required by WHO FluID and for disease burden estimation, a more comprehensive epidemiological data collection tool was developed. In January 2017, 20 surveillance physicians from all 10 hospital sentinel sites were trained on how to use the tool.
- More than 100 medical technologists from different levels of government health facilities received training on sample collection, storage, and transportation, and on laboratory biosafety and infection control.
- IEDCR organized a workshop titled Annual Consultation of Human Health and Animal Health Influenza Activities in January 2017 to strengthen the collaboration between the stakeholders especially related to avian influenza.
- Sixty-nine health managers from the district level (civil surgeons, Divisional Directors) and 367 from the sub-district level participated in NISB data dissemination seminars.

## RESEARCH

CDC's Influenza Division works closely with icddr,b; IEDCR; and DLS to explore the risk of avian influenza among persons who work closely with poultry, potential interventions to interrupt zoonotic influenza transmission, seasonal influenza disease and economic burden among WHO target groups, and the potential value of vaccination programs to avert medically attended illness and its associated cost.

Ongoing research activities include studies to explore:

- Avian influenza in domestic waterfowl in live bird markets in Bangladesh, 2007–2012
- Risk factors for highly pathogenic avian influenza A(H5N1) outbreaks in backyard poultry flocks, Bangladesh, 2009–2012



- Understanding the failure of an intensive behavior change intervention to reduce the risk of avian influenza transmission from flocks to backyard poultry raisers in rural Bangladesh
- Developing and piloting safe home slaughtering practices in a Bangladeshi rural community to reduce human exposure to avian influenza viruses
- Where backyard poultry raisers seek care for sick poultry: implications for avian influenza prevention in Bangladesh
- Risk of avian influenza transmission among poultry in Dhaka live bird markets and possible impact of routine disinfection
- Mild respiratory illness in young children caused by highly pathogenic avian influenza A(H5N1) virus infection in Dhaka, Bangladesh, 2011
- Household-level risk factors for secondary influenza-like illness in a rural area of Bangladesh
- Factors driving customers' health care-seeking at pharmacies for acute respiratory illness and drug sellers' treatment recommendations and outcome, in Dhaka City, Bangladesh, in 2012
- Etiology and incidence rates of hospital-acquired viral respiratory illness in tertiary care hospitals in Bangladesh, 2008–2011
- Viral etiology of pneumonia and outcome in severely malnourished children in an urban hospital
- Incidence of viral respiratory infections among hospitalized children aged <5 years: 2010–2013
- Assessing laboratory-confirmed influenza among family caregivers in district hospitals in Bangladesh
- Piloting hand-hygiene interventions in hospital wards to improve hand hygiene behavior in resource-poor health care facilities in Bangladesh

# BHUTAN



## OVERVIEW

The Royal Center for Disease Control (RCDC) under the Department of Public Health, Ministry of Health (MOH), is in the fifth year of a 5-year CDC capacity building cooperative agreement. With CDC's financial and technical support, several positive changes have been made to the system. These include improved influenza-like illness (ILI) surveillance, improved data collection, strengthened laboratory testing capacity, and the establishment of severe acute respiratory infection (SARI) surveillance.

A total of 11 sentinel sites in strategic areas throughout the country actively participate in ILI and SARI influenza surveillance. Both the epidemiology and laboratory sectors of the influenza surveillance system are managed by the influenza laboratory team within the RCDC.

## SURVEILLANCE

The Bhutan Influenza Surveillance web-based reporting system is comprehensive. From it, the influenza team generates a weekly FluView report, sharing with the MOH, hospital sites, and partners, including CDC and WHO. The report is also available on their website, <http://www.rcdc.gov.bt/web/tag/fluview/>. In addition, a quarterly bulletin is written, and on a weekly basis Bhutan inputs data on WHO's web based FluID and FluNet.

## SURVEILLANCE ACTIVITIES

- Eleven sentinel sites continue to collect and send specimens to RCDC every week; the sites use SMS and the web-based ILI/SARI surveillance information system to submit data.
- RCDC used its 2015–2016 data for a burden of influenza disease study. To verify and validate the data sentinel sites submit, RCDC teams cross-checked patient records, registers, and discharge sheets at 7 SARI sentinel hospital sites. A manuscript on study findings was accepted for publication.
- Bi-annual, onsite monitoring and supervisory visits take place at all sentinel sites. This includes reviewing the operational aspects of the surveillance system, addressing challenges, and providing recommendations.

## HIGHLIGHTS

- The Royal Centre for Disease Control (RCDC) moved to a new building in March 2016 and now has a fully equipped influenza biosafety level 2 (BSL-2) and a BSL-3 facility.
  - The RCDC, in collaboration with CDC and WHO's Regional Office for South-East Asia, has completed data analysis for a burden of influenza disease study. The methodology and preliminary results were presented at the 2017 bi-regional National Influenza Center conference in Malaysia.
  - The IT team at RCDC has developed a high-quality web-based database for influenza sentinel surveillance that can be used to integrate data from sites, clinical data, and laboratory data in a single space.
  - RCDC also introduced an integrated web-based and mobile SMS application for reporting 22 diseases/syndromes from all health centers in the country, which includes acute respiratory illness and severe acute respiratory infection syndrome.
- A data assistant to enter data into multiple international and national database platforms is now part of the team.

## LABORATORY

The RCDC has a new, spacious, well equipped laboratory facility with ample room for PCR testing and for virus isolation. The influenza laboratory PCR space has a dedicated area for each procedure and a good workflow design. Since 2010, the laboratory has used real-time PCR for detecting and subtyping influenza viruses, and started ordering reagents from the CDC International Reagent Resource in 2013. This includes reagents to test for influenza A(H5) and A(H7N9). The influenza laboratory has trained staff and procured all equipment needed to start cell culture and virus isolation and intends to become recognized as a NIC by WHO.

## LABORATORY ACTIVITIES

- RCDC continued to test specimens by real-time PCR and report results regularly.
- The laboratory participated in both the CDC External Quality Assessment Panel and WHO Hong Kong External Quality Assessment Project panel.
- A strong partnership with the US Armed Forces Research Institute of Medical Sciences (AFRIMS) in Thailand has provided the RCDC with technical support and guidance on influenza testing capacity building since 2008.
- A total of 2,487 samples were collected from ILI cases, of which 345 were influenza positive. During the same period, 1,249 SARI samples were collected, of which 164 were influenza positive. In addition, 145 SARI samples were positive for RSV, and 68 were positive for human metapneumovirus (hMPV).
- In Bhutan, there are 2 influenza seasons; the first season is during March–April and the second during August–September. The duration of the seasons depend on weather conditions. In addition to influenza virus, RSV and hMPV are 2 other respiratory viruses commonly detected among SARI cases in children less than 5 years of age.
- District rapid response teams have participated with officials from the human and animal sectors in field simulation exercises intended to test the updated National Influenza Pandemic Influenza Preparedness Plan.
- RCDC published quarterly disease surveillance bulletins, and all are available on the RCDC website.

## TRAINING

- RCDC conducted a round of training for new health workers around the country.
- District Health rapid response teams from all 20 districts were trained on disease outbreak investigation and rapid response.
- Health workers not previously trained were sensitized on the Outbreak Investigation and Rapid Response manual and reporting protocol.
- Annual workshops on ILI and SARI sentinel surveillance protocol from the updated 2014 guidelines were conducted for staff from all sentinel sites.
- Two lab persons from RCDC attended a 10-day influenza virus culture training at the AFRIMS facility in Thailand, in March and April 2017.

## PREPAREDNESS

- The RCDC introduced web-based and mobile SMS reporting for the National Early Warning and Alert and Response Surveillance (NEWARS) system. NEWARS has features of both indicator- and event-based surveillance and collects the number of ILI and SARI cases from all health centers in real time.
- Two acute respiratory illness outbreaks were reported in the first 6 months of 2017.

## PREPAREDNESS ACTIVITIES

- To strengthen rapid response and containment, in 2015, the MOH developed, printed, and distributed an Outbreak Investigation and Rapid Response manual reinforcing the multi-disciplinary rapid response teams. The manual included the protocol on reporting suspect cases or clusters of severe respiratory diseases in humans and illness/deaths in animals.

# INDIA



## OVERVIEW

CDC has worked closely in India with various government health agencies and academic and research institutions to create a stronger surveillance network, to develop burden estimates for influenza and other illnesses associated with respiratory viruses, and to evaluate influenza related prevention and control measures.

## SURVEILLANCE

The National Institute of Virology (NIV), Pune continued to lead the sentinel surveillance network, testing for influenza, RSV, and other common viral respiratory pathogens, and generating crucial epidemiological and virological data. There are 6 surveillance centers distributed geographically. The network systematically enrolls cases of acute respiratory illness (ARI) from outpatient and hospital wards of selected public health facilities. Clinical data and samples are collected by the project staff and brought back to these centers for laboratory testing of common respiratory pathogens including influenza and RSV using real-time PCR.

### SURVEILLANCE ACTIVITIES

- NIV, Pune received laboratory proficiency panels for influenza from the Centre for Health Protection in Hong Kong, the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in Melbourne, Australia, and the WHO CC at CDC; all the results were concordant.
- A meeting of all the site leads was held on March 9, 2017 to review the surveillance activities and data of each site.
- The NIV, Pune continued to submit weekly influenza surveillance data to the WHO FluNet online portal.

## LABORATORY

The laboratorians of NIV have trained extensively with CDC scientists on typing, subtyping, PCR, and real-time PCR and reverse genetics. They have in turn conducted trainings for laboratory scientists in various laboratories in India. Genetic characterization of viruses is carried out at the National Influenza

## HIGHLIGHTS

- A multi-institutional collaborative project involving the All India Institute of Medical Sciences, New Delhi; the National Institute of Virology, Pune; the National Institute of Epidemiology in Chennai; and the National Institute of Cholera and Enteric Diseases in Kolkata was launched to study the burden of influenza among older adults.
- Recent and ongoing studies with CDC help inform the Government of India's policy makers about the burden of influenza in the community and the effectiveness of available vaccines.

Center at NIV, Pune. Notable progress in laboratory surveillance capacity has been achieved over the past 5 years, and the success of this partnership has led to significant enhancements benefiting both India and the Global Influenza Surveillance Network.

### LABORATORY ACTIVITIES

- All network laboratories have so far cumulatively collected 3,649 clinical samples of ARI and SARI cases from January 1, 2017 to April 30, 2017, of which 1,469 (42.3%) samples were found to be positive for 1 or more viruses.
- NIV, Pune routinely submits influenza isolates to the WHO CC at CDC in time for vaccine strain selection.

## 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. Even after the sustainability period for the cooperative agreement ended in 2014, CDC continued to provide technical and laboratory support for ongoing surveillance activities. Current activities focus on continued CDC technical support to the Indian Council of Medical Research (ICMR) influenza network in contributing epidemiological and laboratory surveillance data and response trainings, as well as continued efforts to strengthen the National Centers for Disease Control (NCDC)-led

surveillance network. Current activities are focused on continued CDC technical support of the ICMR influenza network in contributing epidemiological and laboratory surveillance data and response trainings.

### PREPAREDNESS ACTIVITIES

- NIV, Pune and NCDC Delhi were provided with the primers and probes for influenza surveillance, including those for detection of the novel influenza A(H7N9) virus.

### TRAINING

- CDC provided technical support for a training on influenza data management and basic analysis organized by the WHO Regional Office for South-East Asia for participants from South East Asian Region member countries that was held in Pune on January 16–20, 2017.
- CDC, in collaboration with the All India Institute of Medical Sciences (AIIMS) in New Delhi, organized a symposium on Epidemiology, Prevention, and Control of Influenza in India at the 61st annual national conference of the Indian Public Health Association, held in Jodhpur from February 24–26, 2017, which was attended by public health professionals from all over India.

### RESEARCH

AIIMS, New Delhi, in collaboration with CDC, conducted a study titled *Assessment of the Efficacy of Post-Licensure Seasonal Live Attenuated and Inactivated Influenza Vaccines among Children* in India from 2015–2017. The results are expected to help policy makers in India better understand the burden of influenza in the community and the effectiveness of available vaccines.

A multi-institutional project titled *Indian Network of Population-Based Surveillance Platforms for Influenza and Other Respiratory viruses among Elderly (INSPIRE)* involving AIIMS, Delhi; NIV, Pune; NIE, Chennai; and NICED, Kolkata was launched in 2017. This network of population-based surveillance platforms for influenza and other respiratory viruses among elderly individuals aged 60 years or above in 4 regions of India will help to develop an accurate estimation of the burden of influenza in older adults.

Studies were published on the following subject matter:

- Divergent seasonal patterns of influenza types A and B across the latitude gradient in tropical Asia
- Evaluation of case definitions for estimation of RSV-associated hospitalizations among children in a rural community of northern India
- Influenza among returning Hajj and Umrah pilgrims with respiratory illness, Kashmir, north India

Analyses are ongoing for several additional projects. These include estimation of influenza mortality in India, modeling social mixing and contact patterns to better understand influenza virus transmission, and documenting influenza disease burden among pregnant women and their infants.

# INDONESIA

## OVERVIEW

CDC's Influenza Division (ID) supported Indonesia's Ministry of Health (MOH) from 2004 to 2014 with a cooperative agreement to build and sustain routine influenza surveillance and pandemic preparedness measures. Direct monetary assistance is no longer provided, however, CDC continues to fund on-the-ground high-level technical staff who are actively engaged in supporting the MOH's influenza prevention, identification, and response activities and programs.

The Government of Indonesia (GOI) is aware that sustaining influenza-related systems and activities is important and has allocated GOI funding to maintain the number of influenza-like illness (ILI) and severe acute respiratory infection (SARI) sites and the epidemiologic and NIC staff who oversee the program at pre-2015 levels.

The CDC Jakarta office and CDC ID Atlanta office continued providing technical assistance to encourage high-quality ILI and SARI surveillance and laboratory influenza testing.

## SURVEILLANCE

SARI surveillance was established in 2013 in 6 sentinel sites, 1 in each of 6 provinces. This was a collaboration between the Acute Respiratory Infection Subdirector as the epidemiology lead and the National Influenza Center (NIC) at the National Institute of Health Research and Development (NIHRD) as the laboratory lead. The system is set up to collect epidemiologic data on SARI cases and the proportion of cases with severe illness, including pneumonia and deaths. In addition, the East Jakarta Project has provided information about the epidemiology and virology of influenza circulating in an urban area of Jakarta province.

Nasal and throat swabs are collected and tested for influenza at the NIC at NIHRD.

### SURVEILLANCE ACTIVITIES

- Government staff undertook 2 monitoring missions per year to each of the sentinel sites for technical supervision, trouble shooting, and coordination. These visits helped ensure sites were following protocol.

## HIGHLIGHTS

- SIBI—the national severe acute respiratory infection (SARI) surveillance system—continued, in collaboration with the GOI in 6 hospitals in 6 different provinces.
  - SARI surveillance data from 3 of the 6 hospitals were used to calculate influenza disease burden.
  - National influenza-like illness surveillance continued in 26 health care centers in 25 provinces.
- A SARI bulletin was produced monthly with updated data and shared electronically with sentinel site staff and other stakeholders. Data from ILI surveillance were routinely reported to the Global Influenza Surveillance Response System (GISRS) and uploaded on the NIHRD website.
  - In collaboration with WHO, NIHRD and CDC staff conducted a hospital admission survey around 3 SARI sites to help generate inpatient disease burden estimates for influenza in Indonesia.

## LABORATORY

### *Influenza Surveillance*

CDC provided support for the NIC in several ways, including by providing the NIC with an External Quality Assessment panel for real-time RT-PCR testing, and technical assistance in the form of trainings and troubleshooting to improve provincial and regional laboratory capacity.

### *LABORATORY ACTIVITIES*

- From the inception of the SARI project until mid-2017, 3,055 SARI cases were identified and tested; 326 (11%) were positive for influenza.
- The NIC maintains a biosafety level 3 laboratory and continues to participate in both WHO and CDC RT-PCR quality assurance panels.
- The NIC continues to order reagents from the CDC International Reagent Resource and to test for avian influenza, MERS-CoV, and other highly pathogenic viruses.
- The NIC continues to send isolates to a WHO Collaborating Center for Reference and Research on Influenza.

## PREPAREDNESS

CDC support has considerably advanced pandemic influenza preparedness and planning in Indonesia. The pandemic plan that was initially developed by the MOH was adopted by the National Committee on Zoonotic Diseases and has become intersectoral.

### *PREPAREDNESS ACTIVITIES*

- The GOI is revising their Pandemic Influenza Preparedness Guidelines.
- An assessment of the strengths and weaknesses of the pandemic influenza contingency plan was conducted in some provinces, and the findings were used to update the pandemic influenza national guideline.
- An adaptation of the influenza pandemic response plan was written for MERS-CoV and Ebola.
- Exercises were conducted on pandemic influenza planning with the port health authorities, intersectoral entities, the army, and commercial companies.

## TRAINING

- Refresher training for SARI sites on case detection occurred during monitoring activities in 2016.
- Three-day refresher trainings for all ILI sentinel sites and separately for the 6 SARI sites were conducted in 2016. SARI trainings were conducted in Yogyakarta. ILI trainings were conducted in Surabaya, Yogyakarta, and Medan.

## INFLUENZA VACCINE ACTIVITIES

CDC provided technical support for a study conducted by a private medical school in Jakarta on knowledge, attitudes, and practices regarding influenza vaccination among medical students.

# MALDIVES



A child is vaccinated at a vaccine center during the Influenza A H1N1 outbreak in March 2017.

## OVERVIEW

The Health Protection Agency (HPA), the main center for public health protection in the Maldives, was awarded a CDC 5-year capacity building cooperative agreement in September 2013. The agreement aims to build and strengthen the Maldives' national laboratory and influenza surveillance capacity and to support the Ministry of Health in establishing and testing protocols for pandemic preparedness and response.

## SURVEILLANCE

Four influenza hospital sentinel sites, including the tertiary hospital in Malé, the capital, submitted patient case report forms and sent samples from patients meeting the severe acute respiratory infection and influenza-like illness case definitions to the National Influenza Laboratory at the Indira Gandhi Memorial Hospital (IGMH) in Malé for testing. Laboratory results were generated weekly and sent to hospital sites, and summary reports were sent on a monthly basis to the MOH and partners showing influenza activity and observed trends.

## HIGHLIGHTS

- The Maldives influenza surveillance system, set up with CDC support, effectively confirmed, responded to, and managed its first identified influenza outbreak in March 2017.
- Severe acute respiratory infection and influenza-like illness surveillance were expanded to 3 sentinel sites in Malé (the capital) and in 1 hospital at the periphery of the country.
- The Health Protection Agency uploaded data into both WHO FluNet and WHO FluID on a regular basis.
- The National Influenza Laboratory has a fully equipped molecular laboratory with a new real-time RT-PCR system (ABI 7500 Fast PCR) and all other needed equipment.

## SURVEILLANCE ACTIVITIES

- An operational guideline for clinicians, laboratory technicians, and surveillance staff on sample selection, collection, and handling procedures was printed and disseminated to sentinel sites.
- HPA developed a Microsoft Access database to collect linked epidemiology and laboratory data. Data were entered in a timely fashion and data quality queries and reports were programmed into the database for easy assessment.
- HPA maintained frequent communication with sentinel sites which facilitated problem-solving and ensured surveillance protocol was followed.
- Annually, 2 major meetings were held with participation from all senior clinicians from all sentinel sites to review surveillance protocol and strengthen the relationship between HPA and hospital sites.

## LABORATORY

Between October 2015 and September 2017, a total of 1,289 samples were tested by the newly refurbished National Influenza Laboratory at IGMH.

## LABORATORY ACTIVITIES

- Laboratory reagents were successfully acquired from the CDC International Reagent Resource.



- Four additional laboratory technologists were trained on real-time PCR at IGMH in August 2016 so staff could cover for each other as needed.
- Staff got a 100% on their 2017 CDC Influenza Molecular Diagnostic Performance Evaluation Panel.

The Maldives National Influenza Laboratory routinely sends selected influenza-positive samples to the WHO Collaborating Center for Reference and Research on Influenza at CDC for confirmation and verification.

## PREPAREDNESS

Preparedness plans were tested in early 2017 when the Maldives faced their first confirmed influenza outbreak. Several patients were hospitalized and an overwhelming number of samples were sent to the laboratory from hospitals across the country. The Maldives reached out to WHO and CDC for advice and assistance with obtaining additional oseltamivir, influenza vaccine, laboratory reagents, and confirmation of their laboratory results. The influenza epidemic plan was updated with lessons learned from the outbreak.

### PREPAREDNESS ACTIVITIES

- The first airport emergency pandemic preparedness training was in September 2016.
- A guideline and toolkit were developed for rapid response teams.
- Hospital emergency response plans were written by several hospitals and drills conducted to test the plans.
- Clinicians from regional and atoll hospitals were trained to identify outbreaks and respond to them by following the protocols and the assessment formats.

## TRAINING

- Fifteen refresher sessions were conducted for clinicians to ensure staff understood surveillance protocol.
- Influenza surveillance staff took part in the Multi-Country Workshop on Data Management for Influenza Surveillance, held from January 16–20, 2017 in Pune, India.
- National-level rapid response teams were trained in May 2016.
- Members from regional and atoll hospitals were trained to identify outbreaks and respond to them, and workshops with drills and tabletop exercises were done to test hospital emergency preparedness and response plans.

# NEPAL

## OVERVIEW

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 2009. Since then, the cooperative agreement has helped strengthen influenza surveillance in Nepal and has supported building capacity in the National Public Health Laboratory's (NPHL) National Influenza Center (NIC), the Patan Hospital laboratory, and the sentinel hospital sites.

Under the leadership of the NIC/NPHL, with the assistance of the Ministry of Public Health (MOPH) Epidemiology and Disease Control Division (EDCD), a network of partners including Walter Reed Research Unit Nepal (WARUN) and PAHS oversee influenza sentinel sites that cover key geographic areas around the country. There is a strong collaborative relationship between the 3 surveillance partners who regularly share data, organize trainings together, and support each other through technical assistance and recourse when needed.

## SURVEILLANCE

Together, the network of partners oversees several influenza-like illness (ILI) and/or severe acute respiratory infection (SARI) sentinel sites. PAHS oversees 3 hospital sites, each with a peripheral health facility that monitors for ILI. WARUN oversees ILI sites and is expanding. NPHL/NIC initially oversaw surveillance in 5 sentinel sites; however, in the last 2 years, they expanded the number of ILI and SARI sites both within and outside of Kathmandu.

Routine surveillance in Nepal was interrupted for several months after the devastating earthquake in April 2015, but all projects are once again active.

