Coordinated surveillance of influenza viruses in European pigs: Enhanced Virological and Epidemiological analysis from the European Surveillance Network for Influenza in Pigs (ESNIP3)

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L. E. Larsen, P. Kellam, S.Watson, N. Lewis, S. M. Brookes, O.Pybus & ESNIP3 Consortium

http://www.esnip3.eu/index.html

ESNIP3

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ESNIP1 1999-2003
Coordinator
Guus Koch, CVI Lelystad, NL

ESNIP2 2005-2008
Coordinator Kristien Van Reeth, Ugent, BE

ESNIP3
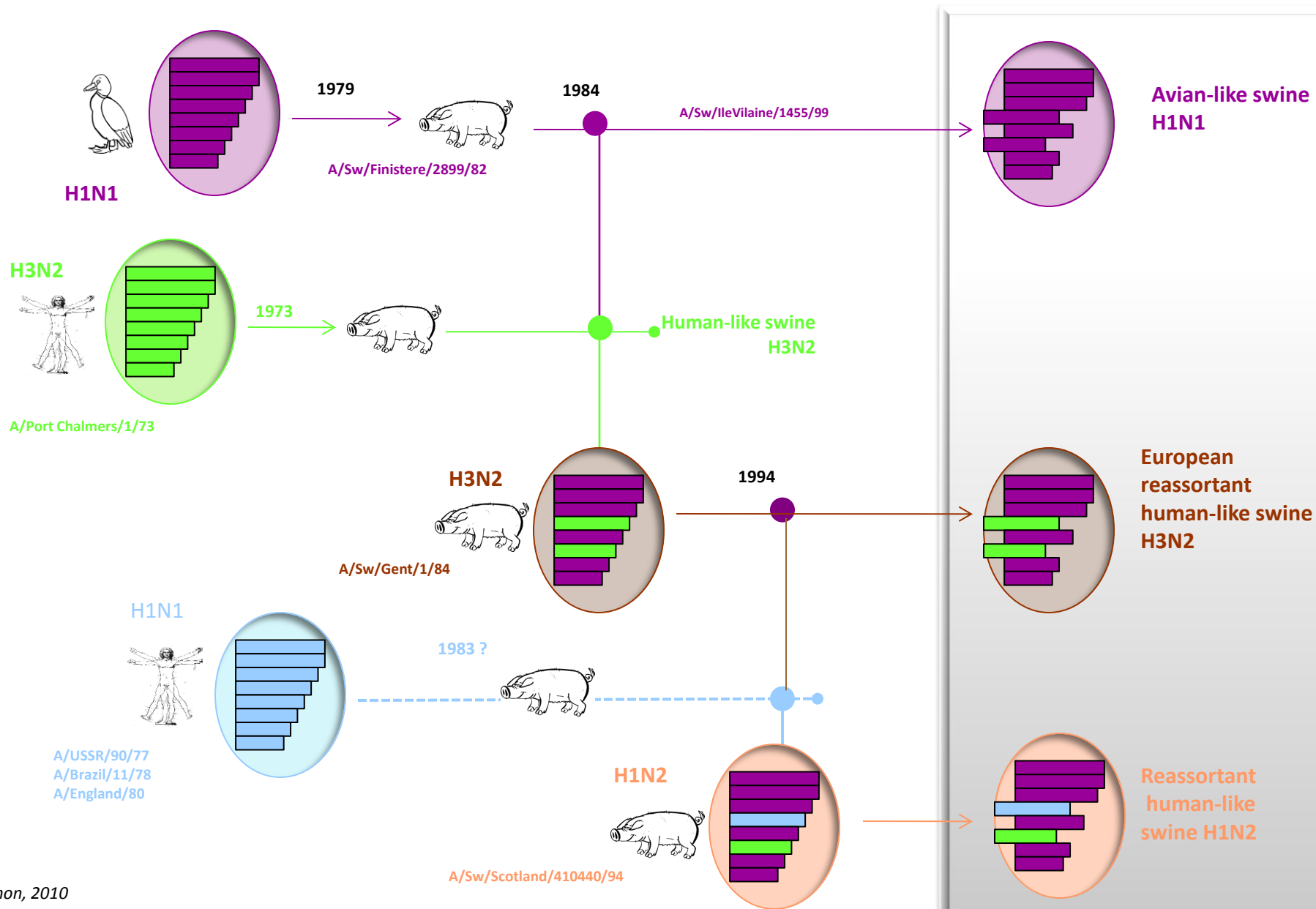Coordinator Ian Brown, AHVLA, UK
2010-2013

