USA Research Update

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USDA-NADC Team
USDA-NVSL
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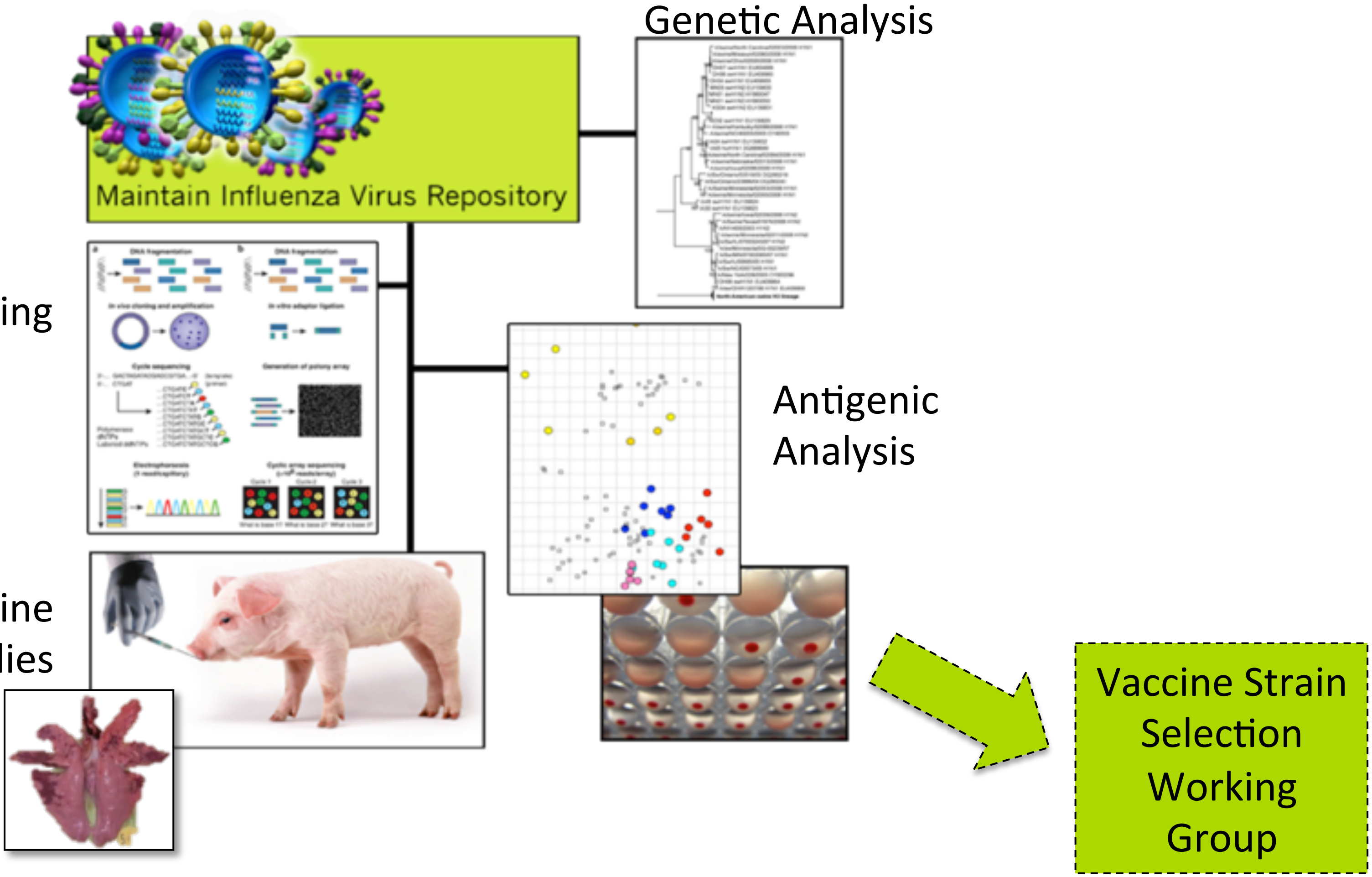
US Swine Producers and Veterinarians