### SURVEILLANCE ACTIVITIES

- Routine ILI and SARI surveillance at Patan Hospital provided consistently reliable and detailed epidemiological and virologic influenza data. ILI and SARI data are analyzed separately by age, gender, geographic distribution, clinical presentation, and death.
- From September 2016 through March 2017, PAHS tested specimens from 143 ILI cases, 27 (18.9%)

## HIGHLIGHTS

- Patan Academy of Health Sciences (PAHS) created an extensive database with 4 solid years of epidemiologic and virologic data.
- The National Public Health Laboratory National Influenza Center (NIC) has a fully equipped biosafety level 3 facility with biosafety measures in place.
- A 2-day multi-year review was held with key partners to systematically look at key aspects of influenza surveillance in the country, including how PAHS and the NIC can best collect data that will enable them to conduct additional in-depth analyses.
- Nepal studied options for conducting and publishing an influenza burden study.

of which were positive for influenza, and tested specimens from 201 SARI cases, of which 13 (6.5%) were positive for influenza.

- Denominator data were collected on both ILI and SARI surveillance, which can be used to help PAHS calculate the burden of influenza.
- During a 2-day partner meeting in December 2016, NPHL and PAHS reviewed and updated their ILI/SARI case definitions and ILI/SARI case report forms to include pregnancy status.

## LABORATORY

NPHL supports public health and clinical diagnostic testing in both public and private sectors and is responsible for testing ILI and SARI samples from all NIC and PAHS influenza sentinel sites. The NIC regularly sent virus isolates to the WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs) in Japan and in the US for further characterization and antiviral testing. Eighty-four isolates were sent in 2015 and 100 were sent in 2016.

The NIC has access to a well-equipped biosafety level 3 (BSL-3) laboratory, which has separate restricted access.

## LABORATORY ACTIVITIES

- The NIC reported laboratory results to the WHO FluNet on a weekly basis.
- The NIC took part in the WHO CC in Hong Kong and CDC external quality assurance panels.
- The NIC conducted both PCR diagnostic testing and viral culture/virus isolation for influenza, and 3 staff were cross-trained in both.
- The NIC routinely performed PCR twice a week, and was prepared in an outbreak situation to run PCR twice a day.

## PREPAREDNESS

Rapid response teams (RRTs) are in place at the central level under the MOH EDCD and in all 75 districts under the District Health and Public offices. The Nepal National Influenza Surveillance Network includes the animal health sector and meets on an as-needed basis.

### PREPAREDNESS ACTIVITIES

- Supported EDCD and the Animal Health Division in responding to avian influenza (AI) poultry outbreaks; no human cases of AI were found.
- Established a joint rapid response team at the national level for immediate mobilization during outbreaks.
- Provided support to Nepal Police Hospital for infection control as part of Ebola preparedness.
- Prepared the NIC to test for suspect avian influenza A (H7N9) virus and MERS-CoV infections.
- Reviewed the National Pandemic Preparedness Plan with the support of WHO. It will be revised to include all emerging and reemerging infectious diseases.

## TRAINING

- Thailand NIC staff conducted an advanced laboratory training for Nepal's NIC staff in Katmandu in November 2016.
- NPHL conducted and supported many in-house trainings and workshops in which the NIC staff participated. They also participated in online trainings.
- The laboratory used a train-the-trainer approach as a way to maintain staff's knowledge base and skill sets.
- Patan Hospital held infection prevention trainings for their hospital staff on a quarterly basis.
- PAHS organized infection prevention trainings at sentinel site hospitals.
- PAHS and NIC conducted workshops on surveillance protocol for 2 sentinel sites in 2017.
- The Influenza Project participated in several trainings and meetings organized by ECDC and NIC

# SRI LANKA



## OVERVIEW

The Ministry of Health's (MOH) Epidemiology Unit (EPID Unit) and the Medical Research Institute's (MRI) National Influenza Center (NIC) in Sri Lanka manage surveillance activities with support from the Health Education Bureau and the Department of Animal Production and Health (DAPH) from the Ministry of Livestock Development and Agriculture. Since CDC funding commenced in 2013, progress has been made in a few key areas. Sri Lanka now collects detailed epidemiologic data from patients with severe acute respiratory infection (SARI) and influenza-like illness (ILI) and maintains a web-based system able to generate relevant data and analysis.

## SURVEILLANCE

Human influenza surveillance in Sri Lanka comprises ILI surveillance in 15 sites and SARI surveillance in 4 sites. The EPID Unit has collected several years of data from both. A centralized epidemiology database, FluSys, allows for the real-time consolidation of surveillance data. The data entry interface includes many data entry validations. Data are easy to export and available in a format for easy analysis.

### SURVEILLANCE ACTIVITIES

- Updated information on influenza activity was presented to stakeholders at the monthly Avian Influenza Advisory Group meetings, and standard laboratory reports were distributed regularly.
- Annual, quarterly, and weekly reports on epidemiological data for influenza surveillance were printed and distributed to target agencies and published on the government website [www.epid.gov.lk](http://www.epid.gov.lk).
- National influenza mortality surveillance was initiated, and a weekly death report form captured the number of influenza-associated deaths by age from all health institutions.
- Surveillance standard operating procedures were updated to help streamline sentinel surveillance activities.
- EPID Unit staff monitored the timeliness and completeness of reported epidemiologic data and actively contacted focal points when data were incomplete or missing.

## HIGHLIGHTS

- The Epidemiology Unit (EPID Unit) and National Influenza Center (NIC) of the Ministry of Health successfully managed a large influenza outbreak in April 2017.
- National Influenza Mortality Surveillance was initiated.
- Necessary logistics were procured and distributed to the NIC, a regional laboratory, and all sentinel sites to facilitate efficient influenza surveillance activities.
- The established 19 sentinel sites routinely collected and sent epidemiological data to the EPID Unit and specimens to the NIC.

## LABORATORY

MRI functions as the main national diagnostic laboratory in the MOH. The NIC, housed at MRI, has capacity to conduct real-time RT-PCR and viral isolation. NIC staff produce a monthly FluAlert report of test results and trends that is distributed via email to the MOH, sentinel sites, WHO, CDC, and other stakeholders. The summary includes the types and subtypes of influenza circulating, how these compare to previous years, and what was unusual and/or worrisome.

### LABORATORY ACTIVITIES

- Sri Lanka entered virological data via WHO FluNet on a weekly basis.
- The NIC routinely contributed seasonal influenza samples to a WHO Collaborating Center for Reference and Research on Influenza.
- NIC staff members demonstrated capability for RT-PCR testing and the capacity to process and test more than 100 samples per week when needed.
- In 2016, the NIC tested 552 ILI samples, of which 3.3% were positive for influenza A and 4.2% were positive for influenza B; the majority of influenza A strains were H3N2. They tested 279 SARI samples, of which 10.8% were positive for influenza A, and 12.9% were positive for influenza B.

## PREPAREDNESS

Influenza surveillance in both humans and animals is conducted as part of the Avian/Pandemic Influenza Preparedness Programme in country. Surveillance in animals is carried out by the DAPH of the Ministry of Livestock Development, and human influenza surveillance is conducted in selected sentinel hospitals overseen by the EPID Unit. Both DAPH and EPID Unit members attend the monthly Avian Influenza Committee meetings where they present their data.

The established structure of the surveillance system and the knowledge of sentinel site staff were an asset for surveillance and management of the 2017 influenza A(H1N1) outbreak.

### *PREPAREDNESS ACTIVITIES*

- The National Technical Committee on Avian/Pandemic Influenza Preparedness and Response streamlined the country's response to pandemics.
- Ongoing discussion occurred with the National Immunization Technical Advisory Groups regarding influenza vaccine policies.
- Antivirals were monitored and provided to hospitals as needed.
- Epidemiologists at the central and regional levels held quarterly capacity-building conferences that provided opportunities to discuss responses to outbreaks.
- The EPID Unit developed a web-based system that linked data between the Unit, MRI, and sentinel sites with potential to facilitate data analysis.

## TRAINING

- Training programs to review protocols for case identification, data collection, reporting, and specimen collection, storage, and transportation were held annually for medical administrators and infection control nursing officers responsible for influenza surveillance in sentinel hospitals.
- Training programs on the web-based influenza surveillance system were conducted for infection control nursing officers responsible for ILI and SARI surveillance in sentinel hospitals.

# THAILAND

## OVERVIEW

Thailand's National Institute of Health (Thai NIH) no longer receives direct monetary assistance from CDC's Influenza Division for routine influenza surveillance. However, the Influenza Division continues to provide on-the-ground high-level technical staff and to support both non-research and research influenza prevention, identification, and response activities. CDC works with Thailand to maintain state-of-the-art vigilance for emerging viruses of pandemic potential in poultry and human populations.

## SURVEILLANCE

Thailand has a long-standing sentinel surveillance system for influenza (operational since 2004). Currently the system collects clinical specimens from 5 sentinel sites around the country and performs influenza virus analysis, drug resistance monitoring, and routinely submits viral isolates and unsubtypeable isolates to WHO Collaborating Centers for Reference and Research on Influenza. The Bureau of Epidemiology, Thai Department of Disease Control (DDC), also conducts influenza surveillance in 40 provinces. Data from the 2 systems are shared weekly with partners and sites in a report posted on a public website. These data are used to inform decisions by policy makers.

Using the strength of the existing influenza surveillance system, the Thai National Influenza Center (NIC) and Thai DDC have collaborated closely with WHO and CDC to expand the system to detect novel viruses such as MERS-CoV and influenza A(H7N9). In addition, CDC is working with Thailand to enhance event-based surveillance for emerging viruses of pandemic potential in poultry and human populations. Educational messages/fact sheets were updated using data from these outbreaks to further inform rapid response policies.

## SURVEILLANCE ACTIVITIES

- The Thai NIC and Bureau of Epidemiology conducted epidemiologic and virological surveillance in 45 provinces across the country.
- The Thai NIH strengthened the event-based surveillance system in Chiang Mai for respiratory diseases with a focus on evaluating and expanding this system to more priority locations.

## HIGHLIGHTS

- Avian influenza was first found in Thailand in humans in 2004, but with effective and aggressive measures put in place, avian influenza has not been detected in humans since 2006.
- The Thai National Institute of Health's existing quality assurance program for laboratory diagnosis of seasonal and avian influenza viruses was enhanced.
- The biosafety program at Thailand's National Institute of Health and its networks was strengthened.
- The event-based surveillance system in Chiang Mai for respiratory diseases and novel emerging viruses such as avian influenza A(H7N9) was strengthened. This model was evaluated for expansion to other priority locations.

- Thailand strengthened the efficiency of the surveillance system for outbreak detection of influenza and other emerging respiratory infections in private hospitals in Bangkok.
- Ongoing surveillance for avian influenza was conducted in live bird markets in Bangkok with a focus on expanding to other priority locations.

## LABORATORY

From October 2016 to May 2017, the Thai NIC tested 1,614 specimens from patients with influenza-like illness (ILI) and severe acute respiratory infection (SARI). Among the specimens from ILI and SARI patients, 382 (23.67%) were positive for influenza viruses (83 were influenza A[H1N1]pdm09, 195 were A[H3N2], and 104 were influenza B).

## LABORATORY ACTIVITIES

- The Thai NIH's existing quality assurance program for laboratory diagnosis of seasonal and avian influenza viruses was enhanced. The performance evaluation scores indicated that 13 centers out of 15 regional Thai NIH laboratories received "excellent" scores, and 2 centers received "very good" scores.
- The biosafety program at the Thai NIH and its networks was strengthened.

- The Virology Association of Thailand; the Biosafety and Biosecurity Network, Thailand; and the Biosafety Association, Thailand were supported in maintaining their websites, which serve as key channels in sharing up-to-date information.

## PREPAREDNESS

In 2013, Thailand published the third version of their pandemic preparedness plan. This version, called *The National Strategic Plan for Emerging Infectious Diseases (EIDs) 2012–2016* has expanded beyond influenza to encompass threats from all emerging infectious diseases. This plan has been revised for use for 2017–2021.

### PREPAREDNESS ACTIVITIES

- CDC's Influenza Division supported revision of the National Strategic Plan for Emerging Infectious Diseases (EIDs) for 2017–2021.
- CDC's Influenza Division supported revision of the medical standard operating procedures for pandemic influenza preparedness and other EIDs in order to adapt the Thai national strategy to IHR requirements.
- Awareness regarding influenza and other emerging and re-emerging infectious diseases was strengthened by conducting refresher courses for newly graduated or young physicians and through provision of training and technical support for pandemic preparedness to physicians and other target groups.
- CDC, with others, supported database update and maintenance of the International Flu Thailand website for the public health, general public, and business sectors.
- Thailand's emergency response capacity for infectious disease threats and respiratory disease outbreak was enhanced.
- A new event-based surveillance strategy in Chiang Mai was developed for evaluation for further expansion.

## TRAINING

CDC partnered with Thailand's Influenza Foundation (IFT) and the Ministry of Public Health for several trainings on the emergence of new viral respiratory diseases, influenza A(H7N9), and MERS-CoV. The Bureau of Epidemiology, with support from CDC, also conducted trainings for event-based surveillance for detecting and responding to respiratory infection.

- In January 2017, IFT held a 1-day workshop to revise guidelines for avian influenza antiviral treatment.
- In February 2017, the Department of Medical Service and IFT organized a training on clinical management and hospital preparedness plans for influenza and other EIDs.
- The Virology Association of Thailand organized a short-course training and workshop on laboratory diagnosis of influenza and emerging respiratory viruses using various methods in July 2017.
- In March 2017, the NIC conducted a 2-day workshop to review the proficiency test program.
- In November 2016, the Bureau of Epidemiology held a training for event-based surveillance investigation.
- CDC supported a scientific writing workshop on influenza for local medical and academic partners.

## RESEARCH

Thailand provides free influenza vaccination to high-risk groups, but coverage is limited. CDC collaborates with the Thai Ministry of Public Health on research to inform policy and program activities to improve vaccine coverage, through development of the evidence base for burden, cost effectiveness, and impact. Areas of research focus include knowledge, attitudes, and practices that relate to influenza vaccination; burden of disease; vaccine effectiveness; surveillance methods; and economic evaluations.

### Research Activities:

- Sets of 500 healthy and 500 chronically ill children aged 0 to 36 months at baseline were followed for 2 years to compare the incidence of mild and severe influenza infection in the 2 groups.
- The effectiveness of the southern hemisphere influenza vaccine to reduce influenza-associated acute respiratory infection in children was determined using a test-negative design.
- The knowledge, attitudes, and practices of pregnant women and their providers towards the influenza vaccine were measured.
- Influenza vaccine coverage and determinants of vaccination in persons aged 65 years and older were evaluated.
- The acceptability, feasibility, and validity of self-swabbing for detection of influenza infection in a population of elderly persons was determined.

- Thailand participated in a multi-country cohort study of pregnant women to measure the burden of influenza in pregnancy and its impact on maternal and perinatal outcomes.
- A nationwide network of hospitals was established to determine the effectiveness of the southern hemisphere influenza vaccine in reducing influenza-associated acute respiratory infection in children.
- A cohort of persons aged 65 years and older was established to measure the effectiveness of the influenza vaccine in reducing the burden of influenza-associated acute respiratory infection among individuals in that age group.





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# WHO Western Pacific Region (WPR)

# WHO Western Pacific Region [WPR]

In Fiscal Years 2016–2017, CDC funded 8 bilateral influenza cooperative agreements in the Western Pacific Region of Asia. These agreements were with Ministries of Health (MOHs) or institutions designated by MOHs to work with CDC to build capacity to routinely identify, diagnose, and respond to seasonal and pandemic influenza.

- Cambodia
- China
- Lao People's Democratic Republic
- Mongolia
- Pacific Community (formerly Secretariat of the Pacific Community)
- Papua New Guinea
- The Philippines
- Vietnam

In addition, CDC supports the WHO Regional Office for the Western Pacific through a cooperative agreement to provide assistance to Pacific Islands Countries and Territories.

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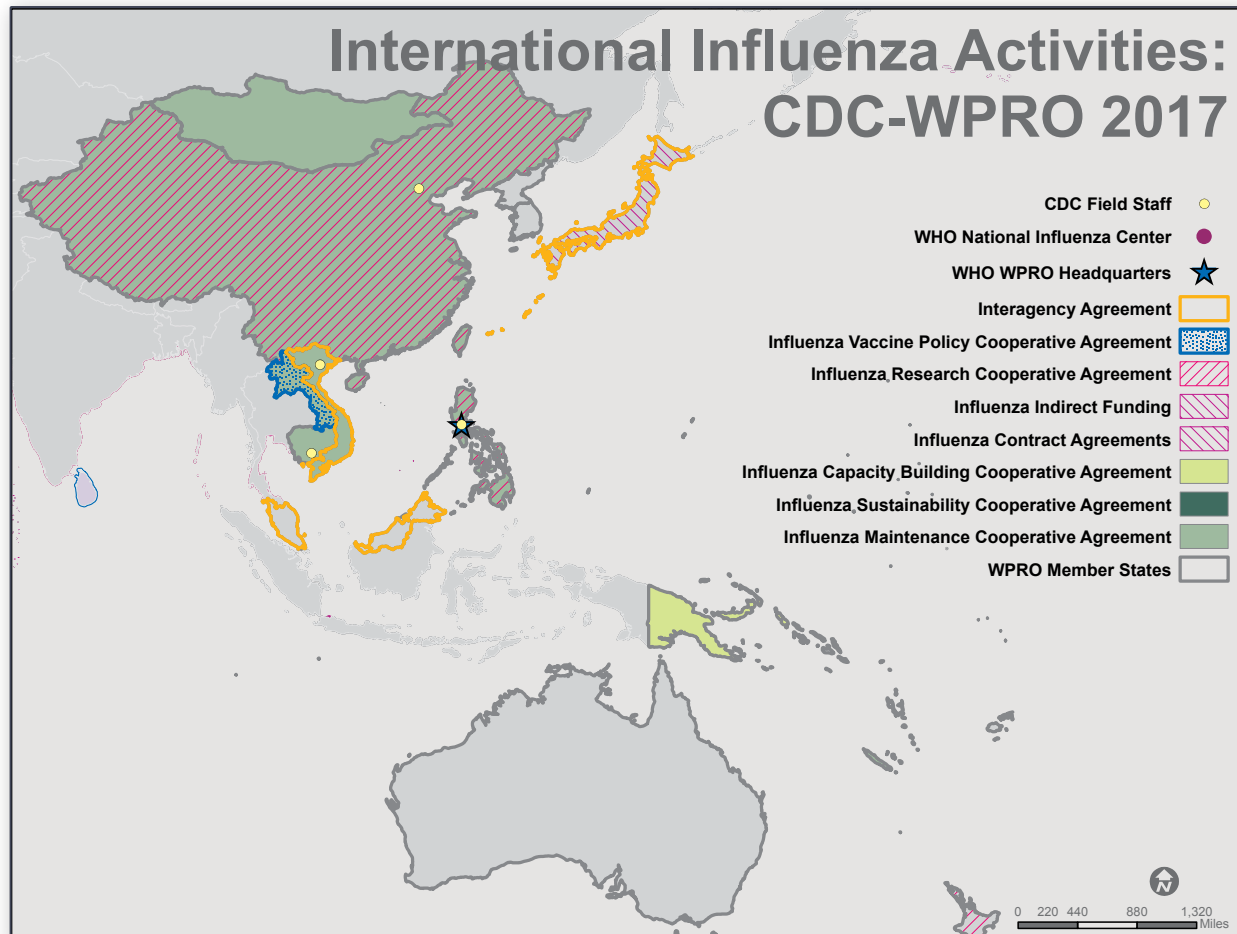
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# WHO Regional Office for the Western Pacific [WPRO]



## HIGHLIGHTS

- WHO's Western Pacific Regional Office (WPRO) co-hosted the tenth NIC meeting in Bangkok, Thailand in July 2016 and hosted the eleventh National Influenza Center (NIC) meeting in Kuala Lumpur, Malaysia in April 2017.
- Regular 3-level and tripartite risk assessments for China's fourth and fifth A(H7N9) waves were conducted.
- Annual external quality assessments (EQAs) for molecular detection were held, with increasing participation and proficiency; the first EQA for virus isolation was successfully completed.
- A web-based regional influenza dashboard was developed.
- A hospital admission survey in was piloted in Cambodia to support disease burden estimates.
- A 5-year review of Western Pacific Surveillance and Response activity was published.
- Response efforts were supported for an unusual pandemic influenza A(H1N1)pdm09 outbreak in Fiji in April 2016.
- WHO PanStop exercises were held at WHO Regional Office for the Western Pacific in Manila, Philippines in December 2015 and in Fiji in January 2017.

## U.S. CDC DIRECT SUPPORT

The WHO Western Pacific Regional Office (WPRO) is located in Manila, Philippines. The office serves 37 countries and areas, spanning 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 1.8 billion people. The Global Influenza Surveillance and Response System (GISRS) in the Western Pacific Region is made up of 21 National Influenza Centers (NICs) in 15 countries; 3 WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs), 1 each in Australia, China, and Japan; 2 Essential Regulatory Laboratories in Australia and Japan; as well as an H5 Reference Laboratory in Hong Kong, China.

The Western Pacific and South-East Asia Regions actively utilize the *Asia Pacific Strategy for Emerging Diseases and Public Health Emergencies* (APSED III) action framework. The development of the original APSED in 2005 was highly influenced by the emergence of avian influenza A(H5N1) and severe acute respiratory syndrome (SARS). APSED III provides a common framework to strengthen national and regional capacities to manage emerging diseases and public health threats, improve pandemic influenza preparedness, and comply with the core capacity requirements of the International Health Regulations (IHR) (2005).

Three consecutive 5-year cooperative agreements between CDC and WPRO continue to support regional influenza activities (October 1, 2006–September 30, 2021: *Surveillance and Response to Seasonal and Pandemic Influenza by Regional Offices of the World Health Organization*). These cooperative agreements paralleled the implementation of the APSED framework, helping to provide technical support for influenza preparedness, surveillance, laboratory, and response capacities. For the period October 1, 2015 to September 30, 2017, support was provided to the Regional Office, and specific funds were allocated for Cambodia, the Lao People's Democratic Republic (Lao PDR), and Pacific Island countries.

## SURVEILLANCE

WPRO has continued to conduct all-hazards event-based surveillance, which includes outbreaks of avian influenza. The regional Detection, Verification, and Risk Assessment Team at WPRO screens more than 200 signals per day. This screening is summarized in official and unofficial reports on influenza activity, particularly human infections with influenza A(H7N9). Between October 2015 and May 2017, WHO was notified of 881 human infections with influenza A(H7N9) under IHR. WPRO continues to disseminate weekly avian influenza and biweekly seasonal influenza reports and is transitioning to reporting via a web-based influenza dashboard. WPRO also supported surveillance and risk assessment for timely decision making and response to an influenza A(H1N1)pdm09 event in Fiji in May 2016, including laboratory support through WHO CCs.

At both regional and country levels, surveillance activities focus on establishing and strengthening severe acute respiratory infection (SARI) and influenza-like illness (ILI) sentinel surveillance as outlined in the sections below.