ESNIP3 objectives

- Expand knowledge of epidemiology and evolution of SIVs in Europe
  - Surveillance for influenza in pigs; harmonised
  - Contemporary data available at EU level
  - Service to pig industry
- Rapid virus characterisation
  - Harmonised diagnostics; new tools
- Use of new technologies/improvements linking datasets
  - Antigenic characterisation/mapping
  - Genetic characterisation
  - Phylogeography
  - Genotypic data
- Provide timely insights to veterinary public health risk
  - EFSA, ECDC
- EU SI Virus database and repository
- Global dissemination of information/exchange
  - Network interaction

European enzootic Swine Influenza Viruses (SIVs)

H1N1

A/Sw/Finistere/2899/82

1979

1984

A/Sw/IleVilaine/1455/99

Avian-like swine H1N1

H3N2

A/Port Chalmers/1/73

1973

Human-like swine H3N2

H3N2

A/Sw/Gent/1/84

1994

European reassortant human-like swine H3N2

H1N1

A/USSR/90/77
A/Brazil/11/78
A/England/80

1983 ?

H1N2

A/Sw/Scotland/410440/94

Reassortant human-like swine H1N2

Simon, 2010

Pandemic virus A/H1N1 2009

North American triple réassortant virus

SwH1-clade γ

H1N2
(1999)

or

rH1N1
(2007)

Eurasian avian-like swine H1N1 (1979)

Date, host, place ?

Swine-Origin A/H1N1
H1N1pdm09

| PB2 |
| PB1 |
| PA |
| HA |
| NP |
| NA |
| M |
| NS |

Classical swine H1N1

Human H3N2 (1998)

Avian H9N2 (1998)

Avian H1N1 (1979)
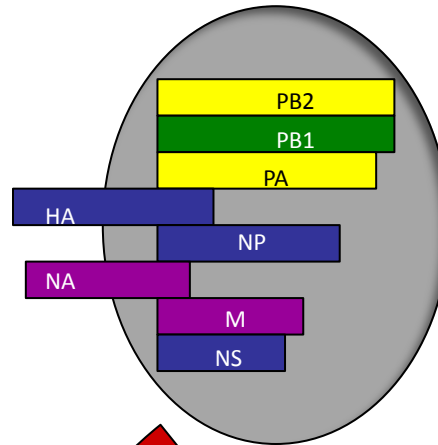
Prevalence in European pigs ?
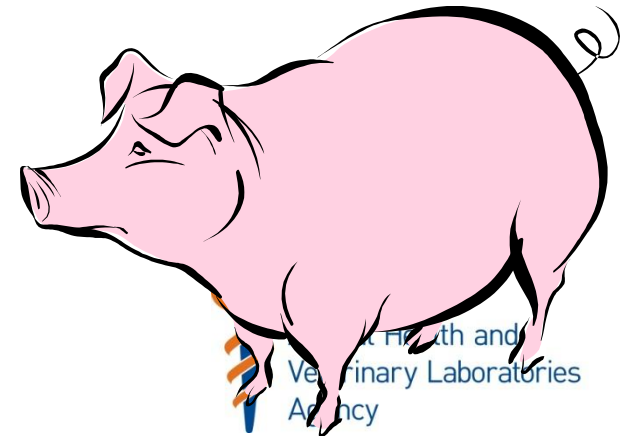
Slide courtesy of Galle Simon

Brookes et al., 2009, 2010; Lange et al., 2009; Simon, Virologie, 2010

Project consortia

- ## 25 partners:
  - ### Veterinary institutes
    - Belgium, UK, The Netherlands, Italy, France, Germany, Denmark, Poland, Spain, Israel, Hungary, Finland, Greece, USA, China
  - ### Vaccine manufacturers
    - Merial (France), IDT (Germany) & Hipra (Spain)

