

Part B. SURVEILLANCE & EPIDEMIOLOGIC INVESTIGATION

NC Department of Health and Human Services, Division of Public Health

The NC Division of Public Health (NC DPH) conducts routine influenza surveillance using a variety of surveillance systems. Some of these systems are active year-round; others are conducted annually October through May. The Communicable Disease Branch (CDB) (formerly General Communicable Disease Control Branch) oversees and coordinates influenza surveillance activities. North Carolina participates in many of the activities of influenza surveillance outlined by the Centers for Disease Control and Prevention (CDC), including:

- Virologic surveillance by the NC State Laboratory of Public Health (SLPH)
- Surveillance of influenza-like illness (ILI) by sentinel providers and the NC Disease Event Tracking and Epidemiologic Collection Tool (NC DETECT)
- Monitoring of hospital admissions for acute respiratory illness by a network of public health epidemiologists (PHEs) in the state's largest healthcare systems
- Reporting of positive test results for viral respiratory pathogens from hospitals in the PHE network
- Reporting of respiratory viral pathogen testing results from laboratories participating in the National Respiratory and Enteric Virus Surveillance System (NREVSS), including 14 laboratories across North Carolina
- Case-based reporting of influenza-associated deaths in adults and children
- Monitoring of pneumonia and influenza deaths identified through the 122-Cities Mortality Reporting System, of which Charlotte is one of the reporting cities

Influenza surveillance in North Carolina also includes the investigation of influenza outbreaks as well as enhanced surveillance for novel influenza viruses in individuals who meet specific epidemiologic criteria (e.g., travelers, refugees, and poultry workers). The state added novel influenza virus infections in humans to the list of reportable conditions in 2006.

In nine of the largest hospital systems in the state, ILI surveillance is augmented by hospital-based public health epidemiologists (PHEs). PHEs perform active surveillance of hospital admissions for ILI, and they investigate clusters of ILI, paying special attention to those involving increased severity or unusual populations. PHEs also assist with case investigations of flu-associated deaths and hospitalized patients who exhibit unusual clinical syndromes or severe morbidity associated with influenza.

The NC DPH has also developed an algorithm for detection and management of suspect cases of avian influenza H5N1 in travelers. This algorithm is reproduced as an interactive .pdf at http://epi.publichealth.nc.gov/gcdc/pandemic/AppendixP1_2007.pdf. Hard copies have been distributed to local health departments and healthcare providers across the state through a variety of mechanisms, including Medicaid bulletins, state medical society websites, and distribution at meetings.

In the event of an influenza pandemic, routine surveillance systems will be adapted rapidly to respond to the challenges of increased influenza cases. In the early phases of a pandemic, surveillance systems will be programmed to detect early human cases of novel virus in the state. In the later phases, surveillance systems will assimilate large amounts of data to determine age-specific attack rates, morbidity, and mortality.

Syndromic surveillance for ILI is being conducted in nearly all hospital emergency departments (EDs) across the state. ED data is collected and analyzed for ILI trends using NC DETECT. NC DPH monitors ED data for specific syndromes on a daily basis. NC DPH relies heavily on NC DETECT to monitor ILI in hospital EDs across the state.

The major challenge we face during a pandemic event is synthesizing this information and these systems in order to provide useful human health intelligence upon which to base critical decisions. North Carolina's approach is to develop a scalable plan related to the CDC pandemic intervals.

A. Planning Assumptions

1. While it is impossible to predict an accurate impact of an outbreak of pandemic influenza, using the 1918 pandemic as a model with a 35 percent attack rate, the result in North Carolina could be as follows:
 - 1.6 million doctor visits
 - 290,000 hospitalizations
 - 65,300 deaths
2. The World Health Organization (WHO) and CDC will coordinate surveillance at the national and international level.
3. Routine influenza surveillance systems will be overwhelmed during the later phases of the pandemic.
4. Influenza surveillance systems must be flexible to accommodate the pertinent epidemiology of the identified virus(es).

B. Investigation Interval

(Characterized by the occurrence of sporadic cases of novel influenza)

1. Maintain routine influenza surveillance. Weekly reports are developed and disseminated from October to May each year, and include the following data sources.
 - a. **Influenza-Like Illness Network (ILINet).** Surveillance for ILI is conducted by a voluntary network of sentinel providers as part of the CDC. These providers also submit nasopharyngeal specimens from a sample of patients with ILI to the State Laboratory for Public Health for testing to identify prevailing strains.
 - b. **Emergency department syndromic surveillance.** This system monitors ED data for specific syndromes, such as ILI, on a daily basis, utilizing emergency department visits from 113 hospitals in North Carolina (and the analysis of chief complaints, triage notes, and vital signs as they relate to ILI through the NC DETECT). Laboratory data from the NC State College of Veterinary Medicine and data from the Piedmont Wildlife Refuge, Carolina Poison Control, and Emergency Medical Services (Pre-Hospital Medical Information System) is also downloaded into the system daily.
 - c. **122-Cities Mortality Reporting System.** Pneumonia and influenza deaths are monitored using vital records data from 122 cities nationwide, including Charlotte.
 - d. **Reporting of outbreaks.** Outbreaks are reported in long-term care facilities, schools, and other settings of public health importance.

