

# **FACING THE RISK OF EMERGENCE AND REVERSE ZOONOSIS: “One Health” surveillance, filling the gaps !**

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# Conflict of interest

- *This presentation is done in total independence from the event organizer.*
- *I have no conflict of interest to declare regarding the current presentation.*

# Overview

1. COVID-19 and animal species

2. Surveillance of animal influenza for both animal and human health purposes

3. Sequencing foodborne zoonosis bacteria : next step for FBD surveillance and control

4. Monkey Pox : risk of reverse zoonosis and of inception of an animal reservoir

# 1. COVID-19 and animal species

# Receptivity and susceptibility of animals to SARS-CoV-2 : an early concern

- First scientific advice of Anses : March 6<sup>th</sup> 2020
- Highlighting of « One Health » concept
- Risk assessment of reverse zoonose
- Possible selection of VOC escaping to immunity and vaccines
- Possible animal reservoir
- Early identification of possible risk linked to mink farms



# Sources

LitCovid - NCBI - NLM - NIH

c.a. 260 000 peer reviewed articles published since jan. 2020

medRxiv COVID-19 SARS-CoV-2 preprints from medRxiv and bioRxiv



Le directeur général

Avis Anses  
Autosaisine n° 2020-SA-0059

Maisons-Alfort, le 16 octobre 2020

**AVIS**  
de l'Agence nationale de sécurité sanitaire de l'alimentation,  
de l'environnement et du travail

Relatif au rôle épidémiologique éventuel certaines espèces animales dans le maintien et la propagation du virus SARS-CoV-2



Exposure of humans or animals to SARS-CoV-2 from wild, livestock, companion and aquatic animals  
Qualitative exposure assessment



**Plateforme ESA**  
Epidémiologie santé animale

[ACCÈS](#) [SUR SUMMON INDEX](#) [PAR FONCTION](#) [PAR VÉT SANITAIRES INTERNATIONAUX](#) [PAR GÉOGRAPHIE](#) [PAR MÉTIERS](#) [PAR INSTITUTIONS](#) [PAR MÉTHODES](#)

**COVID-19 et ANIMAUX DOMESTIQUES. MISE À JOUR AU 18/02/2022**  
Version initiale : 06/04/2020. Date des prédictions utilisées à jour : 16/02/2022, version : 06/04/2020, signe : 06/04/2020, m/17/2020, s/17/2020, o/17/2020, w/17/2020, x/17/2020, y/17/2020, z/17/2020.

**COVID-19 et animaux domestiques**

- Les carnivores de compagnie (chien, chatte et furet) et les hiboux-ducs sont sensibles et infectés par SARS-CoV-2. Ils peuvent être porteurs et transmettre le virus à d'autres animaux et humains. [OIE le renvoie à l'avis 2020-0001](#).
- Les carnivores de compagnie (chien, chatte, furet) peuvent être considérés comme un risque pour l'épidémiologie humaine et la transmission des maladies humaines. Il existe à ce jour aucune preuve scientifique de transmission de SARS-CoV-2 d'un carnivore de compagnie à l'homme. [OIE le renvoie à l'avis 2020-0001](#). [OIE la tente le faire](#).
- Malgré la transmission de SARS-CoV-2 du bœuf à l'homme dans le Hong Kong en novembre 2020, il n'est à ce jour pas justifié de prendre des mesures à l'endroit des animaux de compagnie qui pourraient compromettre leur bien-être ou leur sécurité.
- Certaines espèces domestiques d'animaux peuvent montrer une réceptivité en conditions expérimentales. A ce jour le virus SARS-CoV-2 n'a pas été mis en évidence sur des animaux d'élevage domestiques en condition naturelle (bœuf d'Asie).

[CARTE INTERACTIVE](#) [INTERACTIF](#) [INTERACTIF](#)

