

# Novel platform (wEB) to study flu virus evolution and predict vaccine efficacy

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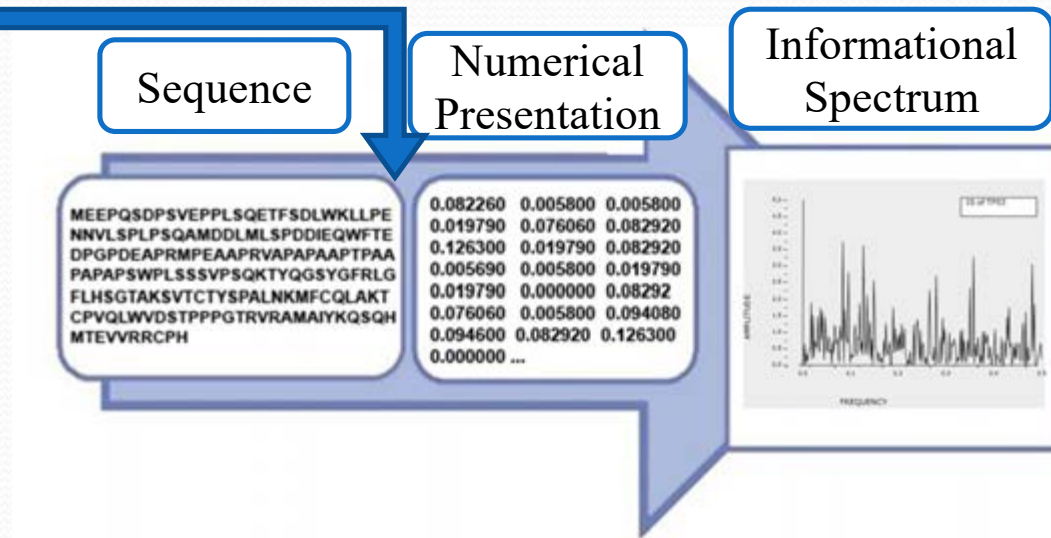




# **EARLY ASSESMENT OF THE EFFECTIVENES OF THE INFLUENZA VACCINE**

# 1. Informational Spectrum Method (ISM)

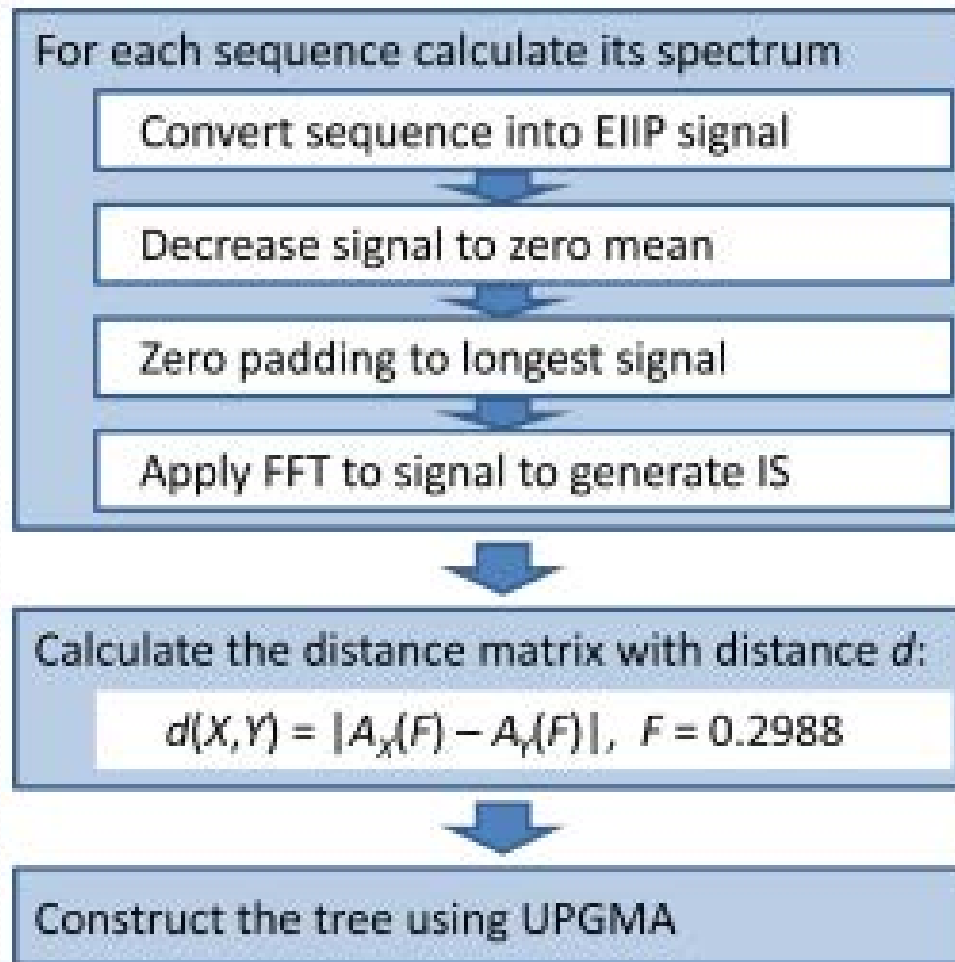
Amino acid	EIIP [Ry]	Amino acid	EIIP [Ry]
Leu	0.0000	Tyr	0.0516
Ile	0.0000	Trp	0.0548
Asn	0.0036	Gln	0.0761
Gly	0.0050	Met	0.0823
Glu	0.0057	Ser	0.0829
Val	0.0058	Cys	0.0829
Pro	0.0198	Thr	0.0941
His	0.0242	Phe	0.0946
Lys	0.0371	Arg	0.0959
Ala	0.0373	Asp	0.1263



- IS correlates with interacting profile, biological properties of proteins
- Mutations which change IS of protein also affect its interacting profile, biological properties

