Centers for Disease Control and Prevention

U.S. Influenza Surveillance: Purpose and Methods

The Influenza Division at CDC collects, compiles, and analyzes information on influenza activity year-round in the United States. FluView, a weekly influenza surveillance report, and FluView Interactive, an online application which allows for more in-depth exploration of influenza surveillance data, are updated each week. **The data presented each week are preliminary and may change as more data are received.**

The U.S. influenza surveillance system is a collaborative effort between CDC and its many partners in state, local, and territorial health departments, public health and clinical laboratories, vital statistics offices, healthcare providers, hospitals, clinics, emergency departments, and long-term care facilities. Information in five categories is collected from nine data sources in order to:

- Find out when and where influenza activity is occurring;
- Determine what influenza viruses are circulating;
- Detect changes in influenza viruses; and
- Measure the impact influenza is having on illness, hospitalizations, and deaths.

It is important to maintain a comprehensive system for influenza surveillance for the following reasons:

- Influenza viruses are constantly changing (this is commonly referred to as “antigenic drift”), and thus ongoing data collection and characterization of viruses are required.
- Influenza viruses can also undergo an abrupt, major change (referred to as “antigenic shift”) that results in a virus that is much different than currently circulating influenza viruses. Surveillance of viruses will detect these changes and inform the public health response.
- Vaccines must be administered annually and are updated regularly based on surveillance findings.
- Treatment for influenza virus infection is guided by laboratory surveillance for antiviral resistance.
- Influenza surveillance and targeted research studies are used to monitor the impact of influenza on different segments of the population (e.g., people in certain age groups, people with underlying medical conditions).

Surveillance System Components

1. Virologic Surveillance

U.S. World Health Organization (WHO) Collaborating Laboratories System and the **National Respiratory and Enteric Virus Surveillance System (NREVSS) –** Approximately 100 public health and more than 300 clinical laboratories located throughout all 50 states, Puerto Rico, Guam, and the District of Columbia participate in virologic surveillance for influenza through either the U.S. WHO Collaborating Laboratories System or NREVSS. Influenza testing practices differ between public health and clinical laboratories and each network provides valuable information for monitoring influenza activity. Clinical laboratories primarily test respiratory specimens for diagnostic purposes, and data from these laboratories provide useful information on the timing and intensity of influenza activity. Public health laboratories primarily test specimens for surveillance purposes to understand what influenza virus types, subtypes, and lineages are circulating and the ages of people that are infected.

All public health and clinical laboratories report each week to CDC the total number of respiratory specimens tested for influenza and the number positive for influenza viruses, along with age or age group of the person, if available. CDC presents data from clinical laboratories that includes the weekly total number of specimens tested, the number of positive influenza tests, and the percent positive by influenza virus type. For public health laboratories, CDC presents the weekly total number of specimens tested and the number positive by influenza virus type and subtype/lineage. In order to obtain specimens in an

efficient manner, public health laboratories often receive samples that have already tested positive for influenza at a clinical laboratory. As a result, monitoring the percent of specimens testing positive for influenza in a public health laboratory is less useful (i.e., we expect a higher percent positive than what is actually occurring in the community). In order to use each data source most appropriately and to avoid duplication, reports from public health and clinical laboratories are presented separately in both FluView and FluView Interactive.

The age distribution of people who have tested positive for influenza reported from public health laboratories can be visualized in FluView Interactive. The number and proportion of influenza virus-positive specimens by influenza A subtype and influenza B lineage are presented by age group (0-4 years, 5-24 years, 25-64 years, and ≥65 years) each week and cumulative totals are provided for the season.

Additional laboratory data for current and past seasons and by geographic level (national, Department of Health and Human Services (HHS) region, and state) are available on FluView Interactive.

Virus Characterization – This includes genetic and antigenic characterization. Most U.S. viruses submitted for virus characterization come from state and local public health laboratories. Due to Right Size considerations, public health laboratories are asked to submit the following specimens, if available, every other week during the 2021-2022 season: 2 influenza A(H1N1)pdm09, 3 influenza A(H3N2), 2 influenza B/Victoria and 2 influenza B/Yamagata viruses. Therefore, the number of viruses that are characterized should be more balanced across types/subtypes/lineages than is observed in the population and will not reflect the actual proportion of circulating viruses. The goals of genetic and antigenic characterization are to assess how similar the currently circulating influenza viruses are to viruses used to produce current influenza vaccines and to monitor evolutionary changes that continually occur in influenza viruses circulating in humans.