# Density of pig production in Europe

my

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Country	Partner	Number of herds investigated	Number of positive cases	Frequency of positive cases (%)		Number of subtyped viruses
United-Kingdom	P1-AHVLA	476	98	20,59		**58**
Belgium	P2-UGent	96	29	30,21		**29**
Netherlands	P2-UGent	46	25	54,35		**25**
	P12-CVI	28	14	50		**11**
	P8-IDT	8	1	12,5		**1**
France	P3-Anses	1338	703	53,44		**350**
Italy	P4-IZSLER	2098	360	17,16		**179**
Denmark	P5-DTU	1171	488	41,67		**254**
Poland	P6-NVRI	153	55	35,95		**29**
	P8-IDT	31	1	3,23		**1**
Slovakia	P6-NVRI	3	1	33,33		**1**
Belarus	P6-NVRI	20	2	10,00		
Russia	P6-NVRI	3	2	66,67		
Lithuania	P6-NVRI	1	0	0,00		**0**
Spain	P7-LCV	10	1	10		**0**
	P22-HIPRA	355	79	22,25		**29**
Germany	P8-IDT	2374	702	29,57		**540**
	P17-FLI	366	154	42,08		**119**
	P2-UGent	1	1	100		**1**
Finland	P9-EVIRA	65	3	4,62		**3**
Israel	P10-KVI	7	?	?		**0**
Hungary	P11-CAO	102	35	34,31		**38**
Greece	P13-UTH	52	9	17,31		**3**
Total Nov10-Oct13		**8810**	**2763**	**31,36**		**1671**

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Regional variation in the epidemiology of SI in Europe (ESNIP3)
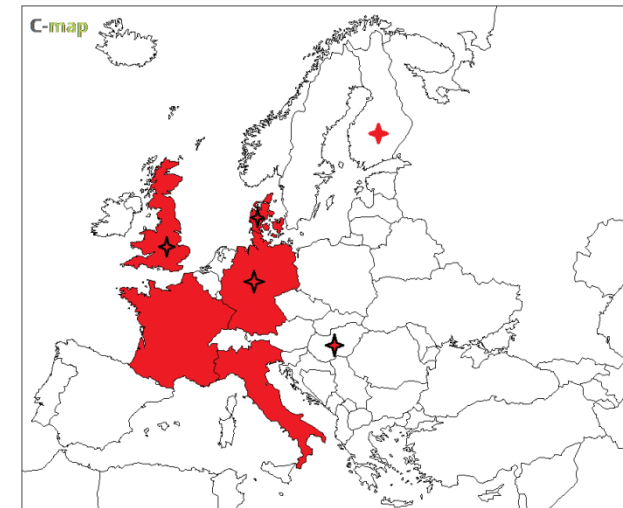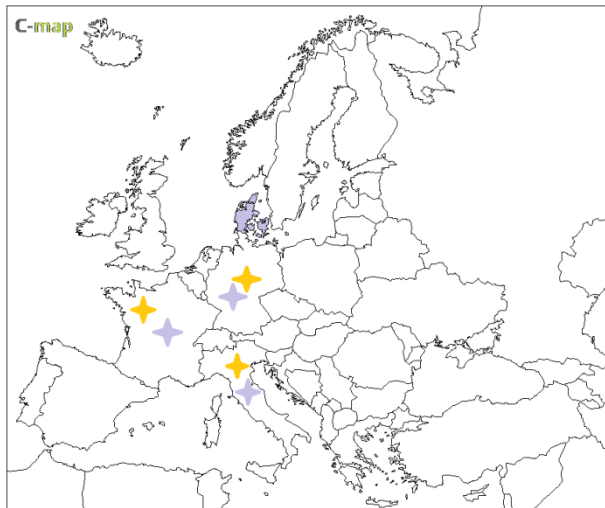
H1avN1 (53%)

H3N2 (9%)