## SURVEILLANCE ACTIVITIES

### WPRO

- WPRO hosted the eleventh annual bi-regional NIC meeting in Kuala Lumpur, Malaysia, in April 2017 and co-hosted the tenth NIC meeting in Bangkok, Thailand in July, 2016.
- Regular 3-level (Headquarters, Regional Office, and Country Office) and tripartite (WHO, Food and Agriculture Organization, and World Organisation for Animal Health) risk assessments for China's fourth and fifth influenza A(H7N9) waves were conducted.
- Member state submission of laboratory and epidemiological data to FluMART was supported.
- A pilot web-based regional influenza dashboard was developed and launched.
- A 5-year review of Western Pacific surveillance and response activity was published.

### Cambodia

- Hospital admission reviews were conducted in Svay Rieng (May 2016) and Siem Reap (May 2017) provinces to support preliminary disease burden estimates.
- Rapid response teams deployed to 4 poultry A(H5N1) and 1 poultry A(H7N3) outbreaks.
- The national public health investigation and response manual was updated in 2017.

### Lao PDR

- A new Joint National Preparedness and Contingency Plan for avian influenza A(H7N9) and A(H5N1) was launched in October 2016.
- Disease burden estimates were completed for 4 SARI sites following a retrospective record review in December 2015.

### Pacific Island Countries and Territories

- A Regional Pacific Public Health Surveillance Network meeting was held in April 2017.
- A Pacific Meeting on International Health Regulations (2005) Implementation was held in June 2017.



## LABORATORY

Laboratories detect and characterize seasonal and pandemic influenza viruses, a key component of the surveillance and response system. A tiered laboratory network exists in the region with referral capacities from local to national (NICs) to international levels (WHO CCs). Laboratory improvements are a priority and high certification rates are achieved through trainings for NIC staff on proper shipping protocols and laboratory safety. Where needed, procurement support is offered through cooperative agreements from CDC.

WPRO has supported the organization of external quality assessment (EQA) programs for molecular detection and virus isolation, which aim to improve virus sharing. EQA program findings informed individualized support for regional workshops; for example, a regional virus isolation workshop was conducted to build capacity in the laboratory. All NICs successfully contributed virological data to FluNet and the Pacific Syndromic Surveillance System reported ILI data weekly. Ongoing support stemming from influenza laboratory capacity has resulted in laboratory detection of other pathogens, such as MERS-CoV and arboviruses.

### LABORATORY ACTIVITIES

#### WPRO

- WPRO participated in the Informal Consultation on Laboratory Detection and Characterization of Emerging Infectious Diseases in the Asia Pacific Region meeting in February 2016.
- WPRO conducted regional biosafety and infectious substances shipping training in April 2016.
- WPRO developed an EQA program for influenza molecular diagnosis and novel EQA for virus isolation.
- WPRO conducted virus isolation training and characterization for NIC staff in collaboration with the WHO CC in Melbourne in May 2017.

#### Cambodia

- National Institute of Public Health (NIPH) testing for ILI and SARI samples, including referral to Institute Pasteur Cambodia for viral isolation, was supported.

- Guidance was provided to NIPH and other laboratory partners in procurement processes for biosafety cabinets, locking systems, and fire alarms to improve biosafety and biosecurity.
- Biosafety assessment and training was conducted in 6 provincial hospital laboratories: Kampot, Kampong Cham, Siem Reap, Battambang, Takeo, and Svay Rieng.

#### Lao People's Democratic Republic (PDR)

- The protocol for collection, storage, and shipment of laboratory specimens was revised.
- The National Center for Laboratory and Epidemiology (NCLE) was supported for participation in an EQA.
- RT-PCR, cell culture, virus isolation, hemagglutination inhibition assay, and sequencing trainings were conducted.
- Influenza laboratory reagents and supplies were procured for NCLE.
- Viral transport media, supplies, and personal protective equipment were procured for sentinel surveillance and non-sentinel sites following a Health Minister Decree on enhanced influenza surveillance and response.

## PREPAREDNESS

PanStop and IHR Crystal exercises are key WPRO preparedness activities conducted on a yearly basis. Core IHR capacities are strengthened and tested through the IHR Exercise Crystal communication activity, which was held regionally in December 2015 and 2016. Another important exercise, PanStop, strengthens communication, coordination and decision-making procedures related to potential rapid containment operations to stop or slow the spread of an outbreak of influenza with pandemic potential. PanStop was conducted internally at WPRO in December 2015 and with Fiji in January 2017. Other preparedness activities focused on infection prevention and control and support for local rapid response teams in Cambodia, Lao PDR, and Pacific Island countries. An example of successful real-life testing of pandemic preparedness was WPRO and Fiji's response efforts to an unusual pandemic influenza A(H1N1)pdm09 outbreak in Fiji in April 2016.

## PREPAREDNESS ACTIVITIES

### WPRO

- WPRO conducted annual IHR Exercise Crystal and PanStop exercises.
- WPRO participated in regional development meetings on the *Tool for Influenza Pandemic Risk Assessment* exercises in May and September 2016.
- WPRO held a Strengthening Surveillance for Response to Outbreaks consultation in March 2016.
- WPRO managed response to an unusual outbreak of pandemic influenza A(H1N1)pdm09 outbreak in Fiji in April 2016.

### Cambodia

- An influenza sustainability workshop, held in February 2016, explored options for sustainable financing of event- and indicator-based surveillance.
- The *National Infection Prevention and Control (IPC) Strategy*, guidelines, and associated training package were revised.

### Lao PDR

- The Joint National Preparedness and Contingency Plan for H7N9 and H5N1 was published.
- A joint risk assessment workshop was held in October 2015.
- Field epidemiology trainees were trained and deployed for rapid response to outbreaks.
- An IPC monitoring checklist and district-level training package were developed.

### Pacific Island Countries and Territories

- A PanStop exercise was held that included representatives from the animal and human health sectors, police, and the foreign affairs ministries.
- Influenza risk assessment and desktop pandemic planning exercises were held during the first National Influenza Surveillance meeting in November 2015.
- Fiji's *Pandemic Influenza Preparedness and Response Plan* was revised.
- Clinical management training was conducted for hospital intensive care units, prenatal services, maternity wards, and health care workers in August–October 2016.
- *Pacific Outbreak Manuals* were created and distributed for online distance learning courses.

## TRAINING

### WPRO

- WPRO conducted annual PanStop and IHR Exercise Crystal exercises.
- WPRO developed a *Tool for Influenza Pandemic Risk Assessment* evaluation in May and September 2016.
- WPRO conducted surveillance site refresher trainings (on case definitions, sample collection, reporting, etc.) in Cambodia and Lao PDR.
- WPRO conducted biosafety and infectious substances shipping training in April 2016.
- WPRO conducted a virus isolation and characterization workshop in June 2017.

### Cambodia

- Influenza A(H7N9) and A(H5N1) and MERS-CoV risk assessment trainings were conducted.
- Cambodia Early Warning and Alert Network (CamEWARN) trainings were conducted in 110 new health centers in 15 provinces.
- An infection prevention and control training-of-trainers was held for university instructors.

### Lao PDR

- Sixteen individuals graduated from the Field Epidemiology Training Program (FETP) in February 2016 and 2017 (Cohorts 7 and 8). Seven FETP abstracts were accepted for the eighth bi-regional Training Programs in Epidemiology and Health Interventions Network (TEPHINET) Conference and International Meeting on Emerging Diseases and Surveillance.

### Pacific Island Countries and Territories

- Quarterly divisional/sub-divisional refresher trainings were held on ILI/SARI surveillance, virological sample collection, and clinical management.
- A 3-day Early Warning and Response System refresher training was held to improve event-based surveillance reporting.

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# CAMBODIA

## OVERVIEW

Since 2006, CDC has provided support to Cambodia through the following non-research cooperative agreements: *Development of Influenza Surveillance Networks Overseas* with Cambodia's Ministry of Health (MOH), and *Surveillance and Response to Avian and Pandemic Influenza* with the WHO Country Office. The collective goals of these cooperative agreements have been to build human and infrastructure capacity in surveillance, response, laboratory diagnosis, and pandemic preparedness for influenza. Other key in-country partners include the WHO Cambodia Country Office, the Institut Pasteur Cambodia (IPC), and the United States Naval Medical Research Unit No. 2 (NAMRU-2). Implementation of these cooperative agreements has resulted in the establishment of laboratory-based influenza surveillance, national public health laboratory capacity to perform molecular detection of influenza viruses, and strengthening of national and local response to avian influenza, pandemic influenza, and other communicable disease outbreaks. The cooperative agreements have developed and strengthened influenza pandemic preparedness (Phase I) and sustained influenza pandemic preparedness (Phase II); Fiscal Year 2016 was the first year of maintenance of influenza pandemic preparedness (Phase III).

## SURVEILLANCE

- Influenza surveillance did not exist in Cambodia prior to receipt of CDC support. Since the implementation of the cooperative agreement, laboratory-based influenza-like illness (ILI) and severe acute respiratory infection (SARI) surveillance systems have been established under the MOH with technical guidance from WHO, CDC, and IPC. Currently, ILI surveillance involves 7 sites (health centers and hospital outpatient departments) located in 6 provinces and Phnom Penh. SARI surveillance consists of 8 hospitals from Phnom Penh, Siem Reap, Kandal, Kampot, Takeo, Kampong Cham, and Svay Rieng provinces. Influenza surveillance has clearly demonstrated annual influenza seasonality in Cambodia. Based on the surveillance data, the influenza threshold has been calculated and implemented.

## HIGHLIGHTS

- The influenza surveillance system was used for outbreak response and preparedness.
- Laboratory capacity was successfully established for influenza molecular detection, culture/isolation, and next generation sequencing methods.
- Influenza virus seasonality information was collected.
- Cambodia's influenza threshold was estimated.
- A hospital admission review for acute respiratory-associated diseases was conducted to support estimation of Cambodia's influenza disease burden.

An influenza burden of disease estimation is in progress; a hospital admission review study was conducted to get the denominator of the catchment area.

## SURVEILLANCE ACTIVITIES

- ILI surveillance utilizing a web-based data input and reporting system was upgraded during the 2015 project year.
- SARI surveillance utilizing a web-based data input and reporting system was upgraded during the 2016 project year.
- Influenza surveillance activities increased, with 4 new SARI sites—Kampong Cham, Takeo, Svay Rieng, and Kampot provinces—established in 2014–2015 to strengthen and expand the SARI system. Necessary equipment, supplies, and training were provided to these sites.
- Microbiologic testing was implemented as part of SARI surveillance.
- Influenza A(H7N9), A(H9N2), and A(H5N1) testing was conducted as part of ILI and SARI surveillance.
- Site visits were conducted at all ILI and SARI sentinel sites.
- Testing for RSV, parainfluenza viruses (PIV), human metapneumovirus (hMPV), and adenovirus was implemented as part of SARI surveillance.
- MERS-CoV tests were conducted for suspected cases related to travel history and contact.
- A monthly Respiratory Disease and Influenza Bulletin was produced.

## LABORATORY

Support from the CDC/MOH cooperative agreement resulted in substantial strengthening of laboratory capacity, including the skills of technicians at the MOHs National Institute of Public Health Laboratory (NPHL). NPHL is able to perform real-time RT-PCR testing for all major influenza virus subtypes, including influenza A(H5N1), influenza A(H7N9), and influenza A(H9N2), in addition to multiplex PCR testing for other selected respiratory viruses. NPHL also expanded the testing for MERS-CoV, Zika virus, and Enterovirus (EV) 71 as a part of global and regional preparedness. The microbiology laboratory at NPHL strengthened their capacity in the areas of SARI surveillance and outbreak responses, specifically bacterial culture, identification, and antimicrobial sensitivity testing, and enhanced capacity building for cell culture and influenza virus isolation, next generation genomic sequencing, and antimicrobial resistance detection. Influenza surveillance provided opportunities for NPHL to develop laboratory capacity in molecular testing, virus isolation, and microbiology platforms for response to global health situations.

### LABORATORY ACTIVITIES

- NPHL tested 6,265 influenza surveillance specimens—4,225 from SARI cases, and 2,040 from ILI cases—and 46 influenza outbreak cases. Multiplex RT-PCR for other respiratory viruses was conducted for 1,563 SARI patients under 5 years old.
- NPHL submitted 100 positives samples to the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in Melbourne, Australia, and 50 positives samples to the WHO CC in Atlanta.
- Real-time RT-PCR testing of specimens from ILI and SARI surveillance and influenza outbreak response was conducted for influenza A and B viruses, and subtypes H1pdm, H3, H5, H7, H9, B Victoria lineage, and B Yamagata lineage.
- Multiplex RT-PCR testing was conducted for PIV1, PIV2, PIV3, RSV, hMPV, and adenovirus for SARI patients under 5 years old.
- Expanded rRT-PCR testing was conducted for EV 71, MERS-CoV, and Zika virus from suspect cases samples.
- A sequencing method (MiSeq Illumina) was successfully set up for influenza genomic sequencing.
- Biosafety level 2+ and cell cultures were established and cell culture testing began.
- WHO's External Quality Assessment Project (EQAP) panels and CDC's Influenza Molecular Diagnostic Performance Evaluation Panel by rRT-PCR platform panel were successfully completed.
- For SARI surveillance, bacterial culture, identification, and antimicrobial susceptibility testing methods were strengthened to improve the performance of NPHL's microbiology laboratory.
- The microbiology laboratory at NPHL participated in an internal quality control and EQAP and received 85–90% success scores.
- Various training was received on influenza virus molecular testing, virus isolation, and next generation sequencing.

## PREPAREDNESS

CDC support through WHO 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 MOH and WHO have led the development of a health sector response plan. In early 2015, a workshop on estimation of influenza disease burden was conducted, and in late 2015, a training workshop on sample collection for emerging and re-emerging pathogens was given to the rapid response team. In July 2016, an avian influenza outbreak workshop was conducted with representatives from the animal and human health sectors together, and in late 2016, a workshop on development of standard operating procedures (SOPs) for outbreak investigation for the animal health sector was conducted. For strengthening the network of outbreak investigation with a neighboring country, in early 2017, a cross-border workshop on joint outbreak investigation in the southern region was conducted with participants from Cambodia, Vietnam, and the Lao People's Democratic Republic (Lao PDR).

### PREPAREDNESS ACTIVITIES

- In August 2015, a workshop on estimation of the influenza disease burden was conducted.
- In September 2015, a training workshop on sample collection for emerging and re-emerging pathogens was given to the rapid response team.

- In July 2016, an avian influenza outbreak workshop was conducted with representatives from the animal and human health sectors.
- A September 2016 workshop on developing SOPs for outbreak investigation for the animal health sector was conducted.
- In February 2017, a cross-border workshop on joint outbreak investigation in the southern region was conducted with participants from Cambodia, Vietnam, and Lao PDR.
- SOPs for MERS-CoV and for Zika outbreak investigation and response were developed.
- Outbreak investigation and response were conducted for a suspected MERS-CoV outbreak.
- A joint external evaluation for International Health Regulations (2005) implementation was conducted.
- Outbreak investigation and response were conducted for a suspected Zika outbreak.
- Outbreak investigation and response were conducted for a suspected EV 71 outbreak.
- Outbreak investigation and response were conducted for a food poisoning outbreak.

## TRAINING

- An ILI surveillance refresher training workshop was provided for staff from all sentinel sites bi-annually, including case enrollment, specimen collection and transport, and data entry.
- A SARI surveillance refresher training workshop was provided for staff from all sentinel sites bi-annually, including case enrollment, specimen collection and transport, and data entry.
- Next generation sequencing and data analysis/ bioinformatics for viral pathogen trainings were held.
- A workshop training on influenza laboratory surveillance was held in China.
- An international training was conducted on molecular testing, virus isolation, and sequencing analysis at the WHO CC in Melbourne.
- An international training on influenza virus isolation was held by the Association of Public Health Laboratories in California, USA.
- An international training on molecular diagnosis for MERS-CoV was conducted by the Taiwan Centers for Disease Control in Taiwan, as was an international training on laboratory diagnosis for dengue/Zika/Chikungunya.

# CHINA

## OVERVIEW

China's CDC collaborated with CDC on 3 influenza-related cooperative agreements (CoAgs) during Fiscal Years 2016 and 2017.

1. The CoAg titled *Protecting and Improving Public Health Globally: Building and Strengthening Public Health Impact from 2014–2019* supports the Chinese National Influenza Center's (CNIC) training activities related to gene sequencing and serologic testing.
2. The 5-year CoAg titled *China-US Collaborative Program on Emerging and Re-emerging Infectious Diseases* was launched in 2012. Through this CoAg, Chinese partners worked with CDC to support quality improvement for national severe acute respiratory infection (SARI) surveillance, an assessment of the Pneumonia of Unknown Etiology (PUE) surveillance system, and avian influenza A(H7N9)-related research.
3. The CoAg titled *Expanding the Use of Seasonal Influenza Vaccines in Public Health Programs in China* from 2013–2016 supported China CDC to work with local CDCs and the US CDC to use domestic scientific evidence to design and implement innovative pilot interventions that might inform seasonal influenza vaccination policy in China.

## SURVEILLANCE

During 2015–2017, the Chinese government continued to support both influenza-like illness (ILI) and SARI influenza surveillance systems in China. The ILI and virology surveillance network includes 408 network laboratories and 554 sentinel hospitals, while SARI surveillance is conducted at 25 sentinel hospitals. During this time, CDC continued to support surveillance quality improvement activities, data analyses, and efforts to share surveillance data with the global community. CDC also supported capacity building training for network laboratories. Recently, the influenza surveillance systems played an important role in identifying a surge of avian influenza A(H7N9) human infections during the fifth A(H7N9) epidemic, and identifying the first reported cases of human infections with highly pathogenic avian influenza (HPAI) A(H7N9) virus.

## HIGHLIGHTS

- China CDC, collaborating with CDC, conducted risk assessments of the fourth and fifth epidemics of avian influenza A(H7N9), disseminating data in a timely manner and facilitating inter-agency virus-sharing.
- The National Health and Family Health Commission issued a new National Influenza Surveillance Guideline, and 5 trainings were held for 1,500 staff members.
- Avian influenza A(H5N6) and A(H7N9) viruses from China were recommended as vaccine candidates.
- The first human infection with highly pathogenic avian influenza A(H7N9) was identified.
- With technical support and training from the Chinese National Influenza Center, the number of network laboratories capable of performing deep sequencing increased.

## SURVEILLANCE ACTIVITIES

- The analysis and utilization of ILI, SARI, and PUE surveillance data for A(H7N9) outbreak response efforts were strengthened.
- China CDC, collaborating with CDC, regularly reviewed data collected through numerous influenza surveillance systems to conduct risk assessments of the fourth and fifth epidemics of avian influenza A(H7N9), and to disseminate data in a timely manner.
- The National Health and Family Health Commission issued a new National Influenza Surveillance Guideline, and 5 trainings were held for 1,500 staff members. The new National Influenza Technical Guideline was developed.
- Human infections with HPAI avian influenza A(H7N9) were identified, and HPAI A(H7N9) virus specimens were subsequently shared with CDC and other WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs).
- Antiviral drug resistance surveillance for viruses collected through the ILI surveillance system was expanded.
- The national influenza surveillance information system was improved.

## LABORATORY

During 2015–2017, the CNIC and CDC worked closely together to enhance ILI surveillance quality and CNIC's capacity to better support their 408 network laboratories. At the national level, 14 senior staff participated in international meetings and trainings on surveillance data analysis, influenza detection technology, and other relevant topics. The goal was to enhance CNIC's capacity to fulfill the requirements and responsibilities as a WHO CC, and to support the antigenic, genetic, and drug resistance testing of avian influenza A(H7N9) virus in a timely manner.

### LABORATORY ACTIVITIES

- Laboratory accreditations were initiated and conducted in CNIC and 4 network laboratories.
- A classical reassortment platform for seasonal influenza candidate vaccine strains was established.
- The capacity of network laboratories to conduct egg-based virus isolation was greatly improved; at this time, more than 50% of laboratories can perform egg-based virus isolation.
- Staff from the CNIC participated in and presented at international meetings, such as the annual Emerging Infectious Diseases meetings and the WHO Western Pacific Region/Southeast Asia Region NIC meetings, playing a greater role in global influenza control.
- The monitoring of mutations of avian influenza A(H7N9) virus in a timely manner was supported, and virus specimens were shared with other WHO CCs.

## PREPAREDNESS

China CDC, with support from CDC and other international organizations, is developing a new national pandemic preparedness plan. From October 1, 2015–September 30, 2017, China CDC held 2 workshops with national, international, and local public health professionals to discuss revisions to China's pandemic preparedness framework. In addition, China CDC is working closely with CDC, WHO, the Food and Agriculture Organization, and other partners to promote One Health approaches to influenza-related activities in China, particularly with respect to avian influenza A(H7N9). Finally, the epidemiologist responsible for outbreak response and pandemic preparedness within China CDC's

Public Health Emergency Response Office conducted a fellowship at CDC from March–May 2017, in part to seek support in the revision of China's pandemic preparedness framework.

### PREPAREDNESS ACTIVITIES

- China CDC collaborated with CDC on the revision of the national pandemic preparedness plan.
- China CDC held 2 workshops with national, international, and local public health professionals to discuss revisions to China's pandemic preparedness framework.
- China CDC held monthly risk assessment meetings with CDC and WHO to discuss recent human infections with avian influenza in China.
- The China CDC staff member responsible for outbreak response and pandemic preparedness within China CDC's Public Health Emergency Response Office completed a 3-month fellowship at CDC in Atlanta to work on pandemic preparedness and response with the Influenza Division and the Office for Public Health Preparedness and Response.

## RESEARCH

CDC is collaborating with China CDC, Fudan University School of Public Health, and Suzhou CDC on the following research projects to inform both seasonal and avian influenza prevention and control recommendations and interventions in China in the future:

- A study investigating the most recent cases of the influenza A(H7N9) avian influenza outbreak in China to identify risk factors associated with human infection with influenza A(H7N9), and to develop recommendations to prevent and control human infections with influenza A(H7N9). As of July 2015, there were 680 human cases of influenza A(H7N9) avian influenza and more than 280 influenza A(H7N9)-associated deaths in China. Collaborations between China CDC and CDC during the influenza A(H7N9) outbreaks have facilitated virus specimen sharing and information exchange.
- A prospective study to define the epidemiological characteristics and economic burden of SARI, and specifically influenza infection, among hospitalized children <5 years of age in Suzhou, China. This study



has established the disease burden of influenza-associated hospitalization among children <5 years old in Suzhou, and has provided local scientific evidence for influenza vaccine policy development in China.

- A community-based study comparing vaccinated and unvaccinated children aged 6 months–5 years to assess influenza vaccine effectiveness in preventing lab-confirmed influenza illness among young children in Suzhou. In recent years, only 1.2% to 37.7% of children <5 years of age in Suzhou have been vaccinated for seasonal influenza each year. Low vaccination coverage could be due, in part, to misconceptions about seasonal influenza vaccine effectiveness. High-quality, local data on influenza disease burden and vaccine effectiveness could inform seasonal influenza vaccination policies and interventions in China.