From Surveillance to Improved Vaccines



Maintain Influenza Virus Repository

Genetic Analysis

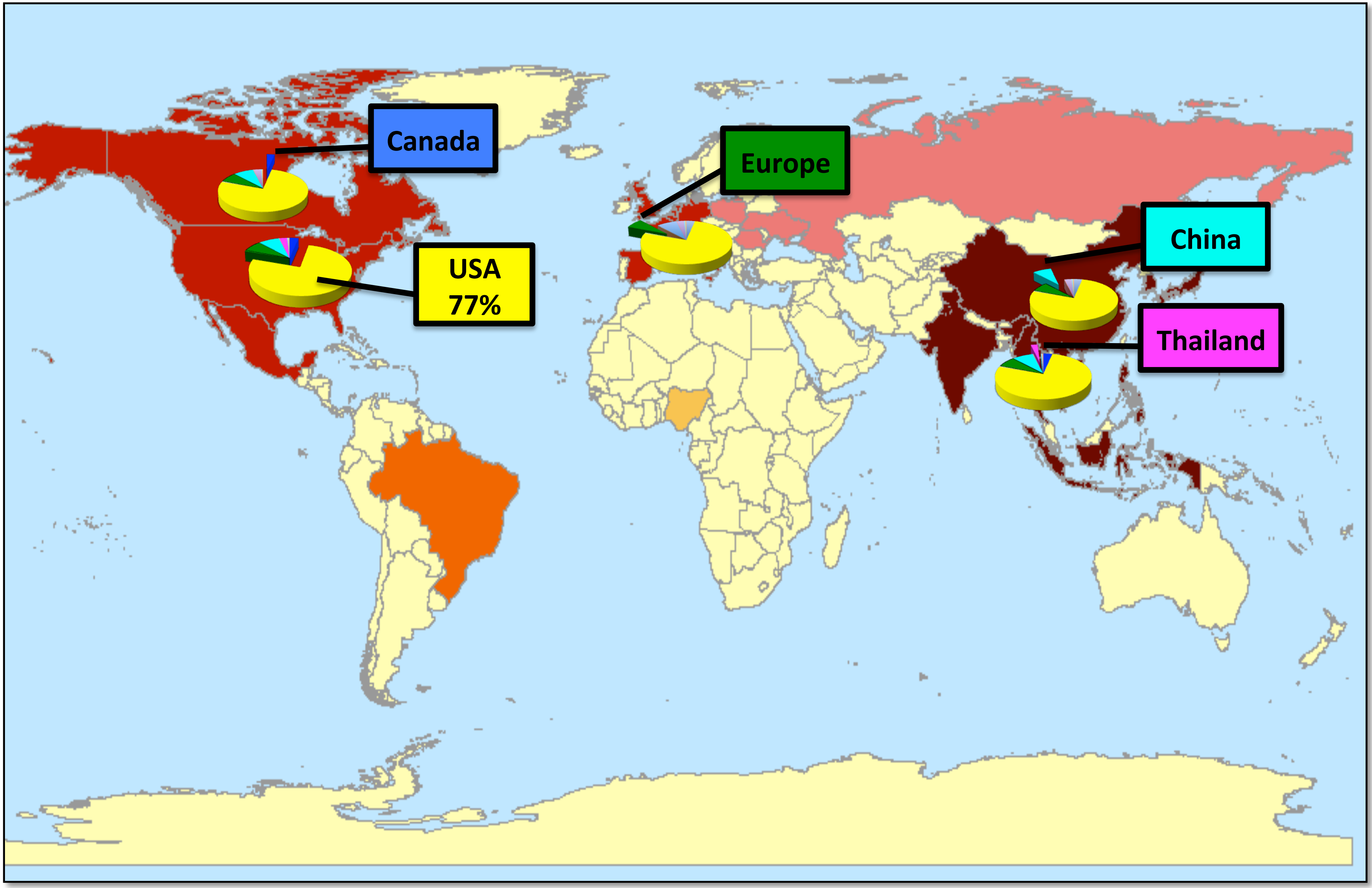
Sequencing

Antigenic Analysis

