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EU Reference Laboratory
for Capripox viruses

Funded by the
European Union

healthy all life long

EU Project DEFEND activities of importance to LSD control

Defend

https://defend2020.eu/

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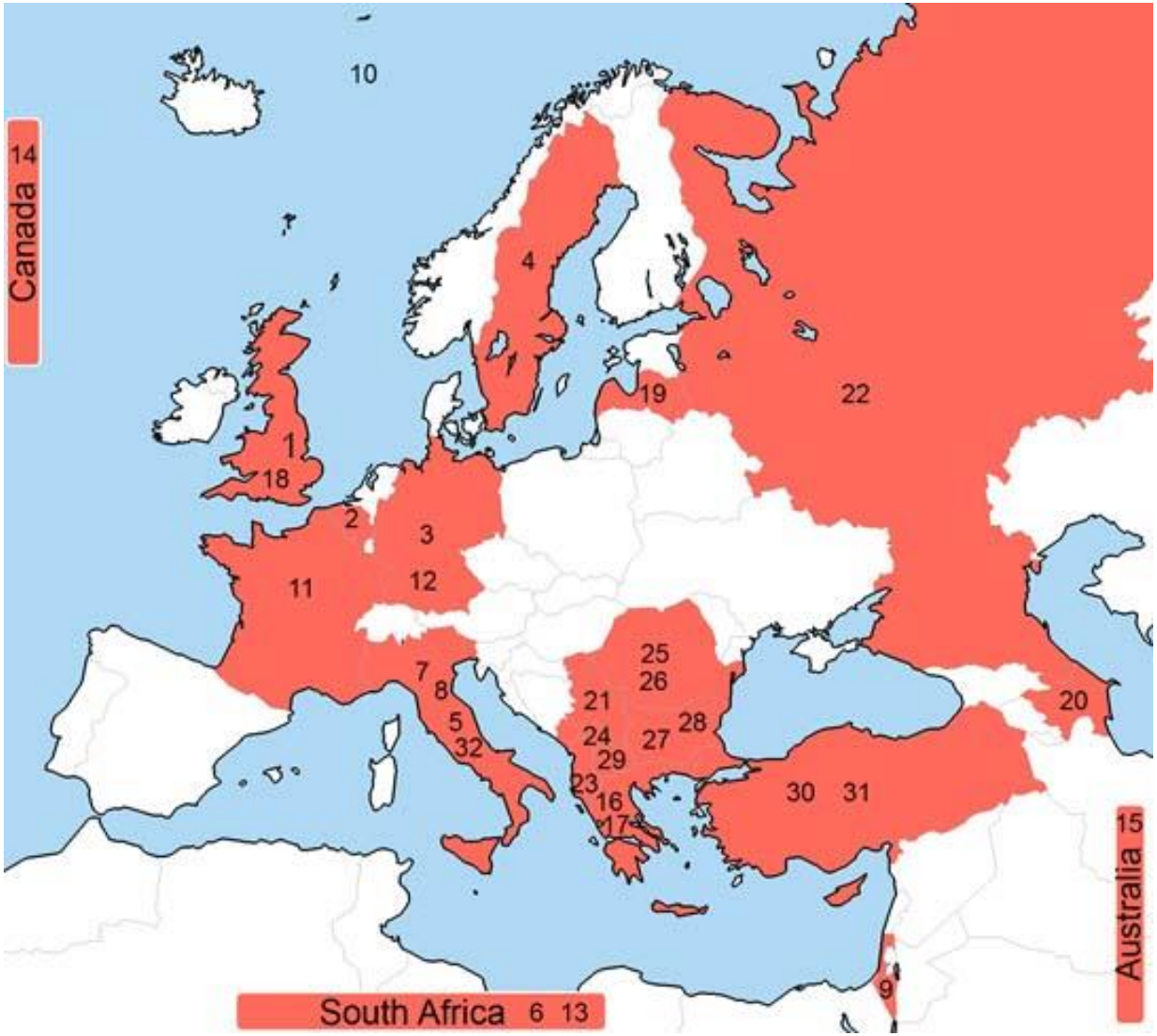
Consortium: Who is involved?