**OIE** ORGANISATION MONDIALE DE LA SANTÉ ANIMALE  
Protéger les animaux, préserver notre avenir

**FICHE TECHNIQUE OIE**

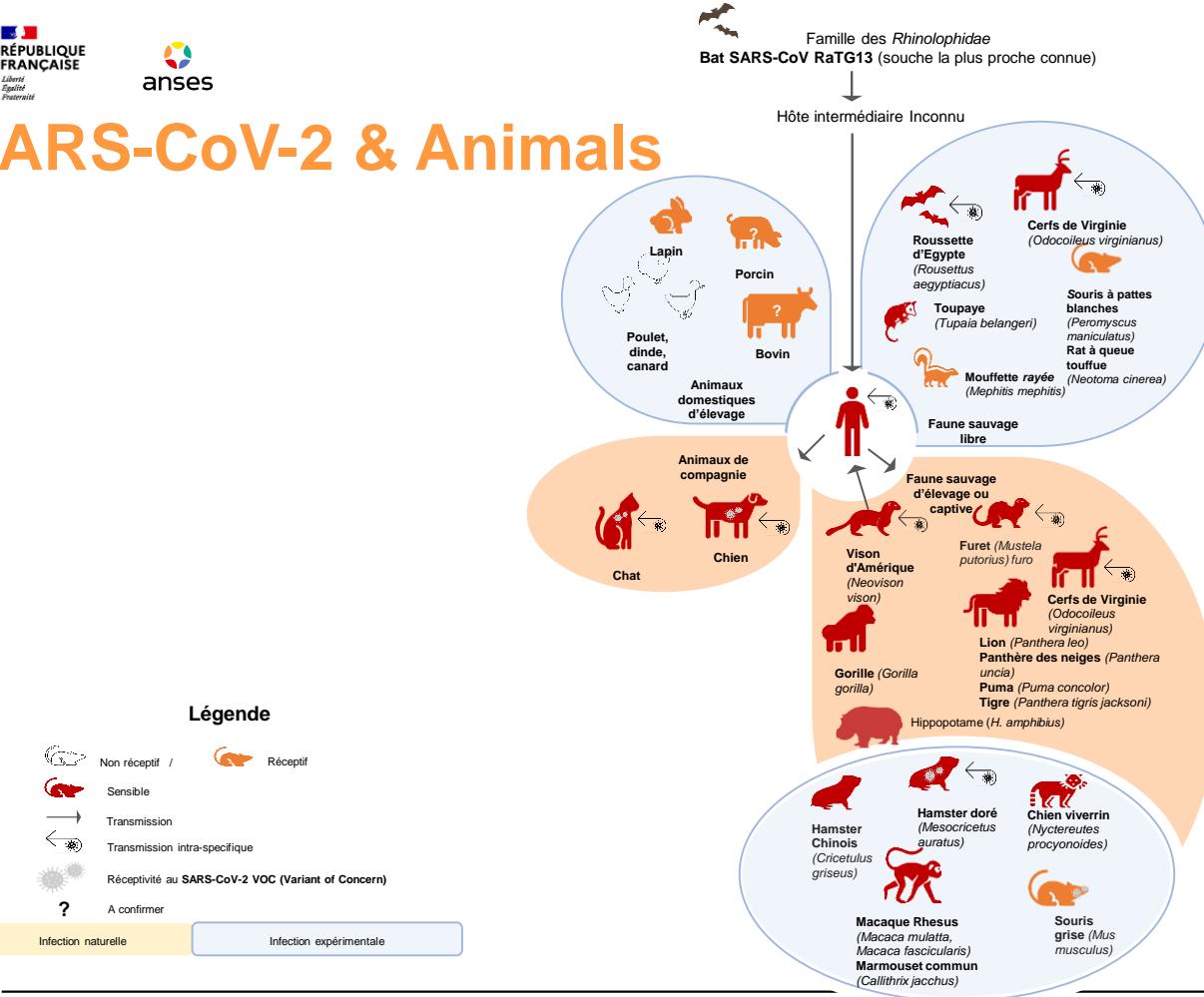
## INFECTION PAR LE SARS-COV-2 CHEZ LES ANIMAUX

