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French agency for food, environmental and occupational health & safety
Investigate, evaluate, protect

OIE FAO

SIV group technical meeting
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Passive surveillance of swIAVs in France

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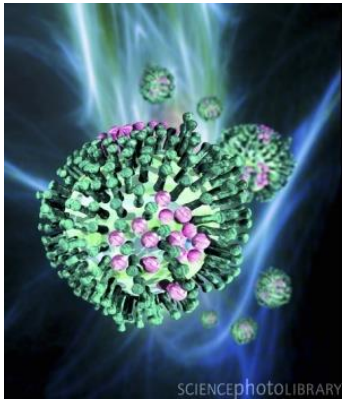
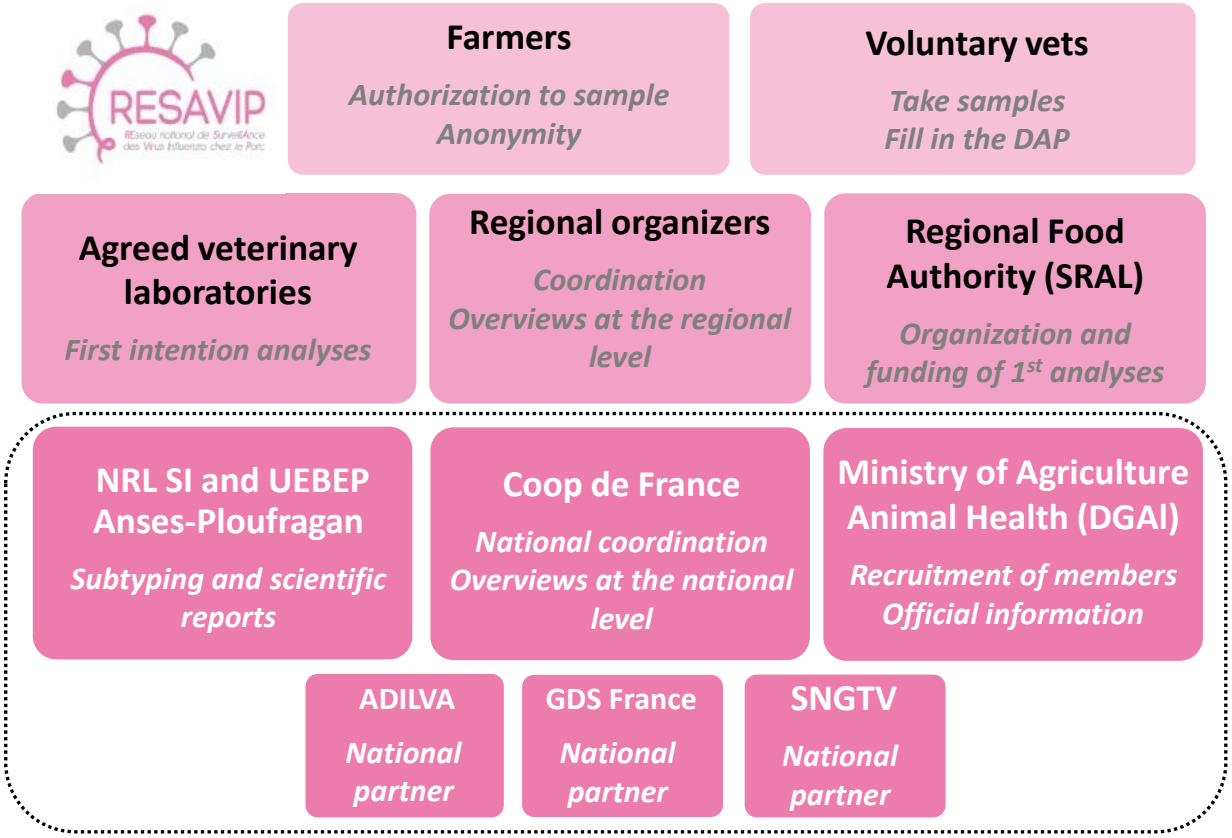


Surveillance programs (1)

✓ **French National Network for swIAV surveillance**



Members of « SIV Group » from the National Epidemiological Surveillance Plateform for Animal Health
(Scientifc and technical support)