For genetic characterization, all influenza-positive surveillance samples received at CDC undergo next-generation sequencing to determine the genetic identity of circulating influenza viruses and to monitor the evolutionary trajectory of viruses circulating in the human population. Virus gene segments are classified into genetic clades/subclades based on phylogenetic analysis. However, genetic changes that classify the clades/subclades do not always result in antigenic changes.

Antigenic characterization is performed using hemagglutination inhibition and/or neutralization assays to compare antigenic properties of circulating viruses to those of cell-propagated reference viruses that represent viruses used in the current influenza vaccines. This allows for the detection of “antigenic drift”, a term that describes the gradual antigenic change that occurs as viruses evolve to escape host immune pressure.

CDC also analyzes influenza viruses collected by public health laboratories for susceptibility to influenza antivirals, including neuraminidase inhibitors (oseltamivir, zanamivir, and peramivir) and a PA cap-dependent endonuclease inhibitor (baloxavir). Susceptibility to the neuraminidase inhibitors is assessed using next-generation sequencing analysis. Neuraminidase sequences of viruses are inspected to detect the presence of amino acid substitutions previously associated with reduced or highly reduced inhibition by any of the three neuraminidase inhibitors. In addition, a subset of viruses is tested using a neuraminidase inhibition assay. The level of neuraminidase activity inhibition is reported using the thresholds recommended by the WHO Expert Working Group of the Global Influenza Surveillance and Response System (GISRS). Susceptibility to baloxavir is assessed using next-generation sequencing analysis to identify amino acid substitutions in the PA protein that are associated with reduced susceptibility to this antiviral. A subset of representative viruses is also tested phenotypically using a high-content imaging neutralization test. For surveillance purposes, antiviral susceptibility is typically conducted on viruses that are collected from patients not treated with influenza antivirals or before initiation of treatment.

Results of genetic and antigenic characterization and antiviral susceptibility testing are presented in the virus characterization and antiviral resistance sections of the FluView report.

Surveillance for Novel Influenza A Viruses – In 2007, human infection with a novel influenza A virus became a nationally notifiable condition. Novel influenza A virus infections include all human infections with influenza A viruses that are different from currently circulating human seasonal influenza H1 and H3 viruses. These viruses include those that are subtyped as nonhuman in origin and those that cannot be subtyped with standard laboratory methods and reagents. Rapid detection and reporting of human infections with novel influenza A viruses – viruses against which there is often little to no pre-existing immunity – is important to facilitate prompt awareness and characterization of influenza A viruses with pandemic potential and accelerate the implementation of public health responses to limit the transmission and impact of these viruses.

Newly reported cases of human infections with novel influenza A viruses in the United States are reported in FluView and additional information, including case counts by geographic location, virus subtype, and calendar year, are available on FluView Interactive.

2. Outpatient Illness Surveillance

Information on outpatient visits to health care providers for influenza-like illness (ILI) is collected through the **U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet)**. ILINet consists of outpatient healthcare providers in all 50 states, Puerto Rico, the District of Columbia and the U.S. Virgin Islands. Approximately 85 million patient visits were reported during the 2020-21 season. Each week, approximately 3,000 outpatient healthcare providers around the country report to CDC the number of patient visits for ILI by age group (0-4 years, 5-24 years, 25-49 years, 50-64 years, and ≥65 years) and the total number of visits for any reason. A subset of providers also reports total visits by age group. For this system, ILI is defined as fever (temperature of 100°F [37.8°C] or greater) and a cough and/or a sore throat. The case definition no longer includes "without a known cause other than influenza". Sites with electronic health records use an equivalent definition as determined by public health authorities. Since ILINet monitors visits for ILI and not laboratory-confirmed influenza, it will capture visits due to any respiratory pathogen that presents with ILI symptoms. These data should be evaluated in the context of other surveillance data to obtain a complete and accurate picture of influenza virus activity.

Additional data on medically attended visits for ILI for current and past seasons and by geographic level (national, HHS region, and state) are available on FluView Interactive.