## INFLUENZA VACCINE ACTIVITIES

Vaccine policy activities focused on promoting seasonal influenza vaccination among high risk groups in China by engaging relevant stakeholders and integrating the recommendation for influenza vaccination into existing health systems. In addition, China donated >400,000 doses of seasonal influenza vaccine to low-resource countries. Some activities of particular interest include:

- China CDC updated national guidelines for seasonal influenza vaccination for 2015–2016, prioritizing pregnant women, family members and care-takers of children <6 months of age, children aged 6 months to 5 years, adults aged ≥60 years, persons with chronic medical conditions, and health care workers.
- China CDC published key influenza immunization messages in Chinese medical journals.
- In August 2016, China CDC, in collaboration with CDC, hosted an influenza vaccination strategies symposium to discuss how to increase seasonal influenza vaccine use in China with officials from the National Health and Family Planning Commission (the Ministry of Health) and representatives from China CDC, local CDCs, US CDC, WHO, and the Asian Pacific Alliance for the Control of Influenza (APACI).
  - » Recommendations were developed for promoting seasonal influenza vaccination among 2 high-risk groups in China: preschool-aged children and older adults.
  - » Meeting notes (including recommendations) were submitted to a Chinese journal for publication.
- Zhejiang Province developed a seasonal influenza vaccination recommendation performance indicator to encourage local community physicians and general practitioners to recommend seasonal influenza vaccine to local adults ≥60 years of age.
- China CDC, in collaboration with APACI, the Chinese Preventive Medicine Association, and CDC, organized a symposium on seasonal influenza vaccination policy development and implementation in June 2017 in Beijing, with 150 international and local experts in the fields of influenza and vaccine policy.
- China CDC's Center for Chronic Disease, in collaboration with CDC, designed a project to promote influenza vaccination through China's chronic disease management system, to be implemented in 2017–2018.
- Hualan, a Chinese pharmaceutical company, partnered with CDC and the Partnership for Influenza Vaccine Introduction to donate >400,000 doses of seasonal influenza vaccine to low-resource countries.
- Collaborating with CDC during the final year of the 3-year vaccine policy CoAg (September 2015–August 2016), Ningbo CDC continued to work through a community-based non-communicable disease (NCD) management platform to conduct the following activities in a pilot intervention neighborhood: mainstreaming the concept of unified prevention of infectious diseases and NCDs; encouraging health care workers to recommend influenza vaccination during NCD follow-up visits; and establishing temporary influenza vaccination service stations.
  - » These practices effectively increased the seasonal influenza vaccination rate among older adults and reduced outpatient visits caused by respiratory illness among NCD patients in the pilot intervention neighborhood.

# LAO PEOPLE'S DEMOCRATIC REPUBLIC



## OVERVIEW

Fiscal Year (FY) 2017 was the first year of CDC's cooperative agreement (CoAg) with the National Immunization Program (NIP), and with the National Center for Laboratory and Epidemiology (NCLE), Ministry of Health (MOH), the Lao People's Democratic Republic (Lao PDR).

The agreement with NIP was established to conduct activities that will lead to evidence-based policy decisions related to the expansion of seasonal influenza vaccination and to support the implementation of a national influenza vaccination strategy, which includes logistical infrastructure that would be rapidly utilized in pandemic scenarios as well. FY 2017 activities included: 1) development of a national immunization policy; 2) strengthening National Immunization Technical Advisory Group (NITAG) operations and integration; 3) a cost analysis of severe acute respiratory infection (SARI) associated with influenza; 4) a review of influenza vaccine information, education, and communication (ICE) materials and needs; 5) and support for transportation and logistics of influenza vaccine to target communities across the country.

In 2012, Lao PDR introduced seasonal influenza vaccine through an innovative private-public partnership. The partnership marked the first time seasonal influenza vaccine was introduced in a low-income country in the region. Influenza vaccine was effectively distributed to priority high-risk groups (pregnant women, elderly, chronically ill individuals, and health care workers).

The CoAg with NCLE is intended to strengthen existing influenza surveillance systems by improving capacity to detect, monitor, and respond to changing virological and epidemiological circumstances, and mitigate transmission of novel influenza among humans. NCLE has had an influenza (virological) surveillance system in place since 2007, and was certified as a National Influenza Center (NIC) in 2010. The surveillance network processed 2,606 specimens in 2015 and 2016 from 7 influenza-like illness (ILI) and 6 SARI sentinel sites that are geographically

## HIGHLIGHTS

- CDC initiated a new cooperative agreement on *Vaccine Policy and Influenza Surveillance Maintenance* between the National Immunization Program (NIP), MOH, Lao People's Democratic Republic (Lao PDR).
- Building on its successful relationship with the global Partnership for Influenza Vaccine Introduction (PIVI), Lao PDR formally incorporated seasonal influenza vaccine into the *National Expanded Program on Immunizations (EPI) Strategy*. This included development of a new National Immunization Law.
- To support transparent and evidence-based approaches for this vaccine implementation, Lao PDR strengthened its National Immunization Technical Advisory Group.
- From September 2016–June 2017, Lao PDR deployed 596,304 doses of influenza vaccine through co-financing between the Government of Lao PDR and PIVI.
- The Center for Vaccine Equity at the Task Force for Global Health managed contributions, highlighting for the third year the value of public-private vaccine partnerships.
- Lao PDR also strengthened its pandemic vaccine infrastructure, with newly established mechanisms to reach pregnant women, elderly persons, chronically ill persons, and health care workers.
- Lao PDR also completed a costing assessment of vaccine benefits weighed against the burden of SARI associated with influenza.
- Lao PDR continued to strengthen its event-based surveillance and epidemic and pandemic rapid response infrastructure through training of national and local epidemiologists.

representative of the country. CDC also trained local epidemiologists to enhance the infrastructure required to combine laboratory information with necessary clinical and epidemiologic information during outbreaks.

## SURVEILLANCE

ILI and SARI surveillance support continued, including workshops, refresher training and monitoring site visits. These included:

- 7 ILI sentinel sites in 5 provinces
- 6 SARI sentinel sites in 6 provinces

Additionally, SARI posters were developed and distributed to all provinces to enhance SARI specimen collection throughout Lao PDR. Overall, 2,606 and 3,850 samples were collected from 7 ILI sentinel sites and 6 SARI sentinel sites, respectively, from October 2015 to May 2017. SARI specimen collection support was continued at 13 priority hospitals throughout Lao PDR with special congressional funding for influenza A(H7N9) surveillance.

Weekly influenza laboratory feedback reports were distributed to all sentinel sites and partners, and virus specimens were promptly shared with the WHO Global Influenza Surveillance and Response System (GISRS). A national weekly influenza bulletin was also circulated to all Provincial Health Offices (PHOs), MOH departments, and partners for information sharing and appropriate interventions. The ILI/SARI surveillance platform was leveraged to support dengue surveillance.

### SURVEILLANCE ACTIVITIES

- Data were collected and analyzed to demonstrate that influenza circulates with year-round occurrence; the percent of surveillance specimens testing positive for influenza was >20% in February 2017.
- Influenza B was predominant compared to influenza A from October 2015 through April 2017, followed by a predominance of influenza A after April 2017.
- The relative importance of influenza as an important causative etiology in febrile illness, especially during the peak of influenza season, was demonstrated.
- Surveillance systems identified and responded to influenza A(H5N1) outbreaks in poultry populations.

## LABORATORY

Lao PDR continued to perform quality laboratory testing using WHO-suggested diagnostic algorithms for the testing of ILI/SARI samples from sentinel and non-sentinel sites during this report period. From October 2015 to May 2017, 2,606 samples were sent from the 7 ILI sentinel sites, of which 442 (16.96%) tested positive for influenza; 3,850 samples were sent from the 6 SARI sentinel sites, of which 410 (10.65%) tested positive for influenza; and 776 samples were sent from other hospitals that were neither ILI nor SARI sentinel sites, of which 53 (6.83%) tested positive for influenza. All samples were influenza A or B seasonal subtypes. No unsubtypeable influenza A viruses were isolated. To date, no human samples positive for avian influenza have been identified. Ongoing vigilance remains essential given the threat of influenza A(H7N9) and other novel viruses in the region.

### LABORATORY ACTIVITIES

- As an NIC, NCLE continued to contribute viral isolates (450 from October 2015 to May 2017) to the WHO GISRS through the WHO Collaborating Centers for Reference and Research on Influenza at CDC and National Institute of Infectious Diseases (NIID)-Japan.
- NCLE participated in both the WHO External Quality Assessment Project (EQAP) and CDC External Quality Assessment Panel, scoring 100% with both EQA programs.
- NCLE regularly shares its weekly influenza laboratory feedback report with all sentinel sites and partners.
- NCLE participated in FluNet and regularly shares laboratory data.

## PREPAREDNESS

Pandemic preparedness activities in Lao PDR were re-activated in response to A(H7N9) and A(H5N1) threats in China and Cambodia, respectively. In October 2015, a simulation exercise for MERS-CoV combining avian influenza began, and a risk assessment training workshop focused on influenza A(H5N1) was conducted October 2016. Additionally, recognition of seasonal influenza vaccine deployment in adult populations has proven critical in preparing Expanded Program on Immunization activities to meet pandemic vaccine demands in the future.

## PREPAREDNESS ACTIVITIES

- A simulation exercise was conducted for MERS-CoV and pandemic preparedness in December 2015.
- A risk assessment training workshop with a focus on influenza A(H5N1) was conducted in Luangprabang in October 2016.
- Influenza-related activities were included and presented in a One Health workshop in September 2016 in Thalath, Vientiane Province.
- WHO procurement of antiviral and outbreak kits for NCLE, the Field Epidemiology Training Program, and all 18 rapid response teams (RRTs) was facilitated at the provincial level.
- A joint avian influenza simulation exercise was conducted in March 2017.
- An RRT training for national and provincial levels was conducted in June 2017.
- A 3-week epidemiology short course was conducted in June 2017.

## TRAINING

- A national ILI/SARI refresher training was conducted at all ILI and SARI sentinel sites twice each year.
- Biosafety and specimen collection training was conducted at all ILI and SARI sentinel sites twice each year.
- Training on influenza testing including RT-PCR, sequencing, cell culture, virus isolation, and hemagglutinin inhibition tests was conducted for NCLE staff.
- A national surveillance workshop was implemented in November 2016.
- Lao PDR's RRTs—including surveillance officers, clinicians, laboratory technicians, and nurses—participated in a regional simulation exercise on MERS-CoV in October 2015.
- National surveillance workshops, organized so that provincial teams could share surveillance findings and exchange experiences, were held in November 2016.
- Refresher training was provided to ILI/SARI sentinel site staff using standard operating procedures and case definitions that were revised in December 2017 and January 2017.

- A One Health approach to epidemic and pandemic response was supported by focusing active surveillance for the detection of influenza A(H7N9) in 5 northern provinces (Phongsaly, Laungnamtha, Oudomxay, Luangprabang, and Xayabouly). A refresher training was held in October 2016.
- Biosafety training for the animal and human laboratory sectors was undertaken in partnership with the US Defense Threat Reduction Agency (DTRA) in November 2016 and May 2017.
- Laboratory training in necropsy and pathology was provided to the National Animal Health Center Laboratory (in collaboration with DTRA and the Mahidol Oxford Research Unit-Armed Forces Research Institute of Medical Sciences) in November 2016 and May 2017.
- Training of hospital staff in Vientiane and Luangprabang was conducted to support the SARI cost analysis assessment.
- Training of NIP data management staff was conducted in conjunction with seasonal influenza vaccine-related projects.

## RESEARCH

In Lao PDR, CDC facilitated the introduction of seasonal influenza vaccine, and has taken on an increasingly impact-oriented vaccine research agenda, in close collaboration with the MOH and other partners including the Oxford Wellcome Trust, the United Nations Children's Fund, and WHO. Findings from recent CDC-supported publications highlight the successful deployment of both pandemic and seasonal influenza vaccines in Lao PDR, attesting to safety and acceptability in prioritized targeted populations (e.g., pregnant women) and serving as an example to other low-income countries considering such disease-reduction vaccine strategies. Vaccine policy adoption in Lao PDR has enabled first-time opportunities to study vaccine issues related to pregnant women, not only in terms of safety, but impact on birth outcomes. Finally, a complementary newly created community-based influenza study platform allows for first-time influenza disease burden estimates in pregnant women. Findings to date have critical implications for moving low-income countries toward seasonal influenza vaccine uptake and future pandemic vaccine considerations.

These findings include:

- No serious adverse events occurred following immunizations in pregnant women, elderly individuals, chronically ill persons, or health care workers in 3 years of seasonal influenza vaccine campaigns in which >1 million doses were administered.
- No significant negative impact of seasonal influenza vaccine was found on birth weight outcome measures, in a study population of 6,000 vaccinated and non-vaccinated pregnant women.
- Preliminary findings indicated that seasonal influenza vaccination could contribute to a reduction in premature birth outcomes.
- Seasonal influenza was recognized via febrile episodes as the single most frequently noted etiology in pregnant women from community-based study findings.

## INFLUENZA VACCINE ACTIVITIES

The NIP of Lao PDR began a CoAg focused on influenza vaccine policy development and enhancement of vaccination programs in the fall of 2016. Lao PDR has been a recipient of vaccine donations through the Partnership for Influenza Vaccine Introduction (PIVI) since 2012 and thus has developed a vaccination program targeted to pregnant women. This grant is meant to enhance that program and formalize an influenza vaccine policy in the country. To date, CoAg activities have focused on the development of a national immunization law, strengthening the NITAG, an analysis of costs associated with SARI, a review of influenza vaccine communication materials and associated needs, and the transport of seasonal influenza vaccine to target communities across the country. Lao PDR deployed 763,000 doses of bioCSL donated vaccine for the third year since seasonal influenza vaccine introduction, again targeting pregnant women, elderly, chronically ill, and all health care workers (May–June 2014).

- After a series of technical consultations, the first draft of a national immunization law has been drafted and comprises more than 80 articles. A workshop on dissemination of the first draft of the law was held in June 2017.

- Lao PDR aims to strengthen the NITAG through recruitment and training of new members on NITAG functioning, and evidence-based review for vaccine policy decision making.
- In order to move vaccine policy forward, Lao PDR has conducted an analysis of SARI-related costs in 4 hospitals throughout the country. Data analysis is ongoing.
- A review of existing local and international communication materials was conducted to gain an understanding of the need for appropriate materials for communication campaigns. While a 2011 knowledge, attitudes, and practices study showed that public acceptability of influenza vaccine is very high (98% of respondents said they would take the vaccine) and that uptake among health care workers and pregnant women were high (99% and 41%, respectively), IEC materials on the benefits of vaccination were not sufficient to reach women in 4 key ethnic groups. Women in these groups are not literate, and new communication materials for these groups will need to be developed.
- Lao PDR received a total of 396,304 doses of seasonal influenza vaccines in August 2016 through PIVI, which were delivered to health centers across all 18 provinces. The vaccines reached pregnant women, the elderly, persons with chronic conditions, and health care workers through existing routine vaccine service delivery, in combination with polio campaigns.

# MONGOLIA



## OVERVIEW

Due to rapid growth in population size and urbanization, Mongolia has been experiencing a serious public health challenge with influenza-like illness (ILI) since the 1970s. The National Influenza Center (NIC) was established in 1974 and joined the WHO Global Influenza Surveillance and Response System (GISRS) in 1978. CDC's Influenza Division began working with Mongolia in 2004 through a capacity-building cooperative agreement to improve influenza surveillance, laboratory capacity, and preparedness activities. This partnership restored the system and improved its quality. Another 5-year cooperative agreement between the Ministry of Health (MOH) Mongolia and the US Department of Health and Human Services was awarded in July 2014 to support pandemic response capacity building and sustainability of the existing influenza surveillance system. This cooperative agreement provides support to the existing influenza surveillance sentinel sites to continue the influenza reporting system and to collect timely and high-quality epidemiologic data. The agreement also provides supportive supervision and continued trainings, complete assessment and evaluation activities in the sentinel sites.

## SURVEILLANCE

Fiscal Year 2016 marked the third year of CDC's cooperative agreement with the National Influenza Center (NIC) of Mongolia's MOH. ILI and severe acute respiratory infection (SARI) surveillance activities are routinely coordinated by the NIC at the National Centre for Communicable Diseases (NCCD). Daily and weekly reports on ILI and SARI data analyses are placed on the [www.flu.mn](http://www.flu.mn) website. During the peak season, the Government of Mongolia undertook several interventions, including: 1) excusing parents and caregivers of children under 5 years old with ILI from work with salary for up to 5 days; 2) giving 10 prescription medicines free of charge to mildly symptomatic persons via physician prescriptions; 3) extending school holidays for 1–2 weeks; 4) vaccinating 23,000 kindergarten children; and 5) providing 55,000 doses of vaccines to health care workers (HCWs), individuals with chronic conditions, elderly, and staff in emergency agencies. Additionally, HCWs received supportive supervision and training in the field sites. Skill trainings were organized for lab staff at the NIC Lab and 4 regional laboratories.

## HIGHLIGHTS

- The subprogram, To Strengthen and Sustain the Influenza Pandemic Preparedness and Emerging and Re-emerging Disease Surveillance within the National Program on Prevention of Communicable Diseases in 2017–2020 was developed and approved by a government resolution.
- Mongolia became 1 of 7 countries involved in the Partnership for Influenza Vaccine Introduction program supported by the Task Force for Global Health and CDC. Through this partnership, Mongolia received 45,000 doses of donated vaccine in 2016, and vaccinated health care workers and persons at high risk for severe disease. CDC provided technical support for the vaccine program and associated evaluations.
- The National Influenza Center (NIC) team participated in the International Health Regulations' Exercise Crystal in 2016, which focused on novel influenza virus outbreaks.
- The NIC expanded to 4 branch laboratories, with real-time RT-PCR for rapid detection of emerging viruses in different regions in the country.

## SURVEILLANCE ACTIVITIES

- Nationwide, 152 outpatient and 37 hospital-based sentinel sites were involved in surveillance network. The epidemiological surveillance data were entered weekly into the flu information online system (<http://www.flu.mn>) and submitted once every 2 weeks to the FluID global system.
- Analyses of weekly data on ILI and SARI were routinely conducted and posted at <http://www.flu.mn>. Feedback reports were sent to all sentinel sites, the MOH, and other collaborating organizations.
- Epidemiological and laboratory surveillance activities in the field were assessed using a monitoring and assessment questionnaire during supportive supervision.
- Weekly joint tele- and audio-conferences were routinely held with specialists from the National Center for Maternal and Child Health and

influenza sentinel sites to strengthen surveillance and response activities during the peak period of influenza season.

- The epidemiologists and media personnel at the NIC conducted a television interview to educate the public on preventing flu and benefits from influenza vaccination before and during the flu season. Infographics were placed on the NCCD web site, the National Institute of Infectious Diseases (NIID)-Japan web site, and other collaborating organizations' sites.
- Influenza surveillance advocacy materials from WHO for the community, HCWs, and news media were updated. Other communication resources were translated and posted on [www.flu.mn](http://www.flu.mn) weekly.

## LABORATORY

Influenza virological surveillance is based on weekly collection of samples from sentinel sites and testing by RT-PCR for detection of influenza and other respiratory viruses, virus isolation, influenza drug resistance detection, and gene sequencing analyses.

Follow-up training for regional laboratory staff in real-time RT-PCR techniques and other tests for detection of influenza and other emerging viruses is conducted by virologists from the NIC. The specialists have training support from experts from CDC, NIID, and China CDC on influenza virus isolation, subtyping, and sequence analyses.

The virology laboratory at the NIC participated successfully in an external quality assessment panel (EQAP) for rRT-PCR subtyping for influenza conducted by CDC and the Public Health Laboratory, Hong Kong. An EQAP for influenza virus isolation was conducted by WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in Melbourne, Australia and was also successful.

The epidemiological and virological database hosted on NIC/NCCD servers is the key point for monitoring ILI and SARI trends and virus circulation by national level in real time on the [www.flu.mn](http://www.flu.mn) website. Weekly virological data are uploaded on FluMart to GISRS.

## LABORATORY ACTIVITIES

- The virology laboratory at the NIC tested 3,200 nasopharyngeal samples. The average weekly number of samples tested was 135.2 during peak season (from weeks 1–8 of 2017) and 58.8 during non-peak season in 2016–2017. The turnaround time was 24–48 hours during the last influenza season.
- In addition to having influenza testing in real time, RT-PCR in the regional laboratories was used for detection of other respiratory viruses by reverse transcription loop-mediated isothermal amplification assay in 2017.
- Monitoring and assessment was conducted by questionnaire for 4 regional laboratories during January and February 2017.
- The virology laboratory at the NIC ordered and received Trioplex real-time RT-PCR assay reagents for detection of Zika, dengue, and Chikungunya viruses from CDC in May 2016, and organized a training titled Laboratory diagnosis of emerging and re-emerging viral diseases including Zika, dengue, and Chikungunya viruses by molecular techniques.
  - » This training was conducted October 19–21, 2016 at the virology laboratory at the NIC with 20 specialists from the regional laboratories, the National Zoonotic Diseases Center, and the veterinary laboratory in attendance.
- During the 2016–2017 season, the virology laboratory at the NIC sent a shipment with 12 strains to the WHO CC in Atlanta, USA in April 2017, and a shipment with 10 strains of influenza A(H3N2) to the WHO CC in Tokyo, Japan in January 2017 for further characterization.

## PREPAREDNESS

The NIC in Mongolia developed and approved the subprogram, To Strengthen and Sustain the Influenza Pandemic Preparedness and Emerging and Re-Emerging Disease Surveillance within the National Program on Prevention of Communicable Diseases in 2017–2020 by government resolution. The *Minister Order #141 on Pandemic Influenza Preparedness Guidance* is under the revision according to the *Surveillance Guidance on PIP (2017)*, *Pandemic Influenza Risk Management WHO Interim Guidance (2013)*, and other guidance.



During the 2016–2017 season, the Mongolian government purchased 33,000 doses of influenza vaccine and received an additional 45,000 doses donated through the Partnership for Influenza Vaccine Introduction. Mongolia vaccinated HCWs, including those with underlying conditions, those who work in emergency agencies, and staff who were pregnant using these vaccines. They conducted a knowledge, attitudes, and practices survey to understand attitudes toward flu vaccine among HCWs, and established surveillance for adverse events following immunization to monitor influenza vaccine safety. NIC enhanced SARI surveillance for influenza A(H7N9) and clinical experts updated and distributed the Guidance on Clinical Management of SARI.

Mongolia expanded its surveillance network by adding 4 regional laboratories for rapid detection of seasonal and potential pandemic viruses in different regions.