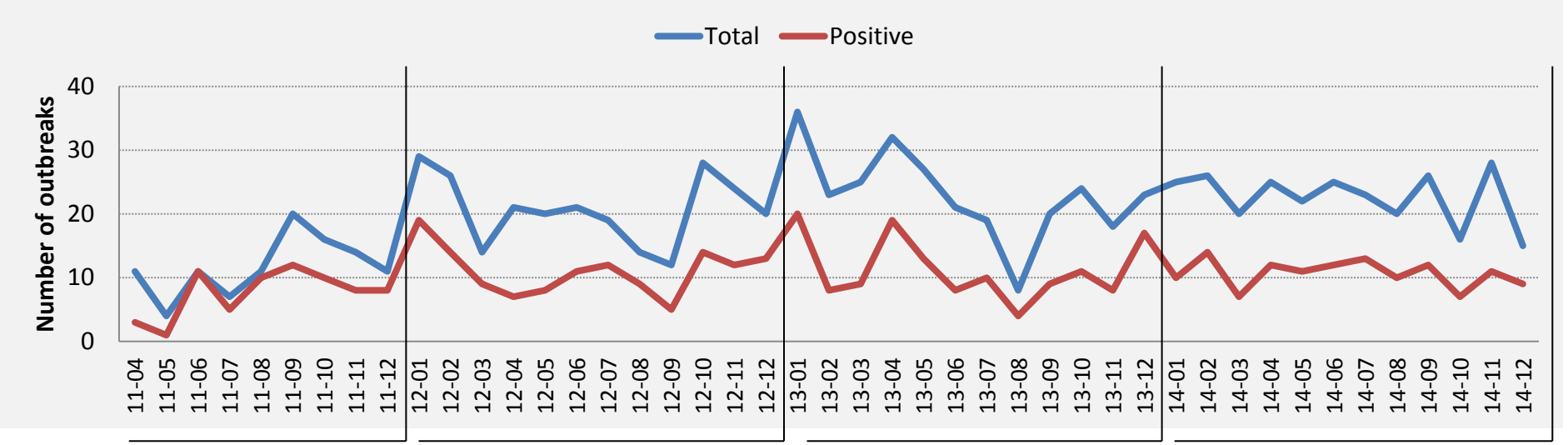
- Set up in April 2011
- **Sampling kits**: 3 nasal swabs + accompanying document (data sheet = DAP)
- Flu outbreaks > samples taken from pigs with body **temperature ≥40.5° C** preferentially
- **1st analyses** (detection) **by regional labs agreed by the Ministry**
- **2nd analyses** (subtyping) **by NRL SI**

Surveillance programs (1)

✓ **French National Network for swIAV Surveillance**

2011-2014: **69 voluntary veterinarians**
900 farms visited in 15 out of 21 regions
465 **positive herds** (**51,7%**)

RESAVIP
REseau national de SurveillAnce des Virus Influenza chez le Porc



Outbreaks investigated all the year
swIAVs detected each month – **no seasonality**

Pigs infected **whatever the age/physiological stage**
Recurrent infections reported in 43% of positive herds
6/8 week old pigs frequently affected (31,2%)

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Surveillance programs (2)

✓ Anses investigations in farms

- Clinical influenza-like events reported by vets, technicians, farmers
- Mainly in the **Western part of France** (Brittany = highest pig density area)

D0 → **D21**

- Identification (ear tag)
- **Nasal swabs**
- Blood samples
- Clinical records

- Blood samples (same pigs)
- Clinical records

✓ Other sources of samples

- Anses cross-sectional **surveys on respiratory diseases**
- **Specific studies** in collaboration with **local investigators** (mainland, over-seas regions)
- **Positive samples** (lungs, nasal swabs) **submitted** by regional or private vet labs for subtyping (**apart from Résavip**)
- Surveillance programs conducted by medical companies (Merial, Boehringer-Ingelheim…)

✓ Other sources of data

- **IDT-Biologika surveillance program** (lab analyses performed by FLI, Germany)

Objectives (2)

- **Anses & Résavip** (farmers, vets & Ministry)
  - To describe the **nature of circulating swIAVs** (subtypes, genetic lineages)
  - To approach their **distribution in the pig population**
  - To **collect epidemiological data** linked to swIAV infections

    >> **To provide continuous monitoring of swIAVs**
  - To improve responsiveness and enable **targeted action when necessary**
  - To anticipate and determine possible **measures to be applied to limit the impact of the infection**, both in terms of public health (zoonotic virus) and veterinary health
  - To **ensure adequate communication**, especially in the event of a major new health episode or the emergence of new viral strains.