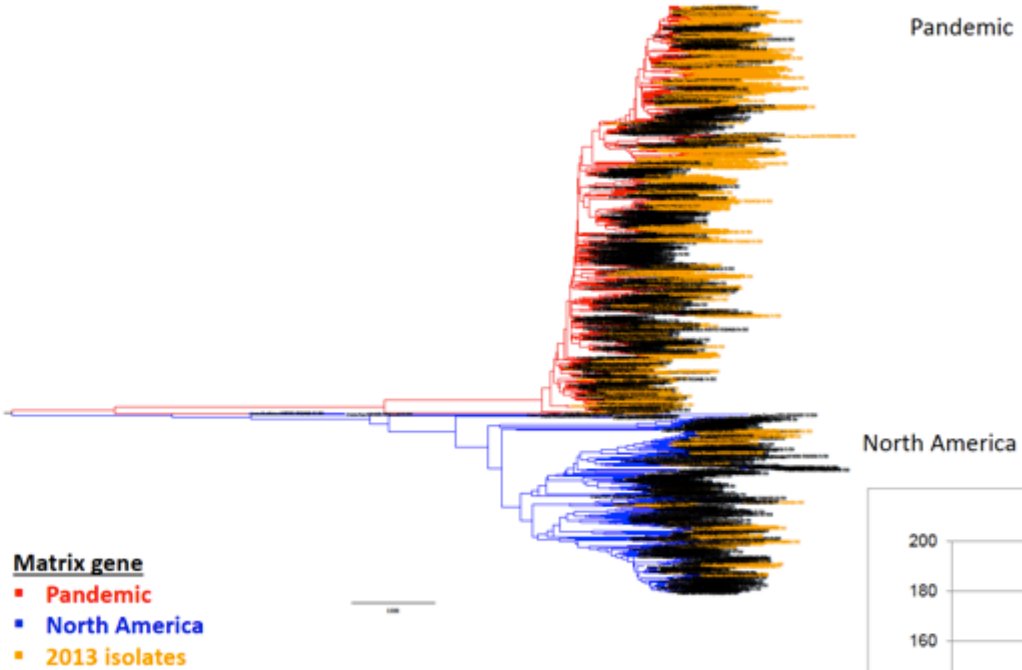
Swine Studies

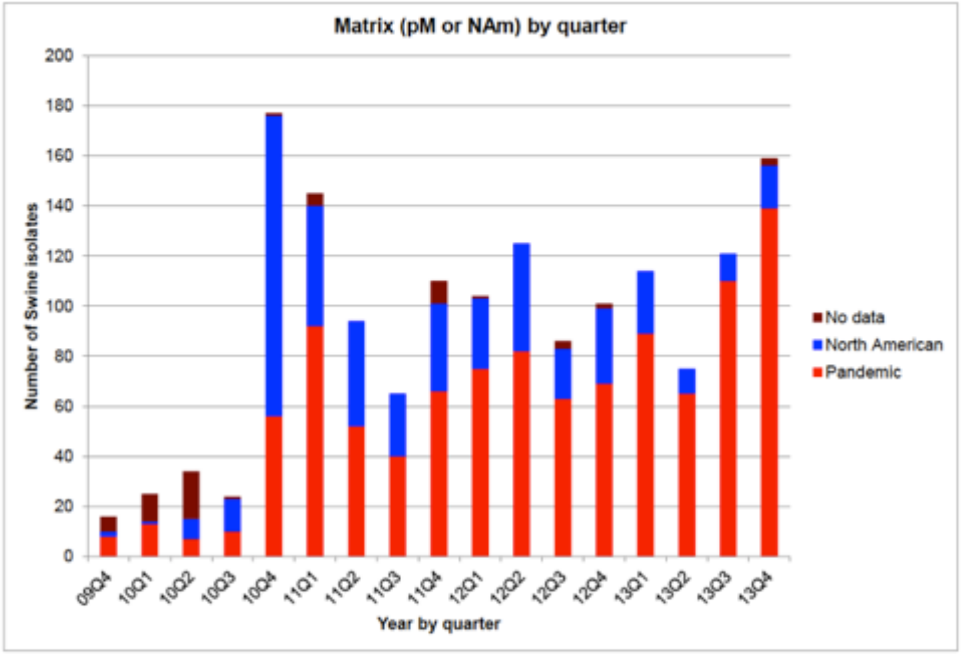
Vaccine Strain Selection Working Group

Global: 3365 full length HA sequences from swine 2000-13