### PREPAREDNESS ACTIVITIES

- The NIC in Mongolia developed the subprogram, *To Strengthen and Sustain the Influenza Pandemic Preparedness and Emerging and Re-Emerging Disease Surveillance*.
- Nationwide, 5,280 tablets of oseltamivir were distributed during the peak season.
- During the 2016–2017 season, a total of 78,000 doses of seasonal influenza vaccines were distributed; 100% were utilized.
- Each district and province hospital opened an extra 30–100 beds for patients hospitalized due to SARI during the influenza outbreak period.
- During the 2017–2018 influenza season, the NIC began enhancing SARI surveillance for A(H7N9) and other respiratory disease pathogens.
- The NIC conducted refresher trainings on surveillance to strengthen response and clinical management activities among field staff. More than 700 HCWs participated.

### TRAINING

- During the 2016–2017 influenza season, training and supportive supervision were conducted in sentinel sites funded primarily by CDC and partly by WHO. Refresher trainings focused on surveillance in order to strengthen response and clinical management activities among field staff; more than 700 HCWs participated.
- An influenza sentinel sites meeting took place on November 24, 2016 at the NCCD, with more than 30 participants. The meeting summarized the results and achievements of influenza surveillance activities in the past season. There were discussions regarding successful implementation of the influenza vaccination campaign, improvement of influenza surveillance data quality, and planning response activity measures to be carried out by health care facilities and staff in the coming season(s).



# PAPUA NEW GUINEA



## OVERVIEW

Papua New Guinea (PNG) is a developing tropical country with a diverse, geographically dispersed population that is primarily agrarian. A large majority of the population living in rural areas has frequent interaction with domestic and wild animals, and biosecurity is virtually unheard of. Additionally, the level of sanitation and hygiene is very low, with PNG having one of the world's lowest rates of access to improved sanitation. Recent modelling suggests that a novel influenza strain could spread exceptionally quickly within the PNG context. In addition, the surveillance system for detecting outbreaks of influenza is rudimentary, primarily based on informal ("rumor") surveillance of unusual events, and a small number of inconsistently reporting sentinel sites for notifiable syndromic conditions, of which influenza-like illness (ILI) is one. PNG is working closely with CDC and WHO to determine projects that will help strengthen the country's influenza surveillance capacity.

## SURVEILLANCE

Territories in PNG have lacked funding to conduct a review of the national surveillance system using WHO/CDC guidelines. PNG would like to further enhance the performance of national laboratories for influenza testing through external quality assessment programs (EQAPs), laboratory management, and training, and routinely test for capacity for influenza and other respiratory diseases by molecular assays given the resources to maintain surveillance efforts. Nonetheless, PNG has continued annual participation in WHO's EQAP, with a 100% satisfactory rating over the past 7 years, and has remained active in National Influenza Center (NIC) meetings to exchange latest strategies in testing for influenza and other related respiratory pathogens, and to monitor disease trends and trigger alerts thereby facilitating rapid response to suspected outbreaks.

## HIGHLIGHTS

- The nation participates annually in WHO's External Quality Assessment Project, with a 100% satisfactory rating
- Active National Influenza Center status was maintained.

## SURVEILLANCE ACTIVITIES

Enhanced pandemic preparedness activities included the following:

- A consultancy and workshop was conducted to review and finalize the PNG All-Hazards Public Health Emergency Plan. The Plan was formalized, including updated risk communication and reporting protocols.
- External pandemic preparedness assessments were conducted, such as the Joint External Evaluation in line with International Health Regulations (2005) and assessment of Global Health Security Agenda requirements.
- Outbreak reviews were conducted as applicable as part of the biennial National Surveillance Review Meeting.

## LABORATORY

The network of reference laboratories was strengthened to support the ongoing testing and confirmation of influenza testing in PNG.

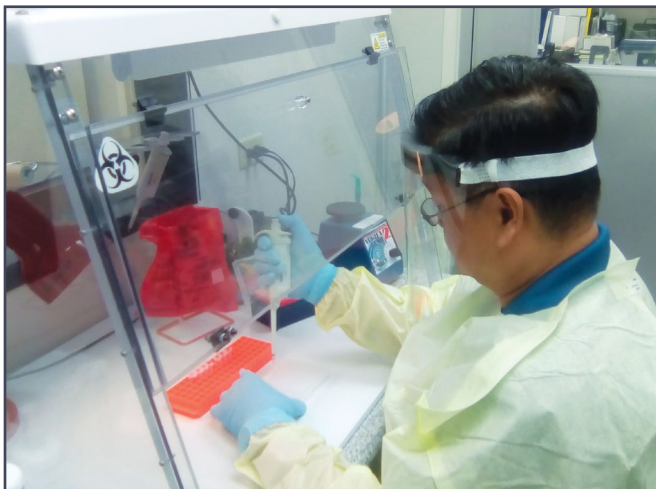
## TRAINING

- As a new partner, a grants management training is being coordinated for the near future.

# PACIFIC COMMUNITY



## (FORMERLY SECRETARIAT OF THE PACIFIC COMMUNITY)



A laboratorian from Guam conducts RNA Amplification following a local training

### OVERVIEW

The cooperative agreement between the Secretariat of the Pacific Community (SPC) and CDC began in 2005. Key collaborating organizations include WHO, the Pacific Island Health Officers Association (PIHOA), Pacific Island Countries and Territories (PICT) Ministries and Departments of Health, and reference laboratories in Australia, New Zealand, Fiji, and New Caledonia.

In August 2010, CDC awarded funding for Developing Sustainable Influenza Networks and Response for Avian and Pandemic Influenza. The cooperative agreement, which was for a period of 5 years from September 1, 2010 until August 31, 2015, built 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.

A new grant, titled Maintenance of Influenza Surveillance Capacity by National Health Authorities Outside of USA—2016, awarded in 2016, is for the period September 30, 2016 to September 29, 2021. The primary 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.

### HIGHLIGHTS

- The functionality of reference laboratories in the region and among local Pacific Island Countries and Territories (PICT) sentinel sites was strengthened.
- Linkage was established between local laboratory-based influenza surveillance and the Pacific Syndromic Surveillance System (PSSS).
- Laboratory-based influenza surveillance was supported through the provision of technical assistance, support, equipment, and laboratory supplies to enhance local testing capacities, and mechanisms to facilitate the shipment of samples to identified reference laboratories for confirmatory testing.
- Weekly reporting of 4 priority syndromes, including influenza-like illness, through the PSSS continues with 132 sentinel sites reporting from 20 PICTs. In 2017, the system was moved to an online platform called Early Warning and Alert and Response Surveillance. Data are entered online by country focal points and then analyzed using an online application.

### SURVEILLANCE

Countries and territories in the Pacific region implement a standard surveillance system, the Pacific Syndromic Surveillance System (PSSS). PSSS is 1 of the 6 services of the regional Pacific Public Health Surveillance Network (PPHSN), started in 2010, introduced with support from SPC and WHO in order to monitor disease trends and trigger alerts, thereby facilitating rapid response to suspected outbreaks.

PSSS collects sentinel surveillance data on 4 syndromes (acute fever and rash; diarrhea; prolonged fever; and influenza-like illness) including 1 optional syndrome (dengue-like illness). In early 2017, the system was moved to an online platform called Early Warning and Alert and Response Surveillance. Data are entered online by country focal points and then analyzed using an online application.

Training courses on public health surveillance and outbreak investigation targeting surveillance officers and laboratory workers were conducted. A total of 132 sentinel sites from 20 PICTs continued weekly submission of surveillance data on 4 priority syndromes, which included influenza-like illness.

### **SURVEILLANCE ACTIVITIES**

In July 2016, epidemiologists from SPC organized and delivered a training on public health surveillance for 24 health staff of the Vanuatu and Tuvalu Ministries of Health.

In October 2016, SPC, WHO, and Hunter New England Population Health jointly conducted a training on outbreak investigation for health workers of Vanuatu.

In May 2017, an epidemiologist and a laboratory specialist from SPC visited the Institut Louis Malarde (ILM) in French Polynesia to discuss and explore ways for ILM to be involved in influenza surveillance as a potential reference laboratory.

With assistance from SPC specialists, national infection prevention and control guidelines for Vanuatu and Tuvalu were updated.

### **LABORATORY**

A network of 5 reference laboratories was strengthened to support the ongoing testing and confirmation of influenza testing in the Pacific. These reference laboratories are 1) the Mataika House Laboratory in Fiji; 2) the Guam Public Health Laboratory (GPHL); 3) the Institute Pasteur in New Caledonia, 4) the ILM in French Polynesia; and 5) the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) in Melbourne, Australia. In addition to training on influenza and proper specimen sample collection, GPHL was provided with laboratory consumables, reagents, and tests kits.

- Ongoing technical assistance was provided to Mataika House laboratory in Fiji to assist in the testing and reporting of outbreak-prone disease targets, including influenza. Fiji's main National Public Health Laboratory is located at Mataika House, under the Fiji Centre for Communicable Disease Control.
- Ongoing certification and re-certification of PICT laboratories was conducted for compliance with International Air Transport Association (IATA) shipping requirements.

- SPC's and PPHSN's commitment to support countries in times of health emergencies was affirmed.

### **LABORATORY ACTIVITIES**

- Samples were shipped to the Melbourne WHO CC for confirmation, sequencing, phylogenetic analysis, and also antiviral testing. The tests revealed the same results.
- A hemagglutination inhibition assay of the A(H1N1)pdm09 viruses was done to look at their antigenic similarity to the vaccine virus and other reference strains. All of the A(H1N1)pdm09 viruses from Fiji strongly reacted with ferret antiserum raised against the current vaccine strain A/California/7/2009. Antiviral testing showed that the strains were susceptible to oseltamivir.

### **PREPAREDNESS**

A regional PPHSN meeting took place on April 19–22, 2017 in Suva, Fiji. The meeting served as a venue for getting feedback from participating PICTs on the challenges and suggested ways forward for the 6 PPHSN services. The meeting was also an opportunity to discuss the CDC grant surveillance and laboratory support packages.

In collaboration with PIHOA, a capacity strengthening initiative for GPHL was completed. The training sessions were meant to further support and strengthen the laboratory, not just for influenza surveillance, but for other functions as well including public health food and water microbiology laboratory capacity.

### **PREPAREDNESS ACTIVITIES**

- The regional meeting of the PPHSN took place April 19–22, 2017 in Suva, Fiji. Fifty-six delegates, including public health surveillance and laboratory officers from PICTs and public health experts and laboratory specialists from the allied member organizations participated.
- A panel presentation/discussion about the cooperative agreement, Maintenance of Influenza Surveillance Capacity by National Health Authorities Outside the United States was conducted to inform the PPHSN body of the activities implemented with CDC grant support in the past year and of upcoming activities for implementation.



- Simulated tabletop exercises were conducted during the PPHSN meeting in Suva, Fiji in April 2017. Delegates from 16 PICTs and 9 delegates from PPHSN allied partners participated.
- The capacity of GPHL for outbreak-prone disease testing was strengthened. The objectives of the training were to provide: (1) training to increase microbiology laboratory diagnostic capacity; (2) preparatory training for the enhancement of public health food and water microbiology laboratory capacity; (3) technical assistance to strengthen laboratory-based surveillance of PPHSN outbreak-prone diseases; (4) assistance in the re-accrediting of GPHL microbiology to a biosafety level (BSL) 2 laboratory level and to provide diagnostic assistance to BSL-1 laboratories in the USA Pacific Islands.

## TRAINING

The Research, Evidence, and Information program of the SPC Public Health Division continues to provide technical assistance to ensure the functioning and linkage of surveillance and laboratory work. In 2016, the following training activities were conducted:

- Training on public health surveillance and outbreak investigation: 24 surveillance officers and laboratory staff attended 2 1-week training workshops: 1 on public health surveillance in July 2016 and 1 on outbreak investigation in October 2016. Among the outputs of the workshops were self-assessments of existing national surveillance systems, which included laboratory and syndromic surveillance systems, to identify gaps and areas for improvement.
- IATA training: A total of 78 laboratory staff from 7 PICTs completed the training and were given certification. Of the 78, 2 were trained as trainers. Six were from Cook Islands, 34 from Fiji, 7 from Kiribati, 5 from Samoa, 5 from Solomon Islands, 9 from Tuvalu, and 10 from Vanuatu.

# THE PHILIPPINES



## OVERVIEW

The Research Institute for Tropical Medicine (RITM) is in a 5-year (2014–2019) cooperative agreement with CDC. Through the support of CDC, national capacity for early detection and rapid response to unusual health events with outbreak potential has been strengthened. One of the project's major activities has focused on establishing and strengthening National Reference Laboratories (NRLs) and 5 hospital-based sentinel sites, also known as the Sub-National Laboratories (SNLs), in responding to respiratory virus threats and public health emergencies of international concern. The project supported the strengthening of these sentinel sites through provision of trainings, technical assistance, and health facilities.

## SURVEILLANCE

Influenza-like illness (ILI) surveillance under the Department of Health's (DOH) Philippine Integrated Disease Surveillance and Response (PIDSR) was established in 2008 and expanded its scope to cover the severe end of the spectrum of epidemiologic surveillance through severe acute respiratory infection (SARI) surveillance in 2012. In 2015, DOH provided augmented support for the surveillance system of the Epidemiology Bureau (EB), which included support to SNLs' SARI surveillance implementation. This surveillance is presently implemented under the supervision of DOH's EB and within the framework of PIDSR. In addition, these special facilities were strengthened for the detection of emerging and re-emerging disease pathogens including SARI. Regular visits to 5 SNLs and 17 ILI sentinel sites were conducted to ensure proper implementation of surveillance activities as well as laboratory procedures for testing influenza samples.

### SURVEILLANCE ACTIVITIES

- Recognition and Terms of Reference of DOH SNLs were created through Department Personnel Order No. 2015-0036 in augmenting laboratory support for national surveillance and outbreak investigation.
- Quarterly visits were conducted to National Reference Laboratories and 5 SNLs by EB, the Disease Prevention and Control Bureau, and

## HIGHLIGHTS

- Severe acute respiratory infection surveillance was established in 6 hospital-based sentinel sites participating in active surveillance.
- Technical assistance and quality assurance in the prevention and detection of and response to diseases that pose public health threats was continuously provided to 6 sentinel sites.
- The Department of Health's One Health Program was strengthened through inter-agency partnerships and collaboration with the Department of Agriculture and the Department of Environment and Natural Resources in addressing zoonotic diseases.
- Trainings and workshops were conducted to improve the incident management system for outbreak response.
- Annual meetings were conducted for updating and reporting among partners and stakeholders.

RITM to monitor and evaluate SARI surveillance implementation.

- Regular visits to 18 ILI sentinel sites were conducted by Philippine National Influenza Center (PNIC) staff to monitor ILI surveillance implementation and provide feedback to the management team for troubleshooting issues and concerns presented.
- PNIC consistently reported virological and surveillance data to FluNET and FluID.
- Two workshops attended by epidemiologists, clinicians, nurses, experts, and stakeholders were conducted to revise and finalize the RITM Outbreak Manual.
- Development of the online PIDSR system for real-time reporting is ongoing.

## LABORATORY

Through the support of CDC and PNIC (housed at RITM), technical assistance was provided to hospital-based sentinel sites through trainings and provision of supplies. Sentinel sites had an operational PCR laboratory facility to test influenza samples for the presence of influenza A and influenza B using real-

time RT-PCR (rRT-PCR) (using CDC's protocol for rRT-PCR detection of influenza viruses, version 2011). Aliquots representative of specimens from the sentinel sites are sent to the National Reference Laboratory at RITM for virus isolation by PNIC and concordance verification by RITM Molecular Biology Laboratory (MBL). A total of 1,674 ILI samples were collected, 346 of which were positive for influenza; 1,099 SARI samples were collected, 102 of which were positive for influenza.

### LABORATORY ACTIVITIES

- PNIC tested a total of 1,674 ILI specimens, with 346 positive for influenza virus.
- PNIC tested a total of 1,099 SARI specimens, with 109 positive for influenza virus.
- PNIC conducted quarterly visits to 6 SARI sentinel sites' laboratories to monitor actual influenza surveillance implementation.

### PREPAREDNESS

The agreement between RITM and CDC has strengthened influenza surveillance activities in the Philippines. Through the project activities, the team collaborated with health sectors and local organizations in identifying and filling gaps in the framework for strengthening national public health surveillance and response systems. This collaboration contributed to the National Strategies for Preparedness Plan addressing emerging and re-emerging infectious disease (EREID) threats.

### PREPAREDNESS ACTIVITIES

- Thirty-six infectious disease specialists and infection control nurses were trained in recognition and reporting of unusual events.
- Two pilot tests were done on the early recognition and reporting of unusual events of EREIDs in the community, which aided in the development of a local EREID Action Plan.
- An RITM outbreak manual for infectious diseases investigations has been developed.
- Program coordinators, surveillance officers, health officials from local government units, information officers, and Health Emergency Management Bureau officers attended Rapid Response Team training to improve coordination mechanisms by understanding their roles and functions in outbreak response.

- A consultative workshop was held for the development of the strategic plan for the Philippine Inter-Agency Committee on Zoonoses.

### TRAINING

- Thirty-six infectious disease specialists and infection control nurses attended a masters class training on hospital preparedness and management of MERS-CoV, facilitated by the RITM Surveillance and Response Unit.
- Three MBL/RITM laboratory staff were trained in bioinformatics analysis for next generation sequencing by the Philippine Genome Center.
- Four MBL/RITM staff participated in a training on multiplex melt-curve assay for respiratory viruses and bacteria conducted by Filanaserve.
- Twenty-nine staff members attended the Annual Refresher Training and Panel Testing for RITM first- and second-line responders.
- Thirty-two local shippers of infectious substances from RITM and SNLs were trained by an International Air Transport Association-certified trainer from Sandia National Laboratories.
- One hundred fifty-nine Regional Epidemiology Surveillance Unit officers, City Epidemiology Surveillance Unit officers, and other partners from private hospitals attended the RITM Surveillance and Response Unit's Annual Meeting, which included a refresher course in the management of EREIDs.
- Two staff from MBL/ITM-MBL attended the Naval Research Laboratory Asian Workshop on Quality 2017 in Yogyakarta, Indonesia.

### RESEARCH

A CDC-funded study, an influenza and RSV in infants study (IRIS) of hospitalized and non-ill infants aged <1 year from 2015–2017, was conducted with local sponsorship by the Research Institute for Tropical Medicine at Governor Celestino Gallares Memorial Regional Hospital, on Bohol Island, The Philippines.

# VIETNAM

## OVERVIEW

The Vietnam Ministry of Health (MOH) has been conducting influenza-like illness (ILI) surveillance since 2006 through the National Influenza Surveillance System (NISS). Surveillance was originally conducted at 15 sentinel hospitals distributed across Vietnam but has been reduced to 4 sites for sustainability purposes. Four cooperative agreements allow collaborative work on active and passive laboratory-supported surveillance for influenza in humans and animals; sharing of influenza virus specimens, resulting in characterization of viruses and development of candidate vaccine viruses; estimates of disease burden; description of influenza seasonality; and descriptions of knowledge, attitude, and practices of physicians and pregnant women regarding influenza vaccination and health care workers' acceptance of influenza vaccination. This facilitates efforts to develop a national policy on the use of human seasonal influenza vaccine and strengthen pandemic preparedness.

## SURVEILLANCE

CDC's Influenza Division works with the Government of Vietnam to strengthen and expand influenza surveillance in humans and animals through standardized specimen collection and testing, timely data analysis and reporting, and use of the results to improve influenza prevention, detection, response, and control.

There are 3 laboratory-supported surveillance systems for influenza in humans in Vietnam. The influenza-like illness (ILI) and severe acute respiratory infection (SARI) surveillance systems are active, and conducted throughout the year at sentinel hospitals, with at least 1 in each of Vietnam's 4 regions. Currently there are 8 ILI sites and 10 SARI sites. Severe viral pneumonia (SVP) surveillance is passive, accepting reports and samples for testing from all hospitals. This event-based surveillance system currently generates only about 150 samples per year.

Laboratory-supported surveillance for influenza viruses is conducted in most provinces among poultry at live bird markets during high-disease months, and outbreaks of highly pathogenic avian influenza in flocks are investigated.

## HIGHLIGHTS

- Vietnam is better prepared to detect, control, and respond effectively to an incursion of influenza A(H7N9) or other novel viruses.
- A second 5-year cooperative agreement with National Institute of Hygiene and Epidemiology to support human influenza surveillance concluded successfully in June 2016, resulting in a third 5-year cooperative agreement to evaluate and maintain influenza surveillance in September 2016.
- Significant progress was made in developing a national influenza vaccine policy with the General Department of Preventive Medicine.

## SURVEILLANCE ACTIVITIES

- After 10 years of CDC support, the Government of Vietnam took over all financing and management of the ILI laboratory-supported sentinel hospital surveillance system in 2016.
- New standard operating procedures were written for the SARI surveillance system in 2016.
- With CDC technical assistance, the National Institute of Hygiene and Epidemiology (NIHE) developed an improved weekly SARI surveillance report in 2016.
- NIHE, with CDC and WHO support, evaluated the first 10 years of ILI and SARI surveillance.
- NIHE, with WHO and CDC support, is evaluating the SVP surveillance system and will provide recommendations to improve it, as this event-based surveillance system is best able to detect the introduction of novel viruses that cause severe disease, such as influenza A(H7N9).
- CDC continues to monitor and provide support to the Department of Animal Health (DAH) to conduct surveillance at 65 live bird markets in 12 provinces, testing about 4,000 pooled samples per year.
- On the basis of the increased risk of an outbreak of influenza A(H7N9), DAH—with CDC support and in coordination with Food and Agriculture Organization (FAO) efforts—conducted increased joint field visits to higher-risk areas, resulting in

increased surveillance at live bird markets in some higher-risk areas.

- DAH provided an Avian Influenza Outbreak Weekly Report.
- A research cooperative agreement with DAH successfully concluded in September 2017 and was followed by a new surveillance 5-year cooperative agreement starting in October 2017.

## LABORATORY

CDC works with both National Influenza Centers (NICs) in Vietnam, at NIHE and at the Pasteur Institute—Ho Chi Minh City (PI-HCMC) to ensure they are able to fulfill their responsibilities as a NIC in the global surveillance network. CDC provides reagents and trains staff in selected advanced techniques and management. NIHE and PI-HCMC continue to provide surveillance influenza virus samples to the WHO Collaborating Center for Reference and Research on Influenza (WHO CC) at CDC for testing not available in Vietnam, confirmatory testing, and development of candidate vaccine viruses.

CDC works with the DAH National Centre for Veterinary Diagnostics (DCVD) providing training to staff on selected advanced techniques and management. DCVD provides about 200 viral isolates to the WHO CC at CDC for further testing and candidate vaccine virus development.