EUROPEAN COMMISSION

Research Executive Agency

Sustainable Resources for Food Security and Growth

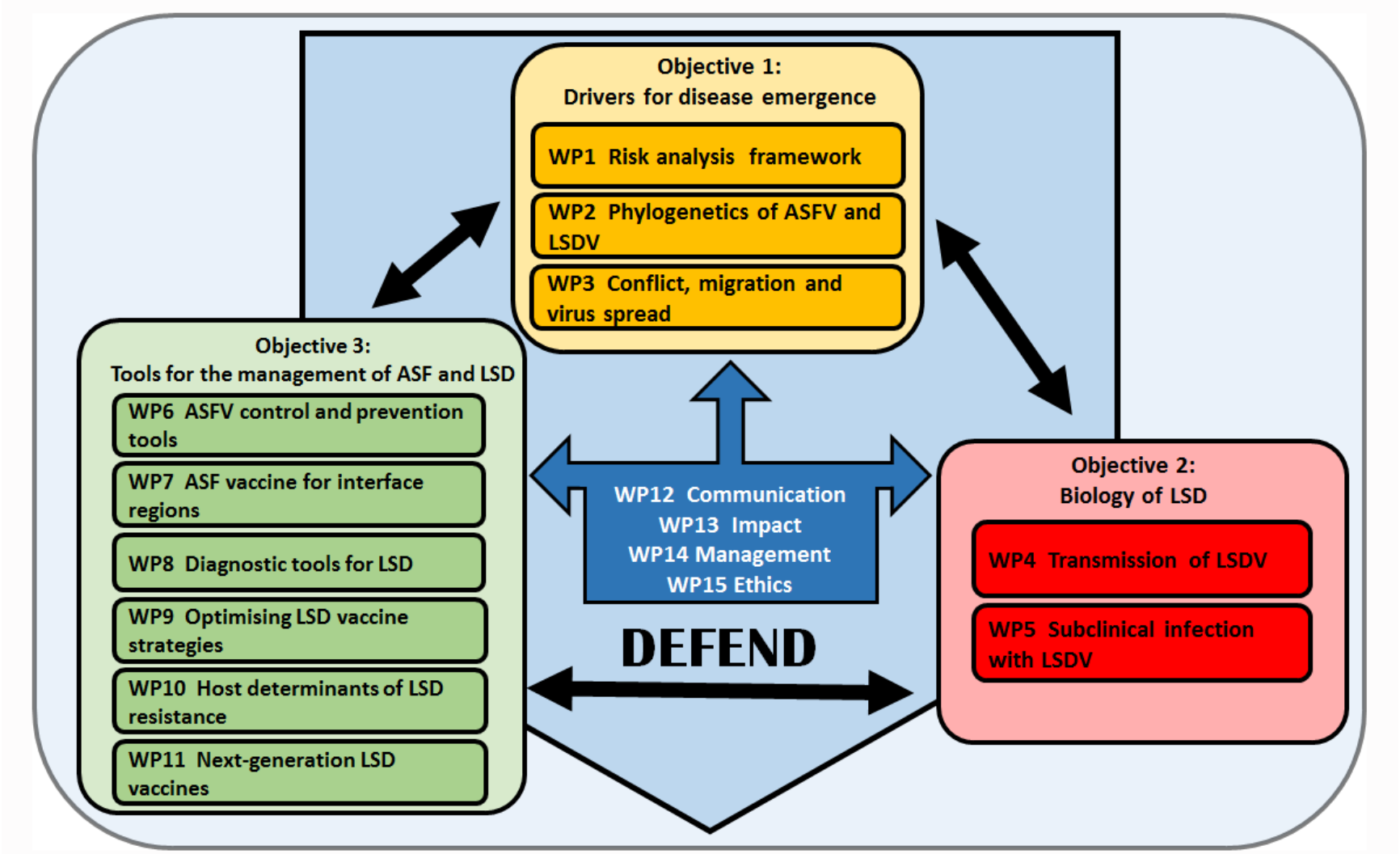
Research and Innovation action
NUMBER — 773701 — DEFEND

Project title: Addressing the dual emerging threats of African Swine Fever and Lumpy Skin Disease in Europe (DEFEND)

The aim:

To understand the drivers of the emergence LSDV and ASFV, and generating research outputs which supports rapid responses by decisionmakers and underpin novel diagnostic tools and vaccines.