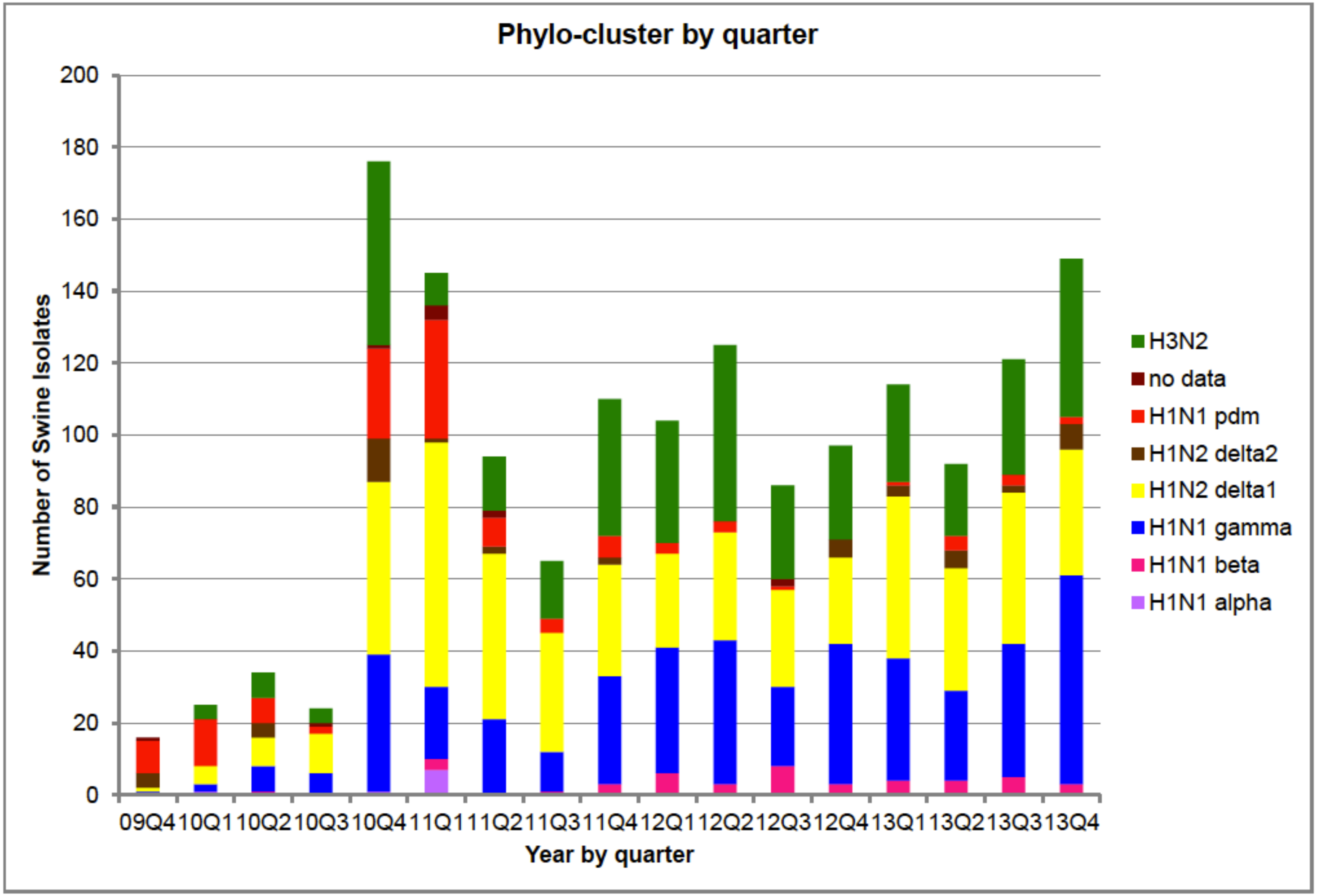
Matrix lineage 2009-2012



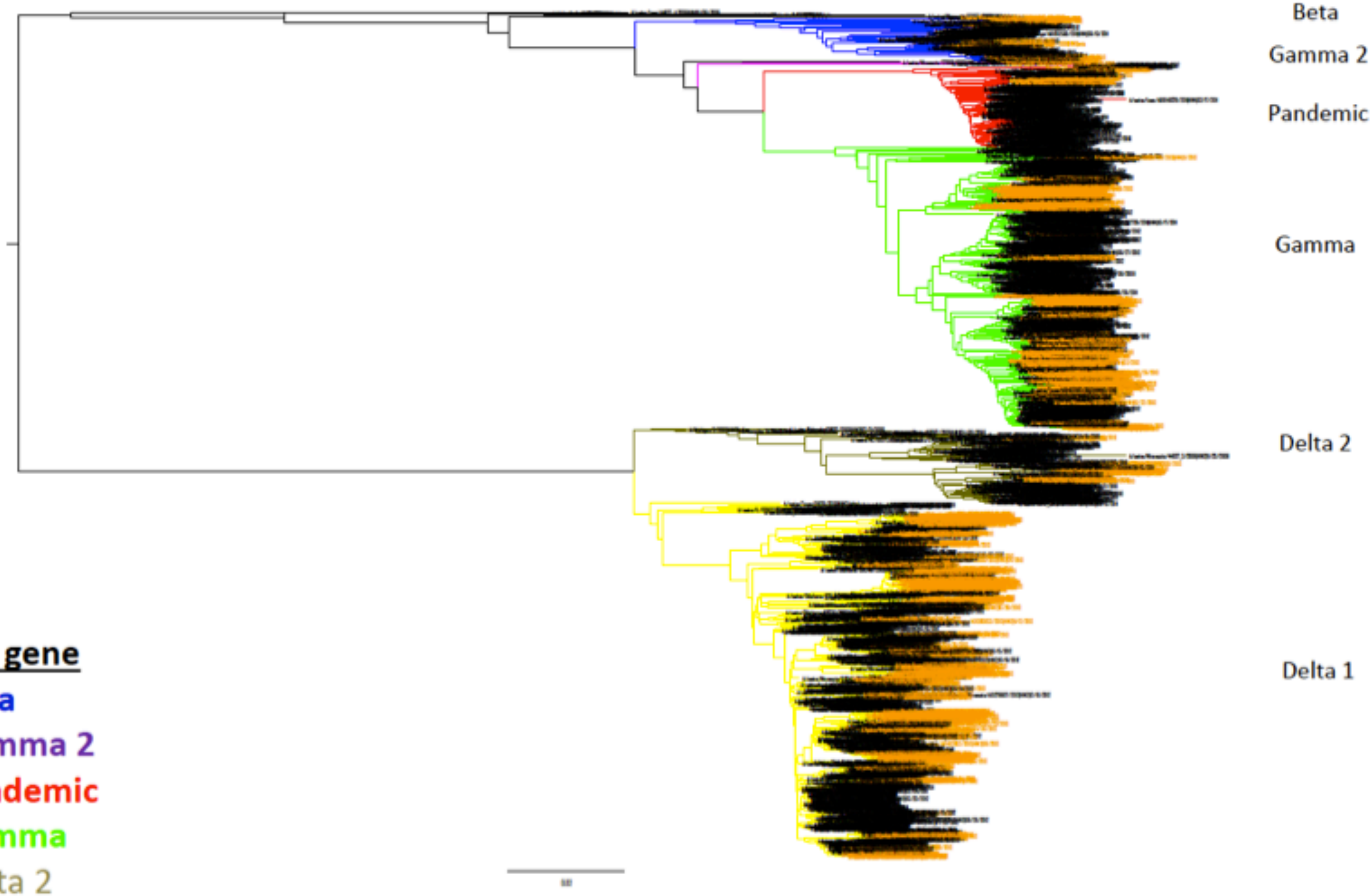


Brian Campbell, unpublished

Relative proportion of genetic clusters