Special collaborative efforts have been made to ensure that both human and animal health laboratories can detect influenza A(H7N9) viruses and other novel viruses with pandemic potential.

### LABORATORY ACTIVITIES

- Vietnam sends approximately 50 virus isolates from human surveillance and approximately 200 virus isolates from animal surveillance to CDC every year. In 2017, 40 samples from poultry outbreaks, 152 from poultry surveillance, and 8 from swine surveillance were sent. These isolates provide information on circulating influenza viruses and their constant changes. Sharing of animal samples is less common and these from Vietnam are invaluable as candidate vaccine viruses.
- Approximately 3,000 SARI surveillance specimens and a lesser number of ILI and SVP samples are tested annually for influenza. Starting in 2017, SARI negative specimens are

tested for 7 other viral pathogens (adenovirus; human metapneumovirus; parainfluenza viruses 1, 2 and 3; RSV; and rhinovirus). In the first 5 months of 2017, 19% of SARI samples were positive for influenza, 20% for rhinovirus, 12% for adenovirus, and 25% with one of the other 5 viruses.

- Staff from NIHE and DAH participated in technical trainings at CDC in Atlanta, and CDC staff came to Vietnam and trained staff.

## PREPAREDNESS

CDC collaborates with Vietnam's General Department of Preventive Medicine (GDPM), NIHE, DAH, and partner agencies including the US Agency for International Development, PATH, WHO, and FAO to make Vietnam better prepared to prevent, detect, respond to and control an influenza pandemic. CDC works with GDPM to update the existing national pandemic preparedness plan and develop a national policy on human seasonal influenza vaccination and with NIHE and DAH to improve surveillance, analysis, and reporting of data, and the use of this information to guide policy and actions. CDC works with GDPM, DAH, and other sectors to conduct periodic risk assessments for influenza A(H7N9) and other viruses with pandemic potential. The Biomedical Advanced Research and Development Authority (BARDA) funds PATH to support the development of human seasonal influenza vaccine manufacturing in Vietnam, and CDC works with GDPM to assess the progress and impact on vaccine policy.

### PREPAREDNESS ACTIVITIES

- GDPM conducts risk assessments periodically with CDC and WHO technical assistance. Multiple sectors participate in the risk assessments, including human health, animal health, border control, hospital authorities, physician organizations, the military, CDC, WHO, and FAO. In response to the recent increase in cases of influenza A(H7N9) in China, risk assessments were conducted approximately every month.

## TRAINING

### GDPM:

- A consultation workshop was held to determine the cost of implementing a human seasonal influenza vaccine program and make recommendations to develop an action plan to include influenza vaccine into the national Expanded Program on Immunizations in 2016.



- A consultation workshop was held on drafting the national influenza vaccination policy in 2016.
- A series of training workshops was conducted on how to organize and implement vaccination of health care workers with human seasonal influenza vaccine.
- Consultation workshops were held to finalize communications materials on seasonal influenza vaccines in 2017.

#### *DAH:*

- A 2-day training course for 110 local veterinary staff on how to conduct influenza surveillance at live bird markets was held in 2015.
- A training workshop for local veterinary staff on sampling methods for live bird market surveillance was conducted in 2016.
- Annual review and training workshops were held with all provinces involved in animal surveillance in 2016 and 2017.

#### *NIHE:*

- Four training workshops, 1 in each of the 4 regions (North, South, Central, and Central Highlands), were held in 2015 to disseminate 10-year data from the national influenza surveillance system and teach first-level surveillance data analysis.
- In 2016, a national training workshop was conducted on influenza policy recommendations.

## RESEARCH

Currently, CDC's Influenza Division has 4 bilateral cooperative agreements with the Government of Vietnam: 3 with NIHE and 1 with DAH. The agreements provide support to build public health capacity toward sustainability through surveillance, research, and policy development activities. Two cooperative agreements, one with MOH and the other with the Ministry of Agriculture and Rural Development (MARD), focus on One Health research activities at the animal-human interface of influenza virus evolution and transmission among avians, swine, and humans. The MOH agreement also focuses on identifying the burden of influenza disease in Vietnam and the health care utilization practices of the population. All research projects occur at the local, provincial, and national levels, and assist in obtaining information and data to enhance both human and animal health policies for influenza prevention and control. The

following are examples of completed research activities between the Vietnam MOH, MARD, and CDC's Influenza Division.

- An animal-human interface longitudinal study to identify influenza viruses infecting humans and animals
- Serological evidence of asymptomatic infection with avian influenza A(H5N1) virus in communities in northern and southern Vietnam in 2012
- A cross-sectional study of influenza viruses in humans and swine at slaughterhouses, 2013–2014
- Health care-seeking behavior for respiratory illness in a northern province of Vietnam
- Influenza-related SARI in the North of Vietnam: Health care burden and economic impact

## INFLUENZA VACCINE ACTIVITIES

Significant progress has been made toward a national seasonal influenza vaccine policy in Vietnam through the joint work of the MOH, GDPM, CDC, and other partners. GDPM worked with CDC and BARDA/PATH on the development of a domestic influenza vaccine manufacturing capacity, complementing a draft national influenza vaccine policy. Work on acceptability among target groups for vaccination, pilot immunization campaigns, and cost evaluations informed this policy. Development of such a policy will lead to greater pandemic preparedness, as vaccine deployment mechanisms are established and strengthened through seasonal influenza vaccination campaigns.

Key vaccine-related accomplishments include:

- Descriptions were gathered of knowledge, attitudes, and practices of physicians and pregnant women toward influenza vaccination, and health care workers' acceptance of influenza vaccination.
- A pilot immunization campaign was conducted for health care workers with seasonal influenza vaccine, potentially strengthening vaccine demand and ability of health care workers to respond effectively during a pandemic.
- CDC worked with GDPM on human seasonal influenza vaccine policy, including the BARDA/PATH-supported development of a domestic influenza vaccine manufacturing capacity.



- A consultation workshop was held to determine the cost of implementing a human seasonal influenza vaccine program and make recommendations to develop an action plan to include influenza vaccine into the national Expanded Program on Immunizations in 2016.
- A consultation workshop on drafting the national influenza vaccination policy was held in 2016.
- A series of training workshops on how to organize and implement vaccination of health care workers with human seasonal influenza vaccine were conducted.
- A consultation workshop was held to finalize communications materials on seasonal influenza vaccines in 2017.



# Research Activities

## NEW ZEALAND

In 2009, the influenza pandemic strain emerged just before the southern hemisphere influenza season, which highlighted the importance of having established systems in the southern hemisphere able to collect high-quality data on the impact and transmission of influenza and other respiratory diseases. In 2011, CDC established direct country support via a cooperative agreement with the Institute of Environmental Science and Research, a government-owned Crown research institute in New Zealand. Countries in the southern hemisphere typically experience seasonal influenza circulation during their winter (the northern hemisphere summer). Therefore, the main goal of this support is to provide critical information on circulating influenza strains in the southern hemisphere, the epidemiology and burden of influenza illness, and the effectiveness of influenza vaccines in preventing outpatient and inpatient medical care associated with influenza.

- Two active, prospective, population-based surveillance systems have been established covering the 906,000 residents living in central, east, and south Auckland, New Zealand: (1) hospital surveillance for influenza and other respiratory pathogens among those patients with respiratory illness, and (2) sentinel general practice surveillance for influenza.
- Surveillance was expanded to include all children <1 year of age visiting the emergency department or admitted to the hospital, regardless of whether or not they exhibited respiratory symptoms.
- Interim and final influenza vaccine effectiveness estimates have been published each influenza season.
- A sero-epidemiologic survey was conducted to estimate rates of mild, atypical, or asymptomatic influenza virus infections that do not trigger medical care seeking.



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# Global Research Activities



# Research Activities—Global

## INFLUENZA AND RESPIRATORY SYNCYTIAL VIRUS IN INFANTS STUDY (IRIS)

This prospective study enrolled a hospital-based cohort of ~3,000 infants (aged <1 year) and a sample of ~1,400 non-ill infants in 4 countries (Albania, Jordan, Nicaragua, and the Philippines), using a common protocol, from 2015 to 2017. After informed consent and within 24 hours of admission, study staff collected blood and respiratory specimens and conducted an interview to assess sociodemographic characteristics, medical history, and symptoms of acute illness (onset  $\leq 10$  days). Vital signs, interventions, and medications were documented daily through medical record abstraction. A follow-up health assessment and collection of convalescent blood specimens occurred 3–5 weeks after enrollment. Influenza and RSV infection was confirmed by singleplex real-time RT-PCR (rRT-PCR) assays. Serologic conversion was assessed comparing acute and convalescent sera using hemagglutination inhibition assay for influenza antibodies and enzyme-linked immunosorbent assay for RSV. Concurrent with hospital-based enrollment, respiratory specimens were also collected (and tested by rRT-PCR) from non-ill infants aged <1 year during routine medical or preventive care.

IRIS promises to expand knowledge of the frequency, clinical features, and antibody profiles of serious influenza and RSV disease among infants aged <1 year, quantify the proportion of infections that may be missed by traditional surveillance, and inform decisions about the potential value of existing and new vaccines and other prevention and treatment strategies. IRIS is funded by Contract HHSD2002013M53890B within CDC's Achieving Public Health Impact through Research contract vehicle and task 200-2014-F-60406 (*The Epidemiology and Prevention of Influenza Virus Infections in Low- and Middle-Income Countries*) to Abt Associates.

## INFLUENZA ILLNESS AND INFLUENZA VACCINE EFFECTIVENESS HEALTH CARE PERSONNEL COHORT STUDIES

Two prospective cohort studies are underway in Peru and Israel, from 2016 to 2020, to describe laboratory-confirmed influenza illness among health care personnel (HCP); examine predictors of immunogenicity, including influenza vaccination history; evaluate influenza vaccine effectiveness in preventing influenza illness, missed work, and patient exposure; and identify predictors of influenza vaccine acceptance and hesitancy. Over 2 years, the HCP cohort studies will each enroll ~2,500 HCPs via random stratified sampling by sex, age group, and occupation and follow them through 2–3 influenza seasons. Participants complete surveys at enrollment and again at the start and end of each influenza season to assess sociodemographic characteristics, health, and work responsibilities. Sera is collected pre- and post-season (and 30 days post-vaccination for those who get vaccinated). Participants complete weekly surveillance for acute respiratory illness during influenza season and self-collect nasal respiratory swabs, which are tested for influenza by rRT-PCR.

## GLOBAL RESPIRATORY HOSPITALIZATIONS—INFLUENZA PROPORTION POSITIVE (GRIPP)

This project generates global estimates of the contribution of influenza viruses to respiratory hospitalizations among different age groups, including infants, older children, and adults.

### Approach

Data used to inform these estimates are from a systematic literature review, as well as influenza surveillance platforms in 34 countries, shared through the GRIPP working group.

### Progress and Findings

In the pediatric analysis, influenza was associated with 10% of respiratory hospitalizations in children <18 years worldwide, ranging from 5% among

children <6 months to 16% among children 5–17 years. On average, we estimated that influenza results in approximately 870,000 (95% CI 610,000–1,237,000) hospitalizations in children <5 years annually. Influenza-associated hospitalization rates were more than 3 times higher in developing countries than in industrialized countries (150/100,000 children/year versus 48/100,000).

## PREGNANCY AND INFLUENZA MULTINATIONAL EPIDEMIOLOGIC (PRIME) STUDY

This is a multi-national, prospective, longitudinal cohort study designed to evaluate the effect of laboratory-confirmed influenza virus infection during pregnancy on pregnancy and perinatal outcomes. Primary outcomes include infant birth weight and preterm birth (defined as birth at <37 weeks gestational age). The research network includes study partners in Lima, Peru; Bangkok, Thailand; and Nagpur, India.

### Objectives

- To evaluate the effect of laboratory-confirmed influenza virus infection on pregnancy and perinatal outcomes among women in low- and middle-income countries
- To estimate the incidences of all-cause acute respiratory illness (ARI), febrile ARI, and laboratory-confirmed influenza virus infection during pregnancy
- To examine the clinical spectrum of illness due to influenza viruses, including duration and severity of illness

### Approach

This prospective, longitudinal cohort study will aim to enroll 13,200 pregnant women in low- and middle-income countries over at least 2 influenza seasons. Women will be eligible to participate if they have an estimated delivery date at least 8 weeks after the anticipated start date of the influenza season (as predicted by influenza surveillance data from previous years). Efforts will be made to recruit pregnant women who are in any of the 3 trimesters of pregnancy for study participation during the enrollment period, so that women in each trimester of pregnancy are represented in the cohort during the influenza season.

At enrollment, participants will complete an enrollment interview, and participants who have not already had an ultrasound at 27 6/7 weeks gestation with pregnancy dating results that can be verified by medical record will have a transabdominal ultrasound done for pregnancy dating. Up to 700 participants per site during each season may also have blood collected for baseline influenza serologic testing at sites that opt to participate in an optional serology substudy for illness meeting the criteria for ARI with measured or reported (subjective) fever. Throughout cohort participation, participants will be instructed to contact study staff if they experience influenza-like symptoms (ILS), and active surveillance for ILS will be conducted via 1 or more contact methods, including twice weekly telephone calls, mobile telephone text messaging, or home visits by local health workers depending upon site capabilities and preferences. Participants with illness episodes meeting the ILS case definition will be asked to complete acute illness and illness follow-up interviews, and during the influenza season, participants will have mid-turbinate nasal swab specimens collected by trained study staff or through self-collection procedures for influenza virus testing by rRT-PCR. Participants will be contacted within 7 days of the end of the pregnancy to complete a survey on the pregnancy course and perinatal outcomes. Women who had blood collected at study enrollment as part of the serology sub-study will also have blood specimens collected within 7 days of end of pregnancy for influenza serologic testing. If women deliver in a study hospital or clinic, infants will be weighed on the day of delivery using standardized digital scales designed to measure weight with precision to the nearest 10 grams. If infants are delivered at a non-study hospital or outside the hospital setting, study staff will attempt to visit the woman on the day of delivery (but no later than 48 hours after delivery) to measure the infant's birth weight using standardized digital scales designed to measure weight with precision to the nearest 10 grams. Women will be contacted again 6–8 weeks postpartum to complete a survey on the postpartum and neonatal course.

### Timeline:

Participant enrollment began in May 2017 in Lima, Peru and in June 2017 in Bangkok, Thailand and Nagpur, India.



### *Progress and Findings:*

As of June 18, 2017, >3,500 women had been enrolled at the 3 participating study sites.

## **SEVERE ACUTE RESPIRATORY INFECTION (SARI) AMONG CHILDREN LESS THAN FIVE YEARS OF AGE IN INDIA, MALAWI, PERU, AND SOUTH AFRICA**

This prospective study is aimed at understanding the causes of severe respiratory disease among hospitalized children <5 years of age. Children <5 years of age who met the WHO case definition for SARI and control children who visited outpatient clinics but were not currently ill were enrolled.

### *Objectives*

- From this study, we will be able to estimate the prevalence of viral and bacterial respiratory pathogens among children <5 years of age hospitalized with SARI and those children within respiratory illness during a 12-month period.
- We will also identify risk factors for severe acute respiratory infection for this population.
- Progress and Findings:
  - » Enrollment is complete at 3 sites, and laboratory testing is complete at 1 site.

## **GLOBAL ROLE AND BURDEN OF INFLUENZA IN RESPIRATORY HOSPITALIZATIONS**

### *Objectives:*

- This effort will generate global estimates of the contribution of influenza to respiratory hospitalizations among different age groups, including infants, older children, and adults.

### *Approach:*

- Data used to inform these estimates are from a systematic literature review, as well as influenza surveillance platforms in 34 countries, shared via the GRIPP working group.

### *Progress and Findings:*

- Preliminary pooled estimates for infant populations have been shared with WHO and other partners to determine the burden of illness that could be prevented through maternal immunization and other prevention strategies worldwide.

# Meetings, Trainings, & Workshops

# Meetings, Trainings, & Workshops

## MEETINGS

### Fifth African Network for Influenza Surveillance and Epidemiology Meeting

**Summary:** The meeting brought together laboratorians, epidemiologists, veterinarians, and other public health practitioners and academicians involved in influenza-related public health activities or influenza research in Africa to promote discussion, build upon best practices, and share work with colleagues across the African continent. Presentations and discussions enabled participants to consider approaches to collection, assessment, analysis, and interpretation of relevant information as well as communication with health care professionals and the public.

**Location:** Kigali, Rwanda

**Dates:** March 7–11, 2016

**Attendees:** One hundred ten (110)

**Countries:** Burkina Faso, Cameroon, Democratic Republic of the Congo, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Mali, Mauritania, Morocco, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, Togo, Uganda, and Zambia

# TRAININGS AND WORKSHOPS

## Assessor Training—Surveillance and Laboratory Reviews

**Summary:** The meeting/training session brought together Council of State and Territorial Epidemiologists (CSTE), Association of Public Health Laboratories (APHL), and CDC participants interested in conducting either laboratory or surveillance assessments in CDC cooperative agreement countries. Participants were trained on the respective assessments tools; expectations of assessors before, during, and after the assessments; and assessment procedures. Throughout the meeting, participants had the opportunity to meet with CDC Project Officers as well as ask questions and voice concerns regarding the assessment tools and processes. A session on inter-rater reliability was conducted to ensure a common understanding of the tool questions and the results expected. Participants left with a better understanding of the process and the tools, and were added to an approved roster of assessors for future trips.

**Location:** Atlanta, Georgia, USA

**Dates:** October 19–21, 2016

**Attendees:** Fifty (50): 20 participants from CSTE, 20 participants from APHL (both groups represented various US states), and 10 CDC laboratorians from Atlanta.

## CDC/APHL Laboratory Mentorship Program (WHO Regional Office for Africa)

**Summary:** The laboratory mentorship program (initially piloted in WHO's Regional Office for Europe) provided technical assistance to countries to strengthen laboratory management systems and capacity, and enhance Biosafety and Quality Assurance programs using a step-wise approach. The program provided a structured year-long mentor relationship between mentor and country laboratorians. Each country team left the meeting with an activity plan and worked with the assigned mentor to accomplish the activities. Plans were developed to provide the technical assistance needed to move the laboratory toward WHO National Influenza Center (NIC) designation.

**Location:** Kigali, Rwanda

**Dates:** July 10–14, 2017

**Countries:** Burkina Faso, Democratic Republic of the Congo, Mali, Mauritania, Mozambique, Nigeria, Niger, Rwanda, Sierra Leone, Togo

## Data Analysis Course

**Summary:** The course served as a follow-up to the “Data Management and Basic Epidemiologic Analysis for Influenza” courses conducted previously (see below). The course design built on basic data management processes and provided more in-depth information on the various epidemiological analysis available. Participants worked with their own data and calculated baselines, identified trends, and participated in discussions about data needed and processes to calculate burden of disease. Building on data cleaning and organization skills previously learned, participants moved to more advanced techniques and learned how to use their data to summarize their country-specific situation.

**Location:** Amsterdam, Netherlands

**Dates:** November 7–11, 2016

**Countries:** Afghanistan, Albania, Cote d’Ivoire, Croatia, Democratic Republic of the Congo, Egypt, Georgia, Macedonia, Moldova, Morocco, Pakistan, Russia, Uganda



Advanced Management Analysis of Influenza Surveillance Data Training Course- Amsterdam, Netherlands, November 7–11, 2016

## Data Management and Basic Epidemiologic Analysis for Influenza

**Summary:** The course reviewed and discussed basic data management and quality issues as well as basic epidemiological practices. The format included lectures and hands-on exercises for participants. The goal was to provide an understanding of good data management practices that participants could apply within their work environment as well as a look at basic analytical concepts. Data collection, data organization, data cleaning, and data analysis concepts were reviewed and participants had the opportunity to practice the skills and review their specific country data with a facilitator and to revise forms and collection systems. Participants were able to take best practices and implement as appropriate in their system.

### *Americas Region*

**Location:** Montego Bay, Jamaica

**Dates:** December 1–3, 2015

**Countries:** Belize, Dominica, Haiti, Jamaica, Puerto Rico, St. Lucia, Suriname



## South-east Asian Region (SEAR)

- Location:** Bangkok, Thailand
- Dates:** March 25–April 1, 2016
- Countries:** Bangladesh, Bhutan, Myanmar, Nepal, Thailand
- Location:** Pune, India
- Dates:** January 16–20, 2017
- Countries:** Lao People's Democratic Republic (Lao PDR), India, Indonesia, Maldives, Myanmar, Sri Lanka, Timor Leste,

### Other Organizations Represented:

WHO Country Officer for Democratic People's Republic of Korea and WHO Regional Officer for South-east Asia



Multi-country database management workshop for surveillance and laboratory for Influenza—Bangkok, Thailand, March 28–April 1, 2018

## Laboratory Management Training (WHO Regional Office for the Eastern Mediterranean)

**Summary:** The format for the course was a combination of lectures, demonstrations, and hands-on exercises. This allowed participants to gain knowledge and information for implementation within their laboratories. The participants learned how to describe key aspects of laboratory biosafety including risk assessment, incident management, and BSL-3 (biosafety level 3) 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 obtaining and/or maintaining an NIC designation.

- Location:** Rabat, Morocco
- Dates:** July 31–August 4, 2017
- Countries:** Afghanistan, Bahrain, Egypt, Islamic Republic of Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, the occupied territory of Palestine, Qatar, Saudi Arabia, Somalia, Sudan, Tunisia, United Arab Emirates



Group photo from the CDC/APHL/EURO Influenza and Laboratory Quality Assurance Mentoring Project Meeting.

## Rapid Response Refresher Training

**Summary:** This training was designed to review influenza sample collection and shipment, current protocols for influenza virus detection, global platforms for influenza data sharing, and tools for pandemic risk assessment using the One Health Approach to rapid response for pandemic influenza.

**Dates:** April 3–7, 2017

**Location:** Accra, Ghana

**Countries:** Burkina Faso, Burundi, Cameroon, Cote d'Ivoire, Kenya, Mali, Mauritania, Mozambique, Niger, Nigeria, Senegal, Sierra Leone, Togo, Uganda, United Republic of Tanzania, Zambia, Zimbabwe

## Regional Biosafety Training

**Summary:** The workshop presented best practices and information to assist in the development of biosafety programs within influenza laboratories. The course work reviewed and discussed laboratory biosafety and biosecurity practices through didactic lectures, hands-on exercises, and demonstrations within the laboratory. Participants left the course with the skills and knowledge to implement biosafety practices in their home laboratories.