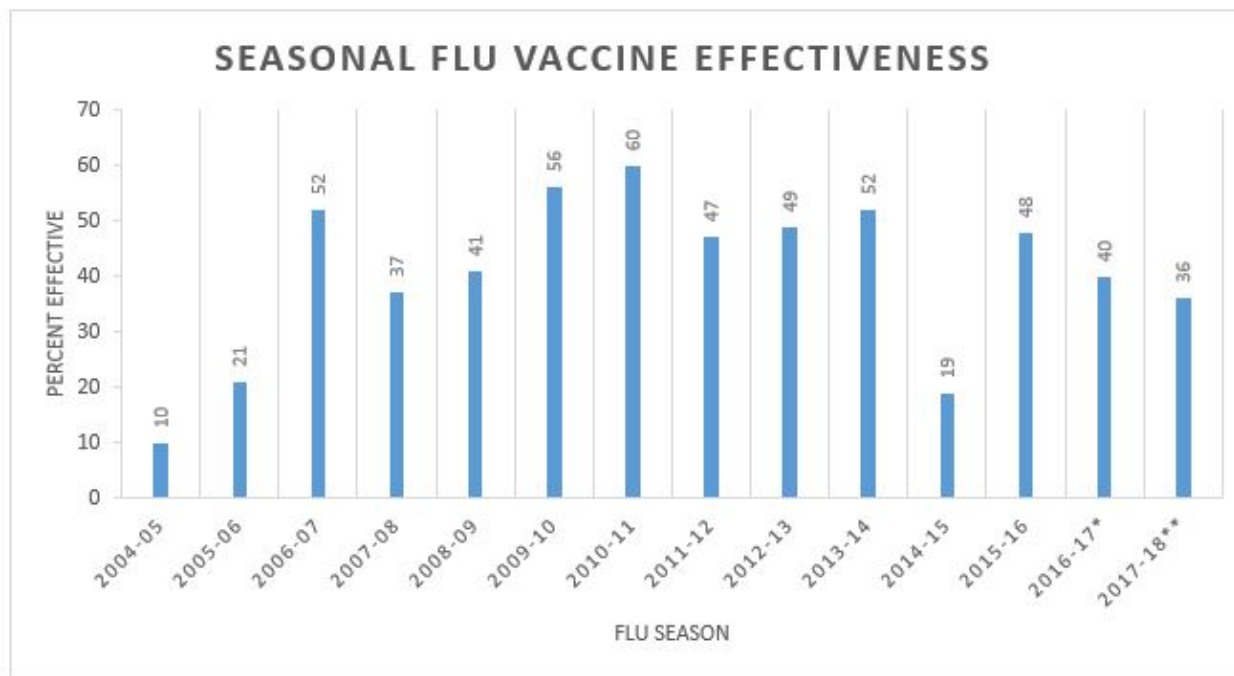


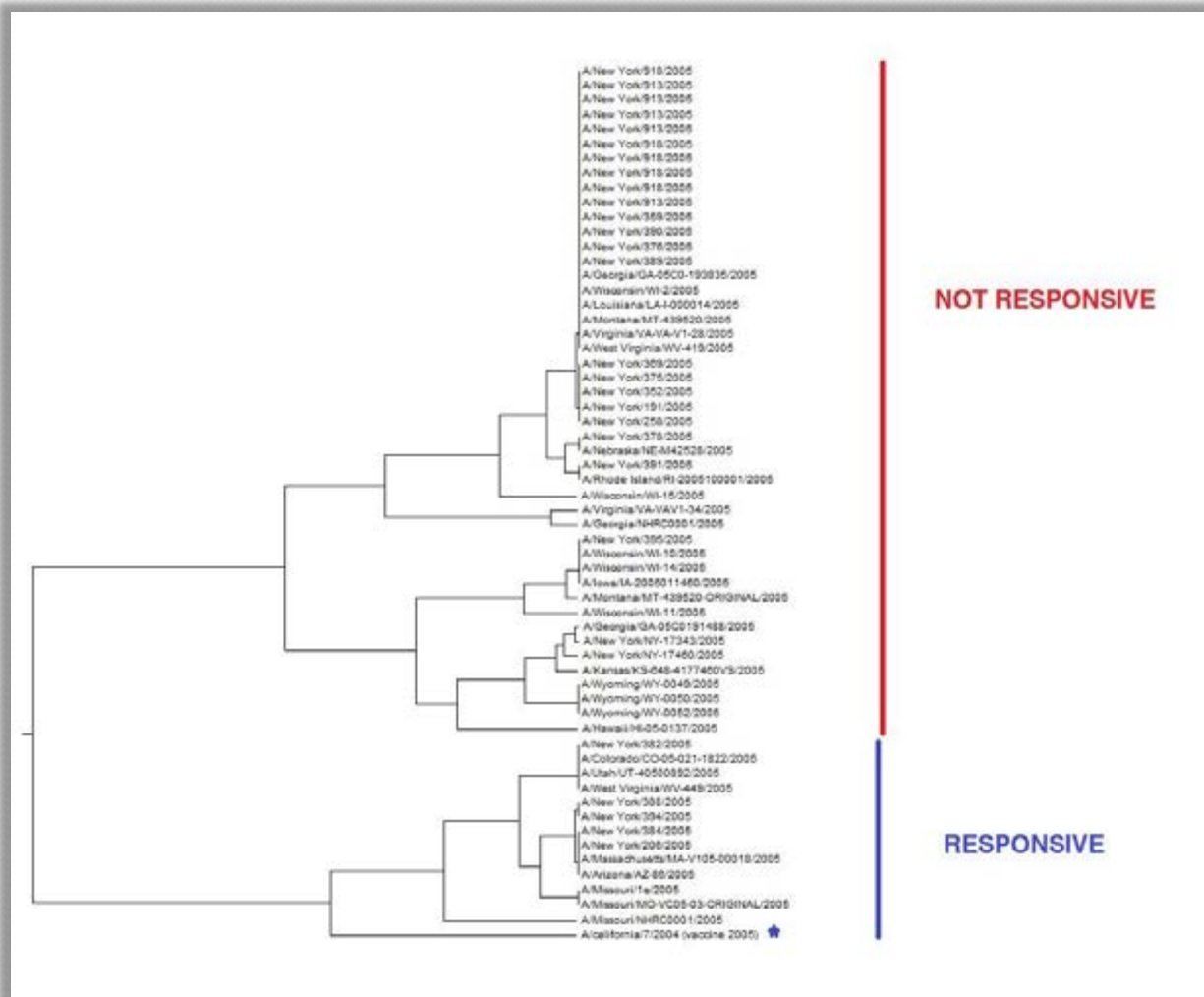
# The schematic presentation the ISM-based phylogenetic algorithm