- e. **Investigations of deaths and severe illness.** The state conducts active surveillance for influenza-associated deaths in adults and children. Influenza-associated deaths are on the list of immediately reportable conditions in North Carolina. Adult flu-associated deaths were added to the list of reportable conditions in North Carolina in 2011.
- f. **Hospital-based public health epidemiologists (PHEs).** PHEs in the largest hospital systems in North Carolina assist NC DPH in ILI surveillance. The PHE hospital systems (as of 12/2011) are as follows:
 - Carolinas Medical Centers, Charlotte (Mercy, Pineville, University)
 - Duke University Medical Center, Durham
 - Mission Hospitals, Asheville
 - New Hanover Regional Health Network, Wilmington
 - Wake Forest University Baptist Hospital, Winston-Salem
 - Pitt County Memorial Hospitals, Greenville
 - University of North Carolina Hospitals, Chapel Hill
 - Wake Med Hospitals, Raleigh and Cary

Some of the responsibilities of the PHEs include:

- i. Performing active surveillance in hospital admissions for acute respiratory illness and investigating and reporting clusters of unusual respiratory illness
 - ii. Conducting case investigation of hospitalized patients who have unusual clinical syndromes or severe morbidity associated with influenza
 - iii. Assisting local health departments with investigation of all flu-associated deaths
 - iv. Weekly reporting of respiratory viral pathogen testing (PCR, DFA and/or rapid) results to NC DETECT
2. Coordinate with NC Department of Agriculture and Consumer Services and the respective industries that currently test for influenza in poultry and swine. Testing of poultry for influenza viruses is performed routinely as well as upon request.
 - a. Testing for avian influenza virus (AIV) is performed at the request of the farmer or company veterinarian.
 - b. Testing for AIV is performed on all poultry with respiratory disease.
 - c. A respiratory sample of all broilers is tested for AIV within 10 days of processing.
 - d. Testing for influenza in swine herds is done at the request of the farmer or company veterinarian.

Upon recognition of unusual patterns of disease with high morbidity or mortality, the influenza surveillance coordinator and the state epidemiologist will make recommendations regarding further testing and infection control provisions, and will coordinate with the CDC regarding elevating the interval phase.

Communication of a single case or outbreak of avian influenza in poultry with the potential to infect humans (H5, H7, and H9) is communicated directly by the state veterinarian (Department of Agriculture) to the state epidemiologist. Active surveillance

of any poultry worker with avian influenza will be coordinated through the Communicable Disease Branch (CDB). This is in accordance with the NC Highly Pathogenic Avian Influenza Response Plan. A report of avian influenza in a poultry worker will trigger an upgrade in the influenza interval phase in NC and will be reported immediately to the CDC.

Identification of a single human case or outbreak of swine-origin influenza will be reported immediately to the CDC.

3. The CDB Flu Surveillance Coordinator regularly monitors bulletins from CDC and WHO regarding virologic, epidemiologic, and clinical findings associated with new variants isolated within or outside the U.S.
4. The CDB Flu Surveillance Coordinator regularly monitors updates from the World Animal Health Organization (OIE) on outbreaks of novel viruses in animals.
5. Monitor ILI in military personnel at the military bases through BioSense and directly through the local health departments that have bases located within their jurisdictions.

6. **Triggers and Actions**

- a. **Trigger.** Identification of animal case of influenza A subtypes with potential implications for human health within the state.

i. **Actions**

- Assess human exposures and risks of infection.
- Monitor for human disease.
- Increase communication between Department of Agriculture and the CDB regarding the presence of avian and swine influenza in NC.
- Establish clear reporting mechanisms for daily exchange of information between the two agencies.
 - Local health departments and DPH will conduct active surveillance in poultry and swine workers if a novel virus is identified in poultry and swine (Appendix B-1).

- b. **Trigger.** Identification of human case of potential novel influenza A infection.

i. **Actions**

If case is within the state, the following must be done:

- Assess case contacts to determine human-to-human transmission and risk factors for infection.
- Share information with animal and human health officials and other stakeholders.
- Expand virologic and disease-based surveillance to year-round surveillance.
- Report cases to the Nationally Notifiable Diseases Surveillance System.
- Submit virus samples to CDC for additional characterization if required.
- Disseminate and widely publicize instructions, including methods of testing, methods on requesting testing, shipment and handling of samples, etc. (Section H, Appendix H-2, H-3). Instructions will be sent to laboratories and

providers through professional newsletters, the NC Health Alert Network (HAN), and at educational events.