H1 phylogenetic tree

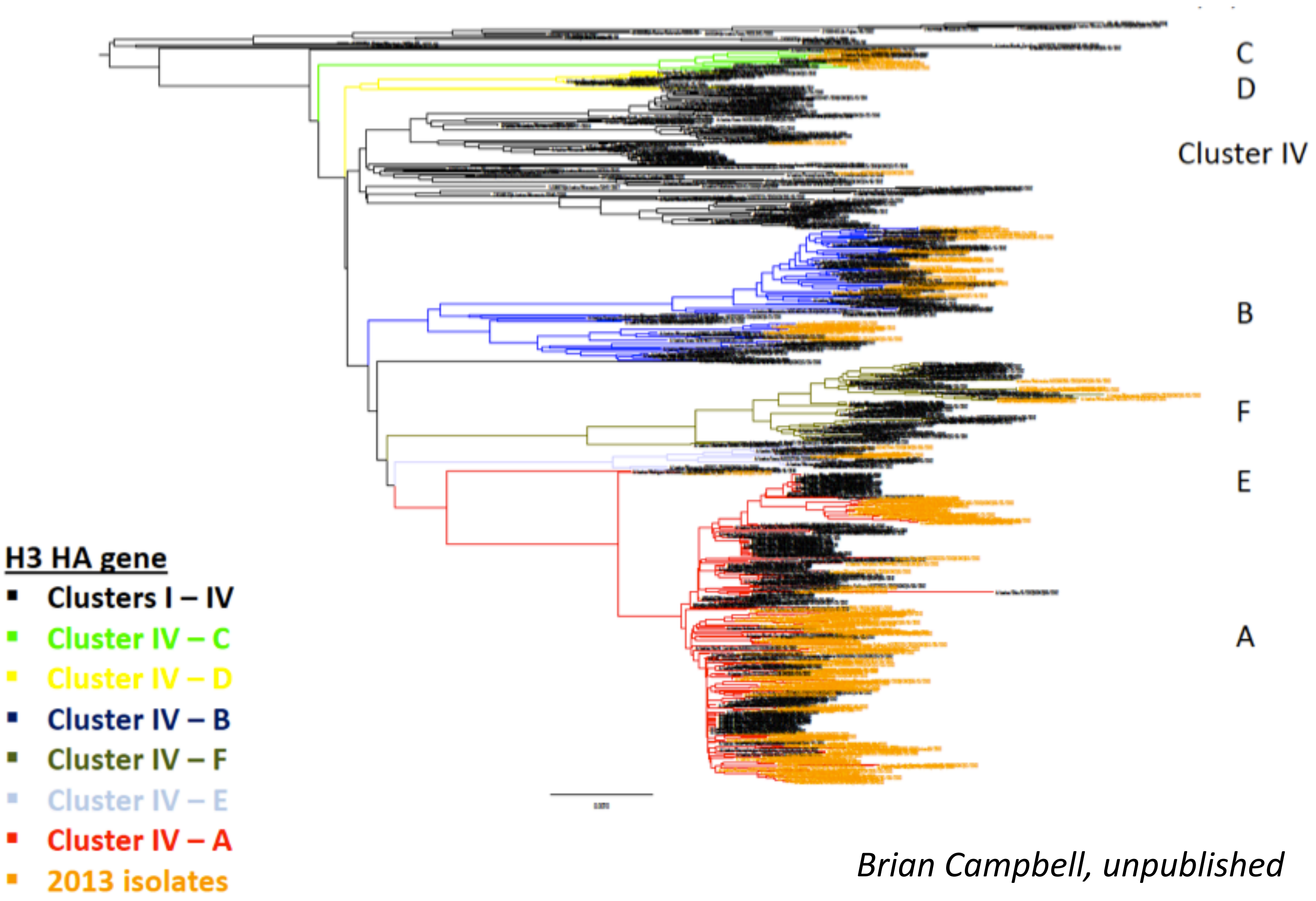


H1 HA gene

- 🟦 **Beta**
- 🟪 **Gamma 2**
- 🟥 **Pandemic**
- 🟩 **Gamma**
- ■ Delta 2
- 🟨 Delta 1
- 🟧 **2013 isolates**