- **Anses (additional)**
  - To study and follow up **virus evolution**, genetically and antigenically (research, adaptation of diagnostic tools, information on vaccine adequacy, etc.)
  - To further study phenotype, pathogenicity, dynamic, inter-species transmission potential of novel reassortants and/or variants

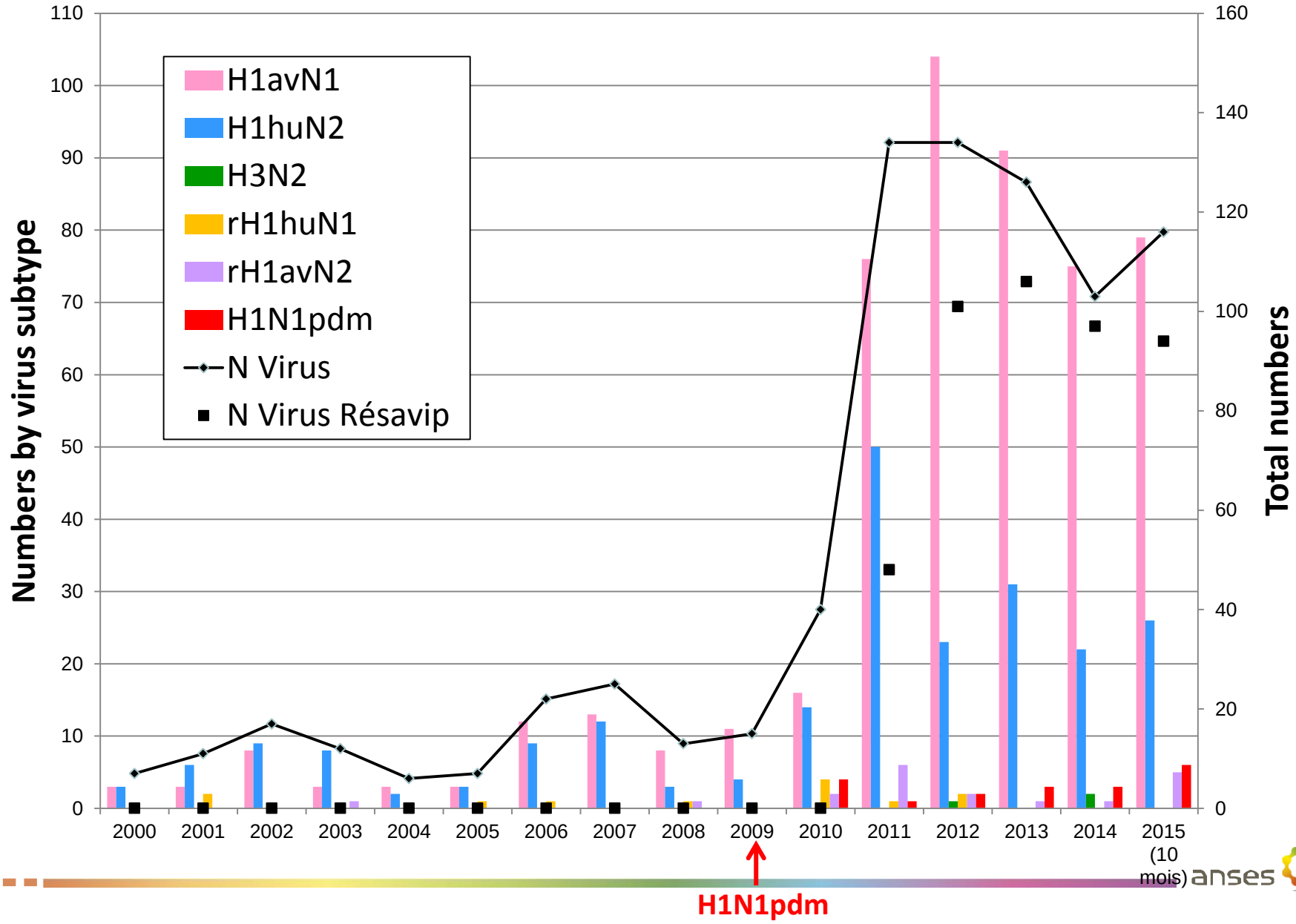
swIAV detection and identification - Methods