Etiologie Epidémiologie Diagnostic Prévention et Contrôle Références

# Ability of SARS-CoV-2 to bind with ACE2 receptor in different species (Anses, 2020)

Animal species	Methods	Observations	Ref
Rhinolophus	HeLa cells expressing homologous ACE2 then infection	Infection	Zhou et al. (2020)
	VLP Spike SARS-CoV-2 on RhiLu/1.1 cells (lung)	VLP entry	Hoffmann et al. (2020)
	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Probable recognition	Wan et al. (2020)
Murin de Daubenton ( <i>Myotis daubentonii</i> )	VLP Spike SARS-CoV-2 on MyDauLu/47.1 cells (lung)	No entry of VLP	Hoffmann et al. (2020)
Civet	HeLa cells expressing homologous ACE2 then infection	Infection	Zhou et al. (2020)
	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Probable recognition	Wan et al. (2020)
Monkey	VLP Spike SARS-CoV-2 on Vero cells (kidney)	Entry of VLP	Hoffmann et al. (2020)
	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Probable recognition	Wan et al. (2020)
Orang-Outan	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Probable recognition	Wan et al. (2020)
Pig	HeLa cells expressing homologous ACE2 then infection	Infection	Zhou et al. (2020)
	VLP Spike SARS-CoV-2 on LLC-PK1 cells (kidney)	No entry of VLP	Hoffmann et al. (2020)
	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Probable recognition	Wan et al. 2020
Mouse  ! B1.351 (SA) & P1 (Bra) VOC able to infect mice	HeLa cells expressing homologous ACE2 then infection	No infection	Zhou et al. (2020)
	VLP Spike SARS-CoV-2 on NIH/3T3 cells (embryo)	No entry of VLP	Hoffmann et al. (2020)
	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Non probable recognition	Wan et al. (2020)
Rat	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Non probable recognition	Wan et al. (2020)
Hamster	VLP Spike SARS-CoV-2 on BHK cells (kidney)	No entry of VLP	Hoffmann et al. (2020)
Bovine	VLP Spike SARS-CoV-2 on MDBK cells (kidney)	No entry of VLP	Hoffmann et al. (2020)
Dog	VLP Spike SARS-CoV-2 on MDCK II cells (kidney)	Entry of VLP	Hoffmann et al. (2020)
Cat	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Probable recognition	Wan et al. (2020)
Ferret	Computer prediction recognition ACE2 & SARS-CoV-2 Spike	Probable recognition	Wan et al. (2020)

# SARS-CoV-2 & Animals



# Limit of a « One Health » surveillance

- Need for investigation in pets and farm animals in contact with infected humans
- Possible on cats & dogs but non mandatory surveillance with the collaboration of practitioner DVM and pets owners
- Negative opinion of CESREES (Scientific and ethical committee for health research, studies and evaluation) for farm animals regarding the risk to GDPR (General Data Protection Regulation).
- Only experimental challenges available for risk assessment
- Difficulties for DVM to access to human health data
- Excellent integration of « One Health » in Emergen consortium and ANRS-MIE

## 2. Surveillance of animal influenza for both animal and human health purposes

# « One Health » collaboration between SPF, NRL, NRC : detection of an influenza A(H1N2)v zoonotic event



## Human case of influenza A(H1N2)v of swine origin, France, 2021

Sibylle Bernard-Stoecklin, DVM PhD  
Infectious Diseases Division  
HSC, 22/09/2021



Les rencontres de Santé Publique France

### Case description

- 03/09/21: notification by the NRC (Institut Pasteur, Paris) of a confirmed human case of infection by an influenza virus A(H1N2)v of swine origin
- Male, 60-69 y.o., comorbidities (chronic lung disease)
- Direct exposure to swine (fattening farm) within the week before symptoms
- 14/08/21 : influenza-like illness (fever, shiver, cough)
- 18/08-25/08 : hospitalisation (including ICU)
- Completely recovered



### Epidemiological investigations

#### Human investigations :

8 co-exposed persons identified

None reported symptoms

Serum samples in 7/8, serological assay ongoing at the NRC

No increased influenza A detections in Brittany since August 2021

Syndromic surveillance of acute respiratory illness shows no signs of increasing trend in the area

#### Animal investigations (Anses) :

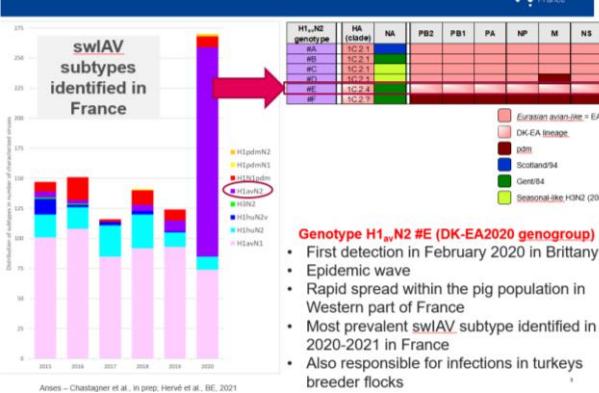
13/09 : visit to the farm by a team of epidemiologists and vets ; sampling of 30 pigs (1 month post-exposure)

No flu symptoms among the animals detected this summer, a few losses

Nasal swabs : all RT-PCR negative for swine influenza (including A(H1N2)v)

Serum samples : detection of antibodies against swine influenza HA of clade 1C.2.4

