Use of health data for research





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Health Data Conference
"Challenges and benefits of health data recording in the context of food chain quality, management and breeding"
30-31 May, 2013, Aarhus, Denmark

ANIMAL HEALTH ISSUES

- Animal Welfare
- Animal Health
- Production traits

Intensification and specialization of livestock sector

ANIMAL HEALTH ISSUES

- Animal Welfare
- Integrated Animal Health Management
- Production traits

Intensification and specialization of livestock sector

ANIMAL HEALTH MANAGEMENT

- Animal Welfare
- Integrated Animal Health Management
- Production traits

Disease control strategies

⊃ **Prevention + Cure**

⊃ **Important decisions on**

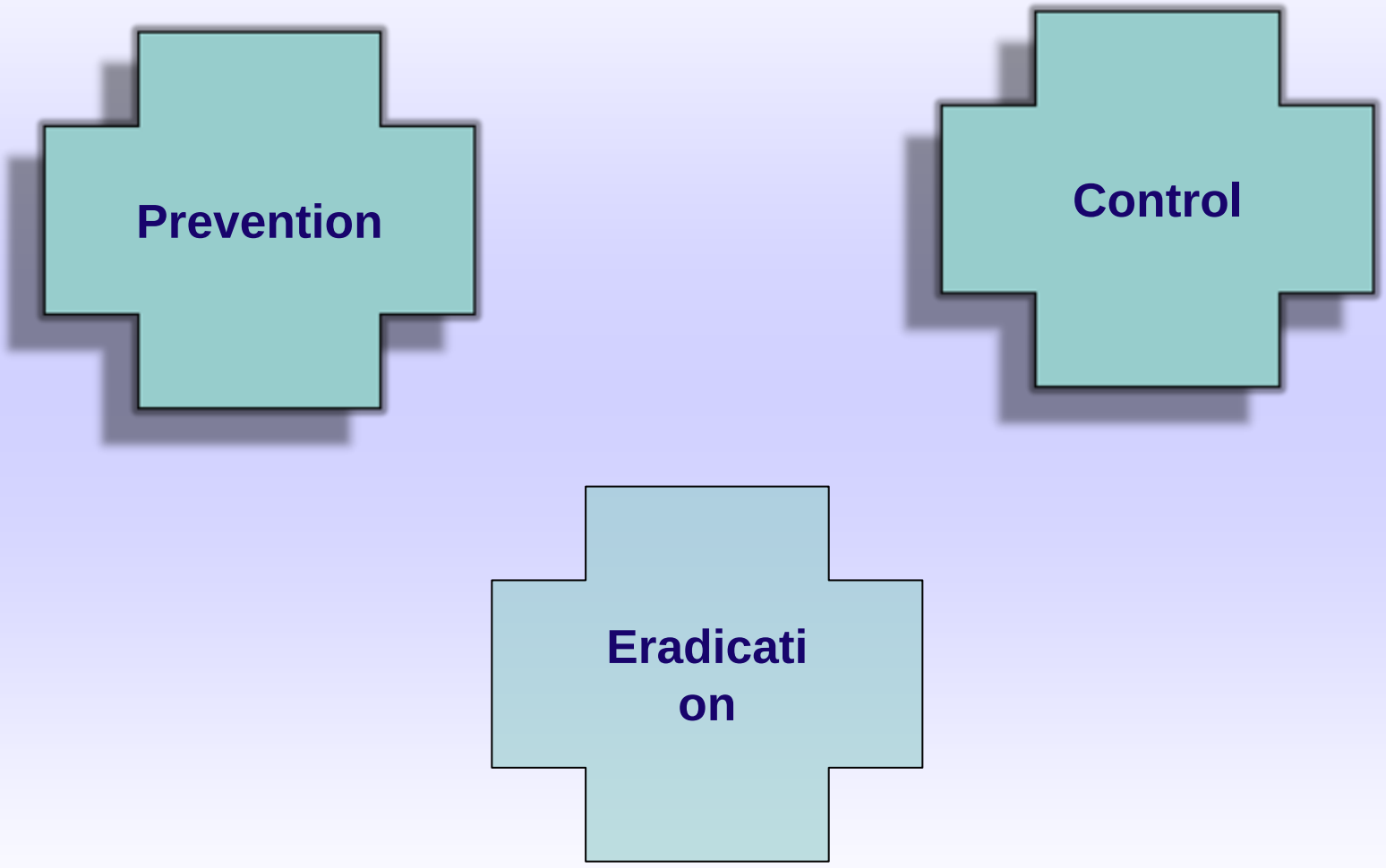
- **Animal** (selection, culling, vaccination...)
- **Pathogen / Environment** (chemotherapy, biosecurity...)

Important step with potentially major effects

***Needs :* Critical evaluation + integrated approach**

=> quality of health data !!

