Swine influenza A viruses: a more global picture

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Antigenic and genetic diversity

Reservoirs of infection
Drivers of emergence
Transmission and disease

Estimated dates of introduction
Phenotype analyses

Comparative analyses of factors involved ecology and evolution of swine IAV Herd-level and structure, age, immune status/vaccination, between and among countries/regions

Relative human-swine contact rates in different production systems

Vaccine efficacy (formulation and use), strain selection

Competition among subtypes/within-subtype variants

Relative risk of introduction to other pig populations and to humans
Swine Influenza - Pandemic Threats Concept

Dr Amy Vincent (USDA)
Dr Nicola Lewis (University of Cambridge)
Adolfo Garcia-Sastre (Mt. Sinai)

Geographic origin of swine influenza isolates
- Asia
- Europe
- USA
- Mexico
- Canada
- Brazil & Argentina

Human influenza isolate blue colour gradient indicates date of isolation:
- Oldest
- Recent
Proposed swine RA pipeline

Putative pipeline for assessing the risk of endemic swine IAV circulating globally to the human population. Swine isolates identified through surveillance and sequencing efforts will be selected to enter the pipeline. The cycle will be repeated annually or as needed as newly characterized swine IAV with antigenic distance from human seasonal viruses are identified.
Step 1
Swine-human antigenic distance

- **CRIP: Amy Vincent NADC**
  - USDA swine surveillance sequence and antigenic analyses and CDC variant viruses.
  - Raise swine sera to selected swine and human seasonal influenza viruses.
  - Provide swine reference antisera and antigens to other Centres and participants -> St Jude’s, Emory, Mt. Sinai.
  - HI with swine strains using swine & ferret antisera.

- **CRIP: Nicola Lewis University of Cambridge**
  - Antigenic cartography and phylogenetic analyses of swine viruses.
  - Selection of reference panels in consultation with AV.
  - Define and identify ‘highly’ divergent swine strains in consultation with AV.

- **CRIP: Adolfo Garcia-Sastre/Randy Albrecht**
  - HI with swine isolates obtained through CRIP with swine & ferret antisera.
  - Raise ferret antisera to selected swine and human seasonal strains in consultation with NADC/Cambridge.
Step 1 continued
Swine-human antigenic distance

- St Jude’s: Richard Webby and Stacey Shultz Cherry
  - HI with swine isolates obtained through SJCEIRS with panel of swine & ferret antisera.
  - Raise ferret antisera to selected swine and human seasonal strains in consultation with NADC/Cambridge. Share ferret antisera panel with other CEIRS.
  - Contribute highly divergent strains to the pipeline.
- Emory: Ralph Tripp/Mark Tompkins
  - HI with swine isolates obtained through Emory CEIRS with panel of swine & ferret antisera.
  - Contribute highly divergent strains to the pipeline.
- Non-CEIRS
  - AHPA/ANSES: HI with swine isolates circulating in Europe against selected NADC swine antiserum and/or ferret antisera
  - Contribute highly divergent strains to the pipeline.
  - Share ferret antisera panel with other CEIRS.
**Human Vaccine Strains for Swine Anti-sera**

<table>
<thead>
<tr>
<th>Vaccine Strain</th>
<th>Year</th>
<th>Subtype</th>
<th>Vaccine Season</th>
<th>NADC Sera</th>
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<tbody>
<tr>
<td>A/California/04/09</td>
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<td>2007-08</td>
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**Comparison of influenza virus phenotype characterised using ferret and swine antisera**

<table>
<thead>
<tr>
<th>Vaccine Strain</th>
<th>Year</th>
<th>Subtype</th>
<th>Vaccine Season</th>
<th>NADC Sera</th>
<th>Received from St. Jude</th>
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<td>A/Singapore/86</td>
<td>1986</td>
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<td>1973</td>
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<td>1974-76</td>
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</table>
Step 2
Population immunity to swine strains

• JHCEIRS: Andy Pekosz
  • Collect a stratified by age human serum panel from community-based sampling in NY.
  • Contribute a Taiwanese human serum panel.
  • Characterise selected swine strains against the human serum panel and submit results for antibody landscaping.

• St Jude’s: Richard Webby and Stacey Shultz-Cherry
  • Contribute a South American human serum panel.
  • Characterise selected swine strains against the human serum panel and submit results for antibody landscaping.

• CRIP: Nicola Lewis
  • Produce antibody landscapes of human sera relative to selected ‘highly’ divergent swine influenza viruses.

Step three
Step 3

Laboratory testing “high risk” swine

- SJCEIRS:
  - Pathogenesis (mouse model and ferret) and pre-pandemic vaccine work
- CRIP:
  - Pathogenesis in ferrets and other (Mt. Sinai)
  - Receptor binding studies
  - Vaccine efficacy studies (NADC)
- Emory:
  - Receptor binding studies
- JHCEIRS: Andy Pekosz
  - Infectivity studies in human primary respiratory epithelial cells
- Other Centers?
Step 4
Inform Public Health

- CRIP, SJCEIRS, Emory, JHCEIRS:
  - Disseminate results through presentations, reports, & publications to key stakeholders.
    - NIH-CEIRS
    - CDC
    - WHO
    - USDA-APHIS
    - Swine industry
    - Veterinary biologics companies

- St. Jude: Richard Webby
  - Share data at WHO Composition of Vaccine Meetings.

- Public Health: Candidate pandemic preparedness vaccine seed strains selected and developed as needed.
  - Pilot lot vaccine production
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