

Influenza 101: Flu Basics and Surveillance Systems



Last updated: October 2016

Outline

- Influenza Virology
- Influenza Disease
- Overview of Influenza Surveillance
 - Levels of Influenza Surveillance
 - Components of Influenza Surveillance
 - Mortality
 - Morbidity
 - Viral

FLU VIROLOGY AND COMMON LAB TESTS

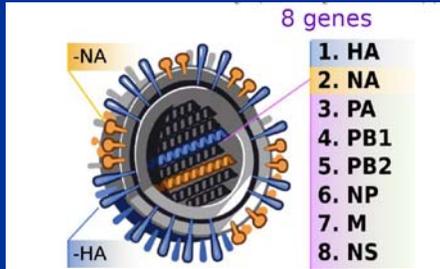
Flu Virus Types

- Influenza A
- Influenza B
- Influenza C
- Influenza D



Influenza Virus Structure

- HA = hemagglutinin
- NA = neuraminidase



Influenza A Subtypes: Species Affected

| Hemagglutinin | | | | |
|---------------|--------|---------|------|------------|
| SubType | People | Poultry | Pigs | Bats/Other |
| H1 | 👤 | 🐔 | 🐷 | |
| H2 | 👤 | 🐔 | 🐷 | |
| H3 | 👤 | 🐔 | 🐷 | 🦇 |
| H4 | | 🐔 | 🐷 | 🦇 |
| H5 | 👤 | 🐔 | 🐷 | |
| H6 | 👤 | 🐔 | 🐷 | |
| H7 | | 🐔 | 🐷 | 🦇 |
| H8 | 👤 | 🐔 | 🐷 | |
| H9 | 👤 | 🐔 | 🐷 | |
| H10 | 👤 | 🐔 | 🐷 | |
| H11 | 👤 | 🐔 | 🐷 | |
| H12 | 👤 | 🐔 | 🐷 | |
| H13 | 👤 | 🐔 | 🐷 | |
| H14 | 👤 | 🐔 | 🐷 | |
| H15 | 👤 | 🐔 | 🐷 | |
| H16 | 👤 | 🐔 | 🐷 | |
| H17 | 👤 | 🐔 | 🐷 | 🦇 |
| H18 | 👤 | 🐔 | 🐷 | 🦇 |

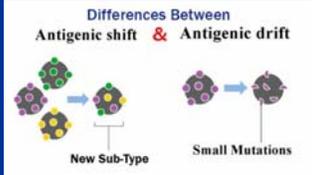
| Neuraminidase | | | | |
|---------------|--------|---------|------|------------|
| SubType | People | Poultry | Pigs | Bats/Other |
| N1 | 👤 | 🐔 | 🐷 | |
| N2 | 👤 | 🐔 | 🐷 | |
| N3 | | 🐔 | 🐷 | |
| N4 | | 🐔 | 🐷 | |
| N5 | | 🐔 | 🐷 | |
| N6 | 👤 | 🐔 | 🐷 | |
| N7 | 👤 | 🐔 | 🐷 | 🦇 |
| N8 | | 🐔 | 🐷 | 🦇 |
| N9 | 👤 | 🐔 | 🐷 | |
| N10 | | 🐔 | 🐷 | 🦇 |
| N11 | | 🐔 | 🐷 | 🦇 |

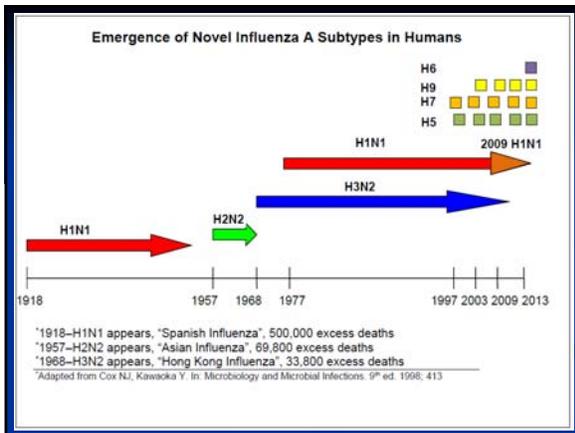
Subtypes and Lineages

- Influenza A subtypes
 - Seasonal/regularly circulate in humans:
 - H1N1
 - H3N2
 - Novel/variant:
 - H5N1, H7N9, H3N2v, etc.
 - Usually don't infect people
- Influenza B lineages – little to no cross-protection
 - Yamagata
 - Victoria