NEED OF HEALTH DATA FOR RESEARCH : FOR AN INTEGRATED APPROACH OF DISEASE CONTROL



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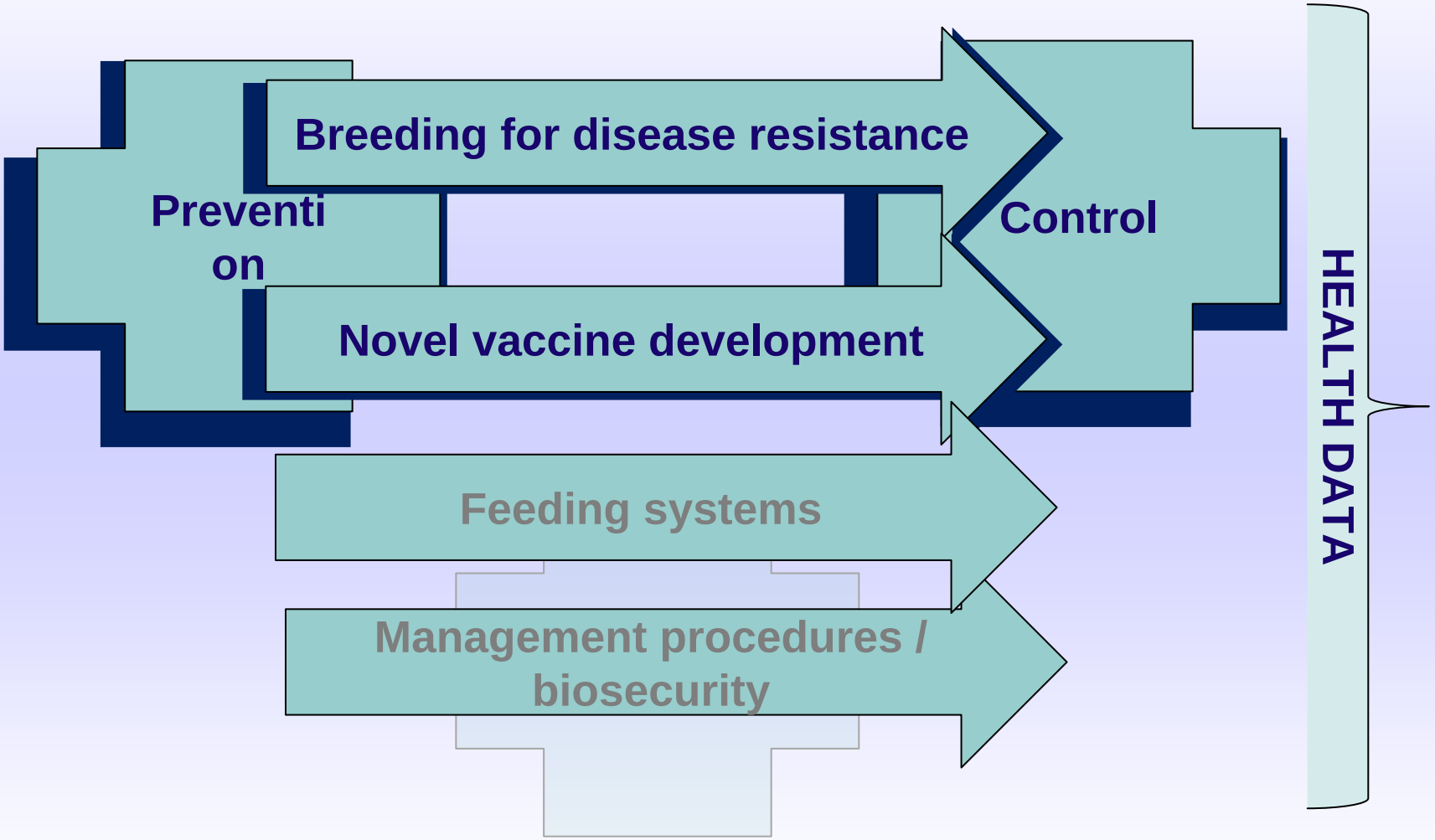
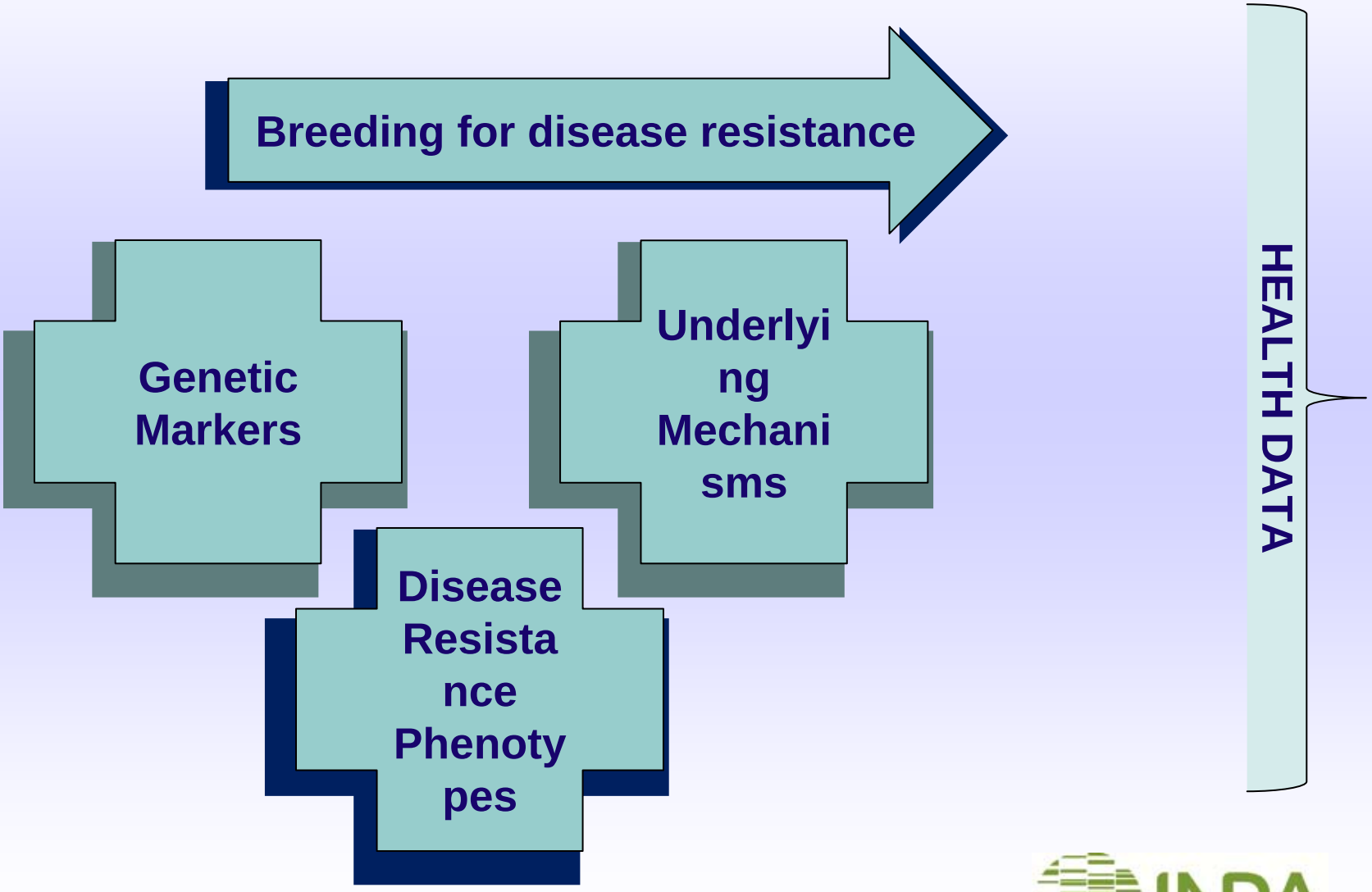


NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE



NEED OF HEALTH DATA FOR RESEARCH

Lack of Disease Phenotypes

-Easy to measure & relevant phenotypes
- Finer phenotypes / mechanisms

THE PHENOTYPIC GAP !!

NEED OF HEALTH DATA FOR RESEARCH : VALIDATING DISEASE RESISTANCE PHENOTYPES

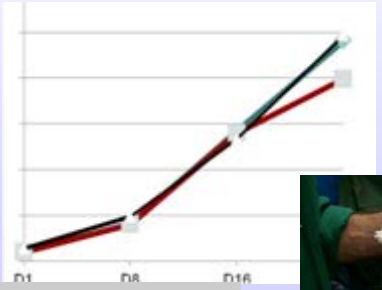
Large panel of Disease Phenotypes

A classical approach :

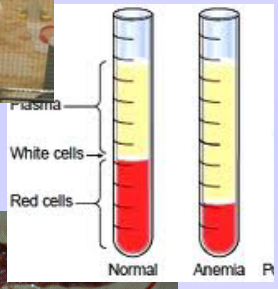
Sensitive

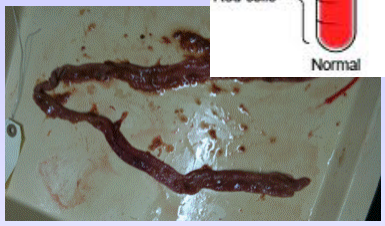
Resistant

EXPERIMENTAL



- **Weight Gain**
- **Plasma Col**
- **Hematocrit**
- **Lesion**
- **Rectal T°**
- **Oocyst count**

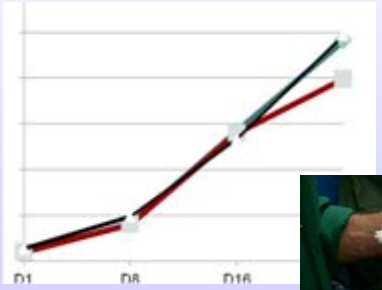




NEED OF HEALTH DATA FOR RESEARCH : VALIDATING DISEASE RESISTANCE PHENOTYPES

Small Set of Disease Phenotypes

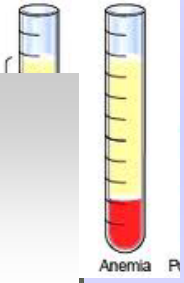
A classical approach :



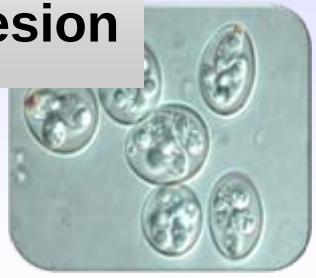
Sensitive

Resistant

EXPERIMENTAL



Hema	0.14			
WGain	0.09	0.56		
Lesion	NS	-0.39	-0.44	
Plasma	0.09	0.56	0.70	-0.48
	T°	Hema	WGain	Lesion



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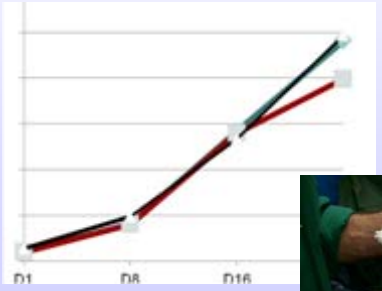