Brian Campbell, unpublished

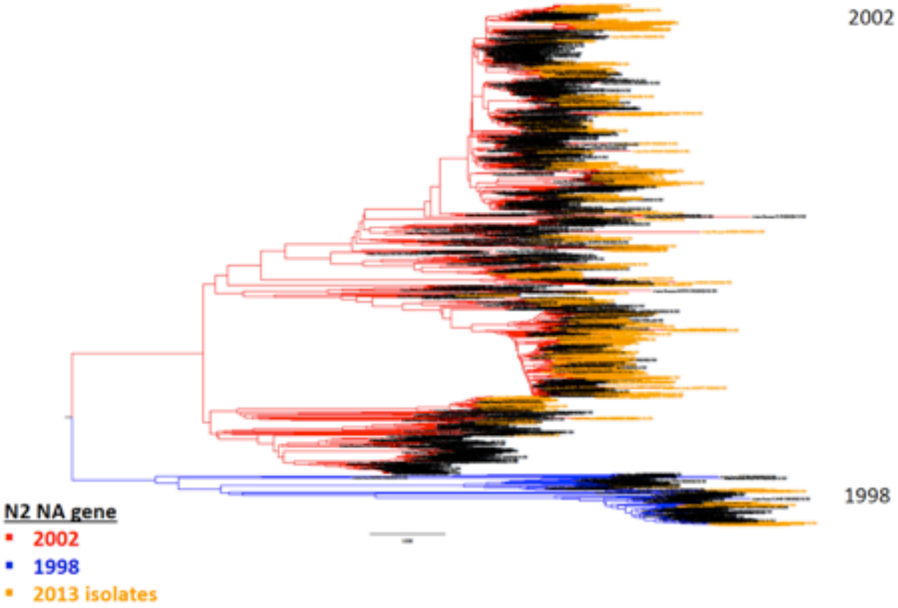
H3 Phylogenetic tree



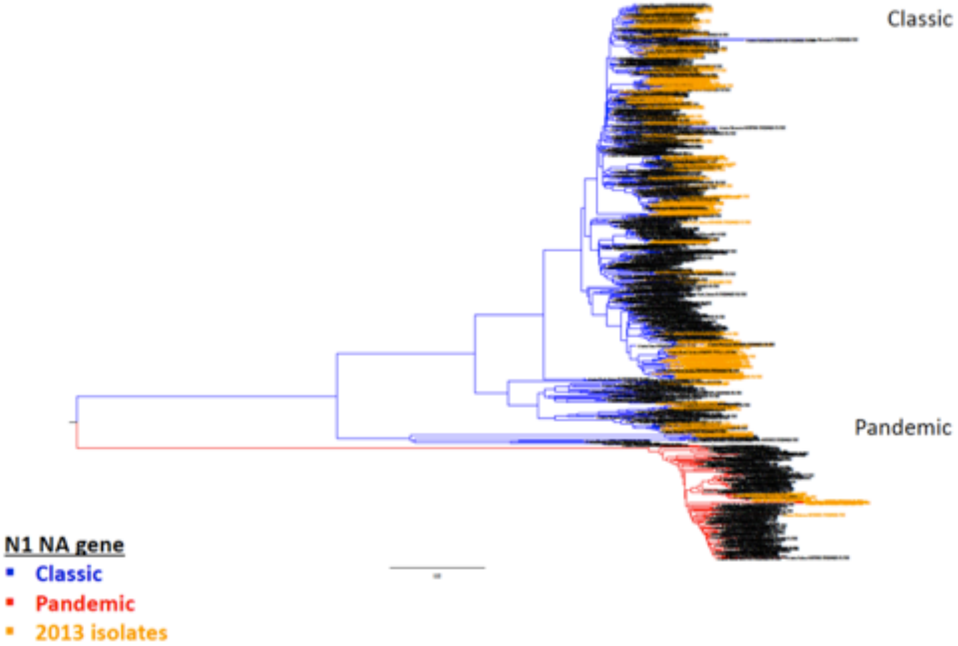
Brian Campbell, unpublished

Diversity in NA genes

N2

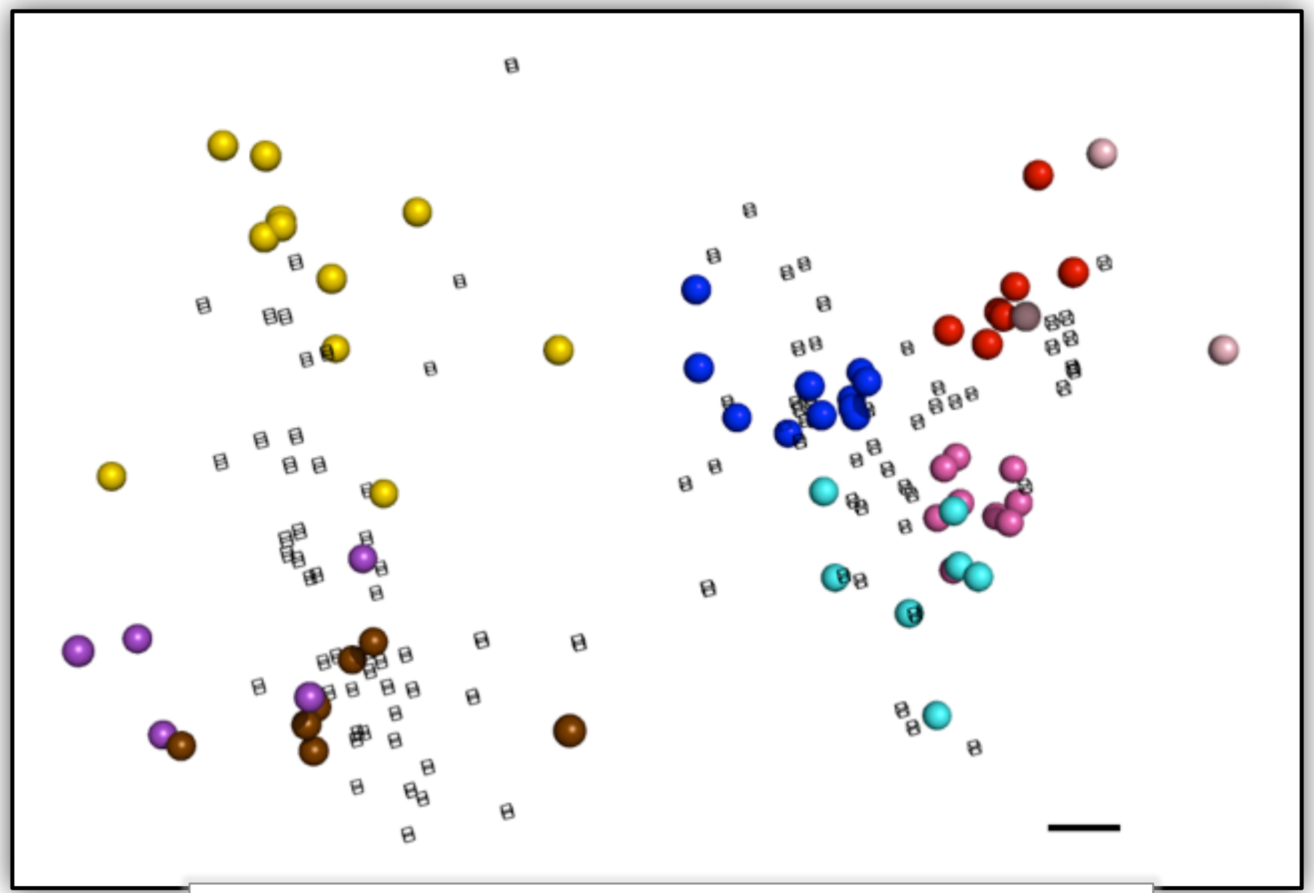


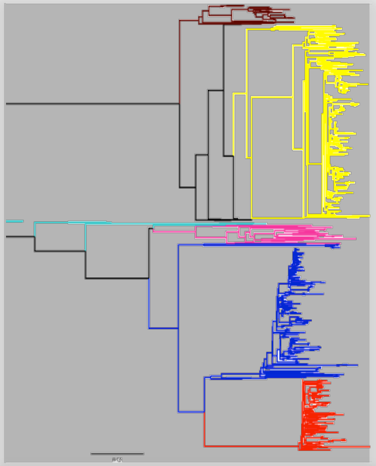
N1



Brian Campbell, unpublished

USA - H1 Antigenic Cartography





Virus Key

- ● Alpha
- ● Beta
- ● Gamma
- ● Swine pdm
- ● Human pdm
- ● Delta-1
- ● Delta-2
- ● Human H1