H1huN2 (16%)
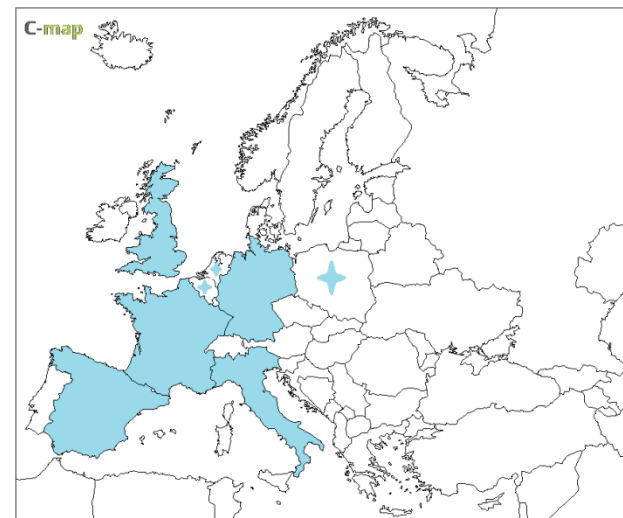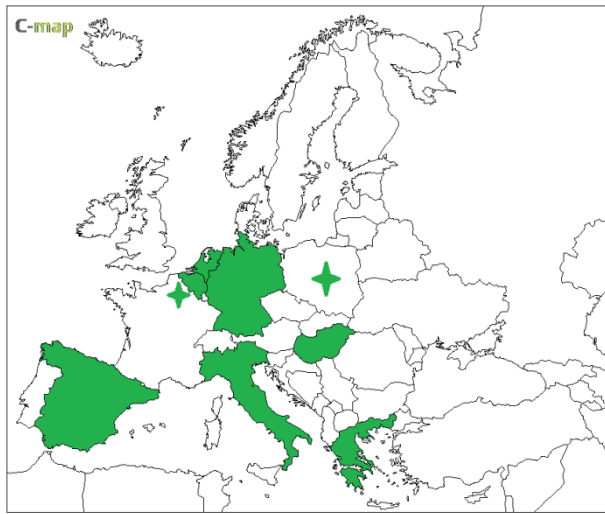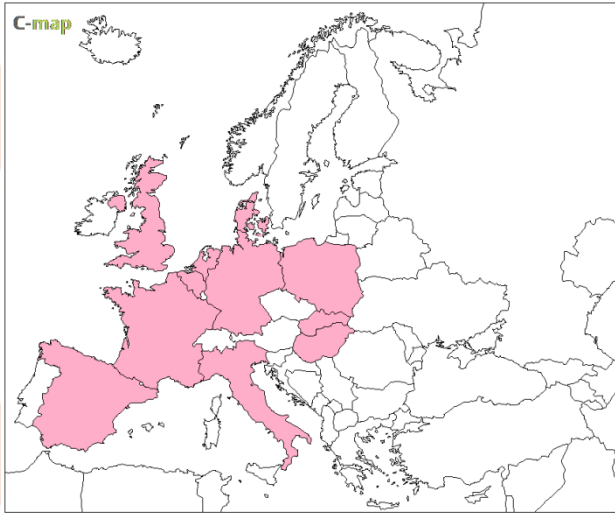
Enzootic lineages

Epizootic lineages
(occasional detections)

rH1huN1 and rH1avN2 (8%)

H1N1pdm and reass. (14%)

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New diagnostics PCR harmonisation

- Validated tools for detection of all SIVs

- Specific detection of North American swine H3N2v confirmed

- New methods under evaluation for rapid serotyping

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Mapping changes in the virus

- Why do we need to do?
  - Changes in virus spread, infectivity, & pathogenesis
  - Changes in virus host range
  - Veterinary Public Health Implications
  - Diagnostics
  - Intervention through vaccination
- Two approaches
  - Mapping antigenic changes
  - Identifying genetic mutations
  - Linking two datasets

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Antigenic mapping

- Understand how the pigs immune response to infection with influenza will reduce infection and spread with other strains

- Probe combinations of virus and different flu antibodies to reveal relationships