Work-Packages



WP1: Risk analysis framework

Aim: to develop risk assessments, taking factors into account that might play a role in the emergence of ASF or LSD in Europe

LSD

Rank	Category	Score
1	Immune status	9.27
2	Movement/ Transport	9.00
3	Disease control	8.50
4	Environmental factors	8.00
5	Biosecurity	7.90
6	Vector properties	5.88
7	Virus properties (LSDV)	5.12
8	Socioeconomic factors*	4.00
9	Husbandry system	3.90
10	Networks*	3.50
11	Surveillance	2.00
12	Cattle properties*	0.75

ASF

viruses MDPI

Systematic Review

Identification of Risk Factors for African Swine Fever: A Systematic Review

Hannes Bergmann [1,*], Johanna Dups-Bergmann [1], Katja Schulz [1], Carolina Probst [1], Laura Zani [2], Melina Fischer [3], Jörn Gethmann [1], Nicolai Denzin [1], Sandra Blome [3], Franz J. Conraths [1] and Carola Sauter-Louis [1]

animals MDPI

Review

A Review of Environmental Risk Factors for African Swine Fever in European Wild Boar

Hannes Bergmann *, Katja Schulz, Franz J. Conraths and Carola Sauter-Louis

WP 2: Phylogenetics of LSDV and ASFV

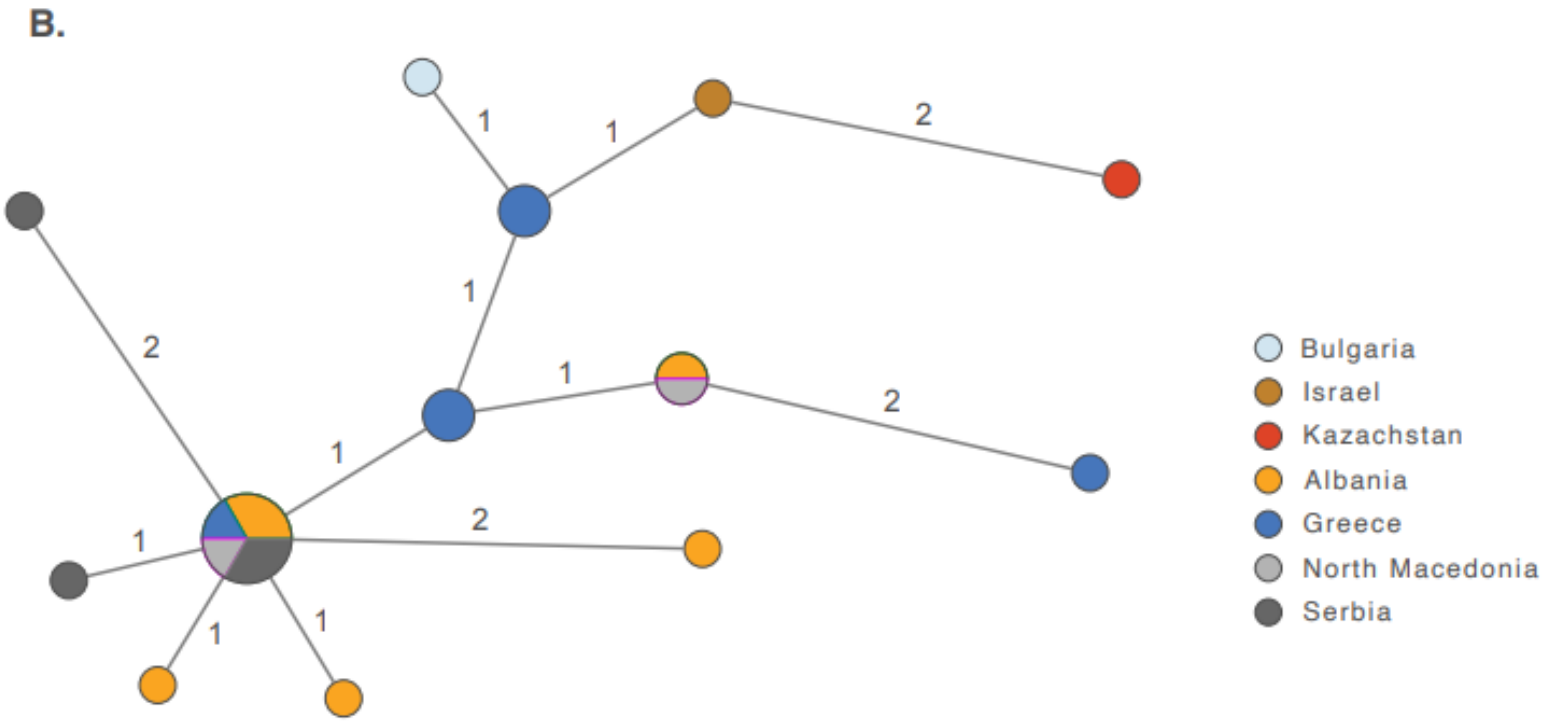
- Increase global resolution, esp. European incursion 2015-2017. Low variation → need whole genome
- Whole genomes → evaluate existing LSDV molecular diagnostics.