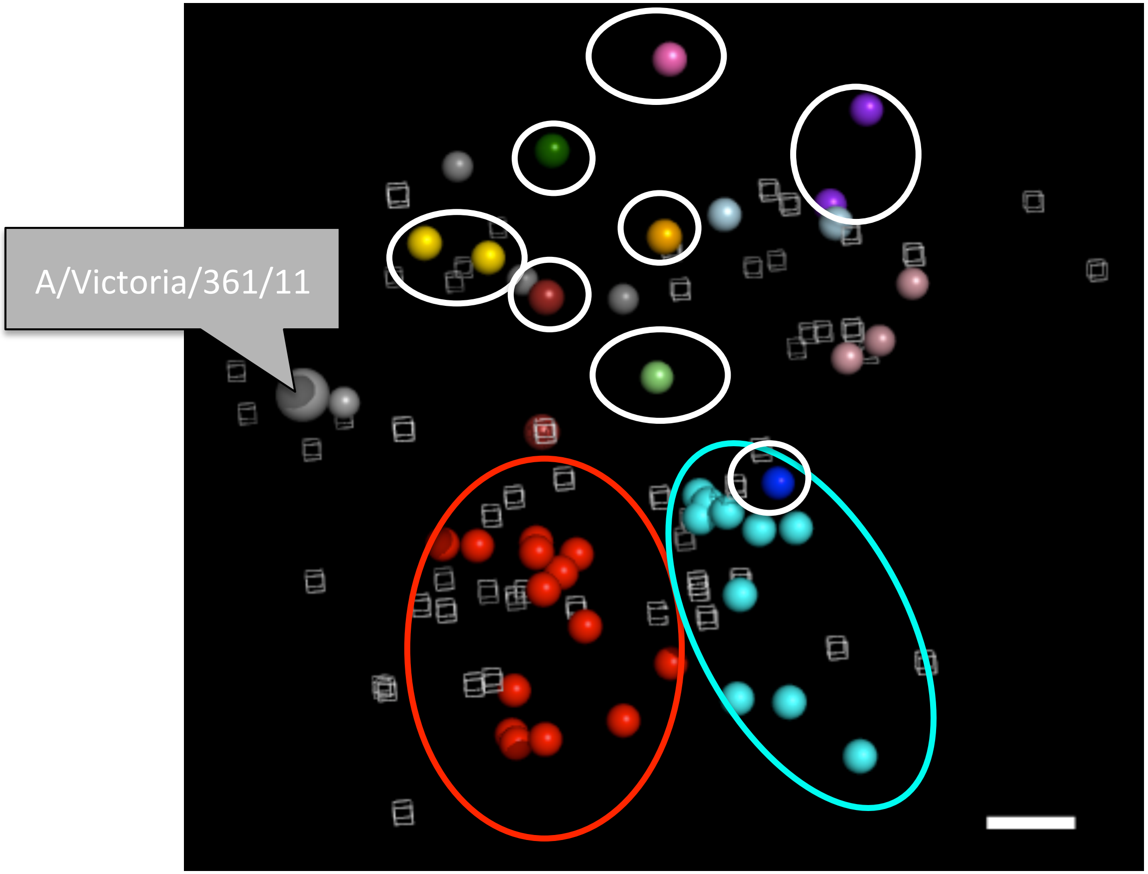
- 36 new viruses to generate swine anti-sera (x2)
    - 5 human strains
- 60 viruses tested against new antisera
- 29 viruses in previous H1 serum panel (x2)

Rajao, Kitikoon, & Lewis, unpublished

New H3 Genetic Clusters (A-F)

Lewis et al., Journal of Virology

USA - H3 Antigenic Cartography



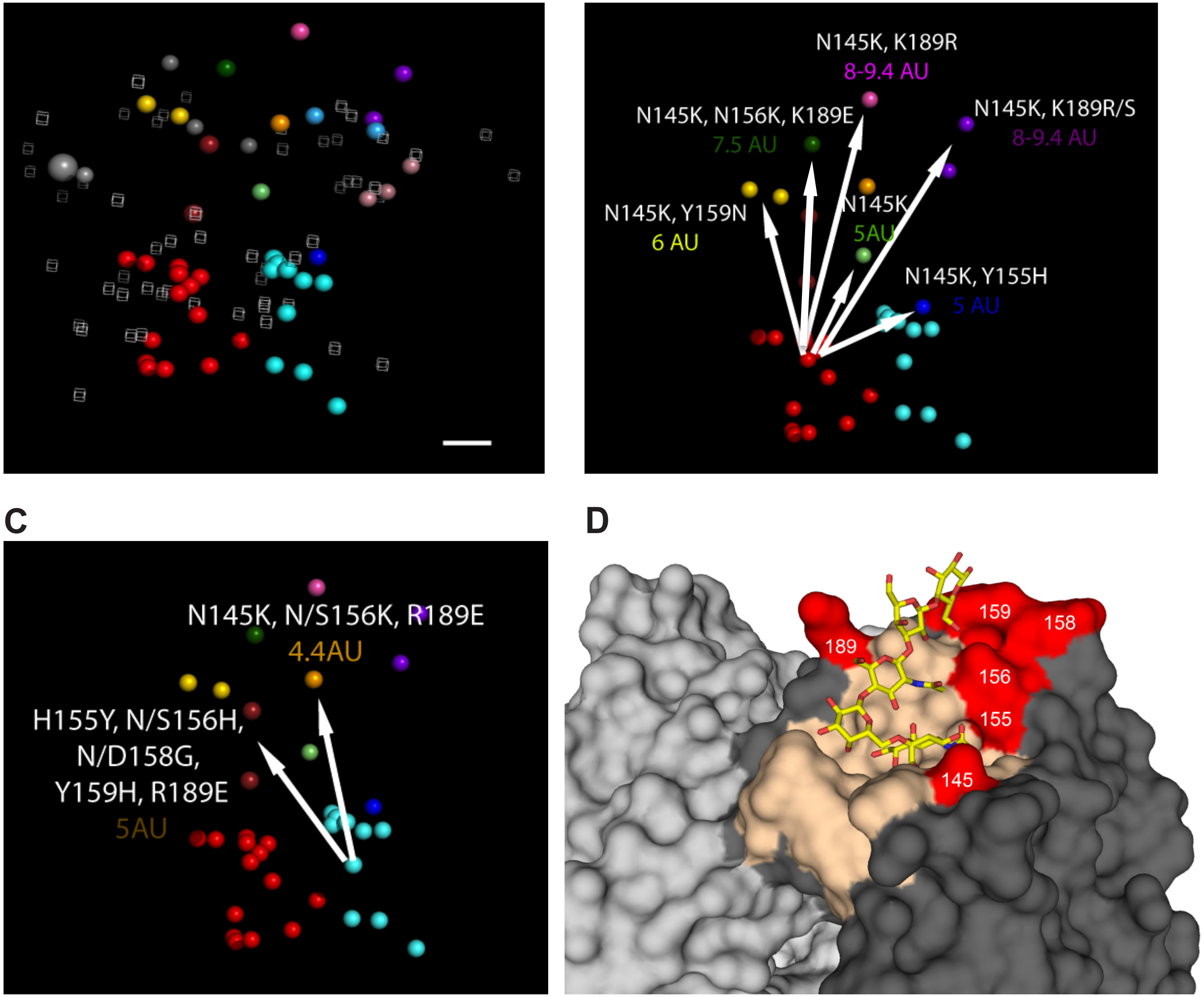
Virus Key

- H3-C1 and A/Wuhan/95
- H3-C2 and Sydney/97
- H3-C4
- H3-C4
- Recent human H3
- **H3 Outliers**