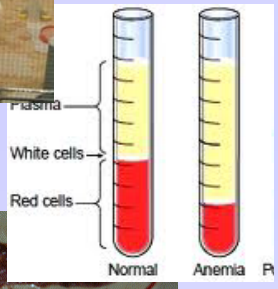

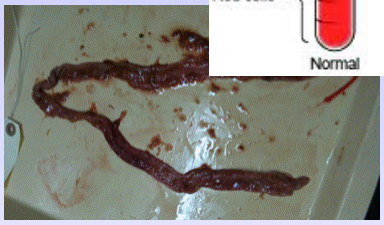

EXPERIMENTAL

Pilot-study

Large scale-study

COMMERCIAL

NEED OF HEALTH DATA FOR RESEARCH : VALIDATING DISEASE RESISTANCE PHENOTYPES

Small Set of Disease Phenotypes

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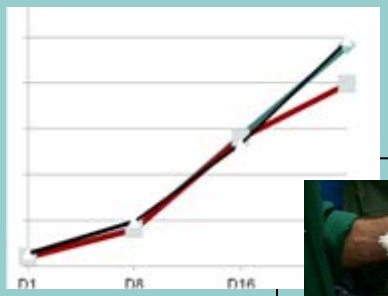

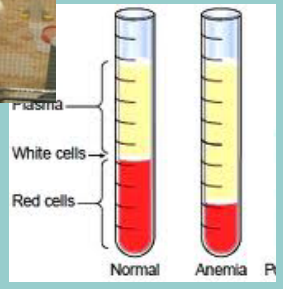

EXPERIMENTAL

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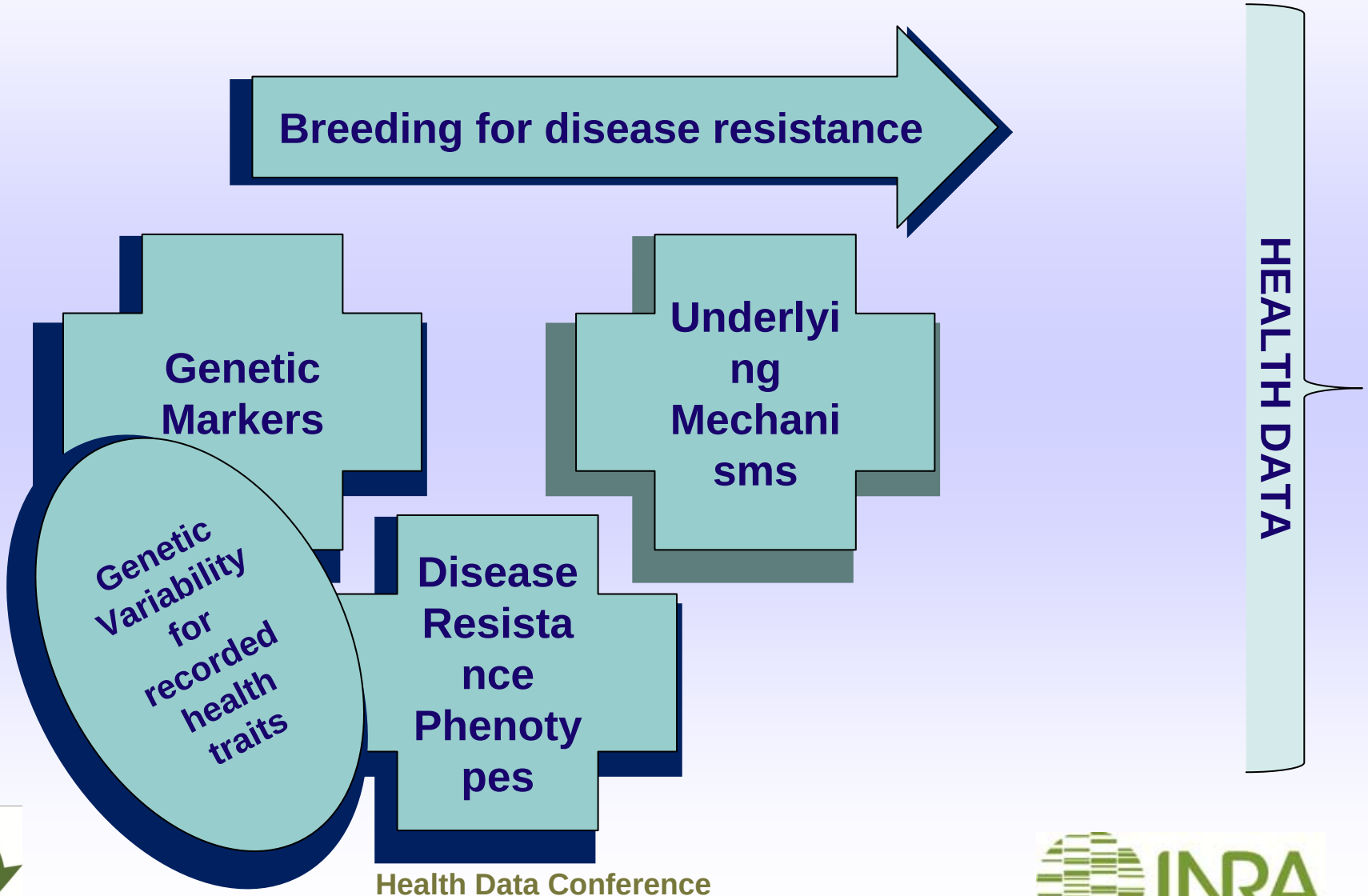
NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

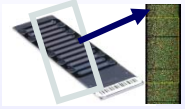


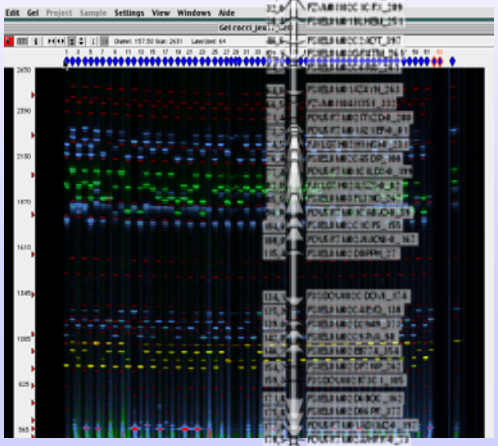
CRITICAL EVALUATION PRIOR INTEREST FOR DISEASE RESISTANCE = *PRIOR MEASURING MORE HEALTH TRAITS*

Disease	Disease score (Industry-eco-public-welfare-zoono.)	Genetic Variation	Priority
Mastitis	**	***	
Bovine leukemia	*	**	
Gastrointestinal parasites	*	**	
Paratuberculosis	**	*	
Bovine TB	(*)	*	
Bacterial pneumonia	*	*	
E. coli	***		
FMD	***		
Brucellosis	***		
IBR	(*)	*	
Salmonella spp	**		
BVD	**		

Davies *et al.*, 2008

IDENTIFYING GENETIC MARKERS OF HEALTH TRAITS





Make use of advanced genome enabled technologies !