# The effectiveness of vaccine in the flu season 2004-2005 in USA- retrospective analysis

<https://www.cdc.gov/flu/professionals/vaccination/effectiveness-studies.htm>

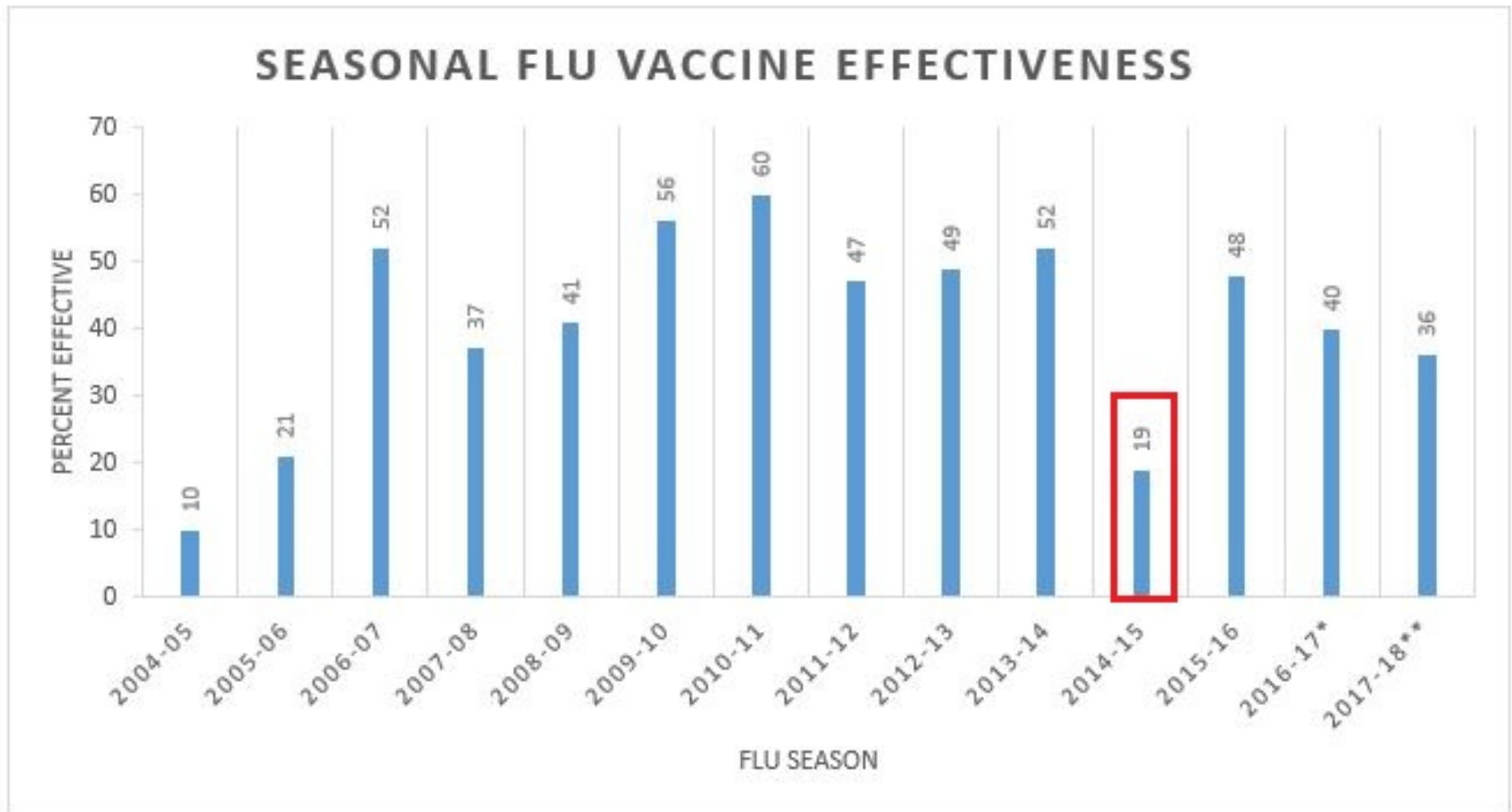




The ISM phylogenetic tree for H3N2 viruses isolated during the peak of the flu season 2005 (GISAID, January 2005)