Antigenic Changes

- Antigenic drift
 - Small changes to the flu virus that happen slowly over time
 - Reason flu vaccine has yearly strain changes
- Antigenic shift
 - Flu A viruses only
 - Dramatic change resulting in novel subtype
 - Can lead to pandemics





BRIEF INTRODUCTION TO LAB TESTING FOR FLU

Lab Testing – Rapid Flu Tests

- Very rapid tests
- Can detect flu types only
- Accuracy Depends Upon Prevalence
 - False-positive (and true-negative) flu test results are more likely to occur when disease prevalence is low
 - False-negative (and true-positive) influenza test results are more likely to occur when disease prevalence is high
- Rapid tests should be not considered confirmatory
 - Outbreak? Suspected novel virus? Severe case? – use PCR for confirmatory testing

Lab Tests – PCR and culture

- Gold standard tests, preferred
- Culture
 - Detects virus capable of causing infection (type, subtype, lineage)
 - Results in days to a week
- PCR
 - Detects virus (type, subtype, lineage)
 - Results in hours
 - DSHS Austin (state lab) and all TX Laboratory Response Network labs do PCR testing for influenza (both seasonal and novel strains), year-round

INFLUENZA DISEASE

Flu's Impact

- An estimated 5%-20% of population gets the flu each year

It has been estimated that each year in the United States, flu results in:

- 31.4 MILLION** missed work days (Madden 08, et al. Influenza 02 2008)
- About 200,000 HOSPITALIZATIONS** (Madden 08, et al. Influenza 02 2008)
- More than \$87 BILLION** in total economic burden (Madden 08, et al. Influenza 02 2008)
- Between 3,000 & 49,000 DEATHS** (Madden 08, et al. Influenza 02 2008)

Flu is a respiratory disease, not a stomach flu. It is caused by influenza viruses, not *Haemophilus influenzae*.

Influenza illness

- Respiratory disease caused by influenza (flu) viruses
 - Not the "stomach flu"
 - Not caused by *Haemophilus influenzae*
- Symptoms: fever, cough, sore throat, runny nose, muscle aches, headaches, fatigue
 - Sometimes GI symptoms

Transmission



- Transmission: droplet spread (e.g., coughing), direct contact (e.g., kissing), contaminated surfaces
- Incubation period: average of 2 days (range: 1-4 days)
- Communicability:
 - Infected persons can transmit virus 1 day before symptoms begin
 - Viral shedding greatest in first 3-5 days of illness
 - Kids, immunocompromised shed longer

Risk Groups for Flu Complications

- <5 years of age
- ≥65 years of age
- Persons with chronic pulmonary, cardiovascular, endocrine, renal, hepatic, neurologic, hematologic or metabolic disorders
- Immunosuppressed persons
- Pregnant or postpartum women
- <19 years of age and receiving long-term aspirin therapy
- Residents of nursing homes/LTCFs
- Persons with morbid obesity (BMI ≥40)
- American Indians and Alaskan Natives

Antiviral Medications

- Adamantanes – Problems with antiviral resistance

- Neuraminidase inhibitors

- Oseltamivir (Tamiflu)
- Zanamivir (Relenza)
- Peramivir, IV only (Rapivab)