Mapping studies
SNPs identified

Health Data Conference
30-31 May, 2013, Aarhus, Denmark

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INRA SCIENCE & IMPACT

IDENTIFYING GENETIC MARKERS OF HEALTH TRAITS

Validated Disease Phenotypes

EXPERIMENTAL

COMMERCIAL

Genetic markers for resistance traits

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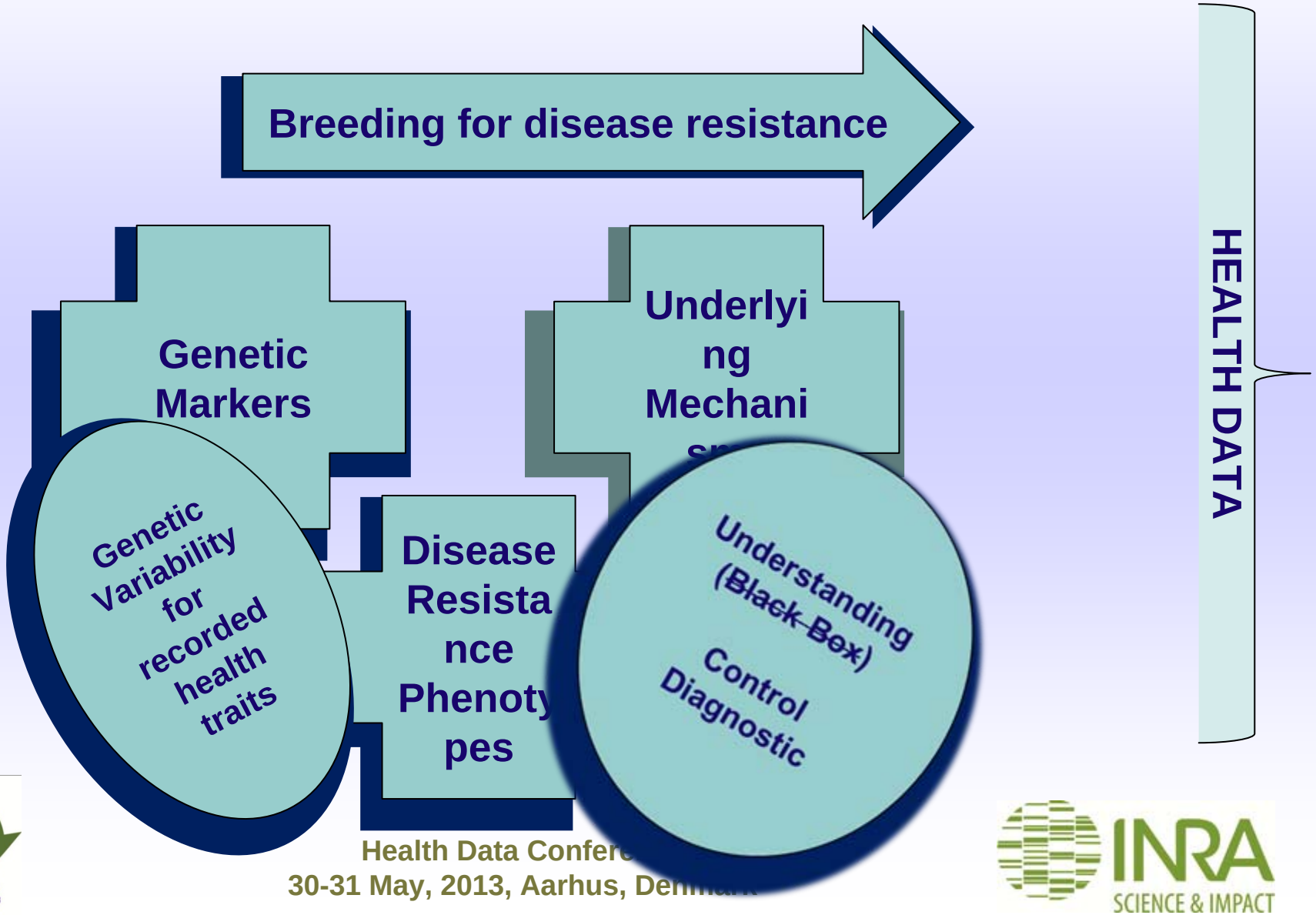
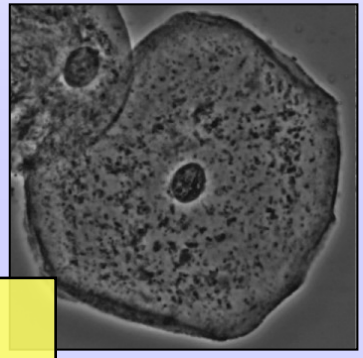
30-31 May, 2013, Aarhus, Denmark

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE



IDENTIFYING GENETIC MARKERS & UNDERLYING MECHANISMS OF HEALTH TRAITS

Validated Disease Phenotypes



Transcriptomic

Immune fonction

Better understand regulation of the disease process

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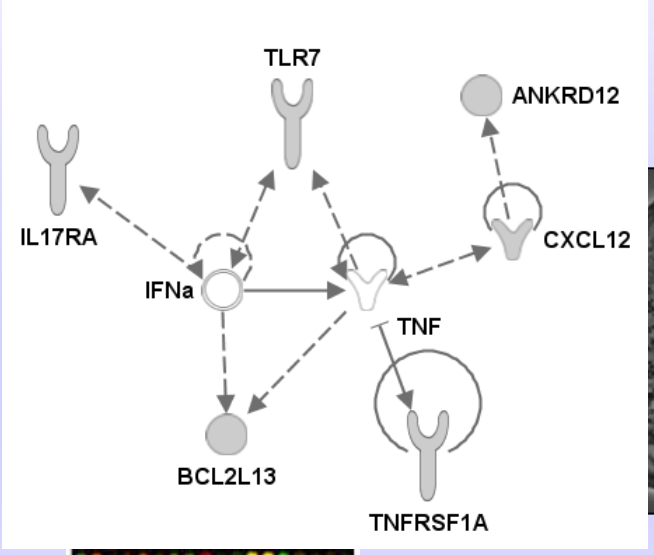
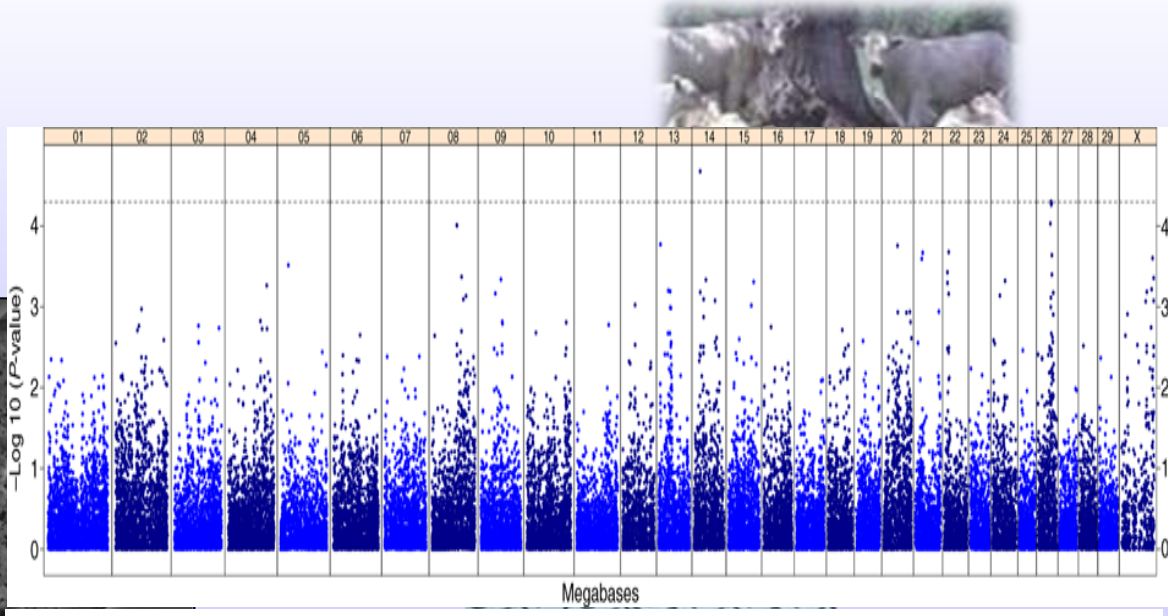
IDENTIFYING GENETIC MARKERS & UNDERLYING MECHANISMS OF HEALTH TRAITS