### Epidemiology of A(H1N2)v, clade 1C.2.4, in France (Anses)



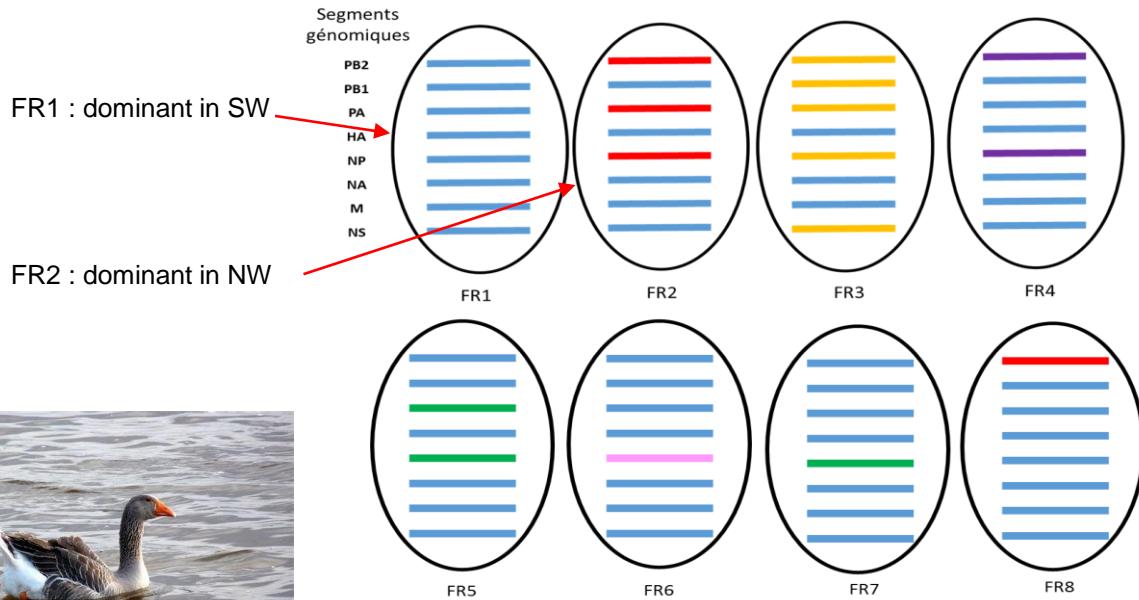
### Risk analysis and response

- Direct exposure to pigs is the most probable source of infection in this case, even though human-to-human transmission can not be excluded at this stage
- No secondary transmission event from this case detected so far, serological analysis ongoing
- A(H1N2)v, clade 1C.2.4, has recently emerged and very rapidly spread through Western France ; data lacks on its adaptation to human
- 10/09/21 : information about this situation released by the health authorities to all healthcare professionals in Brittany
- **National guidelines in case of suspicion of swine flu** : systematic testing for influenza in case of acute respiratory illness + SARS-CoV-2 negative + exposure to swine
- Information of pig farmers / other professionals exposed to pigs



# HPAI A(H5N1) virus genotypes observed in France since November 2021.

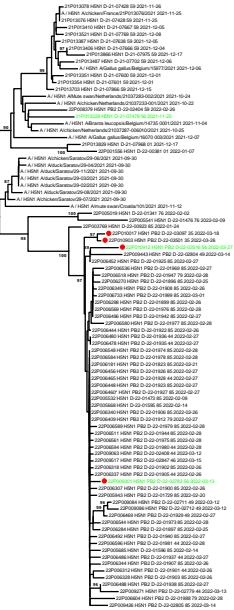
Each colour of genomic segment corresponds to a different phylogenetic origin



FX Briand, B. Grasland, Anses VIPAC AI NRL

FR2: Recent deletion in NS1 protein:  
potential marker of virus adaptation to  
domestic birds and possible increase in  
pathogenicity in birds

No detection of E 627K mutation in PB2

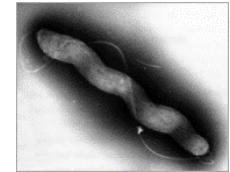


# Active « One Health » surveillance

- Active surveillance networks for both swine & avian influenza viruses
- Animal health Surveillance platform  Plateforme ESA  
Epidémirosurveillance santé animale
- « One Health » Research cluster on human and animal influenza viruses
- Excellent links between NRL & NRC
- Exchange of sequence, viruses, laboratory reagents... to improve rapid diagnostic of possible zoonotic viruses
- Scientific advices on emerging zoonotic influenza viruses (H10N3, H3N8...): SPF, Anses NRL, NRC
- Possible improvement : systematic investigations on pig breeders with influenza symptoms