Flu Vaccine Production



Flu Vaccine

- Vaccines are either trivalent or quadrivalent
 - Trivalent: influenza A (H1N1) strain, influenza A (H3N2) strain, one influenza B lineage
 - Quadrivalent: same as trivalent, plus the second influenza B lineage
- Two main options for route:
 - Injectable
 - Nasal spray: *not available in 2016*
- Several formulations/options: standard dose, high-dose, recombinant egg-free, intradermal, etc.
- Recommended annually for everyone 6 months of age and older without a contraindication

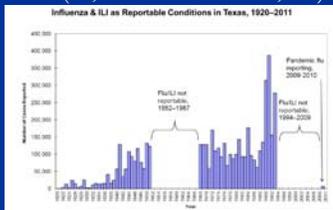
FLU REPORTING AND SURVEILLANCE

Key Term: ILI

- Influenza-like Illness (ILI)
 - Fever $>100^{\circ}\text{F}$, plus:
 - Cough and/or
 - Sore throat
 - In the absence of another known cause other than influenza

What's Reportable in Texas

- Novel influenza A cases in humans
- Pediatric flu deaths
 - Deaths associated with influenza in person < 18 years
- Outbreaks (flu, influenza-like illness, etc.)



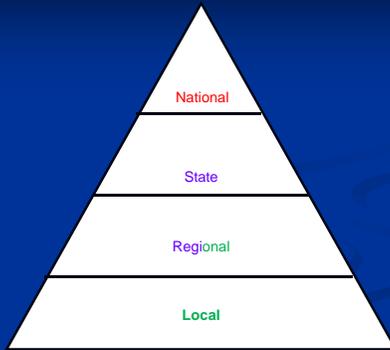
Influenza Surveillance

- The Influenza Surveillance System is a multi-component surveillance network with local, regional, state and national activities.
- Data collection is based on a reporting week that starts on Sunday and ends on Saturday of each week.
 - Designated as Week 32 or week ending 9/05
 - aka CDC MMWR week
 - Flu surveillance season: week 40 to week 20
- Reporting is voluntary except where noted

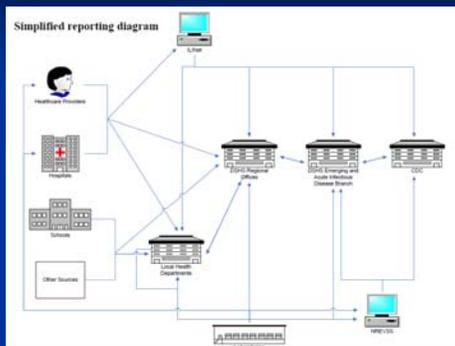
Goals of Influenza Surveillance

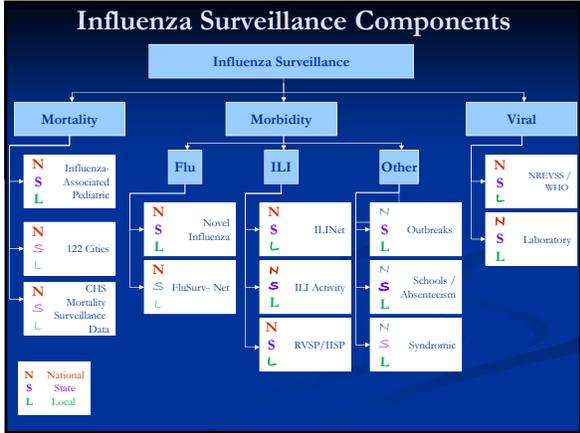
- Find out when and where influenza activity is occurring,
- Determine what type of influenza viruses are circulating,
- Detect changes in the influenza viruses,
- Track influenza-related illness and
- Measure the impact influenza is having on deaths in the United States.