The national percentage of patient visits to healthcare providers for ILI reported each week is calculated by combining state-specific data weighted by state population. This percentage is compared each week with the national baseline of 2.5% for the 2021-2022 influenza season. The baseline is developed by calculating the mean percentage of patient visits for ILI during non-influenza weeks for the most recent three seasons excluding the COVID-19 pandemic and adding two standard deviations As of October 2021 the time period excluded for the pandemic is March 2020 through September 2021. A non-influenza time period (e.g., a "non-influenza week") is defined as two or more consecutive weeks in which each week accounted for less than 2% of the season's total number of specimens that tested positive for influenza in public health laboratories. Region-specific baselines are calculated using the same methodology. Due to the wide variability in regional level data, it is not appropriate to apply the national baseline to regional data.

Regional baselines for the 2021-2022 influenza season are:

Region 1 — 2.0%
Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont

Region 2 — 3.3%
New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands

Region 3 — 2.0%
Delaware, District of Columbia, Maryland, Pennsylvania, Virginia, and West Virginia

Region 4 — 3.1%
Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee

Region 5 — 2.5%
Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin

Region 6 — 3.6%
Arkansas, Louisiana, New Mexico, Oklahoma, and Texas

Region 7 — 1.7%
Iowa, Kansas, Missouri, and Nebraska

Region 8 — 2.8%
Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming

Region 9 — 2.4%
Arizona, California, Hawaii, and Nevada

Region 10 — 1.8%
Alaska, Idaho, Oregon, and Washington

ILI Activity Indicator Map: — Activity levels are based on the percent of outpatient visits due to ILI in a jurisdiction compared with the average percent of ILI visits that occur during weeks with little or no influenza virus circulation (non-influenza weeks) in that jurisdiction. The number of sites reporting each week is variable; therefore, baselines are adjusted each week based on which sites within each jurisdiction provide data. To perform this adjustment, provider level baseline ILI ratios are calculated for those that have a sufficient reporting history. Providers that do not have the required reporting history to calculate a provider-specific baseline are assigned the baseline ratio for their practice type. The jurisdiction level baseline is then calculated using a weighted sum of the baseline ratios for each contributing provider.

The activity levels compare the mean reported percent of visits due to ILI during the current week to the mean reported percent of visits due to ILI during non-influenza weeks. The 13 activity levels correspond to the number of standard deviations below, at, or above the mean for the current week compared with the mean during non-influenza weeks. Activity levels are classified as minimal (levels 1-3), low (levels 4-5), moderate (levels 6-7), high (levels 8-10), and very high (levels 11-13). An activity level of 1 corresponds to an ILI percentage below the mean, level 2 corresponds to an ILI percentage less than 1 standard deviation above the mean, level 3 corresponds to an ILI percentage more than 1 but less than 2 standard deviations above the mean, and so on, with an activity level of 10 corresponding to an ILI percentage 8 to 11 standard deviations above the mean. The very high levels correspond to an ILI percentage 12 to 15 standard deviations above the mean for level 11, 16 to 19 standard deviations above the mean for level 12, and 20 or more standard deviations above the mean for level 13.

The ILI Activity Indicator map reflects the intensity of ILI activity, not the extent of geographic spread of flu, within a jurisdiction. Therefore, outbreaks occurring in a single area could cause the entire jurisdiction to display high or very high activity levels. In addition, data collected in ILINet may disproportionally represent certain populations within a jurisdiction, and therefore, may not accurately depict the full picture of influenza activity for the entire jurisdiction. Differences in the data presented here by CDC and independently by some health departments likely represent differing levels of data completeness with data presented by the health department likely being more complete.

The ILI Activity Indicator Map displays state-specific and core-based statistical area (CBSA) specific activity levels by week for multiple seasons and allows a visual representation of relative levels of ILI activity from state to state. More information is available on FluView Interactive.

3. Long-term Care Facilities

CDC's NHSN provides healthcare facilities, such as long-term care facilities (LTCFs), with a secure reporting platform for reporting patient outcomes and process measures in a systematic way. Reported data are used to strengthen local and national surveillance, monitor trends in infection rates, assist in identifying resource insecurities, and inform progress toward infection prevention goals.

