Influenza: The Current Epidemic, Pandemic Preparedness and the Universal Flu Vaccine

Dr. Bruce Gellin, M.D., M.P.H.
President, Global Immunization
Sabin Vaccine Institute

February 13, 2018
INSTRUCTIONS

• All participants will be muted so please use the Q&A functionality to ask questions during the presentation

• Questions will be anonymous and answered at the conclusion of the presentation

• A recording will be available on the IAIM Network website and in the February issue of the IAIM Network newsletter
Dr. Bruce Gellin, MD, MPH, is President, Global Immunization at the Sabin Vaccine Institute. Dr. Gellin previously served as the Deputy Assistant Secretary for Health and Director of the National Vaccine Program Office at the U.S. Department of Health and Human Service, where he was the principal advisor to the Assistant Secretary for Health on vaccine and immunization programs and policies.
OVERVIEW

• The 2017-2018 flu season in the Northern Hemisphere
• Performance of seasonal flu vaccines
• What does seasonal influenza teach us about pandemic preparedness?
• Updates on research toward a universal flu vaccine
• Questions
Key Terms
INFLUENZA BASICS

- 3-5 million cases of severe illness/year
- 250,000-500,000 deaths/year
- 3 types of seasonal influenza virus

<table>
<thead>
<tr>
<th>Type</th>
<th>Epidemiology</th>
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<tbody>
<tr>
<td>Influenza A</td>
<td>Found in humans and animals; known to cause pandemics</td>
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<tr>
<td>Influenza B</td>
<td>Only found in humans; generally less severe infections</td>
</tr>
<tr>
<td>Influenza C</td>
<td>Detected infrequently; causes mild infections</td>
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Source: WHO Factsheet (http://www.who.int/mediacentre/factsheets/fs211/en/)
THE FLU VIRUS

Source: CDC
INFLUENZA VIRUS GROUPS

Group 1

Group 2
A/Hong Kong/4801/2014 (H3N2)-like virus

- Type of host (human, avian, swine…)
- Geographical region of origin
- Number of lineage
- Year of isolation
- Protein antigen type, described by letter and number
Antigenic Drift
Small changes in the genes of influenza viruses that happen continually over time as the virus replicates.

Antigenic Shift
An abrupt, major change in the influenza A viruses, resulting in new hemagglutinin and/or new hemagglutinin and neuraminidase proteins that are different from the same subtype in humans that most people do not have immunity to the new (e.g. novel) virus.
Global Influenza Surveillance
SURVEILLANCE

Global Influenza Surveillance and Response System (GISRS)
• Monitors the evolution of influenza viruses and provides recommendations on diagnostics and vaccines
• Global alert mechanism for the emergence of viruses with pandemic potential
• Institutions in 114 WHO Member States

FluNet - Global web-based tool for influenza virological surveillance

FluID – Global influenza epidemiological data sharing platform; qualitative and quantitative data to track trends

Source: http://www.who.int/influenza/surveillance_monitoring/en/
Influenza Laboratory Surveillance Information
by the Global Influenza Surveillance and Response System (GISRS)

Global circulation of influenza viruses

Number of specimens positive for influenza by subtype

Data source: FluNet (www.who.int/flunet), GISRS
The 2017-2018 Flu Season
Weekly Influenza Activity Estimates Reported by State & Territorial Epidemiologists*

Week ending February 3, 2018 - Week 5

* This map indicates geographic spread & does not measure the severity of influenza activity.
FluView
A Weekly Influenza Surveillance Report Prepared by the Influenza Division

Influenza Positive Tests Reported to CDC by U.S. Clinical Laboratories, National Summary, 2017-2018 Season

The chart shows the number of positive specimens and percent positive for influenza A and B strains from 2017/18 to 2018/19. The number of positive specimens for influenza A and B strains increased significantly during the season, with peaks in the later weeks. The percent positive for both strains also increased during the season, with a peak in the later weeks. The chart is color-coded to distinguish between influenza A (yellow) and influenza B (green) strains.
WHO: Many nations report brisk flu activity, with influenza B rising

Most countries with flu seasons under way are reporting moderate levels compared with past seasons, with some reporting hospitalization and intensive care unit admission levels at or above earlier seasons, the World Health Organization (WHO) said yesterday in its latest global flu update.

And while H3N2 is still the predominant strain, the proportion of influenza B is gaining, a pattern seen in the latter part of flu seasons, though several Northern Hemisphere countries have reported early, brisk influenza B activity.
INFLUENZA IN EUROPE - WEEK 4
(22-28 JANUARY 2018)

Influenza viruses circulating in 2017–2018
Only sentinel specimens are included

Subtype A(H1N1) 15.7%
Type B/Victoria 0.9%
Type B/Yamagata 28%
Type B no lineage 38.8%
Type A unsubtyped 9.1%

Influenza intensity in week 4
based on sentinel reports of influenza-like illness and/or acute respiratory infections

Bubble size is indicative of country population

Influenza trend
based on the percentage of sentinel specimens found positive, by week

2016–2017
2017–2018

Source: ECDC
Percentage of respiratory specimens that tested positive for influenza
By influenza transmission zone

Note: The available country data were joined in larger geographical areas with similar influenza transmission patterns to be able to give an overview. The displayed data reflect reports of the week from the 25 December 2017 to 07 January 2018, or up to two weeks before if not sufficient data were available for that area.