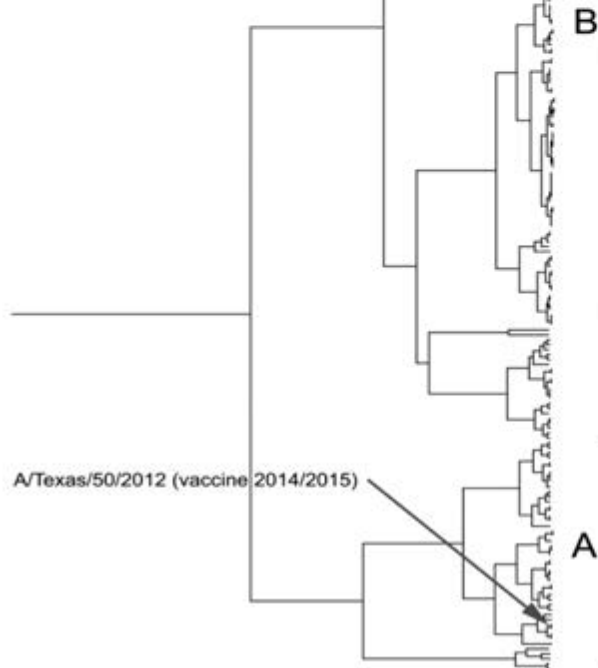


# The effectiveness of vaccine in the flu season 2014-2015 in USA- retrospective analysis



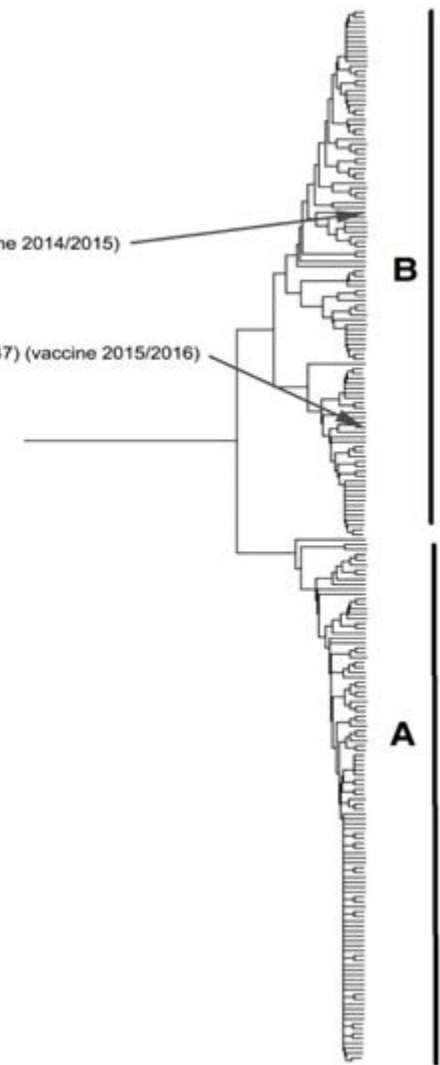
**A**

A/Switzerland/9715293/2013(X-247) (vaccine 2015/2016)

**B**

A/Texas/50/2012 (vaccine 2014/2015)

A/Switzerland/9715293/2013(X-247) (vaccine 2015/2016)