- Cartography – visual tool for presenting datasets

- Applied in ESNIP3 for first time to European SIV's

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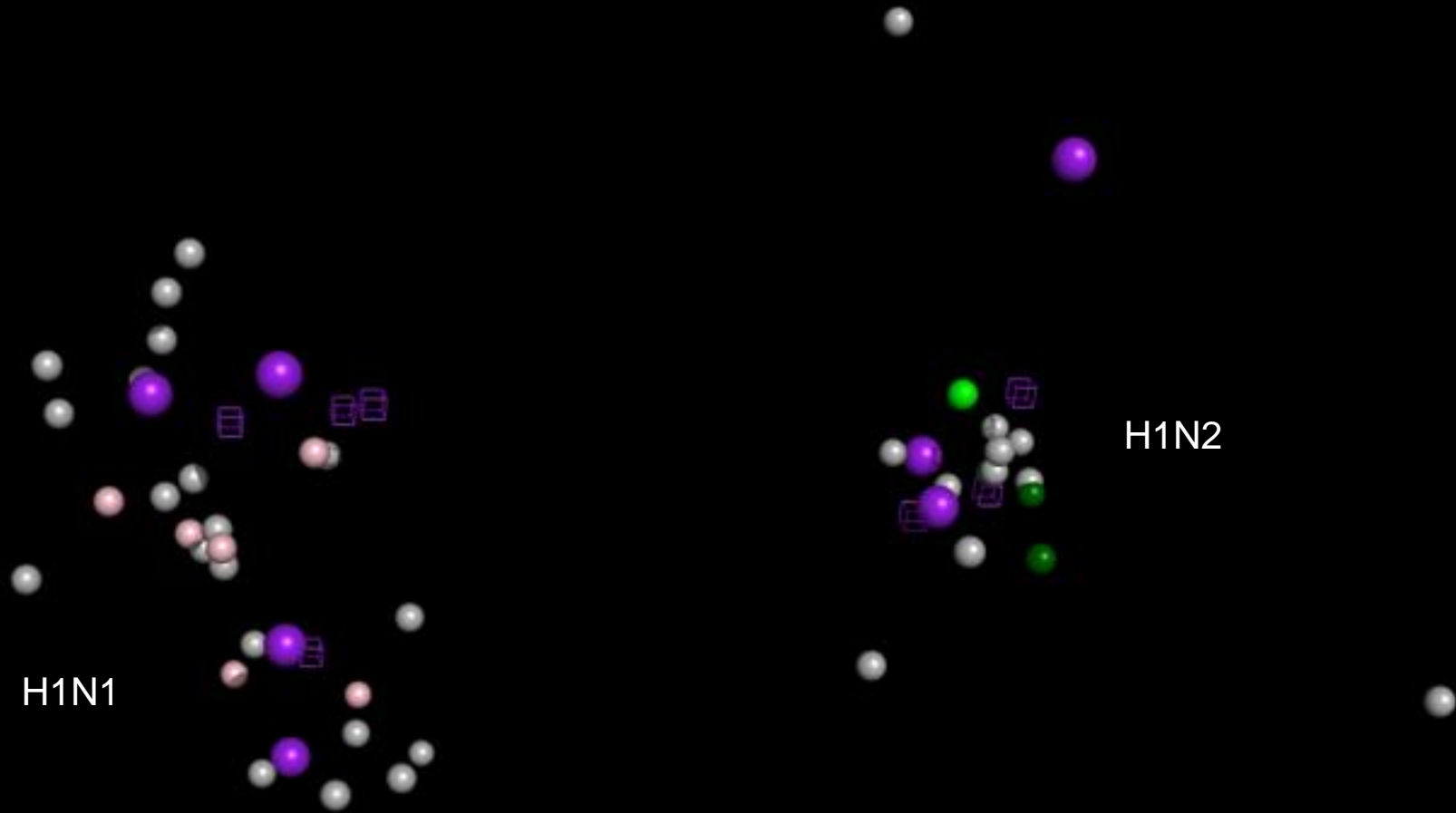
Genetic mapping/monitoring

- How are viruses mutating
- Determine the genetic code of SIV's and compare between strains
- Identify trends/patterns
- Identify new virus genotypes from genetic reassortment

- ESNIP3 has contributed c400 new SIV genomes

- Inform veterinary public health risk

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17 unique genotypes observed

Blue = Eurasian avian-like
Red = pandemic
Purple = Human H1/H3 N1/N2
Blue/Green = Classical swine
Grey = Eurasian avian

| PB2	PB1	PA	HA	NP	NA	MP	NS
pdm	pdm	pdm	pdm	pdm	pdm	pdm	pdm
pdm	pdm	pdm	H1	pdm	N2	pdm	pdm
pdm	pdm	pdm	H3	pdm	N2	pdm	pdm
pdm	pdm	pdm	pdm	pdm	N2	pdm	pdm
pdm	pdm	pdm	EA	pdm	N2	pdm	pdm
pdm	pdm	pdm	EA	pdm	EA	pdm	pdm
EA	EA	EA	H3	EA	pdm	EA	EA
EA	EA	EA	H3	EA	N2	pdm	EA
EA	EA	EA	H3	EA	N2	EA	EA
EA	EA	EA	H1	EA	N2	EA	EA
EA	EA	EA	H1	EA	EA	EA	EA
EA	EA	EA	EA	EA	N2	EA	EA
EA	EA	EA	EA av	EA	N2	EA	EA
EA	EA	EA	EA	EA	EA	EA	EA
hu	hu	hu	H3	hu	N2	hu	hu
CS	CS	CS	CS	CS	CS	CS	CS
EA av	EA av	EA av	EA av	EA av	EA av	EA av	EA av