### *Africa Region*

**Location:** Accra, Ghana

**Dates:** October 26–30, 2015

**Countries:** Burkina Faso, Cote D'Ivoire, Democratic Republic of the Congo, Ethiopia, Ghana, Madagascar, Mali, Mauritania, Mozambique, Nigeria, South Africa, Rwanda, Tanzania, Togo, Uganda, Zambia

### *European Region*

**Location:** Zagreb, Croatia

**Dates:** May 9–13, 2016

**Countries:** Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Kosovo,\* Macedonia, Montenegro, Romania, Serbia, Slovenia

**Location:** Tbilisi, Georgia

**Dates:** November 28–December 1, 2017

**Countries:** Central Asia—Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Turkmenistan; Armenia, Belarus, Azerbaijan, Georgia, Moldova, Russian Federation, Ukraine

### *Americas Region*

**Location:** Panama City, Panama

**Dates:** August 7–11, 2017

**Countries:** Belize, Brazil, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru



Regional Biosafety Workshop for the Containment of Influenza and Other Infectious Diseases of International Concern—Panama City, Panama, August 7–11, 2017

## Sequencing Training Course

**Summary:** The course trained participants on skills needed to promote laboratory capacity in sequencing, analysis, and interpretation of the influenza genome in the Global Influenza Surveillance and Response System (GISRS). The training included lectures and hands-on exercises so attendees could obtain a better understanding of the role of sequencing in the global laboratory surveillance of influenza. Topics such as performing sequencing of influenza gene segments by basic principles of the Sanger method, genomic sequencing analysis using commercial and publicly available software programs, and procedures for uploading genomic sequences into publicly accessible databases (GenBank, GISAID) were covered. The training course facilitated a stronger GISRS with improved participation and closer collaboration among the NICs and the WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs). Upon completion of the practical training, participants had a better understanding of sequencing principles, better laboratory skills, improved knowledge of the potential level of impact of mutations in the evolution of influenza viruses, and enhanced skills for the use of databases for compilation, sharing, and analyses of sequencing data nationally and internationally.

**Location:** Atlanta, Georgia, USA

**Dates:** October 26–November 6, 2015

**Attendees:** Eight (8)

**Countries:** Egypt, India, Indonesia, Thailand

## Surveillance System Evaluation Training

**Summary:** The training provided cooperative agreement partners with the tools, information, and technical assistance needed to conduct a formal review of their surveillance systems. The workshop format included sharing and familiarizing participants with key attributes of surveillance systems such as: (1) data quality (including data completeness and accuracy), (2) timeliness, (3) representativeness, (4) simplicity, (5) flexibility, (6) acceptability, (7) stability, and (8) utility. At the end of the course, participants departed with an evaluation protocol outlining steps for their evaluation, identified indicators for monitoring their systems and sites, and a questionnaire for use in soliciting feedback from surveillance system participants. Throughout the year following the course, participants worked through their evaluation plan and summarized findings.

### *Africa Region*

**Location:** Abidjan, Côte d'Ivoire

**Dates:** October 12–16, 2015

**Attendees:** Twenty-one (21)

**Countries:** Cote d'Ivoire, Democratic Republic of Congo, Ghana, Morocco, Nigeria, Rwanda, Tunisia, Uganda, Zambia

### *European Region*

**Location:** Sarajevo, Bosnia and Herzegovina

**Dates:** February 20–24, 2017

**Countries:** Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Kosovo,\* Macedonia, Moldova, Montenegro, Romania, Serbia



## Virus Isolation Training

**Summary:** The course was designed to assist countries in implementing virus isolation to obtain NIC status or to improve current practices. The course provided both didactic and hands-on opportunities to learn the process and techniques for virus isolation.

### *All Regions*

**Location:** California State Laboratory, USA

**Dates:** May 2016

**Countries:** Armenia, Bangladesh, Bosnia and Herzegovina, Cambodia, Egypt, Lao PDR, Mexico, Mongolia, Montenegro, Philippines, Sri Lanka

### *Africa Region*

**Location:** Dakar, Senegal

**Dates:** March 28–31, 2017

**Countries:** Afghanistan, Algeria, Burkina Faso, Cote d'Ivoire, Democratic Republic of the Congo, Ethiopia, Kenya, Madagascar, Mali, Mauritania, Mauritius, Nigeria, Republic of the Congo, Rwanda, Tanzania, Togo, Uganda

*\*This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo declaration of independence.*

# Monitoring & Evaluation Tools

# Monitoring & Evaluation Tools

Under the cooperative agreements between CDC's Influenza Division and its partner countries, the Division supports the monitoring and evaluation (M&E) of activities associated with international influenza program capacity strengthening. The purpose of M&E in this context is to:

- Document each country's baseline capacity for influenza surveillance, laboratory diagnostics, and pandemic preparedness in a standardized way in order to measure progress toward defined criteria and thereby demonstrate meaningful improvement
- Use results to inform ongoing investment and programmatic planning for influenza detection, assessment, and response systems
- Demonstrate accountability for resources and activities tied to capacity building
- Identify best practices for capacity building that can be shared

The Influenza Division has developed 3 tools for assessment, 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." Each capability is assigned a composite score based on the quality, coverage, and timeliness of 4 related indicators. For example, the core capability of "Infection Control" is measured by determining performance in the following indicators: (1) standards of infection control by level of health care system, (2) integration of infection control training for staff, (3) availability of logistical resources for infection control, and (4) level of institutionalization of infection control efforts. The end-points for the core capabilities are country determined, which allows for variation in public health priorities across countries with differing resource constraints. Countries repeated the assessment every 2 years to monitor changes in pandemic preparedness between 2008 and 2012. For a copy of the National Inventory, please visit [www.cdc.gov/flu/international/tools.htm](http://www.cdc.gov/flu/international/tools.htm).

## International Influenza Laboratory Capacity Review Tool

**Purpose:** The *International Influenza Laboratory Capacity Review Tool* (IILCRT) is designed to assess the capability and capacity of an influenza laboratory to perform influenza diagnostics and use of good laboratory practices.

**Structure and content:** The IILCRT is a series of questions divided into 9 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 of laboratory capacity summary reports and recommendations for countries. The structure and content of the tool was updated in 2011 for clarity. For a copy of the tool, please visit [www.cdc.gov/flu/international/tools.htm](http://www.cdc.gov/flu/international/tools.htm).

**Implementation:** Between September 2009 and September 2017, 63 national laboratories in 69 countries completed laboratory assessments, facilitated by staff from CDC and the Association of Public Health Laboratories (APHL). Several national laboratories completed repeat assessments between Fiscal Years (FYs) 2013 and 2017.

**Outcomes:** The tool has helped 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 6 country laboratories in the Africa region that did not perform virus isolation; all expressed interest and readiness to receive technical assistance in these methods. Likewise, across all regions, many countries received specific recommendations for improving the biosafety of their laboratories. The need for better laboratory management also surfaced during reviews, and as a consequence, the Improving Influenza Laboratory Management Practices course was developed in partnership with APHL to build grantee skills in this area. Regional data management courses, drawing grantees from surrounding countries, have been held in South Africa (2011), Thailand (2012 and 2016), Greece (2014), and Ecuador and Jamaica (2015). In 2015, a review of the biosafety issues identified in assessments was used to develop a biosafety course with new curriculum to address common issues. Grantees from the African, European, and American regions attended these regional biosafety improvement courses in Ghana (2015), Croatia (2016), Panama (2017), and Georgia (2017).

## 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 7 checklists covering influenza-like illness (ILI) and severe acute respiratory infection (SARI) surveillance at the national level, data management and quality, laboratory integration, and readiness to undertake a burden of disease estimate. An additional component of the tool includes scored ILI and SARI site visit checklists. The tool uses a standard format for creating surveillance capacity summary reports including recommendations for countries. For a copy of the tool, please visit [www.cdc.gov/flu/international/tools.htm](http://www.cdc.gov/flu/international/tools.htm).

**Implementation:** Between March and September 2017, surveillance assessments were completed in 61 countries. Among them, 15 had follow-up assessments to review progress. Recommendations for strengthening the capabilities of surveillance systems take a considerable amount of time and investment, therefore, repeat assessments are only necessary after adequate time or reported progress has occurred. In FY 2011, CDC's Influenza Division also began collaborating with the Council of State and Territorial Epidemiologists (CSTE) to provide consultant epidemiologists to assist with conducting reviews in partner countries.

**Outcomes:** The tool has served to highlight overall surveillance strengths and challenges, with specific recommendations documented and sent formally to the assessed institution. Recommendations have included better integration of laboratory and epidemiologic data in analysis and reporting, routine data analysis and reporting to stakeholders, and better coordination between national staff and sites.





# Partnership for Influenza Vaccine Introduction (PIVI)

# Partnership for Influenza Vaccine Introduction

The Partnership for Influenza Vaccine Introduction (PIVI) is an innovative public/private program in which CDC's Influenza Division partners with the Task Force for Global Health, CDC's Global Immunization Division, Ministries of Health (MOHs), corporate partners, and others to help create sustainable, national, seasonal influenza vaccination programs in low- and middle-income countries. The mission of the program is to reduce the global disease burden from influenza and improve the ability to respond to pandemics through the development of sustainable influenza vaccination programs in low- and middle-income countries.

PIVI is organized around 3 main components. First, PIVI identifies and engages MOHs in countries that are ready to create or expand seasonal influenza vaccination programs, but lack sufficient resources or require additional supporting data to do so. PIVI supports partner countries to identify vaccination goals, target groups for vaccination, preferred product profile (e.g., single or multi-dose vials, pre-filled syringes), formulation of vaccine (northern hemisphere or southern hemisphere), and key regulatory and policy gaps, recognizing that the product profile of donated vaccine may not be flexible. Second, PIVI works with industry partners to obtain sufficient vaccine doses and supplies, and the shipping required to meet the needs of the partner countries. Donors may donate material (vaccine doses and supplies), funds to purchase vaccine and supplies, or provide discounted or in-kind services (e.g., at-cost vaccine doses and shipping). Third, PIVI supports MOHs in partner countries to conduct evaluations of the vaccination programs that are intended to provide data for the MOHs to refine the program and to understand the value of influenza vaccination. The types of evaluations are determined by country needs, but have included enhanced adverse event surveillance, post-introduction evaluations, vaccine effectiveness and impact evaluations, economic assessments, and surveys of knowledge, attitudes, and practices among key stakeholders, including key target groups and health care staff. The experience from these evaluations also expands the global evidence base for influenza vaccinations, for use by key global partners.

PIVI's current paradigm requires that each partner country develop a multi-year plan that accommodates a 3–5-year period of PIVI support, with the country progressively assuming the costs and responsibility for sustaining the influenza vaccine program beginning in year 3 and continuing in subsequent years. This time-limited engagement allows PIVI to work with new countries as mature countries “graduate” from the partnership, thereby continually expanding the number of partner countries over time.

## ACCOMPLISHMENTS

Since 2013, PIVI has provided programmatic, financial, and technical assistance in Albania, Armenia, Cote D'Ivoire, Kenya, Kosovo,\* Kyrgyzstan, the Lao People's Democratic Republic (Lao PDR), Moldova, Mongolia, Morocco, Nicaragua, Thailand, and Vietnam. PIVI has supplied more than 2 million doses of flu vaccine to MOHs in Albania, Armenia, Kyrgyzstan, Lao PDR, Moldova, Mongolia, Morocco, and Nicaragua. The partnership will expand into additional countries over the next 5 years. Vaccination programs in Nicaragua, Lao PDR, Armenia, and Moldova have made successful steps towards creating sustainable programs.

## 2015–2017 ACTIVITIES

During 2015–2017, PIVI supported the distribution of nearly 1 million vaccine doses to Albania, Armenia, Kyrgyzstan, Lao PDR, Moldova, Morocco, and Mongolia. In Lao PDR and Nicaragua, evaluations were conducted to assess the impact of maternal immunization on subsequent birth outcomes, documenting both safety of influenza vaccines in this population and potential benefits to infants of immunized mothers. In Albania, PIVI and local partners piloted a new tool for economic evaluation of their expanded program of influenza vaccination of health care workers. In Albania, Kyrgyzstan, Moldova, and Mongolia, acceptance surveys were implemented in multiple target groups, in order to identify targets for improving vaccine coverage. PIVI

is also working with local partners and global experts to strengthen countries' National Immunization Technical Advisory Groups (NITAGs), in order to support the generation of evidence-based influenza vaccination policies. This effort included a NITAG orientation workshop for all PIVI country partners in March 2016 and in-country training in several countries.

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## FUTURE PLANS

The Partnership plans to: (1) add 1–2 countries each year to the partnership; (2) expand partnerships with industry partners that will increase the vaccine options for partner countries and add more predictability to the annual number of doses available; (3) analyze experience to understand predictors of success—that is, what factors will help predict which countries are likely to develop sustainable vaccination programs by engaging with PIVI; (4) add focus on supporting countries to refine their plans for pandemic influenza vaccination implementation and policy development; and (5) increase support of vaccine policy development in partner countries by supporting NITAGs.

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- Arriola CS, Vasconez N, Thompson M, Mirza S, Moen AC, Bresee J, Talavera I, Roper AM. Factors associated with a successful expansion of influenza vaccination among pregnant women in Nicaragua. *Vaccine* 2016;34(8):1086–90. doi: 10.1016/j.vaccine.2015.12.065
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- Olsen SJ, Mirza SA, Vonglokhom P, Khanthamaly V, Chitry B, Pholsena V, Chitranonh V, Omer SB, Moen A, Bresee JS, Corwin A, Xeuatvongsa A. The effect of influenza vaccination on birth outcomes in a cohort of pregnant women in Lao PDR, 2014–2015. *Clin Infect Dis* 2016;63(4):487–94. doi: 10.1093/cid/ciw290

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*\*This designation is without prejudice to positions on status, and is in line with United Nations Security Council Resolution 1244 and the International Court of Justice Opinion on the Kosovo declaration of independence.*



# Sustainability



# Sustainability

Sustainability can be defined as a country's ongoing maintenance and support of a routine virologic and epidemiologic influenza surveillance system, including the capacity to financially maintain the system or a portion of the system.

When countries transition from the capacity building phase to the sustainability phase, they are asked to develop and implement a plan for influenza surveillance initiated or enhanced during the capacity building phase. The plan should be reviewed annually or as changes occur. Developing such a sustainability plan is a critical part of the transition to a sustainable system. A written plan can provide overarching guidance for an initiative. A plan can help an organization:

- Sustain systems using government funds
- Obtain input and agreement from key stakeholders (e.g., Ministries of Health [MOHs], WHO)
- Make the best use of human capital, funding, and other resources to achieve objectives
- Develop strategies for long-term success

To assist grantees with their plans, CDC's Influenza Division developed the International Influenza Program Sustainability Guide and Framework (the Guide). The Guide consists of 6 elements: Program Capacity, Strategic Planning, Partnerships, Funding, Communications, and Program Evaluation. These elements provide the framework for sustainability planning and implementation.

CDC's Influenza Division created sustainability indicators to measure the extent to which countries sustain continued routine influenza surveillance and virologic testing over the course of the capacity building, sustainability, and maintenance phases and beyond. CDC collects this information on a yearly basis for any country that received a capacity building cooperative agreement. The sustainability measures require no input from countries to collect, and little effort to validate. Measures used to determine sustainability include:

- Reporting weekly influenza test results to FluNet via the WHO website. This serves as a proxy to judge whether influenza virologic surveillance is

occurring and being reported within the Global Influenza Surveillance and Response System (GISRS) as recommended by WHO.

- Participating and performance in WHO External Quality Assessment Project (EQAP) panels, which helps to evaluate the quality of RT-PCR diagnostics for influenza.
- Sharing viruses with WHO Collaborating Centers for Reference and Research on Influenza (WHO CCs) for the bi-annual vaccine strains selection process. Collaboration in this GISRS network will contribute to a more representative and accurate influenza vaccine based on global strain monitoring.
- Sharing of national influenza surveillance system data and findings overtime through website and peer-reviewed publications.
- Participating in the CDC International Reagent Resource platform to acquire necessary reagents for influenza diagnostics over time.

A larger scope of performance measures can be developed during the capacity building, sustainability, and maintenance phases of the cooperative agreements through standardized reporting mechanisms set up directly with countries and WHO Regional Offices.

A few examples of sustainability efforts for this period include:

- Establishing country ownership and investment in country-led plans, including the Global Health Initiative.
- Developing a digital dashboard as a tool for regional influenza monitoring. The dashboard summarizes overall influenza activity and surveillance capacity in the region. By linking various laboratory and epidemiological data and information sources, the regional system will serve as an operational hub to inform risk assessment and decision making. In the face of pandemics, the regional dashboard could provide both baseline and real-time surveillance information for risk assessment.
- Identifying and diversifying funding sources through public and private streams.

- Decreasing the number of sentinel sites to a more manageable number.
- Regularly providing isolates to WHO CCs for vaccine strain selection; reporting weekly to FluNet, participating in WHO and CDC EQAP panels; sharing information through conferences and publications; and better marketing the program among stakeholders.

Sustainability should be discussed continuously and plans updated as circumstances change, so countries can develop surveillance networks that will continue after US government funding ends and provide the necessary data to accurately identify and track potential public health issues.





# Acronyms





# Acronyms

<b>AFR</b>	World Health Organization African Region
<b>AFRIMS</b>	Armed Forces Research Institute of Medical Sciences
<b>AFRO</b>	World Health Organization Regional Office for Africa
<b>AMR</b>	World Health Organization Region of the Americas
<b>APHL</b>	Association of Public Health Laboratories
<b>ARI</b>	Acute respiratory illness
<b>BSL</b>	Biosafety level
<b>CDC</b>	U.S. Centers for Disease Control and Prevention
<b>CDC-CAP</b>	Centers for Disease Control and Prevention—Central America and Panama
<b>CoAg</b>	Cooperative agreement
<b>ECDC</b>	European Centers for Disease Control
<b>EMR</b>	World Health Organization Eastern Mediterranean Region
<b>EMRO</b>	World Health Organization Regional Office for the Eastern Mediterranean
<b>EOC</b>	Emergency Operations Center
<b>EQAP</b>	World Health Organization External Quality Assessment Project
<b>EUR</b>	World Health Organization European Region
<b>EURO</b>	World Health Organization Regional Office for Europe
<b>FAO</b>	Food and Agriculture Organization
<b>FETP</b>	Field Epidemiology Training Program
<b>FELTP</b>	Field Epidemiology and Laboratory Training Program
<b>FY</b>	Fiscal Year
<b>FMOH</b>	Federal Ministry of Health
<b>GISRS</b>	World Health Organization Global Influenza Surveillance and Response System
<b>HI</b>	Hemagglutination inhibition assay
<b>HCW</b>	Health care worker
<b>HHS</b>	United States Department of Health and Human Services
<b>HPAI</b>	Highly pathogenic avian influenza
<b>IATA</b>	International Air Transport Association
<b>ID</b>	Influenza Division
<b>IDSR</b>	Integrated Disease Surveillance and Response
<b>IHR</b>	International Health Regulations

<b>ILI</b>	Influenza-like illness
<b>IRR</b>	International Reagent Resource
<b>MERS-CoV</b>	Middle East respiratory syndrome-coronavirus
<b>MOH</b>	Ministry of Health
<b>NAMRU</b>	United States Naval Medical Research Unit
<b>NITAG</b>	National Immunization Technical Advisory Group
<b>NCIRD</b>	National Center for Immunization and Respiratory Diseases
<b>NIC</b>	National Influenza Center
<b>PAHO</b>	Pan American Health Organization
<b>PATH</b>	Program Appropriate Technology in Health
<b>PCR</b>	Polymerase chain reaction
<b>PIVI</b>	Partnership for Influenza Vaccine Introduction
<b>PPE</b>	Personal Protective Equipment
<b>RRT</b>	Rapid Response Team
<b>RSV</b>	Respiratory syncytial virus
<b>RT-PCR</b>	Reverse transcription polymerase chain reaction
<b>rRT-PCR</b>	Real-time reverse transcription polymerase chain reaction
<b>SARI</b>	Severe acute respiratory infection
<b>SARS</b>	Severe acute respiratory syndrome
<b>SEAR</b>	World Health Organization South-East Asia Region
<b>SEARO</b>	World Health Organization Regional Office for South-East Asia
<b>SECID</b>	South East European Center of Infectious Diseases Surveillance and Control
<b>SOP</b>	Standard operating procedure
<b>SPC</b>	Secretariat of the Pacific Community
<b>TB</b>	Tuberculosis
<b>TESSy</b>	The European Surveillance System
<b>WPRO</b>	World Health Organization Regional Office for Western Pacific
<b>WPR</b>	World Health Organization Western Pacific Region
<b>WHO</b>	World Health Organization
<b>WHO CC</b>	World Health Organization Collaborating Center for Reference and Research on Influenza



# Appendix



# Descriptions for maps and figures

## Page 4

### US CDC International Activities and Support, FY 2004

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2004. The Influenza Division has Cooperative Agreements with the following countries: China, India, Indonesia, Mongolia, Pakistan, Philippines, South Korea and Thailand. These countries are shaded light green.

The Influenza Division also has cooperative agreements with WHO, as indicated by a blue star, in the following countries: Philippines (Manila), Switzerland (Geneva) and the United States (Washington, DC).

The Division collaborates with the U.S. Department of Defense (DoD), indicated by an orange triangle, in Indonesia (Jakarta).

### US CDC International Activities and Support, FY 2007

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2007. The Influenza Division has Capacity Building Cooperative Agreements with the following countries: Afghanistan, Angola, Argentina, Bangladesh, Brazil, Cambodia, China, Cote d'Ivoire, Democratic Republic of Congo, Ethiopia, India, Indonesia, Kazakhstan, Kenya, Mexico, Mongolia, Morocco, Nigeria, Pakistan, Peru, Philippines, Romania, Rwanda, South Africa, Tanzania, Thailand, Uganda, Ukraine and Vietnam. These countries are shaded light green.

The Influenza Division provided indirect funding to Lao People's Democratic Republic (PDR). This country is shaded dark green.

The Influenza Division also has Cooperative Agreements with World Health Organization (WHO), indicated by a blue star, in the following countries: Democratic Republic of Congo (Kinshasa), Denmark (Copenhagen), Egypt (Cairo) India (New Delhi), Philippines (Manila), Switzerland (Geneva) and the United States (Washington, DC).

The Division collaborates with the U.S. Department of Defense (DoD) indicated by an orange triangle in the following countries: Cambodia, Egypt, Indonesia, and Peru.

Global Disease Detection (GDD) Sites, indicated by the red X's, are located in the following cities: Beijing (China), Cairo (Egypt), Guatemala, New Delhi (India), Almaty (Kazakhstan), Nairobi (Kenya), Pretoria (South Africa), and Bangkok (Thailand).

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## Page 5

### US CDC International Activities and Support, FY 2009

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2009. The Influenza Division has Capacity Building Cooperative Agreements with the following countries: Afghanistan, Angola, Argentina, Bangladesh, Brazil, Cambodia, Cote d'Ivoire, Democratic Republic of Congo, Egypt, Ethiopia, Ghana, Kenya, Madagascar, Mexico, Moldova, Mongolia, Morocco, Nepal, Nigeria, Paraguay, Peru, Rwanda, South Africa, Sri Lanka, Tanzania, Uganda, Ukraine, Vietnam, and Zambia. These countries are shaded light green.