Levels of Influenza Surveillance



Flow of Surveillance Data







Influenza-Associated Pediatric Mortality

- **Activity:** Influenza-Associated Pediatric Mortality
- **Level:** National (2004); state, regional and local (2007)
- **Who:** As required by law in Texas
- **What:** Individual reports on influenza associated deaths in anyone <18 years old
- **How:** Individual report form faxed to health department within 1 work day

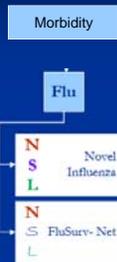
Year Round Reporting

Center for Health Statistics (CHS) Mortality Surveillance Data

- Activity: Pneumonia and Influenza (P&I) Mortality Surveillance
- Level: National and State
- Who: Vital Statistics offices across the US (including Texas) & CHS offices (National and state)
- What: P&I death percentages at the national level and total number of P&I deaths of Texas residents at the state level
- How: Vital Statistic offices send death certificate data to National CHS office who then sends death certificate data back to the state CHS office who then sends a weekly P&I death report to the State Influenza Coordinator

Year Round Reporting

Morbidity - Influenza



Novel/Variant Influenza

- Activity: Novel Influenza reporting
- Level: State, regional and local
- Who: As required by law in Texas; typically laboratories
 - Note: Only public health labs can confirm a novel/variant flu infection
- What: Individual reports on patients with influenza that is confirmed by a laboratory to be novel or variant
- How: Call to local health department

Year Round Reporting

Special Reporting

FluSurv-NET

- **Activity:** Flu expansion of Emerging Infections Program
- **Level:** National
- **Who:** Select hospitals in 13 states; no participating sites in Texas
- **What:** lab confirmed influenza in hospitalized people <18 years old and adults
- **How:** Directly to CDC

Seasonal Reporting

Morbidity - ILI

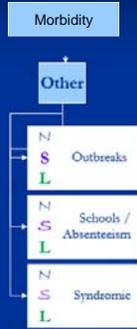


ILINet

- **Activity :** US Outpatient Influenza-Like Illness Surveillance Network
- **Level:** National with a state level coordinator
- **Who:** Over 2,900 providers are enrolled in this network; 176 were in Texas for the 2015-2016 flu season
- **What:** Aggregate count all patients seen and of ILI patients by age group
- **How:** Reported weekly through the CDC website

Year Round Reporting

Morbidity - Other



Outbreaks

- **Activity :** Outbreak reporting
- **Level:** Local, regional, state
- **Who:** As required by law
- **What:** Report of suspected outbreak or cluster of illness
- **How:** Call to health department ; Surveillance data analysis

Year Round Reporting

School Surveillance

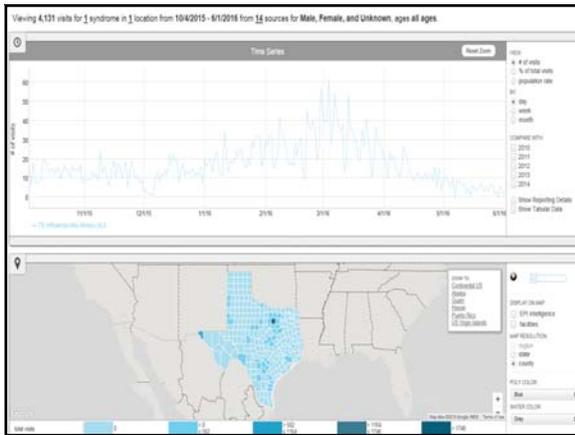
- **Activity :** Varies
- **Level:** Regional and local
- **Who:** School nurses and/or attendance clerks
- **What:** number of students sent home with ILI and/or who called in sick with ILI or absenteeism in general
- **How:** Faxed or emailed weekly to health department; some electronic systems are available

Seasonal Reporting

Syndromic Surveillance

- **Activity** : Syndromic programs: ESSENCE, RODS, BioSense, etc.
- **Level**: Regional and local
- **Who**: Hospitals with emergency rooms
- **What**: emergency room visits categorized by syndrome, age, zip code, date (de-identified)
- **How**: Electronic data automatically sent from hospital to syndromic servers. Frequency of reports may occur hourly, daily or weekly.