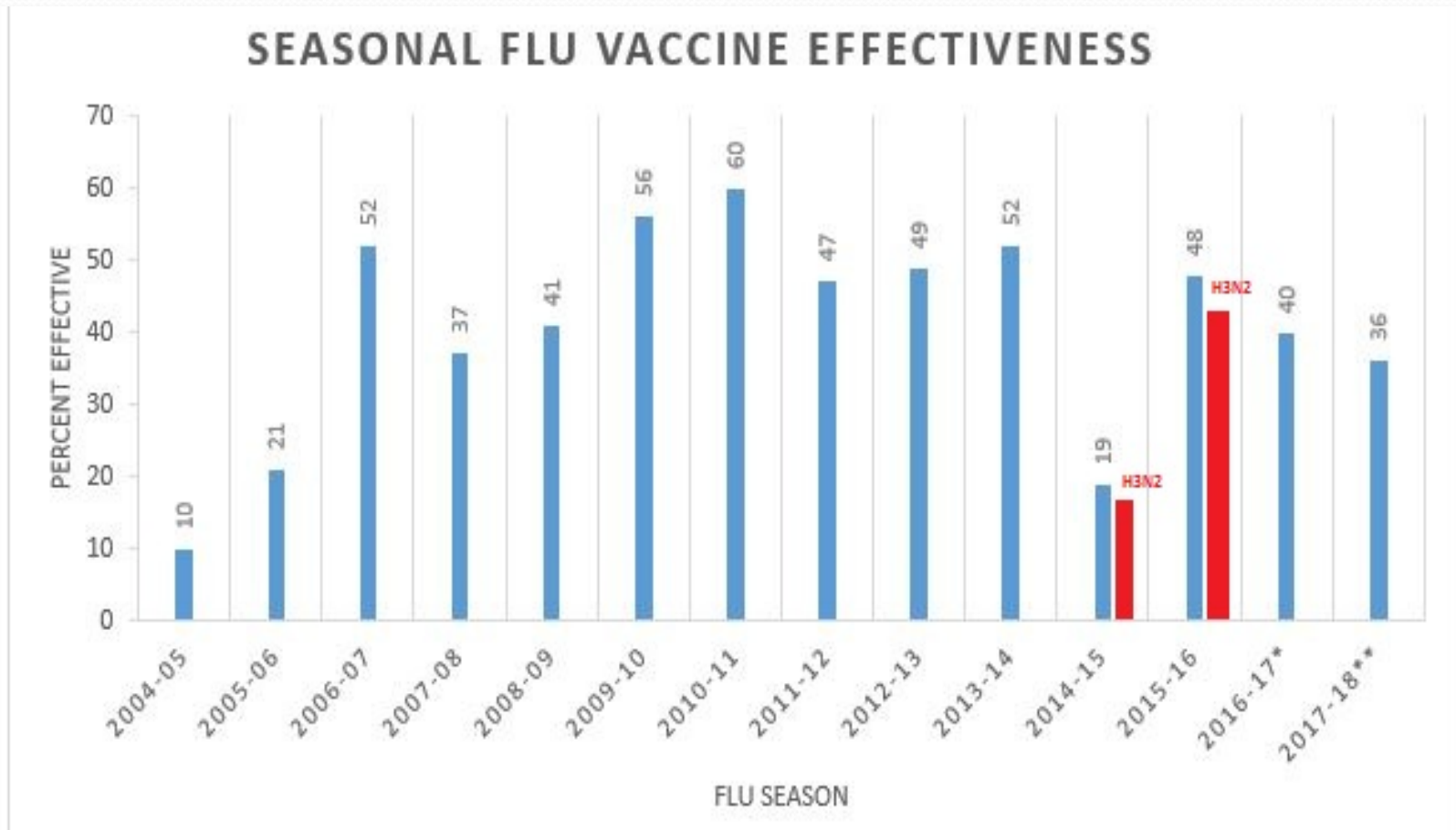


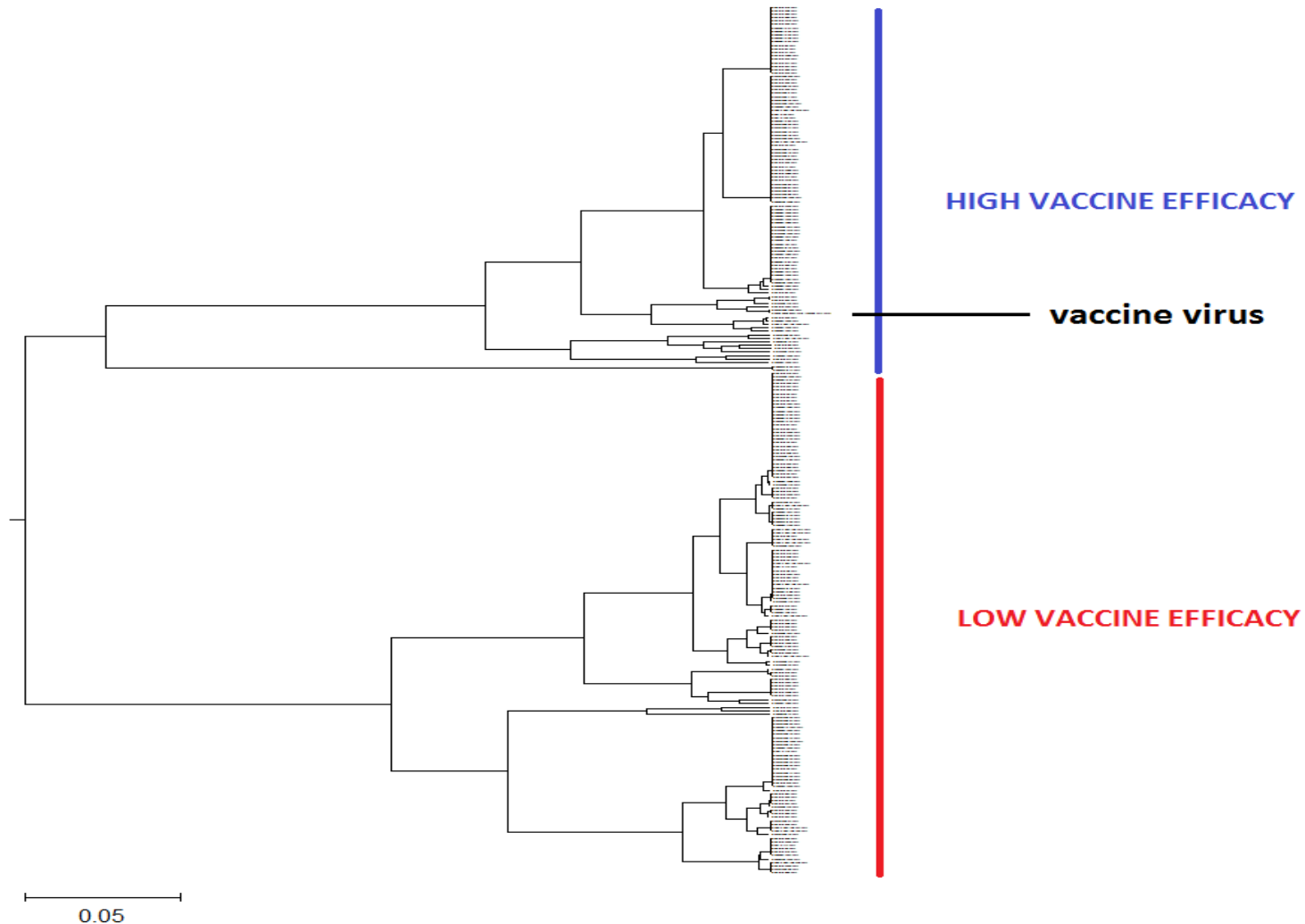
**The phylogenetic analysis of HA1 from 2,379 H3N2 viruses collected in Europe and North America from January 2014 to February 2015**



**The observed high efficacy of vaccine against H3N2 in the flu season 2015-2016 in USA was predicted in September 2015**

*[Frontiers Microbiol 2015; doi: 10.3389/fmicb.2015.01456]*



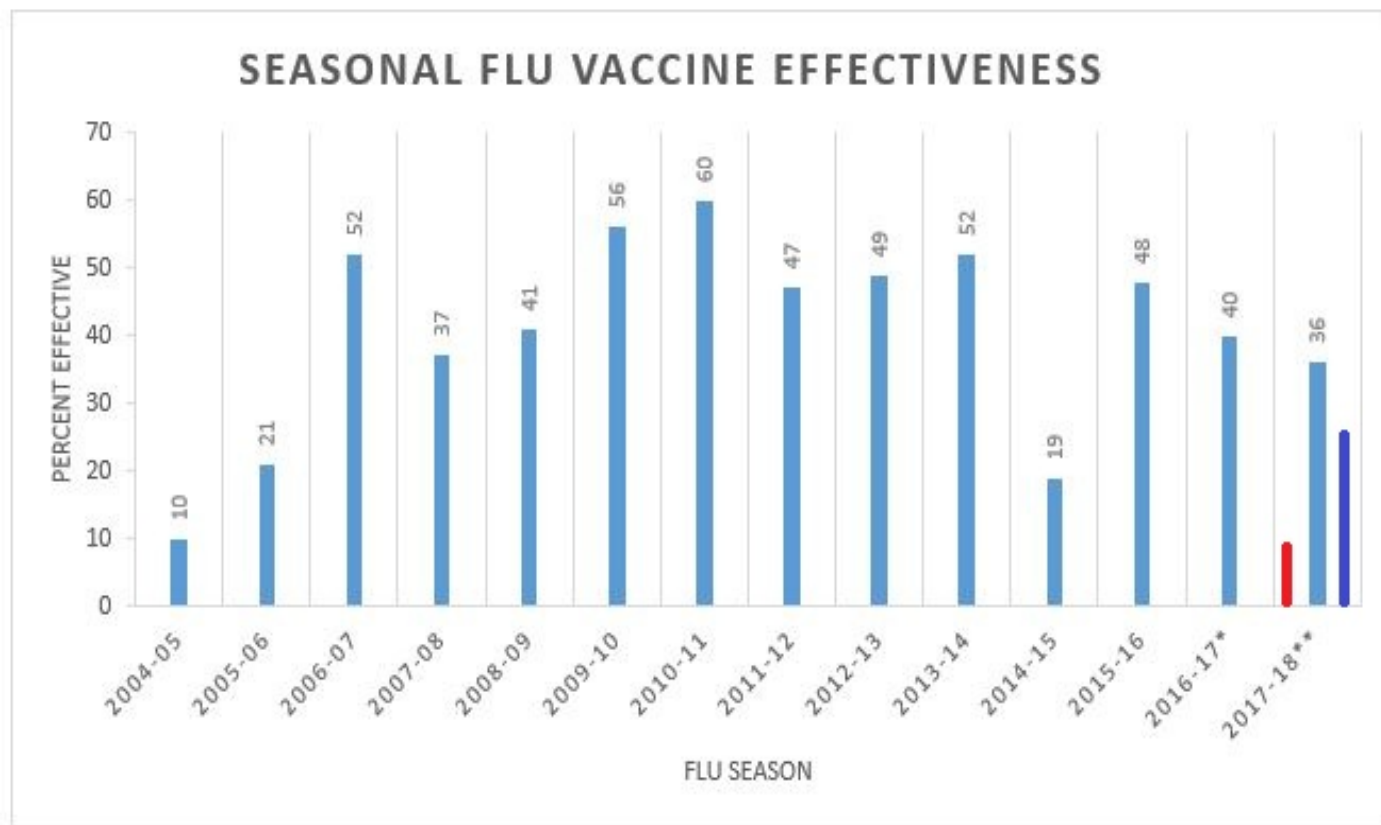


The ISM-based phylogenetic tree of HA from human H3N2 influenza viruses collected in Australia from July to September 2017 suggesting the low effectiveness of vaccine in Australia in the flu season 2017