The Influenza Division also has Sustainability Cooperative Agreements with the following countries: China, India, Indonesia, Pakistan, Philippines, and Thailand. These countries are shaded dark green.

The Influenza Division provided indirect funding to Kazakhstan, Lao People's Democratic Republic (PDR), Papua New Guinea and Romania. These countries are shaded pink.

The Influenza Division also has Cooperative Agreements with World Health Organization (WHO), indicated by a blue star, in the following countries: Democratic Republic of Congo (Kinshasa), Denmark (Copenhagen), Egypt (Cairo) India (New Delhi), Philippines (Manila), Switzerland (Geneva) and the United States (Washington, DC).

The Division collaborates with the U.S. Department of Defense (DoD) indicated by an orange triangle in the following countries: Cambodia, Egypt, Indonesia, and Peru.

Global Disease Detection (GDD) Sites, indicated by the red X's, are located in the following cities: Beijing (China), Cairo (Egypt), Guatemala, New Delhi (India), Almaty (Kazakhstan), Nairobi (Kenya), Pretoria (South Africa), and Bangkok (Thailand).

## US CDC International Activities and Support, FY 2010

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2010. The Influenza Division has Capacity Building Cooperative Agreements with the following countries: Afghanistan, Angola, Argentina, Bangladesh, Brazil, Cambodia, Cote d'Ivoire, Democratic Republic of Congo, Egypt, Georgia, Indonesia, Kenya, Madagascar, Mexico, Moldova, Mongolia, Morocco, Nepal, Nigeria, Paraguay, Peru, Philippines, South Africa, Sri Lanka, Tanzania, Uganda, Ukraine, and Zambia. These countries are shaded light green.

The Influenza Division also has Sustainability Cooperative Agreements with the following countries: China, India, Indonesia, Mongolia, Pakistan, Philippines, Thailand, and Vietnam. These countries are shaded dark green.

The Influenza Division provided indirect funding to Lao People's Democratic Republic (PDR), Papua New Guinea and Romania. These countries are shaded pink.

The Influenza Division also has Cooperative Agreements with World Health Organization (WHO), indicated by a blue star, in the following countries: Democratic Republic of Congo (Brazzaville), Denmark (Copenhagen), Egypt (Cairo), India (New Delhi), Philippines (Manila), Switzerland (Geneva) and the United States (Washington, DC).

The Division collaborates with the U.S. Department of Defense (DoD) indicated by an orange triangle in the following countries: Cambodia, Egypt, Indonesia, and Peru.

Global Disease Detection (GDD) Sites, indicated by the red X's, are located in the following cities: Astana (Kazakhstan), Bangkok (Thailand), Beijing (China), Cairo (Egypt), Guatemala City (Guatemala), Johannesburg (south Africa), Nairobi (Kenya), and New Delhi (India).

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### US CDC International Activities and Support, FY 2013

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2013. The Influenza Division has Capacity Building Cooperative Agreements with the following countries: Bhutan, Kyrgyzstan, Maldives, Mali, Mozambique, SECID (Albania, Bosnia and Herzegovina, Macedonia, and Montenegro), and Tunisia. These countries are shaded light green.

The Influenza Division also has Sustainability Cooperative Agreements with the following countries: Afghanistan, Angola, Armenia, Bangladesh, Brazil, Cambodia, China, Cote d'Ivoire, Democratic Republic of Congo (DRC), Egypt, Ethiopia, Georgia, India, Indonesia, Madagascar, Mexico, Moldova, Mongolia, Morocco, Nepal, Nigeria, Pakistan, Paraguay, Peru, Philippines, Russian Federation, Rwanda South Africa, Secretariat of the Pacific Community (SPC), Sri Lanka, Tanzania, Thailand, Uganda, Ukraine, Vietnam and Zambia. These countries are shaded dark green.

In addition, the Influenza Division has Vaccine Policy Cooperative Agreements with the following countries: China, Morocco, Kenya, Uganda and Vietnam. These countries are indicated by blue shading with dots.

The following countries have Research Cooperative Agreements: Bangladesh, Ghana, India, Kenya, Senegal, and Vietnam. These countries are identified by pink hash marks.

The Influenza Division also has Cooperative Agreements with World Health Organization (WHO), indicated by a blue star, in the following countries: Democratic Republic of Congo (Brazzaville), Denmark (Copenhagen), Egypt (Cairo), India (New Delhi), Philippines (Manila), Switzerland (Geneva) and the United States (Washington, DC).

CDC Influenza Division Field Staff, indicated by a yellow dot outlined in red, are located in: Accra, Ghana; Bangkok, Thailand; Copenhagen, Denmark; Dhaka, Bangladesh; Geneva, Switzerland; Guatemala City, Guatemala; Hanoi, Vietnam; Manila, Philippines; Nairobi, Kenya; New Delhi, India; Pretoria, South Africa; Vientiane, Lao PDR; and Washington, DC, USA.

The Influenza Division provided indirect funding to Belize, Costa Rico, Dominican Republic, El Salvador, Fiji, Ghana, Guatemala, Honduras, Lao People's Democratic Republic (PDR), Malawi, Nicaragua, Panama, Papua New Guinea, Republic of Congo, and Romania. These countries are shaded pink.

### US CDC International Activities and Support, FY 2015

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2015. The Influenza Division has Capacity Building Cooperative Agreements with the following countries: Bhutan, Kyrgyzstan, Maldives, Mali, Mozambique, SECID (Albania, Bosnia and Herzegovina, Macedonia, Montenegro and Kosovo), and Tunisia. These countries are shaded light green.

The Influenza Division also has Sustainability Cooperative Agreements with the following countries: Afghanistan, Armenia, Bangladesh, Brazil, Cambodia, Côte d'Ivoire, Democratic Republic of Congo (DRC), Egypt, Ethiopia, Georgia, Madagascar, Mexico, Moldova, Morocco, Nepal, Nigeria, Paraguay, Peru, Russian Federation, Rwanda, South Africa, Secretariat of the Pacific Community (SPC), Sri Lanka, Tanzania, Uganda, Ukraine, Vietnam and Zambia. These countries are dark green.

Five countries have Maintenance Cooperative Agreements; they are China, Indonesia, Mongolia, Pakistan, and Philippines. These countries are shaded yellow on the map.

In addition, the Influenza Division has Vaccine Policy Cooperative Agreements with the following countries: China, Morocco, Kenya, Uganda, and Vietnam. These countries are identified by blue shading with dots.

The following countries have Research Cooperative Agreements: Bangladesh, Ghana, India, Kenya, Malawi, Senegal, South Africa, and Vietnam. These countries are identified by pink hash marks.

The Influenza Division provided indirect funding to Belize, Costa Rica, Dominican Republic, El Salvador, Fiji, Guatemala, Honduras, Lao People's Democratic Republic (PDR), Mauritius, Nicaragua, Panama, Papua New Guinea and Seychelles. These countries and/or islands are shaded pink.

The Influenza Division also has Cooperative Agreements with WHO, indicated by a blue star, in the following countries: Denmark (Copenhagen), Egypt (Cairo), India (New Delhi), Philippines (Manila), Republic of Congo (Brazzaville), Switzerland (Geneva) and the United States (Washington, DC).

The Division collaborates with the U.S. Department of Defense [DOD], indicated by an orange triangle, in the following countries: Egypt and Peru.

Global Disease Detection [GDD] Sites, indicated by the red X's, are located in the following cities: Beijing (China), Cairo (Egypt), Tbilisi (Georgia), Guatemala City (Guatemala), New Delhi (India), Almaty (Kazakhstan), Nairobi (Kenya), Pretoria (South Africa), and Bangkok (Thailand).

CDC Influenza Division Field Staff, indicated by a yellow dot, are located in: Accra, Ghana; Bangkok, Thailand; Copenhagen, Denmark; Dhaka, Bangladesh; Geneva, Switzerland; Guatemala City, Guatemala; Hanoi, Vietnam; Manila, Philippines; Nairobi, Kenya; New Delhi,

India; Pretoria, South Africa; Vientiane, Lao PDR; and Washington, DC, USA.

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### US CDC International Activities and Support, FY 2016

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2016. CDC Influenza Division Field Staff, indicated by a yellow dot, are located in : Accra, Ghana; Bangkok, Thailand; Beijing, China; Cairo, Egypt; Copenhagen, Denmark; Dhaka, Bangladesh; Geneva, Switzerland, Guatemala, City, Guatemala, Hanoi, Vietnam, Jakarta, Indonesia; Manila, Philippines; Nairobi, Kenya, New Delhi, India; Phnom Penh, Cambodia; Pretoria, South Africa; Vientiane, Lao PDR; and Washington, DC, USA.

The Influenza Division also has Sustainability Cooperative Agreements with the following countries: Angola, Bangladesh, Brazil, Cambodia, China, Cote d'Ivoire, Democratic Republic of Congo (DRC), Ethiopia, India, Indonesia, Mexico, Mongolia, Nigeria, Pakistan, Peru, Philippines, Russian Federation, Rwanda, South Africa, Secretariat of the Pacific Community (SPC), Tanzania, Thailand, Uganda and Vietnam. These countries are shaded dark green.

The Influenza Division provided indirect funding to Belize, Costa Rica, Dominican Republic, El Salvador, Fiji, Ghana, Guatemala, Honduras, Lao People's Democratic Republic (PDR), Tanzania, Thailand, Uganda and Vietnam. These countries are shaded pink.

The Influenza Division also has Cooperative Agreements with WHO, indicated by a blue star, in the following countries: Denmark (Copenhagen), Egypt, (Cairo), India (New Delhi), Philippines (Manila), Republic of Congo (Brazzaville), Switzerland (Geneva) and the United States (Washington, DC).

### US CDC Global Influenza Activities and Support, FY 2017

A global map outlining the countries in which the U.S. CDC conducted international influenza activities and provided support for Fiscal Year 2017. CDC Influenza Division Field Staff, indicated by a yellow dot, are located in : Accra, Ghana; Bangkok, Thailand; Beijing, China; Cairo, Egypt; Copenhagen, Denmark; Dhaka, Bangladesh;



Geneva, Switzerland, Guatemala, City, Guatemala, Hanoi, Vietnam, Jakarta, Indonesia; Manila, Philippines; Nairobi, Kenya, New Delhi, India; Phnom Penh, Cambodia; Pretoria, South Africa; Vientiane, Lao PDR; and Washington, DC, USA.

The Influenza Division also has Sustainability Cooperative Agreements with the following countries: Angola, Bangladesh, Brazil, Cambodia, China, Cote d'Ivoire, Democratic Republic of Congo (DRC), Ethiopia, India, Indonesia, Mexico, Mongolia, Nigeria, Pakistan, Peru, Philippines, Russian Federation, Rwanda, South Africa, Secretariat of the Pacific Community (SPC), Tanzania, Thailand, Uganda and Vietnam. These countries are shaded dark green.

The Influenza Division provided indirect funding to Belize, Costa Rica, Dominican Republic, El Salvador, Fiji, Ghana, Guatemala, Honduras, Lao People's Democratic Republic (PDR), Tanzania, Thailand, Uganda and Vietnam. These countries are shaded with purple hash marks.

The Influenza Division also has Cooperative Agreements with WHO, indicated by a blue star, in the following countries: Denmark (Copenhagen), Egypt, (Cairo), India (New Delhi), Philippines (Manila), Republic of Congo (Brazzaville), Switzerland (Geneva) and the United States (Washington, DC).

Influenza Maintenance Cooperative Agreements are shaded yellow, Influenza Research Cooperative Agreements are shaded with pink hash marks, and Influenza Capacity Building Cooperative Agreements are shaded in light green.

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**Figure 1—The IRR provides influenza reagents to 426 laboratories in 155 countries including the US to support year-round research and surveillance activities.**

The International Reagent Resource (IRR) was established in 2008 by the U.S. CDC to provide influenza viruses, reagents, kits and panels to researchers, public health laboratories, vaccine manufacturers and diagnostic test developers in order to improve influenza diagnostics and vaccines and promote basic influenza research. This map shows the locations of influenza reagents in 426 laboratories in 155 countries, including the U.S.

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**Figure 2—The IRR website provides registered laboratories with information about its large influenza reagent catalog and receives all online orders.**

Picture of the International Reagent Resource (IRR) website, showing microscopic pic of influenza virus. IRR provides registered laboratories with information about its large influenza reagent catalog and receives all online orders.

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**International Influenza Activities: CDC-AFRO 2017**

A map of the WHO African Region (AFR) shows all 47 AFR member states/countries. The member countries, outlined with gray borders, include Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Côte d'Ivoire, Democratic Republic of Congo, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinée-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Republic of Congo, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, South Africa, South Sudan, Swaziland, Togo, Uganda, United Republic of Tanzania, Zambia and Zimbabwe.

Countries with shading indicate that the Influenza Division provides project funding and technical assistance through cooperative agreements. Kenya, Malawi, Senegal and South Africa are shaded with red diagonal stripes to indicate Research Cooperative Agreements. Mali and Mozambique are shaded light green to indicate Capacity Building Cooperative Agreements. Côte d'Ivoire, Democratic Republic of Congo, Ethiopia, Madagascar, Nigeria, Rwanda, South Africa, Tanzania, Uganda and Zambia are shaded dark green to indicate Sustainability Cooperative Agreements. Mauritius and Seychelles are shaded with pink hash marks to indicate that they receive indirect funding from the Division. Kenya and Uganda are also shaded blue with dots to indicate Vaccine Policy Cooperative Agreements.

CDC Influenza Division Field Staff, indicated by a yellow dot, are located in the following cities: Accra, Nairobi, and Pretoria.

WHO National Influenza Centers (NICs), indicated by a purple circle are located in the following cities: Abidjan, Accra, Algiers, Antananarivo, Bangui, Candas, Cape Town, Dakar, Entebbe, Ibadan, Nairobi, Sandringham, and Yaoundé.

The WHO Regional Office for Africa (AFRO) Headquarters, indicated by a blue star, is located in Brazzaville, Republic of Congo.

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### International Influenza Activities: CDC-EMRO 2017

A map of the WHO Eastern Mediterranean Region (EMR) shows all 22 EMR member states/countries. The member countries, outlined with gray borders, include Afghanistan, Bahrain, Djibouti, Egypt, Iraq, Iran, Jordan, Kuwait, Lebanon, Libya, Oman, Pakistan, Morocco, Occupied Palestinian Territory, Qatar, Saudi Arabia, Somalia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen.

Countries with shading indicate that the Influenza Division provides project funding and technical assistance through cooperative agreements. Tunisia is shaded light green to indicate a Capacity Building Cooperative Agreement. Egypt is shaded dark green to indicate Sustainability Cooperative Agreements. Morocco, Afghanistan, and Pakistan are shaded medium green to indicate a Maintenance Cooperative Agreement. WHO National Influenza Centers (NICs), indicated by a purple dot, are located in the following cities: Amman, Baghdad, Beirut, Cairo [2], Damascus, Doha, Islamabad, Kabul, Khartoum, Manama, Muscat, Rabat, Shaab, Tehran and Tunis.

The WHO Regional Office for the Eastern Mediterranean (EMRO), indicated by a pink star, is located in Cairo, Egypt.

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### International Influenza Activities: CDC-EURO 2017

A map of the WHO European Region (EUR) shows all 53 EUR member states/countries. The member countries, outlined with gray borders, include Albania, Andorra, Armenia, Austria, Azerbaijan, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Georgia, Germany, Greece, Hungary, Ireland, Israel, Italy, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Luxembourg, Malta, Monaco, Montenegro, Netherlands, Norway,

Poland, Portugal, Republic of Moldova, Romania, Russian Federation, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Tajikistan, North Macedonia, Turkey, Turkmenistan, Ukraine, United Kingdom of Great Britain and Northern Ireland, and Uzbekistan.

Countries with light green shading indicate that the Influenza Division provides project funding and technical assistance through Capacity Building Cooperative Agreements. Kyrgyzstan, the Southeast European Center for Surveillance and Control of Infectious Diseases (SECID) priority countries (Albania, Bulgaria, Croatia, Montenegro, Romania, Serbia and Kosovo) as well as Bosnia and Herzegovina and North Macedonia are included in this group. The Republic of Moldova is shaded dark green to indicate that they have a Sustainability Cooperative Agreement. Shaded medium green on the map are Armenia, Georgia, the Russian Federation, and Ukraine, which are the countries in the Maintenance phase of the Cooperative Agreement cycle.

CDC Influenza Division Field Staff, indicated by a yellow dot, are located at the WHO Regional Office for Europe in Copenhagen, Denmark and at WHO Headquarters in Geneva, Switzerland.

The Global Disease Detection [GDD] Sites, indicated by the red "X", are located in Georgia and Kazakhstan.

WHO National Influenza Centers (NICs), indicated by a purple dot, are located in Albania (Tirana), Armenia (Yerevan), Austria (Vienna), Belarus (Minsk), Belgium (Brussels), Bulgaria (Sofia), Croatia (Zagreb), Czech Republic (Prague), Denmark (Copenhagen), Estonia (Tallinn), Finland (Helsinki), France (Lyon and Paris), Georgia (Tbilisi), Germany (Berlin), Greece (Athens and Thessaloniki), Hungary (Budapest), Iceland (Reykjavik), Ireland (Dublin), Israel (Tel Hashomer), Italy (Rome), Kazakhstan (Almaty), Kyrgyzstan (Kyrgyzstan), Latvia (Riga), Lithuania (Vilnius), Luxembourg (Luxembourg), Malta (Msida), Netherlands (Rotterdam), Norway (Oslo), Poland (Warsaw), Portugal (Lisboa), Romania (Bucharest [2] and Lasi), Russia Federation (Moscow and St. Petersburg), Serbia (Belgrade and Novi Sad), Slovakia (Bratislava), Slovenia (Ljubljana), Spain (Barcelona, Madrid and Valladolid), Sweden (Solna), Switzerland (Geneva), Turkey (Ankara), Ukraine (Kiev), and United Kingdom (Aberdeen, London and Glasgow).

The WHO Regional Office for Europe (EURO), indicated by a blue star, is located in Copenhagen, Denmark. WHO Headquarters is located in Geneva, Switzerland.

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### International Influenza Activities: CDC-PAHO 2017

A map of the WHO Region of the Americas (AMR) shows all 35 AMR member states/countries. The member countries include Antigua and Barbuda, Argentina, Bahamas, Barbados, Belize, Bolivia, Brazil, Canada, Chile, Columbia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, United States of America, Uruguay, and Venezuela.

Countries with shading indicate that the Influenza Division provides project funding and technical assistance through cooperative agreements. Jamaica is shaded light green to indicate a Capacity Building Cooperative Agreement. Paraguay is shaded dark green to indicate a Sustainability Cooperative Agreement. Mexico and Brazil are shaded medium green to indicate Maintenance Cooperative Agreements. Peru, Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama are shaded with pink hash marks to indicate that they receive indirect funding from the Division.

CDC Influenza Division Field Staff, indicated by a yellow dot, are located in the following cities: Washington, DC and Guatemala City, Guatemala.

WHO National Influenza Centers (NICs), indicated by a purple dot, are located in Argentina (Buenos Aires, Córdoba, and Mar Del Plata), Brazil (Ananindeua, Sao Paulo, and Rio de Janeiro), Canada (Winnipeg), Chile (Santiago), Columbia (Bogota), Costa Rica (Cartago), Cuba (Havana), Ecuador (Guayaquil), El Salvador (San Salvador), France-French Guiana (Cayenne), Guatemala (Barcenus), Honduras (Tegucigalpa), Jamaica (Kingston), Mexico (Mexico City), Nicaragua (Managua), Panama (Panama City), Paraguay (Asunción), Peru (Lima), Trinidad and Tobago (Port of Spain), United States of America (Atlanta, Georgia), Uruguay (Montevideo), and Venezuela (Caracas).

The Pan American Health Organization (PAHO) Headquarters, indicated by a blue star, is in Washington, DC (USA).

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### International Influenza Activities: CDC-SEARO 2017

A map of the WHO South-East Asia Region (SEAR) shows all 11 SEAR member states/countries. The member countries, outlined with gray borders, include Bangladesh, India, Indonesia, Nepal, Sri Lanka, Thailand, Bhutan, DPR Korea, Myanmar, Maldives and Timor-Leste.

Countries with shading indicate that the Influenza Division provides project funding and technical assistance through cooperative agreements. Bhutan and the Maldives are shaded light green to indicate Capacity Building Cooperative Agreements. Nepal and Sri Lanka are shaded dark green to indicate Sustainability Cooperative Agreements. Bangladesh is shaded medium green to indicate a Maintenance Cooperative Agreement. Bangladesh, India and Thailand have diagonal stripes across the country to indicate Research Cooperative Agreements.

CDC Field Staff, indicated by a yellow dot, are located in the following cities: Bangkok, Dhaka and New Delhi.

The Global Disease Detection [GDD] Sites, indicated by red X's, are located in Bangkok, Thailand; Dhaka, Bangladesh; and New Delhi, India.

WHO National Influenza Centers (NICs), indicated by a purple dot, are located in the following cities: Colombo, Dhaka, Jakarta, Kathmandu, Nonthaburi, Pune, Pyongyang, and Yangon.

The WHO Regional Office for South-East Asia (SEARO), indicated by a blue star, is located in New Delhi, India.

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### International Influenza Activities: CDC-WPRO 2017

A map of the WHO Western Pacific Region (WPR) shows 12 of the 37 WPR member states/countries. The member countries shown, outlined with gray borders, include Australia, Cambodia, China, Japan, Lao PDR, Malaysia, Mongolia, Papua New Guinea, Philippines, Singapore, South Korea, and Vietnam.

Countries with dark green shading indicate that the Influenza Division provides project funding and technical assistance through Sustainability Cooperative Agreements. Cambodia, Secretariat of the Pacific Community (SPC), and Vietnam are shaded dark green on the map. Fiji, Lao PDR and Papua New Guinea are shaded with pink hash marks to indicate that they receive



indirect funding from the Influenza Division. Vietnam has black diagonal stripes to indicate that they have a Research Cooperative Agreement. China and Vietnam are also shaded with blue dots to indicate that they have Vaccine Policy Cooperative Agreements. China, Mongolia, and Philippines are shaded medium green to indicate Maintenance Cooperative Agreements.

CDC Influenza Division Field Staff, indicated by a yellow dot, are located in the following cities: Beijing, Hanoi, Manila, and Vientiane.

The Global Disease Detection [GDD] Site, indicated by a red "X", is located in Beijing.

WHO National Influenza Centers (NICs), indicated by purple dots, are located in the following cities: Beijing, Goroka, Hanoi, Ho Chi Minh City, Hong Kong, Kuala Lumpur, Manila, Phnom Penh, Singapore, Taipei, Tokyo, Ulaanbaatar and Vientiane.

The WHO Regional Office of the Western Pacific (WPRO), indicated by a blue star, is located in Manila, Philippines.

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