- **Influenza A Virus detection** in nasal swabs (or lung samples)
  - M gene real-time RT-PCR (in duplex with β-actine or GAPDH gene)
  - Two commercially available kits (Biomerieux and Thermo Fisher), validated by NRL

- **Molecular sub-typing**
  - Real-time RT-PCRs specific to HA and NA genes from swIAVs enzootic in European pigs: $H1_{av}N1$, H3N2, $H1_{hu}N2$, H1N1pdm
  - In-house developed and validated (collab. FLI for some of them)
    - 5 simplex rtRT-PCRs : $H1_{av}$; $H1_{hu}$; H3 ; H1pdm ; N1pdm
    - 1 duplex rtRT-PCR: N1+N2
  - Three commercially available kits (Biomerieux and Thermo Fisher) validated by NRL
    - 2 kits = duplex H1pdm + β-actine or GAPDH
    - 1 kit = duplex N1pdm + β-actine
  - New: in-house rtRT-PCR specific to antigenic $H1_{hu}$ variant ($H1_{huV}$) detected in France

- **Virus isolation** (MDCK cells ; embryonated chicken eggs)
- **Antigenic sub-typing** (HI tests) *> production of hyperimmune sera on SPF pigs*
- **Sequencing** (HA, NA, Internal genes)

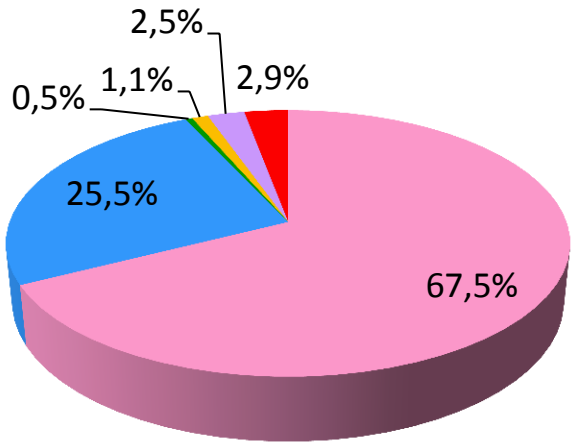
swIAVs detected in France (2000-2015)



swIAVs detected in France (2010-2015)

	N Virus	$H1_{av}N1$	$H1_{hu}N2$	H3N2	$rH1_{hu}N1$	$rH1_{av}N2$	H1N1pdm
2010	40	16	14	0	4	2	4
2011	134	76	50	0	1	6	1
2012	134	104	23	1	2	2	2
2013	126	91	31	0	0	1	3
2014	103	75	22	2	0	1	3
2015 (10 months)	110	75	25	0	0	4	6
Total	**647**	**437**	**165**	**3**	**7**	**16**	**19**

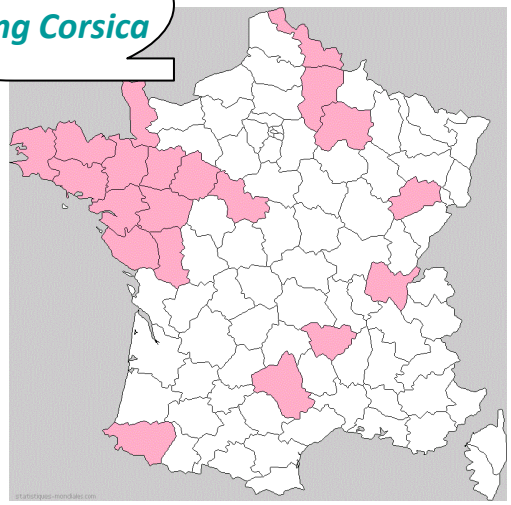
Relative frequencies



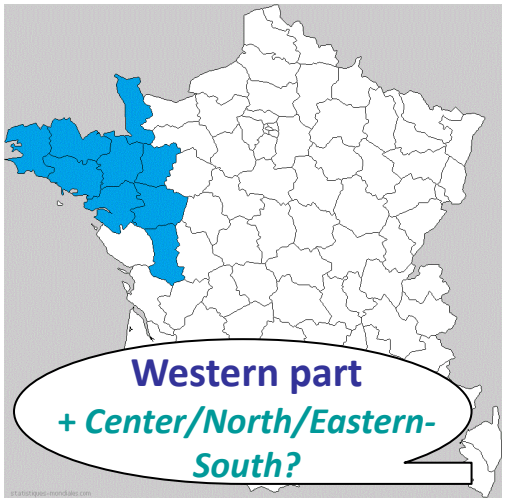
Geographical distribution of swIAVs detected in France since 2010