# 3. Sequencing foodborne zoonosis bacteria: next step for FBD surveillance and control

# WGS and Surveillance of FB pathogens

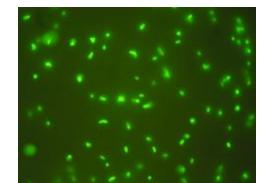


- To have robust and representative (spatio-temporal) genomic databases of the different sources of isolates
- Consolidation of work on source attribution, animal origin (*Campylobacter*)
- Consumer exposure and risk assessment by integrating virulence markers / antibiotic resistance genes...

- Interaction with the SCA FP



- Anticipation in the framework of the investigation of health alerts
- OH approach and relations with WGS database of isolates of human origin



# Interest of systematic WGS of FB bacterial strains

- **Food Sector:**

- Self checking of FB bacteria is mandatory in food industry for both food and their environment of production
- Results must be available for food inspectors
- No mandatory sequencing, no mandatory depository in a central database, mandatory serotyping for *Salmonella* strains only in poultry production
- No mandatory transmission of the strain to NRL even in case of recall/withdrawal of a food product
- Transfert of FB strains to the NRL on a voluntary base.

- **Human Health (NRC):**

- FB pathogens responsible for human cases are WGS by the NRC
- Most of the time difficult to link human strains and food or environmental strains

# Evolution of the EU surveillance system

## ❖ OH WGS – EFSA / ECDC Juin 2022

- mandatory transmission of WGS – metadata to EFSA
- *Salmonella, L. monocytogenes, EHEC, & Campylobacter*
- Country officer (Anses)
- Data provider : *Salmonella, L. monocytogenes, Campylobacter*  
(Anses)



## ❖ Tools for data collection developed in OHEJP: COHESIVE...



# Interest of systematic WGS of FB bacterial strains

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# Question & regulatory issues to address

- Investigate the feasibility of systematic and mandatory WGS of FB strains issued from self checking of food and their environment by food business operators
- Data & metadata shared in a common base accessible to both NRL & NRC
- Building an alert system based on WGS analysis involving both VPH & PH authorities
- Who is willing to pay for WGS ?
- Need for a regulation to implement such a policy.

## 4. Monkey Pox : risk of reverse zoonosis and of inception of an animal reservoir

# Anses scientific advice : risk assessment of reverse zoonose related to pets & exotic pets : questions

- Short term question : Recommendations to veterinarians and owners respectively, on what to do with pets (dogs, cats, rodents in particular) in contact with a confirmed case of MPX
- Later : document the risk of transmission of the virus by a patient to his pets, to peridomestic fauna and, via domestic effluents in particular, to the environment,
- Recommendations for reducing this risk





Roland Wirth

# Anses scientific advice : risk assessment of reverse zoonose related to pets & exotic pets : answers

- *Sciuridae*, including squirrels and prairie dogs: susceptible family, greater risk of infection,
- Keeping and sale of these animals should be monitored but is no longer authorised in France.
- Pet rodents (brown rats, mice, guinea pigs, hamsters...) appear to be less susceptible to MPXV in adulthood.
- Lagomorphs, the most common “exotic” pets, are receptive and susceptible specially young rabbits.
- Lack of data for ferrets and dogs, and a single serological study (with negative results) for cats
- Avoid contact of patients with animal *via* skin lesions, droplets & contaminated environment (gloves & masks).

# Further investigations

- Analysis of a Cohort of pets in contact with MPX symptomatic patients
- Contamination of waste water
- Replicability of the virus potentially found in waste water
- Risk assessment for peridomestic rodents and other species exposed to waste water

# Conclusion : One Health in action !



## Before COVID-19 :

- « One Health » is mainly a concept claimed by VPH
- Even if some joint actions were done since 1992 between SPF & Anses, NRC & NRL, (e.g. *L. monocytogenes* in cheeses and delicatessen )
- Active in AMR research & surveillance

## After (or during? ) COVID-19 :

- « One Health » is earlier involved in research & surveillance one potential zoonosis
- EMERGEN & ANRS MIE are real opportunities for dialog & shared data
- Some regulatory gap to address :
  - To get access to human health data for non MD
  - To get access to data issued from the food industry
  - To investigate more systematically potential emerging infectious diseases within populations in contact with farm animals