Region	Genomes completed (Sanger confirmation ongoing)	Variable positions detected within region
ALBANIA	6	7
GREECE	6	5
N.MACEDONIA	2	2
SERBIA	4 (+1)	4
BULGARIA	(1)	
KAZACHSTAN	(1)	
ISRAEL	(1)	
EUROPE (+)	**22**	**19**

Variation dispersed over genome: cannot target region for partial sequencing

Growing number of public genomes: Russia; Vietnam; South Africa; Turkey; China; Namibia; India ; Thailand; Nigeria ; ….

Spatiotemporal phylogenetic reconstruction



First exploration using methods for slowly evolving pathogens (bacteria): SNP haplotype network.

(Dellicour et al., Epidemiological hypothesis testing using a phylogeographic and phylodynamic framework. Nature Communications, 2020)

WP 3 “Conflict, migration and virus spread”

- **Objective:** to assess how conflicts, insecurity situation and migrations act as drivers for animal disease emergence and spread.

Conference Paper · May 2022
A methodology to identify socio-economic factors and movements impacting on ASF and LSD in rural and insecure areas.
Angeloni et al., 2022

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WP 4: Transmission of LSDV

Experimental evidence of mechanical lumpy skin disease virus transmission by *Stomoxys calcitrans* biting flies and *Haematopota spp.* horseflies

C. Sohier[1,3*], A. Haegeman[1,3], L. Mostin[1], I. De Leeuw[1], W. Van Campe[1], A. De Vleeschauwer[1], E. S. M. Tuppurainen[2], T. van den Berg[1], N. De Regge[1] & K. De Clercq[1]

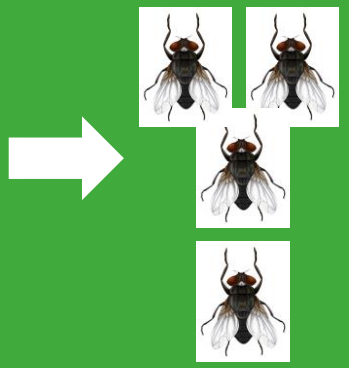
SCIENTIFIC REPORTS
natureresearch

- Mechanical transmission has been demonstrated to occur by blood-feeding insects and some African tick species – no data available on vector potential European ticks - restriction zones need to cover the flying distance of vectors (50km)

DEFEND - WP4: Transmission of LSDV

Task 4.2: In vivo feeding: In vivo transmission: setup

Donors (n=10)



Acceptors

<u>Mass exposure</u>
2 batches
Each batch 2/3 days
~350 flies per animal

<u>Low exposure</u>
1 day
1 cage of 20 flies

Preliminary results:
Transmission from low exposure similar to mass exposure !!

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Transmission direct / indirect / semen

- Direct contact or Indirect contact via shared water and feed troughs and contaminated environment ?

- Direct/Indirect contact transmission with recombinant LSDV strains

- Task 4.5: Evaluation of transmission by semen

  ✓ LSDV positive semen obtained from an LSDV clinical bull but No transmission experimentally

DEFEND – WP5: Subclinical infection with LSDV

Infected Donors
without clinical signs
= subclinical

10 min

1 h interval

Acceptors

(N=13)

Main conclusion / remarks

- **Transmission from sub-clinical animals is possible**
- **One acceptors became again sub-clinical infected !**
  → dangerous cycle !!
- **Eliminating only clinical diseased LSD animals is insufficient → probability of reappearance of LSD is high**

WP 8: Diagnostic tools for LSD

Objectives

- To study the immune response to lumpy skin disease virus and the difference between infected and vaccinated animals
- To use this knowledge to improve serological tests (humoral immunity) and interferon gamma assays (cellular immunity).