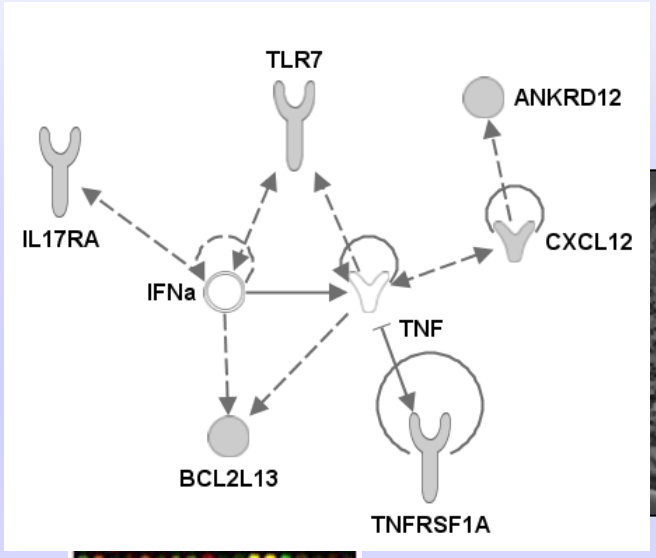


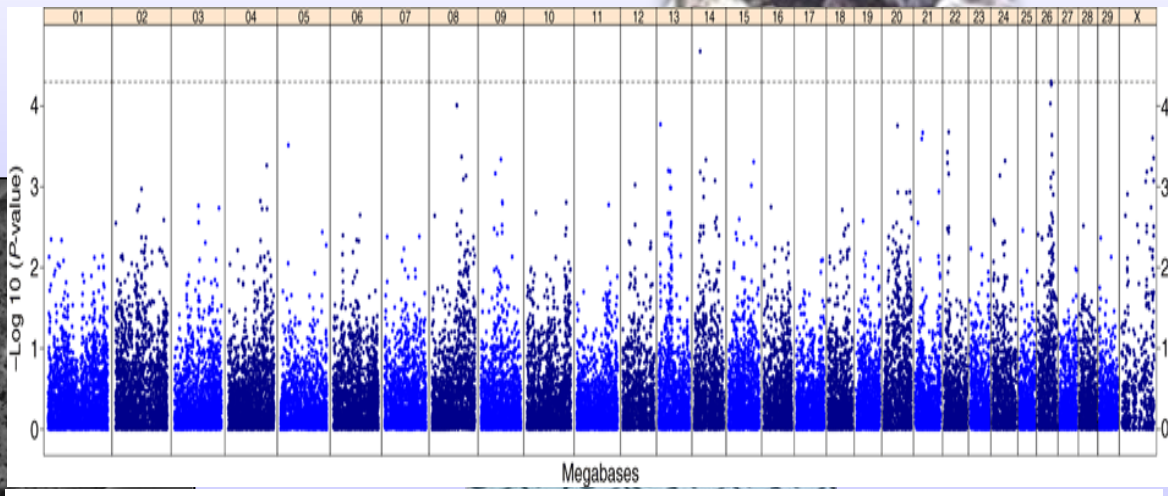
Whole-Genome association analysis of susceptibility to paratuberculosis in Holstein cattle

Transcriptomics => Identify genes being transcribed in a particular tissue at a particular time

QTL approach => Identify mutations underlying genetic variations seen between hosts

IDENTIFYING GENETIC MARKERS & UNDERLYING MECHANISMS OF HEALTH TRAITS



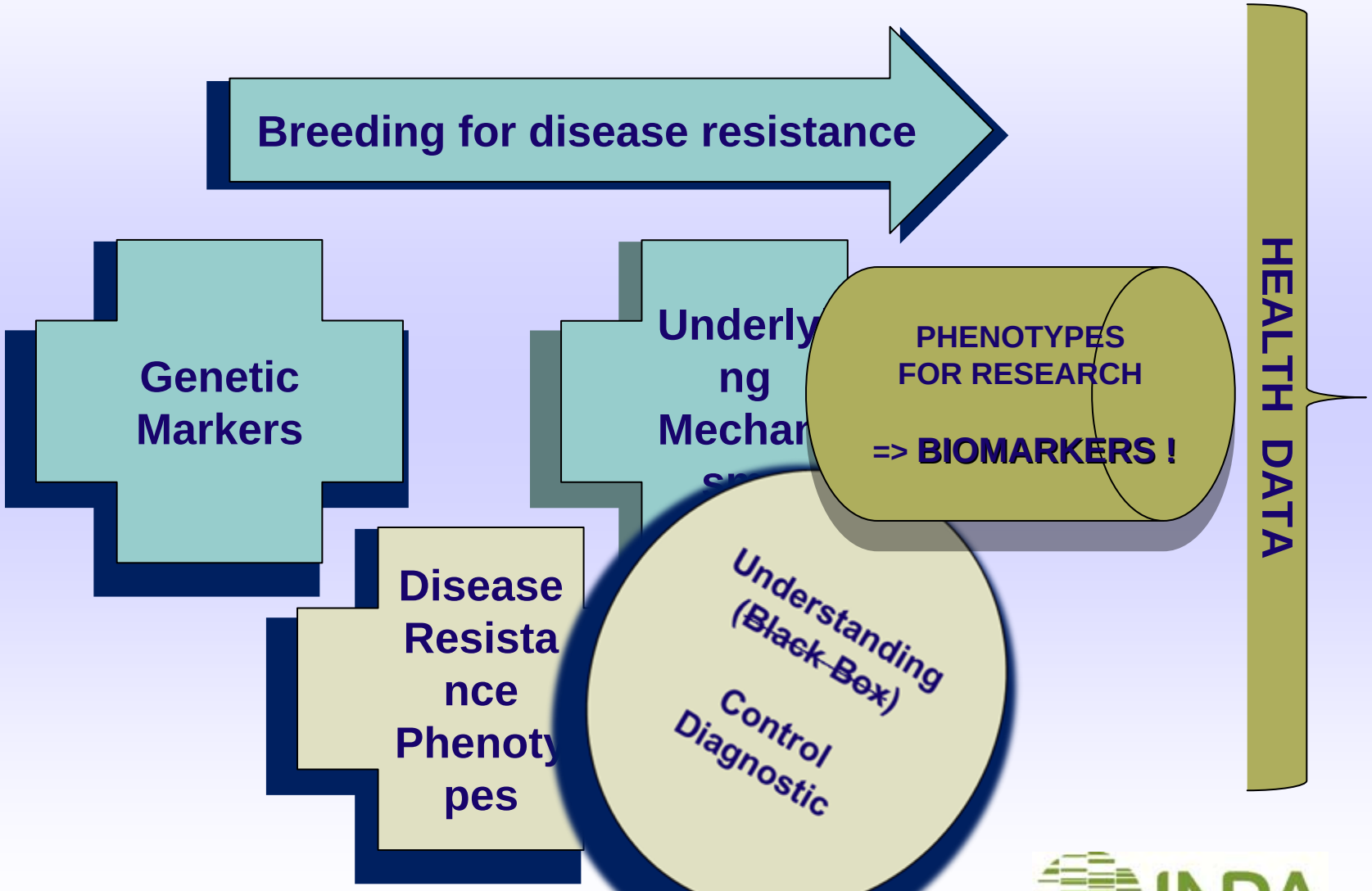


Whole-Genome association analysis of susceptibility to paratuberculosis in Holstein cattle

Complementary approach towards genetic / functional disease markers

Steps to give tools to dissect, understand & utilize host genetic variation

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE...BIOMARKERS



NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Complementary in research

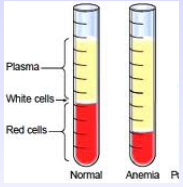
Experimental (“controlled”) challenge

Farm recorded health data

Field health data

PHENOTYPES FOR RESEARCH

=> BIOMARKERS !



HEALTH DATA

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Experimental (“controlled”) challenge

Complementary

Farm recorded health data

PHENOTYPES FOR RESEARCH

=> BIOMARKERS !

HEALTH DATA

Field health data

ROBUSTNESS

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Experimental ("controlled") challenge

Complementary

Farm recorded health data

Standardisation

Make use of differences

PHENOTYPES FOR RESEARCH

=> BIOMARKERS !