# The ISM-based phylogenetic tree of HA from human H3N2 influenza viruses collected in US from July to September 2017





**The ISM-based phylogenetic analysis suggested the effectiveness of vaccine against H3N2 in USA for the season 2017-2018 similar to the one in the season 2016-2017**  
[*F1000Research*, November 2017; doi: [10.12688/f1000research.13198.1](https://doi.org/10.12688/f1000research.13198.1)]

The vaccine effectiveness predicted on the base of data from Australian flu season 2017 was 10% for the season 2017-2018 in USA (in red).

[*New Eng J Med*, January 2018; doi: [10.1056/NEJMp1714916](https://doi.org/10.1056/NEJMp1714916)]

The observed vaccine effectiveness in 2017-2018 in USA against H3N2 was 36% for all ages (in blue) and 56% for children.

## How well will the flu vaccine work this winter?

**Date:** December 13, 2017

**Source:** University of Texas Medical Branch at Galveston

**Summary:** Scientists have predicted which H3N2 variants would become 'vaccine resistant', and this prediction has been confirmed during the 2017 Australian flu season. The results published suggest that the current flu vaccine will work better during the 2018 US flu season than the 2017 Australian flu season.

Clinical Topics

# DoD ANALYSIS SHOWS FLU MORE EFFECTIVE THAN EXP 2017


by ANNETTE BOYLE

September 14, 2018

FALLS CHURCH, VA—Predictions that the influenza vaccine would be largely ineffective in the U.S. based on results seen in Australia the previous summer troubled many federal infectious disease specialists going into last year's flu season.

Researchers at a leading National Institute of Allergy and Infectious Diseases (NIAID) laboratory appeared contrarian, expecting the vaccine to perform about as well as usual. Based on reports from the national Centers for Disease Control and Prevention (CDC) and two DoD agencies that track vaccine effectiveness, those researchers were right. That may be cause for greater concern this year, however, flu experts suggested.

In 2017, Australia experienced record-breaking numbers of influenza-related hospitalizations and deaths. Reports indicated that the vaccine used there had at best 10% effectiveness against the dominant A strain of the virus, H3N2. According to a report in Medical Surveillance Monthly Report by DoD researchers, the vaccine's effectiveness against H3N2 in Australia "was not statistically significantly different from zero."<sup>1</sup>