The NHSN Long-term Care Facility Component supports the nation's COVID-19 response through the LTCF COVID-19 Module. In 2020, the Centers for Medicare and Medicaid Services (CMS) issued an Interim Final Rule requiring approximately 15,400 CMS-certified LTCFs (e.g., nursing homes/skilled nursing, long-term care for the developmentally disabled, and assisted living facilities) from all 50 states and U.S. territories to report COVID-19 and influenza positive test results among residents and staff and PPE supply data to CDC's NHSN using the COVID-19 Resident Impact and Facility Capacity Pathway form. CMS requires all certified nursing homes to report once a week, by Sunday at midnight. Influenza data elements include:

- Number of residents/staff/personnel with new laboratory-confirmed influenza.
- Number of residents/staff/personnel with new acute respiratory illness symptoms, excluding laboratory-confirmed SARS-CoV-2 (COVID-19) and/or laboratory-confirmed influenza.
- Number of residents/staff/personnel with a co-infection with new laboratory-confirmed influenza and SARS-CoV-2 (COVID-19).

The number of LTCFs reporting at least one confirmed influenza case among residents to CDC's NHSN and the number of facilities reporting each week are reported at the national and HHS region level. Of note, data collection week for this component is shifted one day compared to the other national influenza surveillance system components and runs from Monday to Sunday rather than Sunday through Saturday. This change should have minimal impact on the weekly numbers and will not affect monitoring trends over time.

Additional information about CDC's NHSN Long-term Care Facility COVID-19 Module, including collection forms, form instructions, trainings, and future updates are available here.

4. Hospitalization Surveillance

FluSurv-NET

Laboratory-confirmed influenza-associated hospitalizations are monitored through the Influenza Hospitalization Surveillance Network (FluSurv-NET). FluSurv-NET conducts population-based surveillance for laboratory-confirmed influenza-related hospitalizations in children younger than 18 years of age (since the 2003-2004 influenza season) and adults (since the 2005-2006 influenza season).

A full description of this system is available at Influenza Hospitalization Surveillance Network (FluSurv-NET). FluSurv-NET data including hospitalization rates for multiple seasons and different age groups and data on patient characteristics (such as virus, type, demographic, and clinical information) are available on FluView Interactive.

HHS Protect Hospitalization Surveillance

As of March 2020, all hospitals registered with CMS and non-CMS hospitals are required to report COVID-19 and influenza information on laboratory testing, capacity and utilization, and patient flows to facilitate the public health response to the 2019 Novel Coronavirus (COVID-19) pandemic. The data are reported to the HHS Protect ecosystem, a secure platform for authentication, amalgamation, and sharing of healthcare information and are made available on the HHS Protect Public Data Hub .

Currently, hospitals from all 50 states and U.S. territories report COVID-19 and influenza data to HHS Protect. The detailed list of reported data elements are provided here . For the 2021-2022 season, the influenza variables will include:

- Total number of hospitalized patients with laboratory-confirmed influenza virus infection.
- Previous day's number of admissions with laboratory-confirmed influenza virus infection.
- Total number of hospitalized ICU patients with laboratory-confirmed influenza virus infection.

The numbers of new hospital admissions with laboratory-confirmed influenza virus infection reported to HHS Protect are aggregated by week at the national and HHS region level. New hospital admissions are defined as patients who were admitted to an inpatient bed on the previous calendar day and had a positive influenza test at admission or during the 14 days prior. Laboratory confirmation includes detection of influenza virus infection through molecular tests (e.g., polymerase chain reaction, nucleic acid amplification), antigen detection tests, immunofluorescence tests, and virus culture. For hospital reporting, laboratory-confirmed influenza is defined as influenza A or B. These datafiles are available to the public at the HHS Protect Public Data Hub from the 'unified hospital analytic' dataset .

5. Mortality Surveillance

National Center for Health Statistics (NCHS) Mortality Surveillance Data – NCHS collects death certificate data from state vital statistics offices for all deaths occurring in the United States. Deaths included in this component of the U.S. Influenza Surveillance System are those which are classified based on ICD-10 multiple cause of death codes as associated with influenza, COVID-19, or pneumonia. Data are aggregated by the week of death occurrence. NCHS surveillance data are released one week after the week of death and percentages for earlier weeks are continually revised and may increase or decrease as new and updated death certificate data are received by NCHS.

Prior to the 2020-2021 influenza season, the NCHS surveillance data were used to calculate the percent of all deaths occurring each week that had pneumonia and/or influenza (P&I) listed as a cause of death. Due to the ongoing COVID-19 pandemic, COVID-19 coded deaths were added to P&I to create the PIC (pneumonia, influenza, and/or COVID-19) classification. PIC

includes all deaths with pneumonia, influenza, and/or COVID-19 listed on the death certificate. Since many influenza deaths and many COVID-19 deaths have pneumonia included on the death certificate, P&I is not currently measuring the impact of influenza in the same way that it had prior to the COVID-19 pandemic. This is because the proportion of pneumonia deaths associated with influenza is now influenced by COVID-19-related pneumonia. The PIC percentage, number of influenza deaths, and number of COVID-19 deaths are presented in order to help better understand the impact of these viruses on mortality and the relative contribution of each virus to PIC mortality.