Genotype frequency throughout Europe
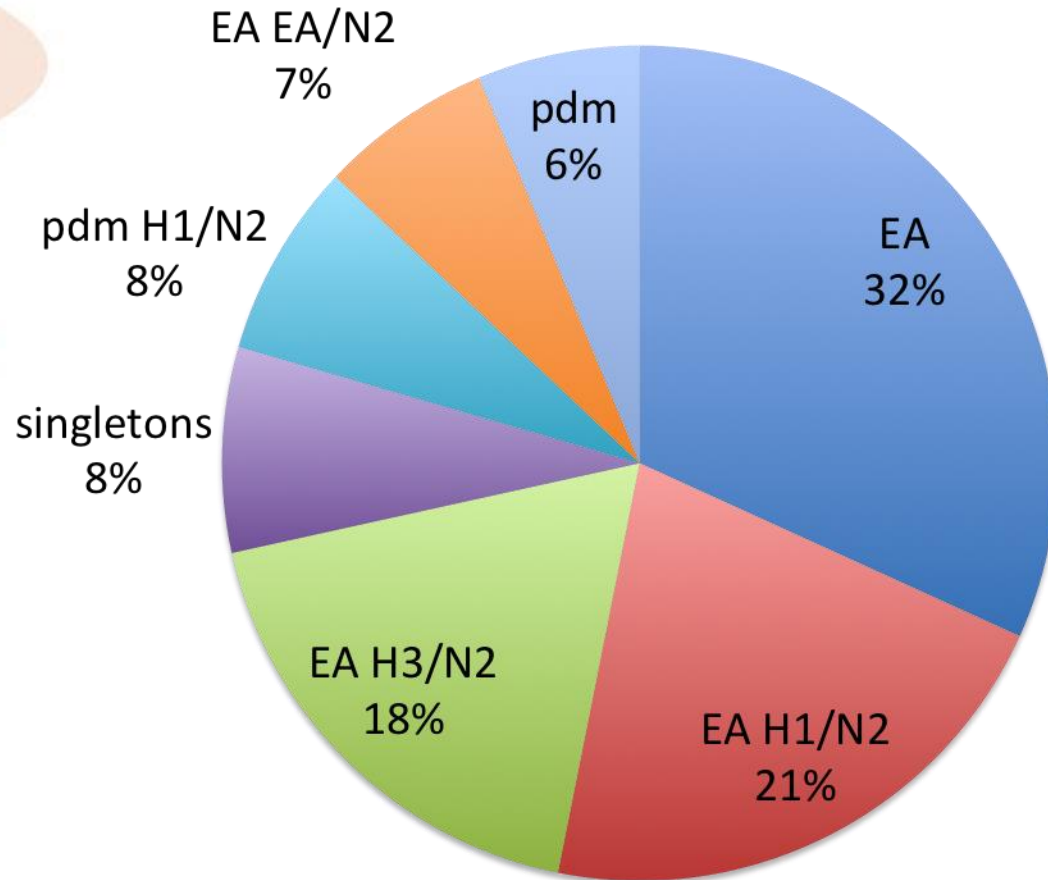
Pandemic genotype observed in 5 European countries