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: Global Influenza Surveillance and Response System (GISRS), FluNet (www.who.int/influenza)
CURRENT VACCINE RECOMMENDATIONS

Strategic Advisory Group of Experts (SAGE) on Immunization - 2012

- Pregnant women are the highest priority group for vaccination
- Based on local circumstances, countries should consider annual vaccination among the following groups:
  - Healthcare workers
  - Children (<2 years, 2-5 years)
  - The elderly
  - Individuals with underlying health conditions
- Countries should decide relative priority of these groups

Source: http://www.who.int/influenza/vaccines/SAGE_information/en/
Performance of Seasonal Influenza Vaccines
MATCH
SEASONAL FLU VACCINE EFFECTIVENESS

Figure. Effectiveness of Seasonal Flu Vaccines from the 2004-2017 Flu Seasons

Source: https://www.cdc.gov/flu/professionals/vaccination/effectiveness-studies.htm
Influenza Vaccine Manufacturing
Annual Influenza Vaccine US Supply Timeline

- **Strain Selection** (March)
  - CDC
  - FDA
  - WHO

- **Surveillance & Reassortants**

- **Production (at risk)**
  - Production
  - (may be at risk)

- **Production**
  - Produce Working Seed
  - Production
  - Production

- **Strain Balancing**

- **Formulation**

- **Filling & Packaging**

- **Annual License Approval**

- **Vaccination**

- **Distribution**

- **Limited time (≈6 months) to supply vaccine:** delaying strain selection will impact vaccine distribution schedules

FDA Advisory Committee, March 2017
STRAIN SELECTION

• Annual composition of influenza vaccines is determined separately for northern and southern hemispheres
• Average vaccine development time is 5-6 months
• Decision is made 6 months before the flu season begins
  • Northern hemisphere – February
  • Southern Hemisphere – September
The flu vaccine is only 10 percent effective this year. Blame eggs.

The way we make vaccines isn’t a good match for the virus type circulating this year.

By Julia Belluz | @juliaoftoronto | julia.belluz@voxmedia.com | Updated Feb 2, 2018, 8:48am EST

- Adaptive mutations increase viral attachment to chicken cells
- Hemagglutinin mutation in current egg-adapted H3N2 strain alters antigenicity
- In response to vaccine, humans (and ferrets) produce antibodies that poorly neutralized H3N2 viruses circulating in 2016-2017
Influenza Vaccine: Implications for Pandemic Preparedness
THE RACE BETWEEN THE VIRUS AND THE VACCINE, 2009-2010

The Virus

The Vaccine
GLOBAL VACCINE DISTRIBUTION BY WHO 2009-2010

Figure 7. Monthly vaccine deliveries made through the WHO Deployment Initiative

Source: http://www.who.int/influenza_vaccines_plan/resources/h1n1_deployment_report.pdf
The Search for a Universal Flu Vaccine
The Pathway to a Universal Influenza Vaccine

Catharine I. Paules,¹ Hilary D. Marston,¹ Robert W. Eisinger,¹ David Baltimore,² and Anthony S. Fauci¹,*
¹Office of the Director, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD 20892, USA
²California Institute of Technology, Pasadena, CA 91125, USA
*Correspondence: afauci@niaid.nih.gov
https://doi.org/10.1016/j.immuni.2017.09.007

Development of a universal influenza vaccine is a research priority for the National Institute of Allergy and Infectious Diseases (NIAID) at the National Institutes of Health. To facilitate this goal, we convened a workshop in Rockville, Maryland to identify knowledge gaps in influenza research and develop strategies to fill them.
REACHING THE GOAL OF A UNIVERSAL FLU VACCINE

A vaccine with:
- $\geq 75\%$ protection against symptomatic disease caused by Group 1 and Group 2 influenza A viruses
- lasting $\geq 12$ months
- in all populations
<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Coverage</th>
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<tr>
<td>Strain-specific</td>
<td>Current circulating strains</td>
</tr>
<tr>
<td>Subtype-specific</td>
<td>All strains within a single HA subtype (e.g., H1)</td>
</tr>
<tr>
<td>Multi-subtype</td>
<td>Multiple HA subtypes within single group (e.g., H1/H5/H9)</td>
</tr>
<tr>
<td>Pan-group</td>
<td>Covering all group 1 or 2</td>
</tr>
<tr>
<td>Universal influenza vaccine</td>
<td>All influenza A ( +/- influenza B )</td>
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</tbody>
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Courtesy Gary Nabel
THE PATHWAY

- Epidemiology, Transmission, Natural History, Pathogenesis
- Preexisting Immunity
- Protective Immune Mechanisms
- Vaccine Platforms
- Diagnostics
- Animal Models
- Human Challenge Model
- Population Based Data (Framingham)
- Standardized Protocols
- Coordination
QUESTIONS

Please use the Q&A functionality to ask your questions.
THANK YOU!

Thank you for attending today’s webinar! We will send you a link to the recorded session and additional resources soon.

Not yet a member of the IAIM Network? Visit iaimanagers.org and sign up today!