HEALTH DATA

ROBUSTNESS

Field health data

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Experimental ("controlled") challenge

Complementary

Farm recorded health data

Field health data

PHENOTYPES FOR RESEARCH

=> BIOMARKERS !

ROBUSTNESS

HEALTH DATA

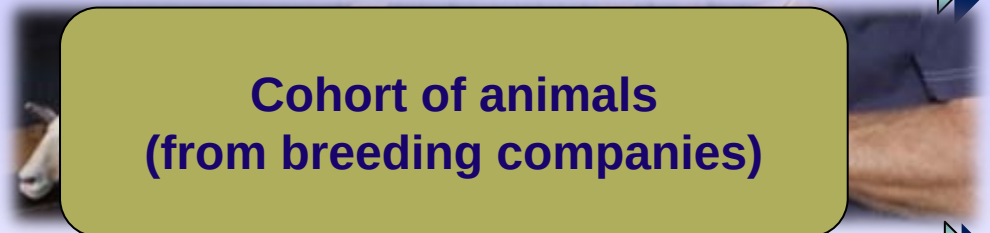
Epidemic surveillance => lots of prior data + confirmation
Ex: Bovine TB

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Experimental ("controlled") challenge

Complementary

Farm recorded health data



Cohort of animals
(from breeding companies)

Field health data

Make use of outbreaks

Ex: PRRS

PHENOTYPES
FOR RESEARCH

=> BIOMARKERS !

ROBUSTNESS

HEALTH DATA

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Experimental ("controlled") challenge

Complementary

Farm recorded health data

Field health data

Livestock exposed to extremes environment/diseases = reservoir of health data *(and genotypes)*

PHENOTYPES FOR RESEARCH

=> BIOMARKERS !

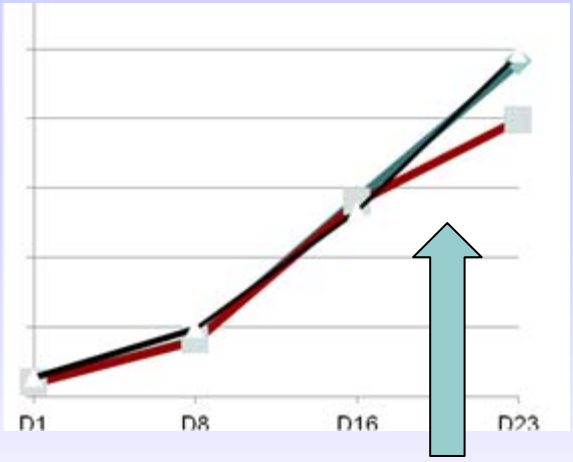
ROBUSTNESS

HEALTH DATA

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Complementary

- **Detailed health records ?**
- **Use of animal performance as a proxy ?**
- **Identifying underlying immunological correlates ?**



PHENOTYPES FOR RESEARCH

=> BIOMARKERS !

ROBUSTNESS

HEALTH DATA

ICAR 2013

onference

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INRA SCIENCE & IMPACT

NEED OF HEALTH DATA FOR RESEARCH : FOR BREEDING FOR DISEASE RESISTANCE

Complementary

- Detailed health records ?
- Use of animal performance as a proxy ?
- Identifying underlying immunological correlates ?

PHENOTYPES FOR RESEARCH

=> BIOMARKERS !

HEALTH DATA

Across a variety of environments and infection challenge conditions !

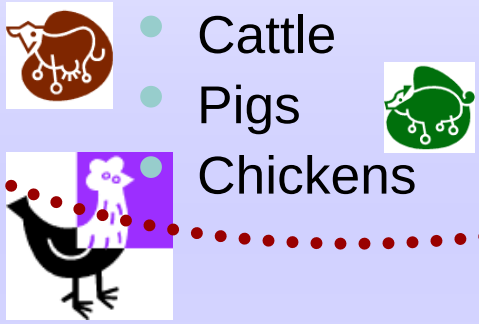
= > Large scale ! Multidiscipline ! Maximized use of animals !

ROBUSTNESS

HOW TO MAKE THE BEST OUT OF HEALTH DATA ?
Collaborative Research !

EX 1: Joint research programme on Early responses in Salmonella

- **Different animal species**.
  - Cattle
  - Pigs
  - Chickens

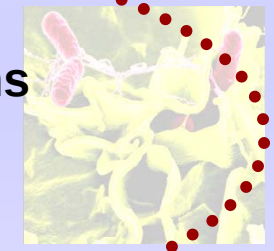


EADGENE

Different Salmonella strains

S. enteritidis

S. typhimurium



- **Different challenge models**
  - Route of infection
  - Dose of infection
  - Age before primary infection

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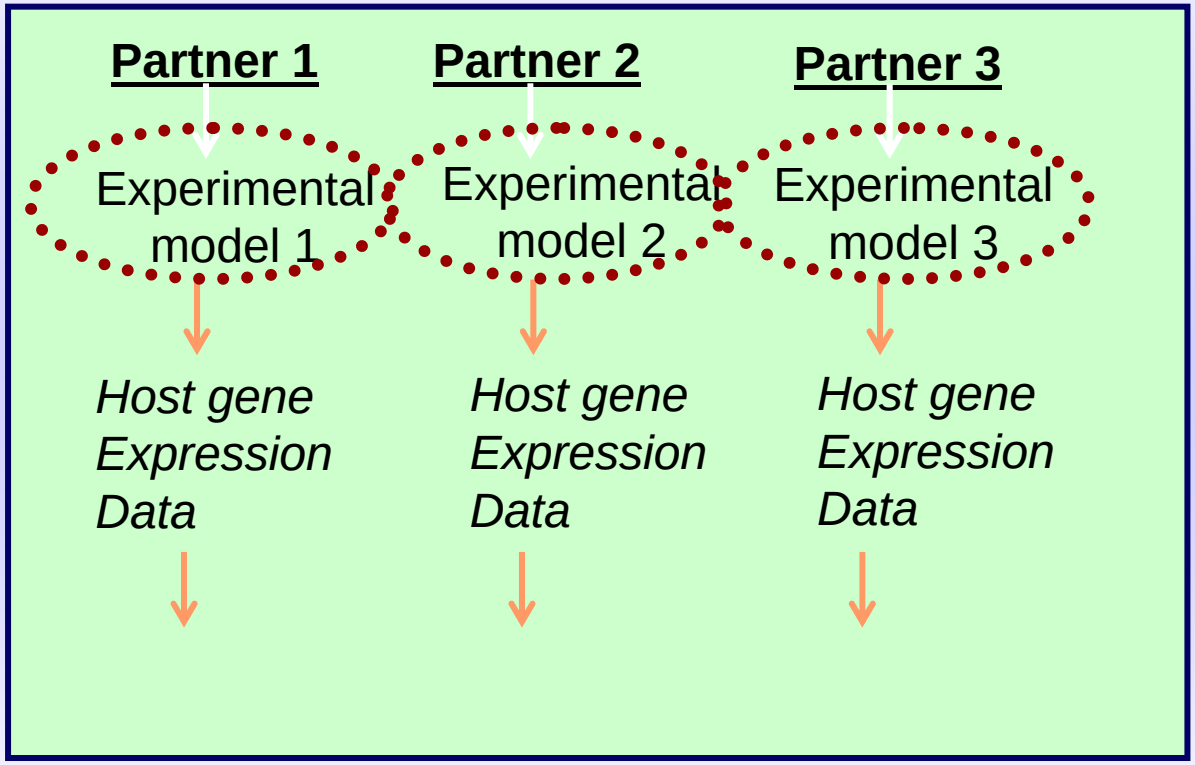

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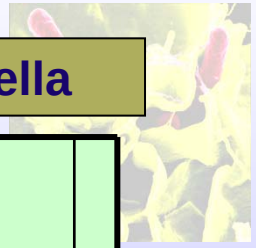


EX 1: Joint research programme on Early responses in Salmonella

	Salmonella	Host species	Organ	Time post infection	In vitro infection	
	SE		Caeca Entero, mono	3w – 6w	Monocytes, Epithelial	
	STM		MLN	1d – 1w	Macrophage PMN	
	STM		Intestine Jejunum	2 – 8 hours	NO SISP	
	SE		Intestine Jejunum	1d – 3w	NO	
	STM		-	-	Enterocyte	
	STM/ SE		-	-	Monocytes, PMN, DC	

HOW TO MAKE THE BEST OUT OF HEALTH DATA ?
Collaborative Research !