Year Round Reporting



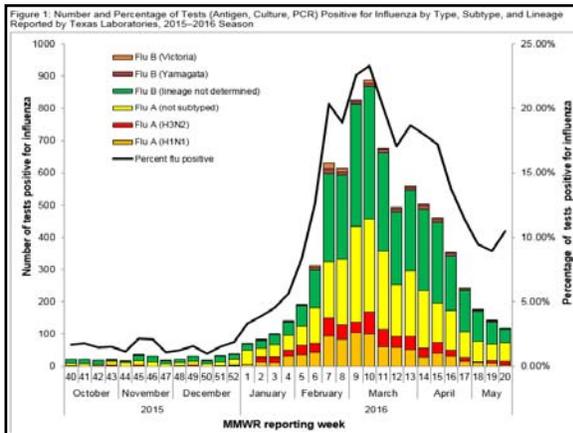
Viral Surveillance



NREVSS / WHO

- **Activity :** National Respiratory and Enteric Virus Surveillance System and WHO Collaborating Labs
- **Level:** National coordination
- **Who:** Volunteer public health and hospital laboratories
- **What:** Total number of respiratory specimens tested and number of positives
- **How:** Reported weekly to CDC
- **Note:** Tracks multiple respiratory pathogens. Not all labs report all pathogens.

Year Round Reporting



Laboratory Surveillance

- **Activity :** Influenza Laboratory Surveillance (PCR)
- **Level:** State, regional, and local coordination
- **Who:** Selected providers
 - Identified by health departments
 - May include ILINet providers
- **What:** Specimens from patients suspected of having influenza
- **How:** Specimens sent to the DSHS lab or Texas LRNs
- **Note:** Subset of submitted specimens sent every two weeks to CDC for further testing

Year Round Reporting

RESOURCES

Reporting

- Flu reports
 - DSHS flu reports and information:
 - www.TexasFlu.org
 - www.dshs.state.tx.us/idcu/disease/influenza/
 - CDC FluView: www.cdc.gov/flu/weekly/

DSHS Flu Surveillance Workshop

- Annual meeting of Texas regional and local influenza surveillance coordinators and public health laboratorians
- Held in Austin during the summer
- 2017 will be the 10th year
- Topics:
 - Flu surveillance methods
 - Laboratory testing
 - Outbreak response
 - Etc.

Outbreak Resources

- DSHS Flu Surveillance Handbook
- CDC infection control for healthcare facilities:
<http://www.cdc.gov/flu/professionals/infectioncontrol/index.htm>
- Unexplained Respiratory Outbreaks: <https://www.cdc.gov/urdo/>



Flu Vaccine Resources

- DSHS Immunization Unit flu vaccine information:
<https://www.dshs.texas.gov/immunize/flu.shtm>
- CDC vaccine FAQ page:
<http://www.cdc.gov/flu/protect/keyfacts.htm>
- CDC vaccine supply:
<http://www.cdc.gov/flu/about/qa/vaxsupply.htm>
- HealthMap vaccine finder: <https://vaccinefinder.org/>

Novel Influenza Resources

- EAIDB Investigation Guidelines, Novel/variant flu chapter
- CDC Avian Influenza:
<http://www.cdc.gov/flu/avianflu/healthprofessionals.htm>
 - Infection control
 - Laboratory guidance
 - Treatment and prophylaxis (including close contacts)
 - Case definitions:
 - H5N1: <http://www.cdc.gov/flu/avianflu/h5n1/case-definitions.htm>
 - Other H5 infections: <http://www.cdc.gov/flu/avianflu/hpai/case-definitions.htm>
 - H7N9: <http://www.cdc.gov/flu/avianflu/h7n9/case-definitions.htm>

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Questions?

- Email comments, feedback, and suggestions to flutexas@dshs.state.tx.us
- Thank you for your participation!
- Pdf of presentation posted at <http://www.dshs.texas.gov/idcu/disease/influenza/links/>, under the heading "DSHS Influenza Resources"