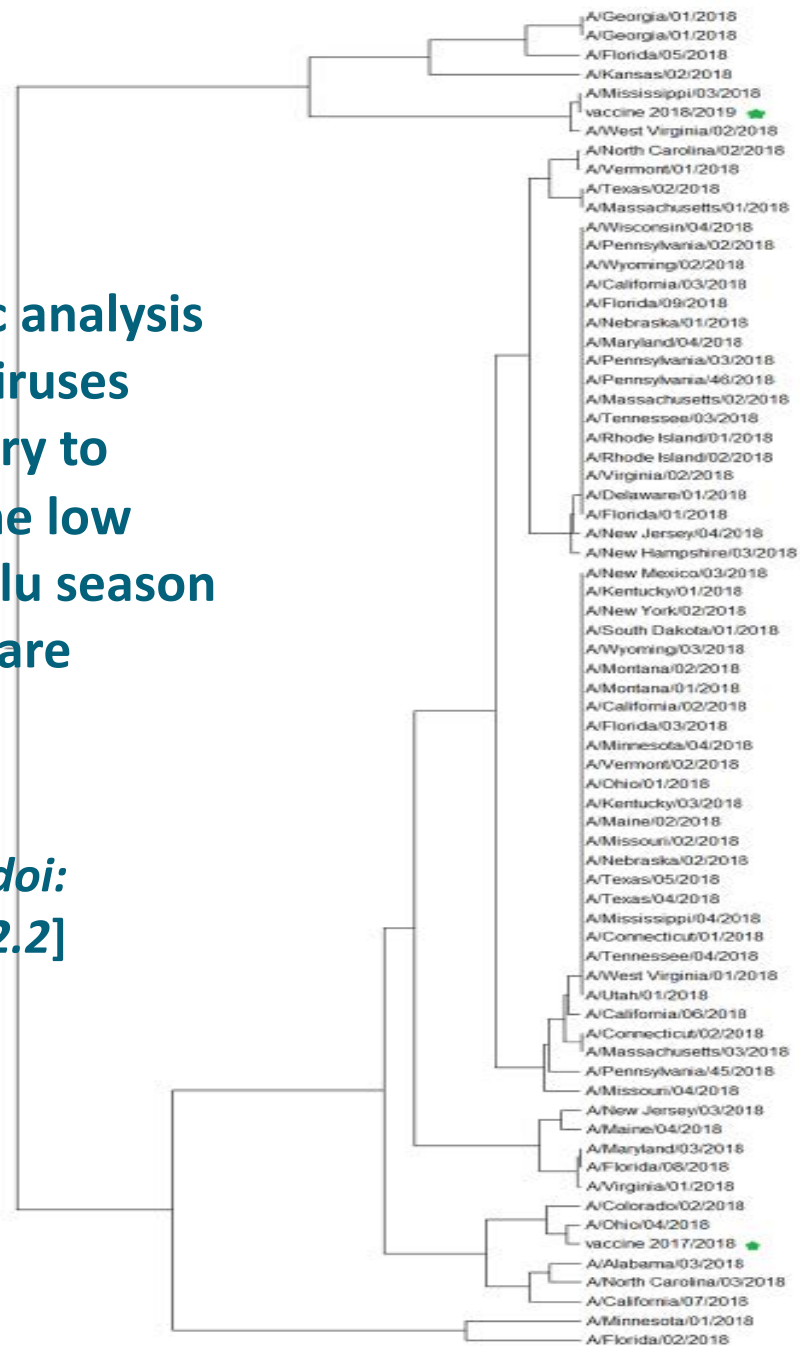


# **Prediction of the vaccine efficacy against H3N2 for the flu season 2018-2019 in USA**

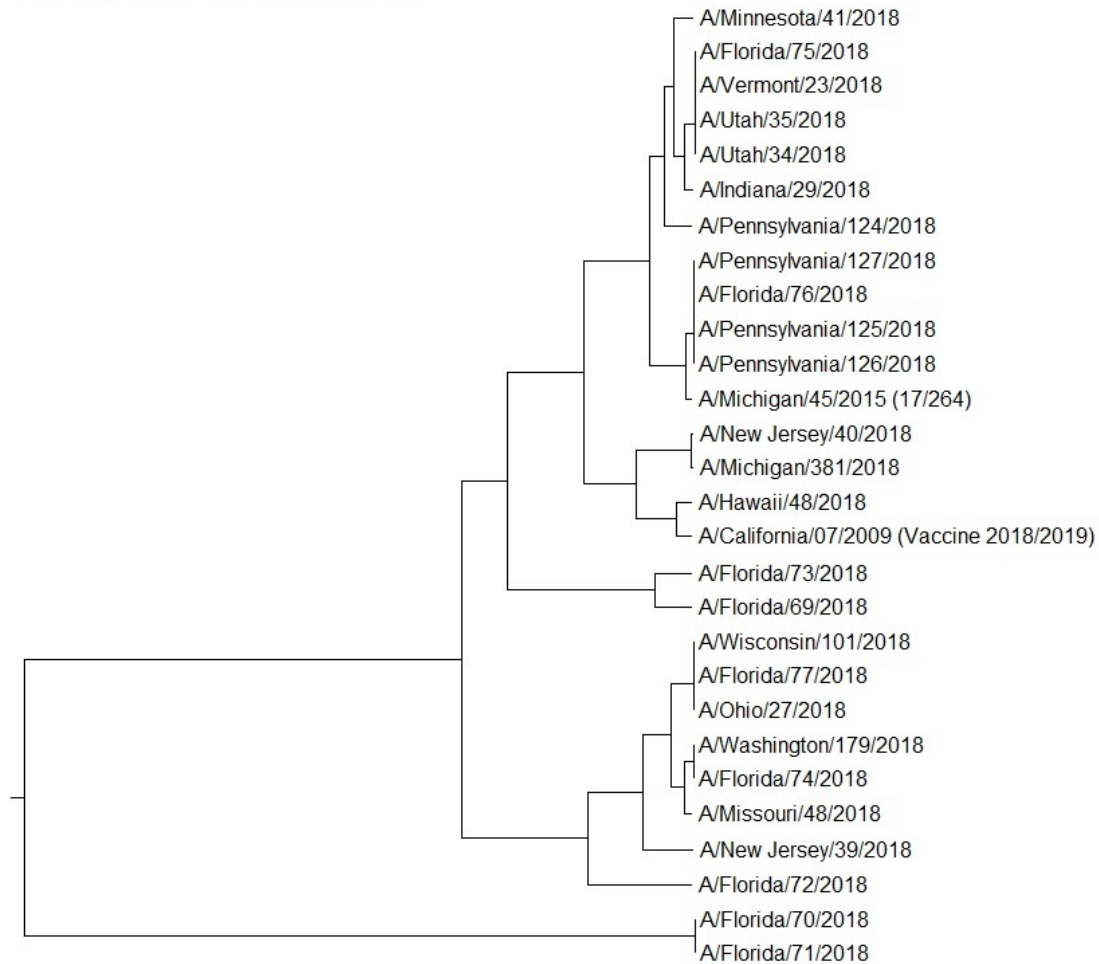


The ISM-based phylogenetic analysis of HA1 from human H3N2 viruses collected in USA from January to February 2018 suggesting the low vaccine efficacy during the flu season 2018/2019. Vaccine viruses are marked with green asterisk

[*F1000Research*, March 2018; doi: 10.12688/f1000research.14142.2]



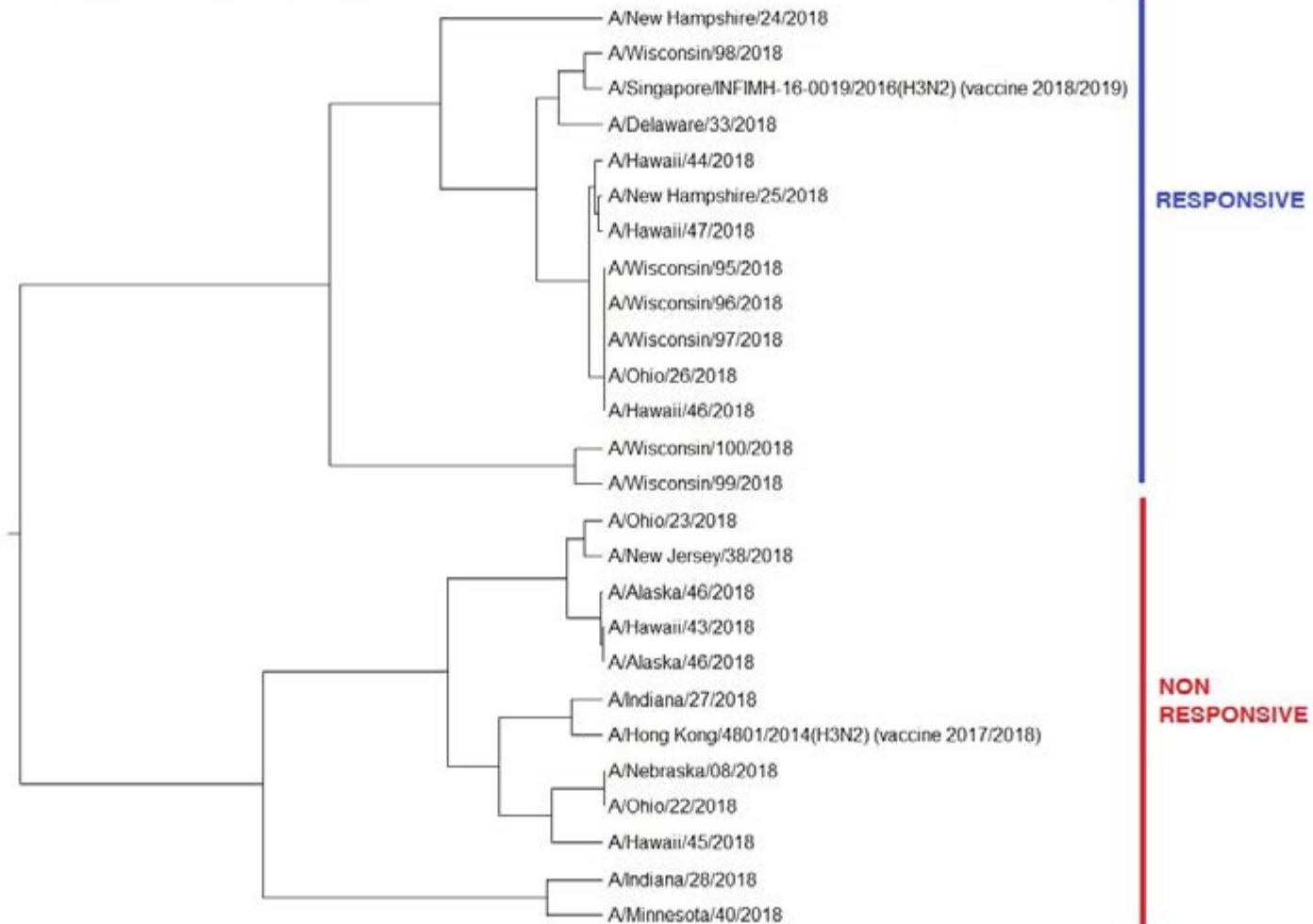
## H1N1 (June - August, 2018)