- Enhance surveillance among travelers or those relocated from geographic areas in which novel viruses have been isolated (Appendix B-1, B-2 and B-3).

If case is outside the state, surveillance measures listed above will continue.

- c. Routine surveillance measures will continue during the investigation interval, as listed in B.1.
- d. The CDB Flu Surveillance Coordinator regularly monitors bulletins from CDC and WHO regarding virologic, epidemiologic and clinical findings associated with new variants isolated within or outside the US.
- e. The CDB Flu Surveillance Coordinator regularly monitors updates from the World Animal Health Organization (OIE) on outbreaks of novel viruses in animals.
- f. Monitor ILI in military personnel at the military bases through BioSense and directly through the local health departments that have bases located within their jurisdictions.

C. Recognition and Initiation Intervals

(Characterized by clusters of novel influenza cases identified and confirmation of sustained and efficient human-to-human transmission)

1. Triggers and Actions

a. Trigger

- Confirmation of human cases of novel influenza A and demonstration of efficient and sustained human-to-human transmission.
- Two or more laboratory-confirmed pandemic cases that are not epidemiologically linked to any previous case.

i. Actions

If within the state, the following must be done:

- Continue/initiate actions described for investigation interval.
- Implement case-based investigation and containment.
- Confirm all suspected cases at public health laboratory.
- Report cases according to Nationally Notifiable Diseases Surveillance System.
- Conduct enhanced novel influenza A surveillance.
- Activate an incident management team and evaluate need for full activation of the Public Health Coordination Center. This will establish a clear chain of accountability, meet staffing requirements for an extended period, and establish communications/coordination plans with partner responding agencies.

- The CDB flu surveillance coordinator and the SLPH will report to Operations Branch of the Incident Management Team.
- The liaison officer will coordinate efforts between DPH, Department of Agriculture, and NCEM.
- Contact the State Emergency Response Team to assess if the state EOC will be activated beyond routine operations.
- Activate all current surveillance methods for influenza if outside of the regular influenza season.
- Establish contact with the major military installations in NC to coordinate active surveillance in military personnel returning from areas where novel virus has been isolated or confirmed in humans.
- The CDB flu surveillance coordinator will continue to monitor updates from CDC, WHO, and OIE frequently in order to maintain a high level of situational awareness.
- The CDB flu surveillance coordinator will produce at minimum weekly reports on flu activity in NC and updates to the status of the pandemic. This list will be distributed to all public health and responder partners.
- If activated, the NC State Mortuary Operations and Recovery Team (SMORT) will have the capacity to generate electronic records of people who are deceased and can supplement a sentinel surveillance system (the SMORT is currently being developed as a resource in NC).
- Monitor school absenteeism due to ILI through reports from local health departments or through statewide data if available from the NC Department of Public Instruction.
- Initiate collection of additional surveillance data as needed to meet state or federal surveillance needs.
- In conjunction with CDC, local health department, and other partners, design studies that may perform some or all of the following:
 - Document outbreaks of influenza in different population groups.
 - Determine age-specific attack rates, morbidity, and mortality.
 - Describe unusual clinical syndromes, risk factors, and treatment.
 - Describe factors associated with fatal cases.
- The CDB flu surveillance coordinator will report to CDC as requested the numbers of cases and other required information.
- In conjunction with CDC, CDB and the Immunization Branch will conduct efficacy studies for available vaccine.
- CDB will implement tools to study the effectiveness of control methods and community containment measures.
- CDB with the Office of the Chief Medical Examiner (OCME) will conduct mortality surveillance for influenza and pneumonia deaths

If novel influenza cases are identified outside the state, the following must be done:

- Continue/initiate actions described for investigation interval.
- Conduct enhanced novel influenza A surveillance.
- Implement appropriate screening of travelers and other border health strategies, as directed by CDC.

- Perform active surveillance for ILI in travelers returning to NC from areas where novel influenza virus infection has been confirmed in humans (see Attachment B2).

If a novel virus is identified in a North Carolina resident, it will be reported directly to the local health department. Local health departments will notify the CDB on-call epidemiologist. This is in accordance with the procedures in place for all immediately reportable conditions.

- The Communicable Disease Branch will work with local health department personnel to conduct the epidemiologic investigation to determine possible sources of exposure and identify contacts.
- Isolation of the individual and quarantine of the contacts will be conducted by the local health director.
- CDC will be notified by the state epidemiologist.
- Local health departments will maintain records of all known isolated and quarantined individuals and provide a regular report to the flu surveillance coordinator.