The PIC percentages are compared to a seasonal baseline of P&I deaths that is calculated using a periodic regression model incorporating a robust regression procedure applied to data from the five years prior to the COVID-19 pandemic (2015 week 10 through 2020 week 9). An increase of 1.645 standard deviations above the seasonal baseline of P&I deaths is considered the "epidemic threshold," (i.e., the point at which the observed proportion of deaths attributed to pneumonia, influenza, or COVID-19 was significantly higher than would be expected at that time of the year in the absence of substantial influenza- or COVID-19-related mortality).

Additional P&I and PIC mortality data for current and past seasons and by geographic level (national, HHS region, and state) are available on FluView Interactive. Data displayed on the regional and state-level are aggregated by the state of residence of the decedent.

Influenza-Associated Pediatric Mortality Surveillance System — Influenza-associated pediatric mortality became a nationally notifiable condition in 2004. For surveillance purposes, an influenza-associated pediatric death is defined as a death in a person less than 18 years of age, resulting from a clinically compatible illness that was confirmed to be influenza by an appropriate laboratory diagnostic test. There should be no period of complete recovery between the illness and death. Demographic and clinical information is collected on each case and reported to CDC.

Information on influenza-associated pediatric deaths including basic demographics, underlying medical conditions, bacterial co-infections, and place of death, is available on FluView Interactive for the current and past seasons.

Summary of the Geographic Spread of Influenza

The **State and Territorial Epidemiologists Report,** a weekly estimate of the geographic spread of influenza activity in each jurisdiction, was suspended for the 2020-21 influenza season due to the ongoing COVID-19 pandemic which impacted the data systems used to generate the estimates. After discussions with public health partners during the summer of 2021, the decision was made to permanently retire this surveillance component due in part to the fact that the systems used to determine the level of spread remain significantly altered. Additionally, it was determined that a measure of geographic spread was not necessary any more given the advances of other influenza surveillance system components in recent years. Data from previous seasons will remain available on FluView Interactive.

Influenza Surveillance Considerations

It is important to remember the following about influenza surveillance in the United States.

- All influenza activity reporting by public health partners and health-care providers is voluntary.
- The reported information answers the questions of where, when, and what influenza viruses are circulating. It can be used to determine if influenza activity is increasing or decreasing but it does not directly provide the number of influenza illnesses. For more information regarding how CDC classifies influenza severity and the disease burden (number of illnesses, hospitalizations and deaths) of influenza, please see Disease Burden of Influenza.
- The national influenza surveillance system consists of nine complementary surveillance components in five categories. These components include reports from more than 350 laboratories, approximately 3,000 outpatient health care providers, vital statistics offices and the National Center for Health Statistics, research and healthcare personnel at FluSurv-NET sites, hospitals, long-term care facilities and influenza surveillance coordinators and state epidemiologists from all state, local, and territorial health departments.
- Influenza surveillance data are aggregated according to the week the event (e.g., positive laboratory test, outpatient visits, death) occurred. The week starts on Sunday and ends on the following Saturday. Each surveillance participant is requested to report their data to CDC by Tuesday afternoon of the following week. The data are then downloaded, compiled, and analyzed at CDC. FluView and FluView Interactive are updated weekly each Friday.
- The reporting period for each influenza season begins during *Morbidity and Mortality Weekly Report*(MMWR) week 40 and ends week 39 of the following year. MMWR weeks refer to the sequential numbering of weeks (Sunday through

Saturday) during a calendar year. This means that the exact start of the new influenza surveillance season varies slightly from season to season. The 2021-2022 influenza season begins October 3, 2021, and ends on October 1, 2022.

- “Flu season” — as determined by elevated flu activity – also varies from season to season. During most seasons, activity begins to increase in October, most often peaks between December and February and can remain elevated into May. The flu season is said to have started after consecutive weeks of elevated flu activity is registered in the various CDC influenza surveillance systems.

Page last reviewed: August 17, 2022