Pandemic segments observed throughout European swine

SIV genotypes in Europe

ESNIP3
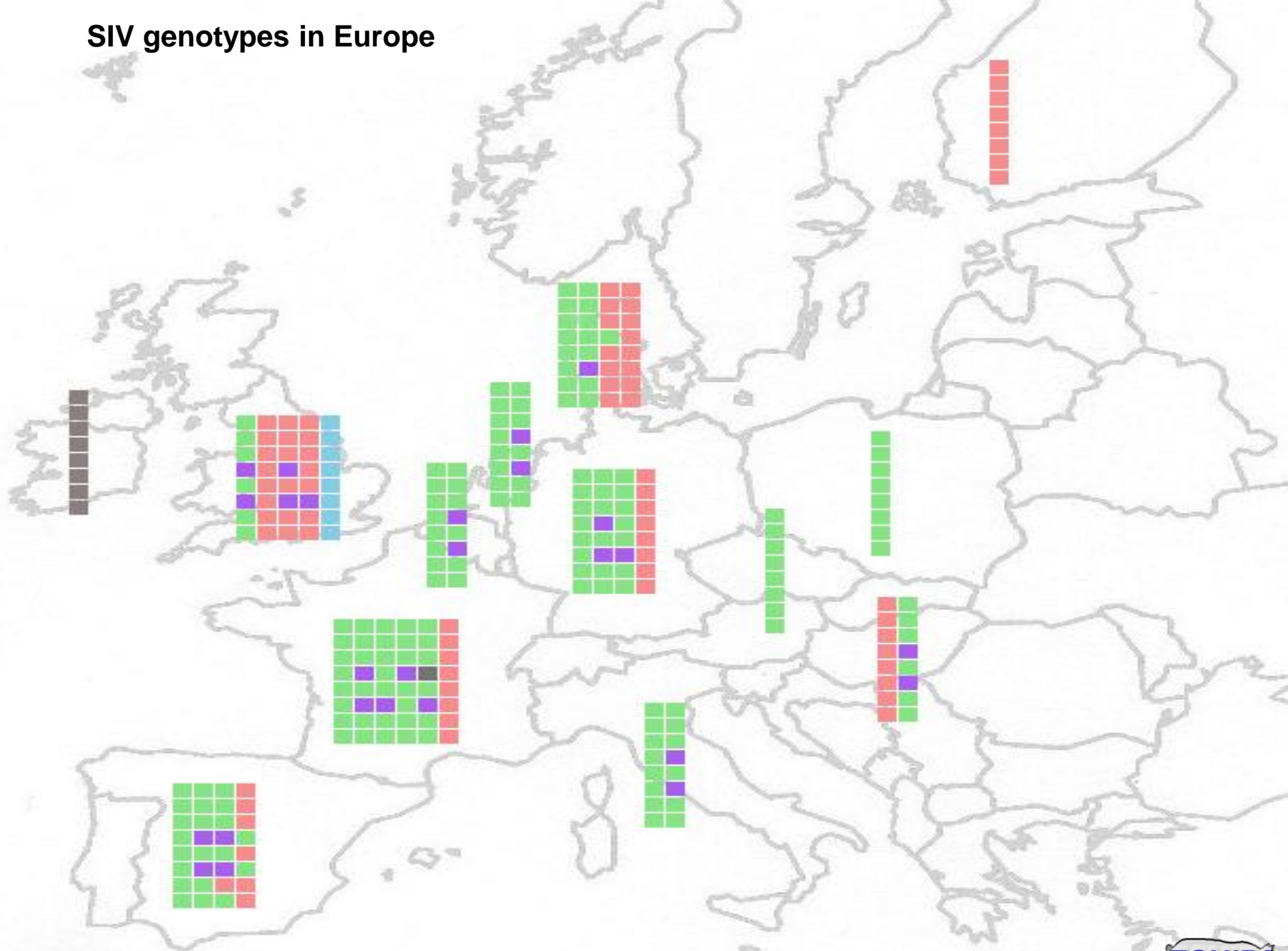
Implications of genotypic variation

- Continual virus mixing in the pig
- New introductions primarily from humans
- Viruses that are best fitted to replicating and spreading pigs will be 'selected'
- Contribute to virus change over time
- Importance of ongoing surveillance
- Implications for
  - control
  - economics
  - public health

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Conclusions

- Surveillance approaches harmonised
- Four viruses cocirculating
- Significant regional variation
- Diagnostics fit for purpose
- Preliminary antigenic maps for H1 & H3
- Genomic data generated- genotypic evolution including with pdm09

- Data/knowledge exchanged with other networks, official bodies

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The future?

- Project completion 31.10.13!
- Publication of work
- Continued engagement with stakeholders

- Future utility

- ESNIP4???
  - Lobbying & consultation
- Interest from commercial companies to sponsor an annual meeting
- No immediate prospect for continued funding of the network ☹

Acknowledgements

- EU commission
- Competent authorities supporting surveillance programmes
- Industry: producers, PVS's stakeholder groups etc
- Collaborating partners: WHO, OIE institutes

Thank you for your attention

Questions

Your views & comments welcome

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