D. Acceleration Interval

(Characterized by recognition of containment efforts not succeeding and onward transmission occurring)

1. Actions and Triggers

- a. **Trigger.** Increasing numbers of cases that exceed resources to provide case-based control measures.
 - i. **Actions**
 - Elevate the activation level to the Public Health Coordination Center to effectively manage DPH resources over the extended period of a pandemic.
 - Communicate with the State Emergency Response Team regarding needed support,
 - Dispatch representatives, provide technical assistance, and deliver reports as requested to the state EOC.
 - Transition surveillance from individual case confirmation to mortality and syndromic disease monitoring.
 - Monitor ILI in hospitals through the NC DETECT and PHEs, and communicate with OEMS regarding data obtained through the State Medical Asset Resource Tracking Tool (SMARTT) system. (SMARTT is the NC web-based reporting system that collects information on hospital, long-term care facilities, and other medical facilities resources, including numbers and types of beds, medications, durable equipment [e.g., ventilators].) Specific queries will be made based on pandemic needs.
 - Monitor (through the ILINet) the number of cases being seen in outpatient settings, even if only gross numbers can be obtained.
 - Laboratory surveillance will be conducted as follows:
 - Once circulation of pandemic influenza is documented in NC, routine or diagnostic testing will continue in order to monitor

hospitalizations and mortality associated with novel influenza infection. Testing at the SLPH will be conducted after joint consultation with CDB, SLPH, and the medical provider to:

- Monitor relative proportions of pandemic and seasonal strains in circulation.
- Monitor for mutations in circulating strains, including presence of mutations conferring antiviral resistance.
- The CDB flu surveillance coordinator will report to CDC as requested the numbers of cases and other required information in the frequency requested.
- Monitor effectiveness of community mitigation activities, including school dismissal, cancellation of large gatherings, etc.
- Monitor vaccination coverage levels, antiviral use, and adverse events.
 - Investigate possible pandemic influenza in a person receiving antiviral medications (after consultation with CDB epidemiologists) to confirm treatment failure or determine resistance.
 - Confirm pandemic influenza in a vaccinated person (after consultation with CDB epidemiologists) to confirm vaccine failure.
- Assist in the determination of illness if highly unusual circumstances arise.
- Continue/initiate actions described for initiation interval.

E. Peak Interval

(Characterized by extensive transmission in the community)

1. Actions and Triggers

a. Triggers

- Percentage of visits due to ILI reported by ILINet providers exceeds peak value averaged over the past three seasons, or percentage of ED visits due to ILI reported through NC DETECT exceeds peak value averaged over the past three seasons, **and** more than 20 percent of specimens from patients with ILI submitted to the state public health laboratory are positive for the pandemic strain during a seven-day period.
- Widespread geographic influenza activity is reported by the state epidemiologist using CDC surveillance criteria.
- Health care system surge capacity has been exceeded.

i. Actions

- Continue/initiate actions described for acceleration interval.
- Conduct laboratory confirmation of only a sample of cases as required for virologic surveillance.
- Continue primarily syndromic surveillance and surveillance for mortality and severe or unusual clusters of disease.

F. Deceleration Interval

(Characterized by declining rates of pandemic influenza)

After the first pandemic wave, surveillance methods will return to a previous level, although the pandemic may re-accelerate into a second wave. Surveillance will be

directed at determining the onset of subsequent waves and assessing the efficacy of containment measures such as vaccine, antiviral medications, school dismissal, and cancellations of large gatherings.

1. Actions and Triggers

a. Triggers

- Percentage of visits due to ILI reported by ILINet providers falls below peak value averaged over the past three seasons. Percentage of ED visits due to ILI reported through NC DETECT falls below peak value averaged over the past three seasons, *and* less than 10 percent of specimens from patients with ILI submitted to the state public health laboratory are positive for the pandemic strain for at least two consecutive weeks.
- Regional, local, or sporadic geographic spread of influenza activity is reported by the state epidemiologist using CDC surveillance criteria.
- Healthcare system utilization is below surge capacity.

i. Actions

- Continue/initiate actions described for peak interval.
- Transition surveillance from syndromic to case-based monitoring and confirmation.

G. Resolution Interval

(Characterized by pandemic cases occurring only sporadically)

1. Actions and Triggers

a. Triggers

- Laboratory-confirmed pandemic influenza cases occur sporadically.
- Healthcare system utilization approaches pre-pandemic levels.

i. Actions

- Return to routine surveillance activities to verify resolution of epidemic wave.
- Continue/initiate actions described for deceleration interval.
- Resume enhanced virologic surveillance to detect emergence of increased transmission.
- Prepare for possible second wave.
 - Review and analyze epidemiologic data obtained during the pandemic:
 - Age-specific mortality, morbidity, and attack rates
 - Vaccine efficacy
 - Antiviral medication efficacy
 - Community containment measures