Results

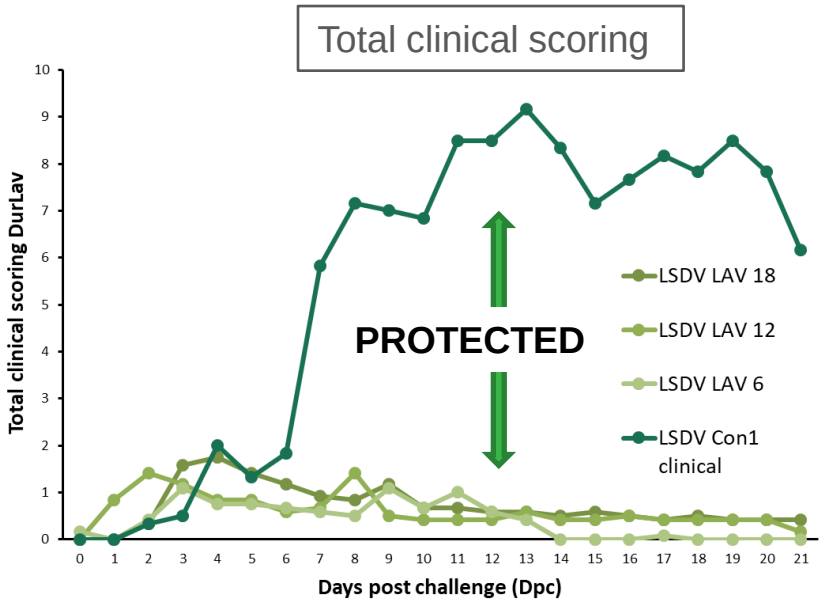
- ✓ Several new monoclonal antibodies (Mab) against LSDV developed
- ✓ New serological tests based on Mab developed
- ✓ Several proteins synthesized for stimulation of cells in the interferon gamma assays
- ✓ DIVA assays under evaluation

WP 9: Optimising LSD vaccine strategies

Duration of immunity: estimated by infection of vaccinated animals after 6m, 12m and 18months

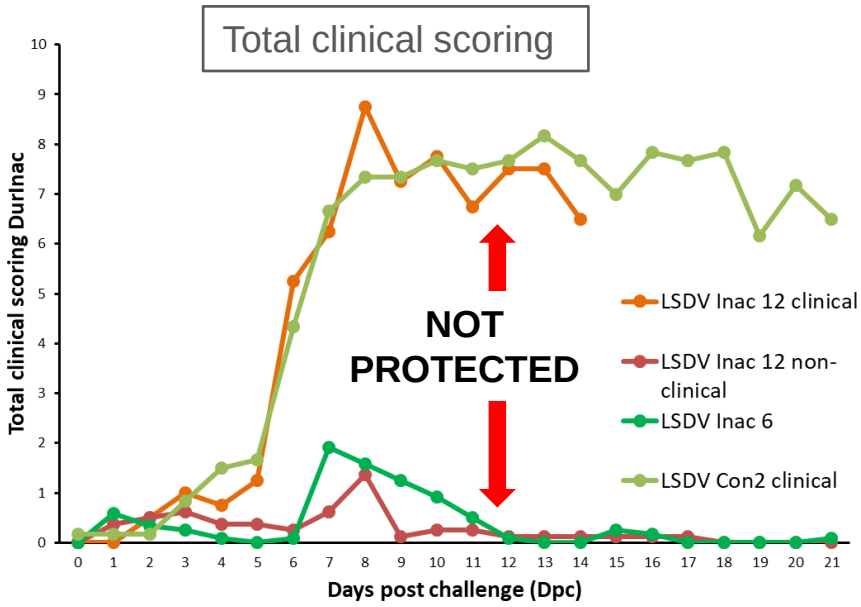
Live attenuated vaccine

- No nodule formation
- Almost no clinical scoring



Inactivated vaccine

- Nodule formation in LSDV Inac 12m (2/6)
- Clinical scoring in 2 animals LSDV Inac 12m



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GALVmed Protecting Livestock – Improving Human Lives

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Haegeman et al. (2023). Duration of immunity induced after vaccination of cattle with a live attenuated or inactivated Lumpy skin disease virus vaccine. Microorganisms 2023, 11, 210.

WP 10: Host determinants of lumpy skin disease (LSD) resistance and susceptibility

Aim

- To quantify the genetic contribution to host susceptibility or resistance and evaluate different strategies to improve host resistance

Preliminary Results:

A Genome-wide association (GWAS) study showed that there are genomic signatures related to LSD susceptibility on chromosomes 4 and 23.

There are significant differentially expressed (SDE) genes between LSD symptomatic and asymptomatic animals.

Day 7 post infection is the best time point.

Van Borm et al. (2022). Host variation in susceptibility to lumpy skin disease: gene expression analyses of experimentally infected cows. Proceedings of 12th World Congress on Genetics Applied to Livestock Production.
DOI: 10.3920/978-90-8686-940-4_154.

WP11: Next generation LSD vaccines

Aim: Construct a subunit vaccine designed to stimulate humoral immune response to LSDV

Preliminary Results:

- ✓ Vaccine construct made.
- ✓ Immune response (antibodies) against construct after injection.
- ✓ After challenge: no protection yet.
- ✓ Future: Develop DIVA ELISA

Thanks to the EC for the support

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