$H1_{av}N1$

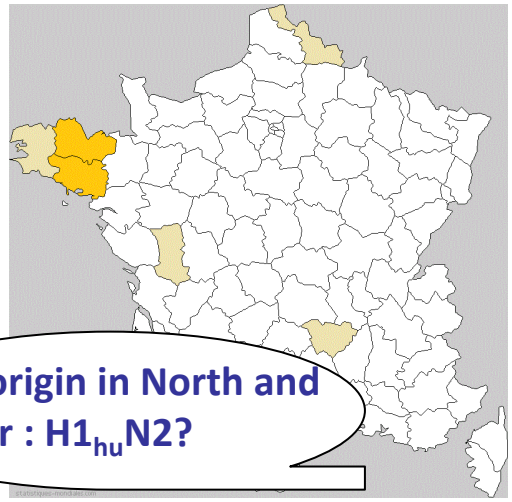
Whole France *including Corsica*



$H1_{hu}N2$

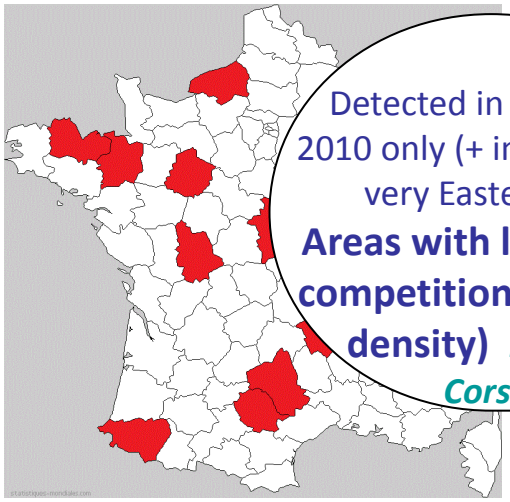


H3N2



$rH1_{hu}N1$
(alone or in mixtures)

$rH1_{av}N2$



H1N1pdm
(alone or in mixtures)

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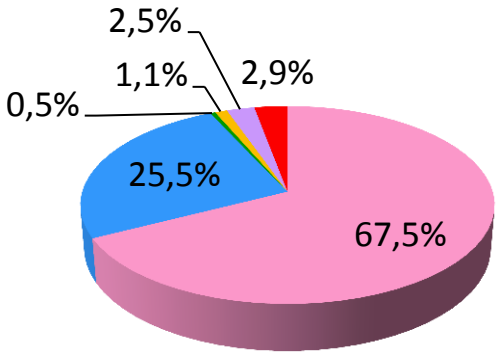
Genotypes and evolution of French swIAVs

> 7 out 23 genotypes identified at the European level (ESNIP3)

	Internal genes						External genes	
	PB2	PB1	PA	NP	M	NS	HA	NA
A								
B								
C								
G								
H								
J								
P								

European swIAVs N=270		
Lineage	Count	%
$H1_{av}N1$	85	**29**
H3N2	38	**13**
$H1_{hu}N2$	26	**9**
$rH1_{av}N2$	5	**2**
$rH1_{hu}N1$	3	**1**
$H1_{hu}N2$	2	<1
H1N1pdm	35	**12**

French swIAVs (2010-2015)
Relative frequencies (N=647)



- ✓ **$H1_{av}N1$**: slow genetic evolution ; updating of reference antigens and sera every 5-6 years
- ✓ **$rH1_{av}N2$:** 2 different populations? (North-Western part *versus* South-Western part)
- ✓ **$H1_{hu}N2$**: several genetic clusters ; antigenic drift in 2012 > concomitant circulation (50/50) of 2 different viruses, **$H1_{hu}N2$** and **$H1_{hu}N2$ Δ146-147**
- ✓ **H1N1pdm**: still closely related to H1N1pdm isolated in humans despite increasing number of mutations over years ; *de novo* human to pig transmission during seasonal epidemics in humans
- ✓ **H3N2**: closely related to Belgian and other European H3N2 swIAVs
- ✓ To date, **no reassortant with 1 or more gene(s) from H1N1pdm**

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