- 26 viruses to generate swine antisera (x2)
  - 8 human seasonal strains and 1 H3N2v
  - 18 USA swine strains
- 42 viruses tested against antisera panel

Lewis et al., Journal of Virology

6 amino acid sites correlated with antigenic divergence

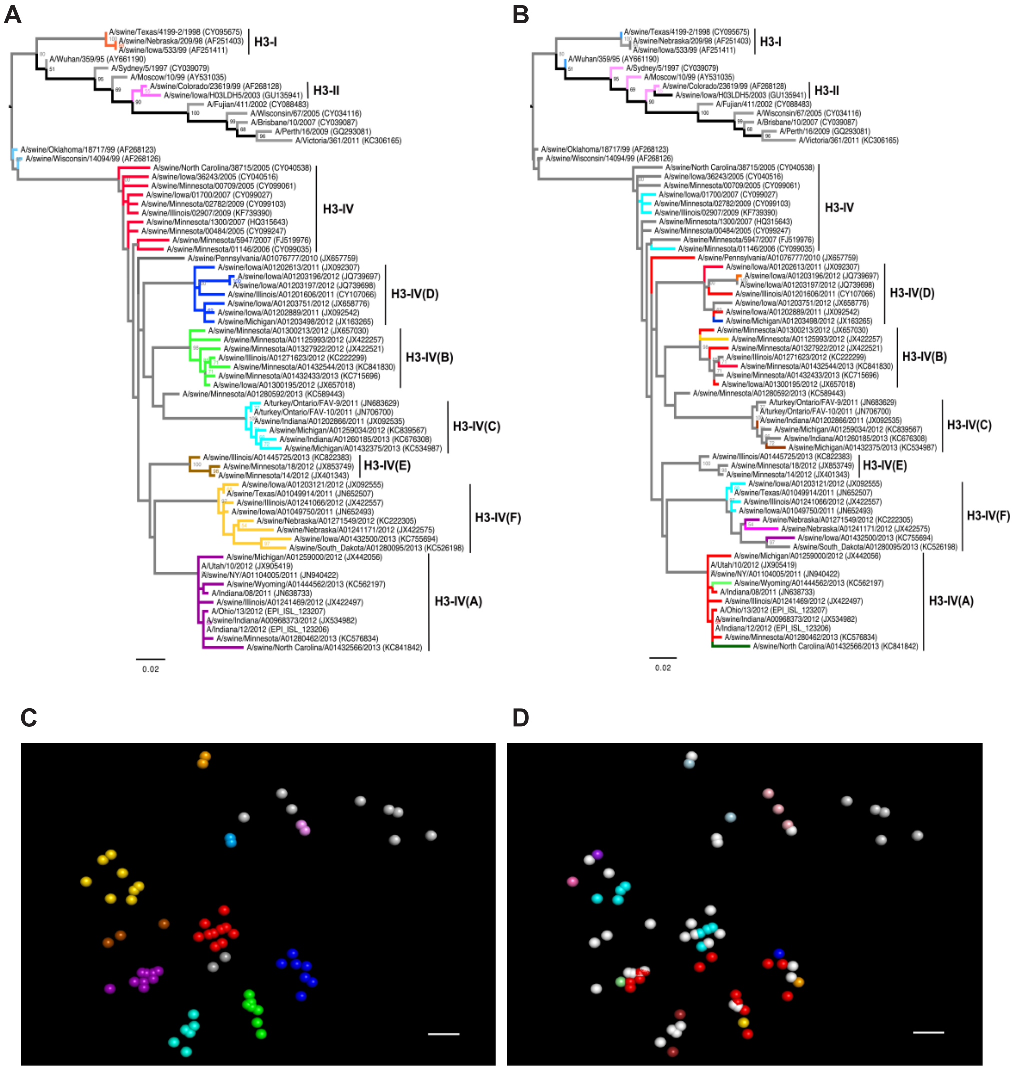


Lewis et al., Journal of Virology

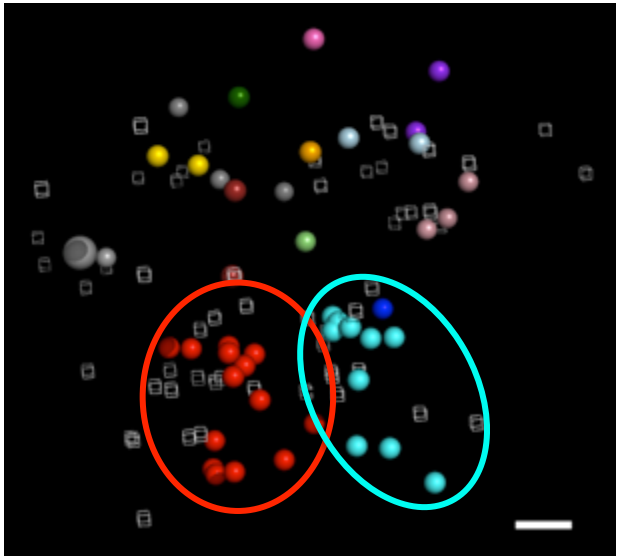
Antigenic clusters were **not** predicted by genetic cluster

Color coded by genetic cluster

Color coded by antigenic cluster



Antigenic Clusters



Lewis et al., Journal of Virology

Next steps

- Point mutations and reverse engineering H3 virus to test individual and pairs of amino acids
  - Cross-HI
  - Vaccine studies
- Similar approach to H1
  - More complicated with classical and human (delta) lineages
    - Focus on delta-1