**RESPONSIVE**

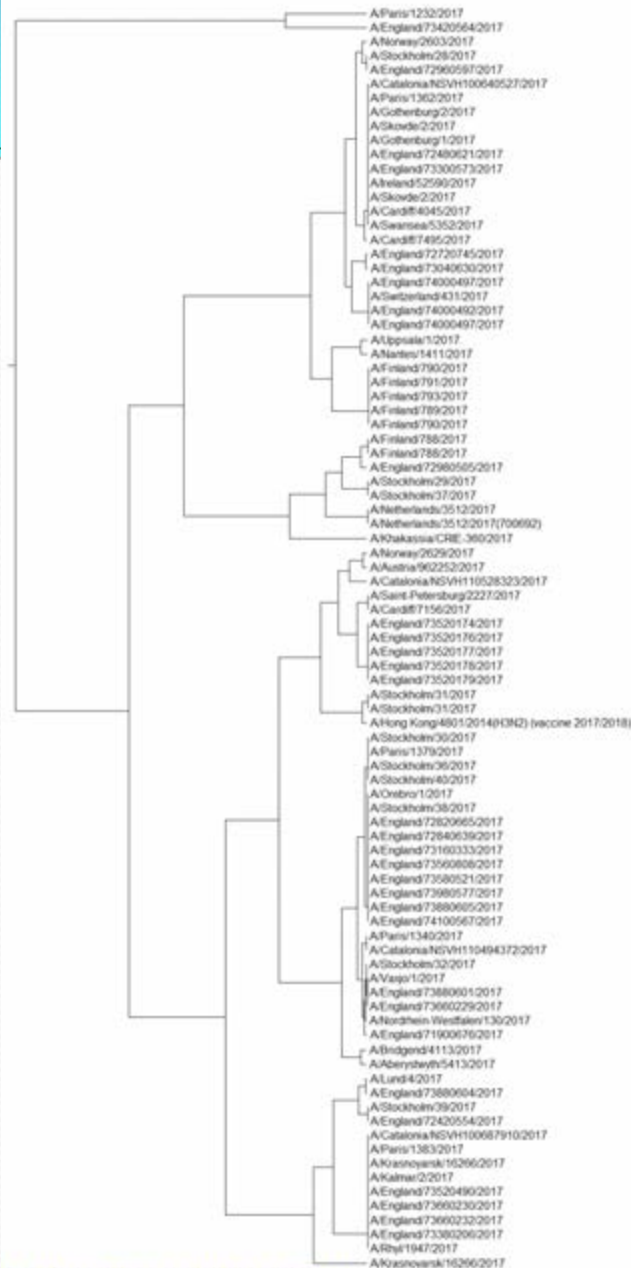
**NOM RESPONSIVE**

### H3N2 (June - August, 2018)





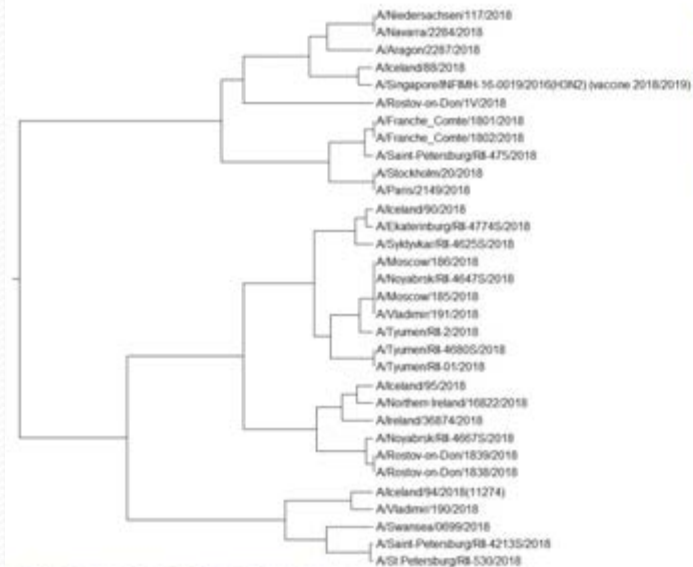
# Assessment of the vaccine responsiveness of pre-seasonal H<sub>3</sub>N<sub>2</sub> viruses in Europe for 2017 and 2018 based on the ISM phylogenetic analysis



RESPONSIVE

61 %

EUROPE MAY-SEPTEMBER 2017



RESPONSIVE

32 %

EUROPE MAY-SEPTEMBER 2018



# Thank you!

- Software used for ISM for flu is owned by BiomedProtection, LLC, Galveston, TX.