EX 1: Joint research programme on Early responses in Salmonella

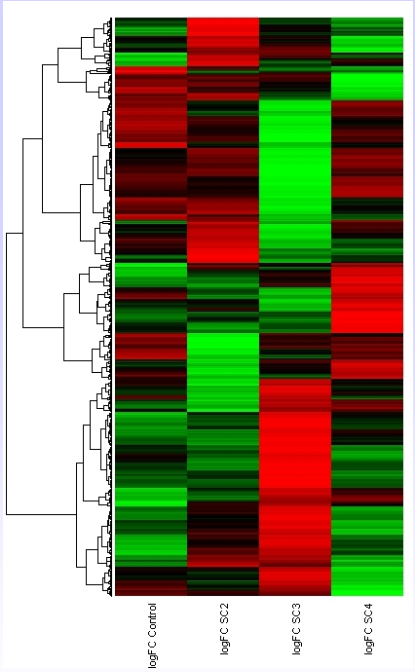
Host responses differ significantly after Salmonella infection

Dependent on species, Salmonella strain, challenge model, cell-type

There are some similarities in gene regulation between hosts

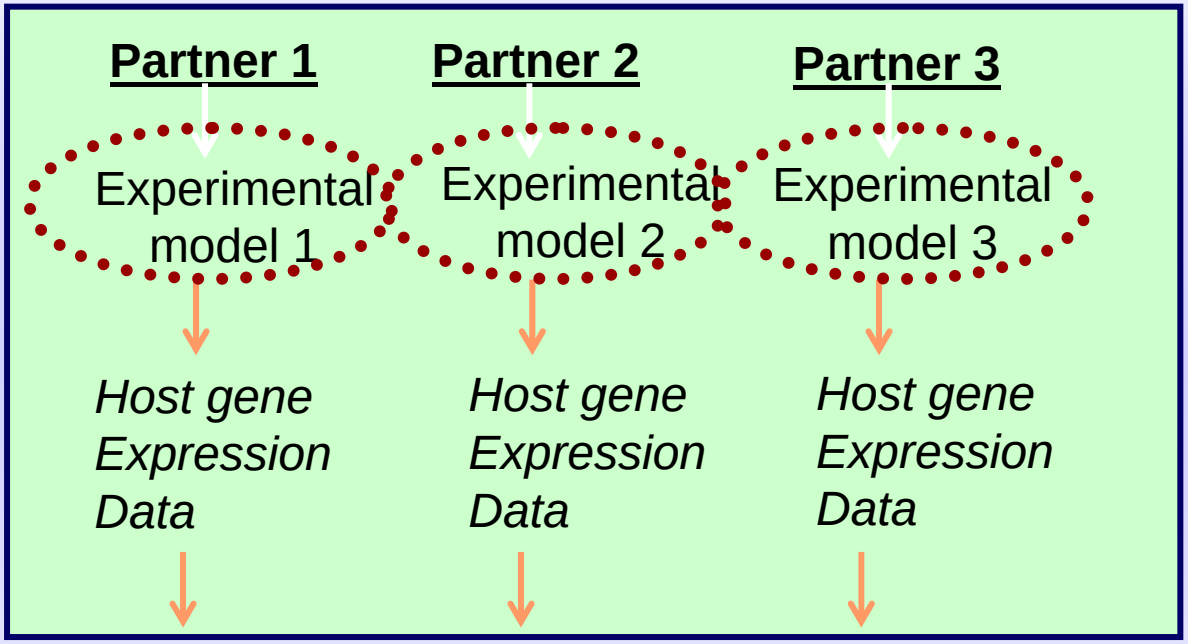
Independent of species, challenge model

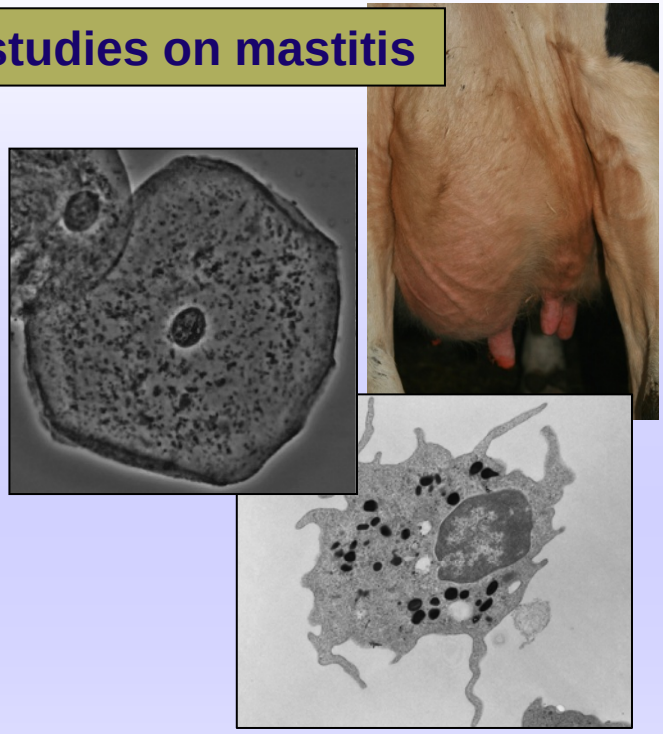
Role of TLR4



HOW TO MAKE THE BEST OUT OF HEALTH DATA ?
Collaborative Research !

EX 2: Joint research programme on transcriptomic studies on mastitis





Sharing of mRNA, data, qPCR primers, protocols

HOW TO MAKE THE BEST OUT OF HEALTH DATA ?
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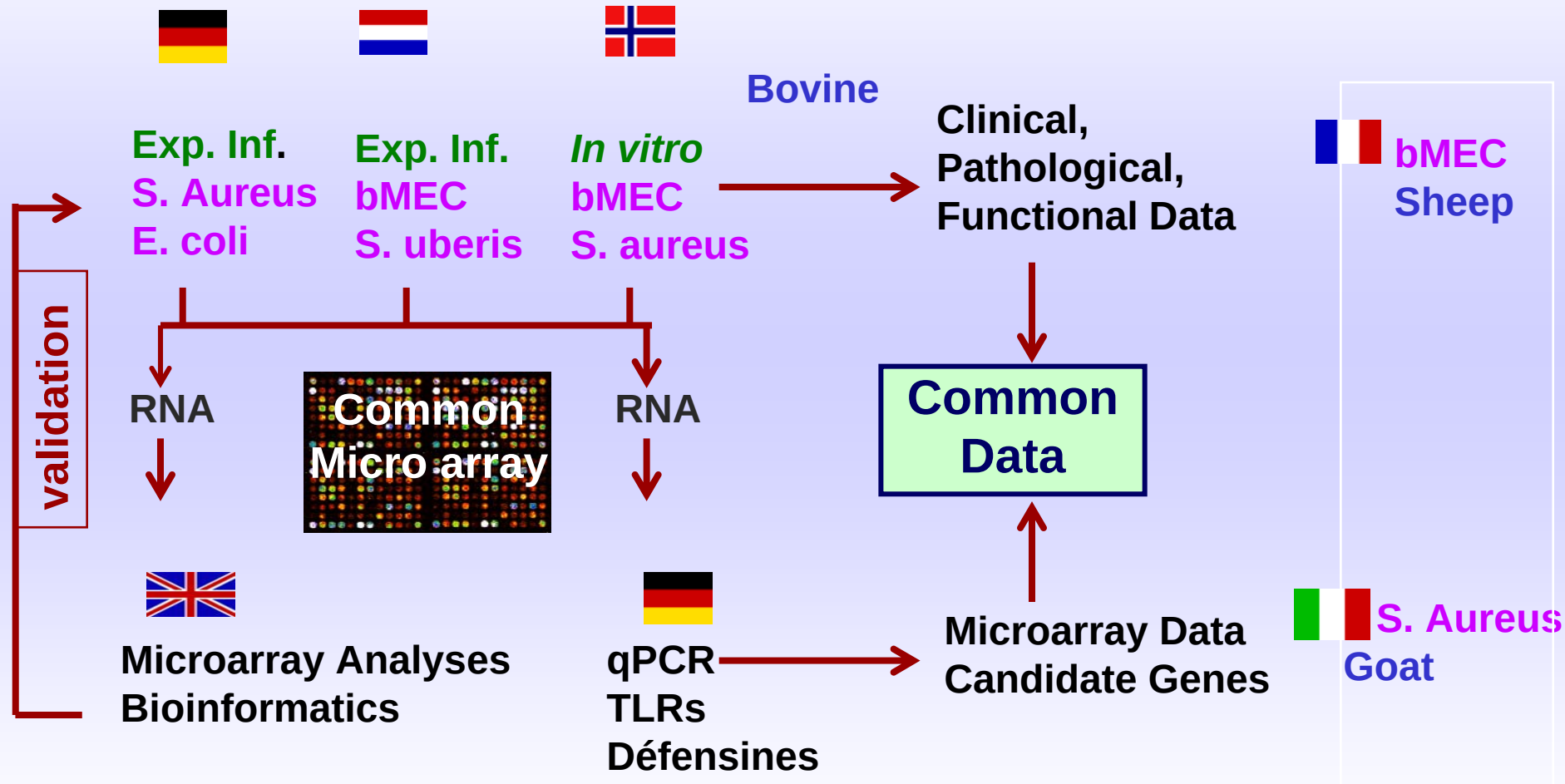

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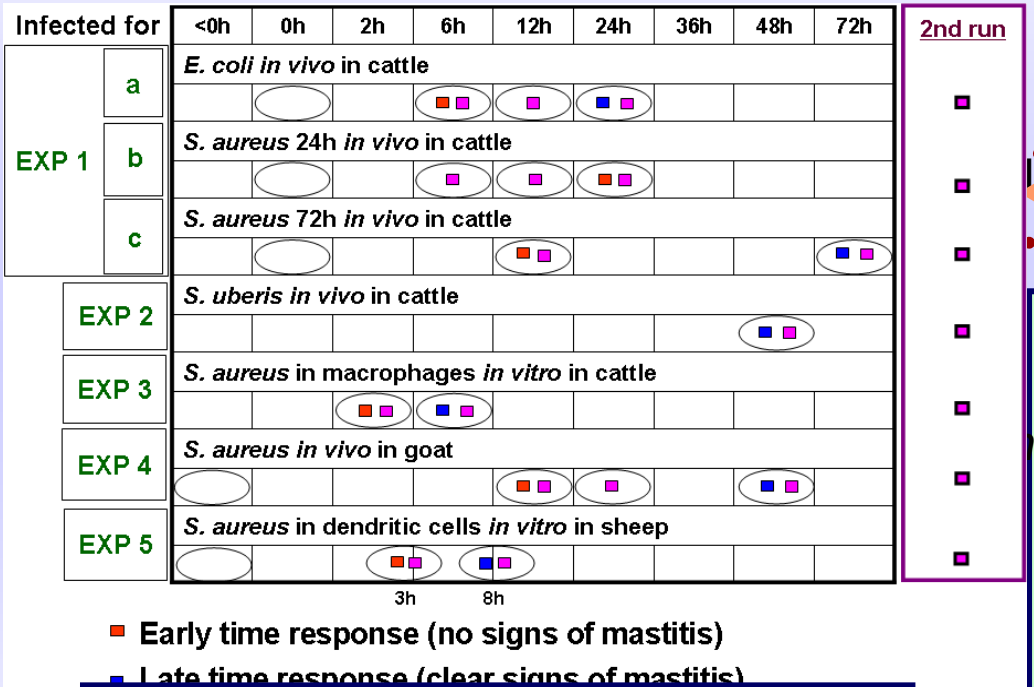


Meta-analysis

- experimental designs & sizes
- host species & tissues & pathogens,
- arrays & time points

11 gene lists analyzed

- Bovine specific response
- Goat specific response
- Sheep specific response
- General, overall response
- Early time response
- Late time response
- Early time specific
- Late time specific
- General, overall in vitro response (bovine MO & sheep DC)
- Late time in vitro response (bovine MO & sheep DC)
- Early time in vitro response (bovine MO & sheep DC)

Commonalities identified

- **Early inflammatory response**
- **Cytokines and cell signaling**

NEED OF HEALTH DATA FOR RESEARCH

WHAT ARE THE BEST HEALTH DATA ?

For general health issues :
need = best means to describe host genetic effects

Phenotypes defined narrowly ↑

Power of detection ↑

Data health collection challenging ↑

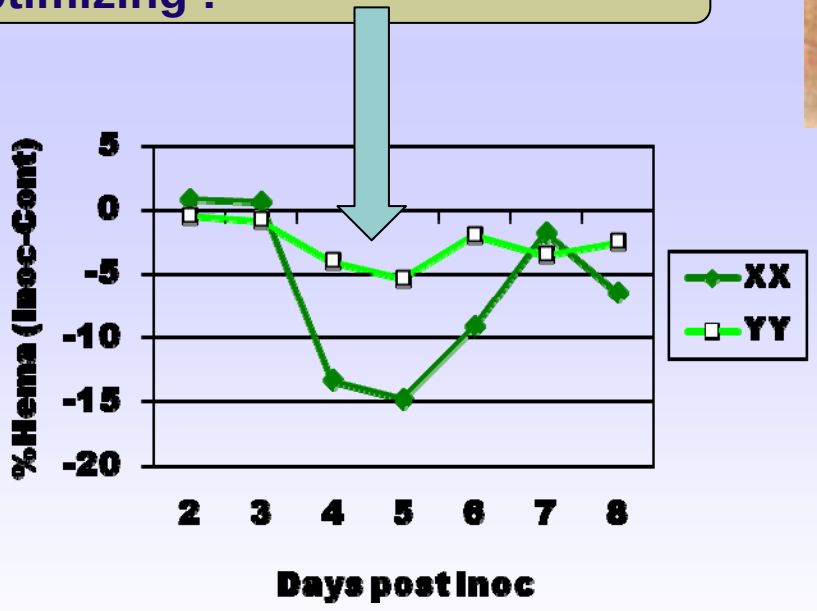
Optimizing data collection !
(need prior research)

NEED OF HEALTH DATA FOR RESEARCH

WHAT ARE THE BEST HEALTH DATA *(for R&D)* ?

For general health issues :
need = best means to describe host genetic effects
= optimizing !

Optimum timing of Data health collection

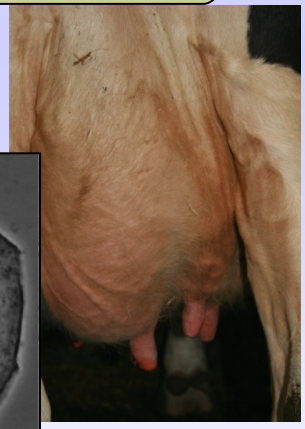


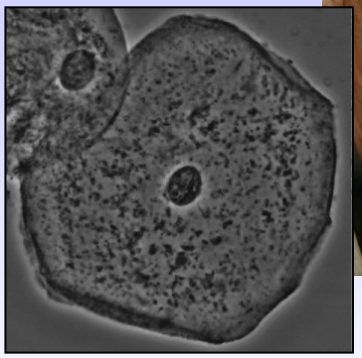
NEED OF HEALTH DATA FOR RESEARCH

WHAT ARE THE BEST HEALTH DATA *(for R&D)* ?

For general health issues :
need = best means to <u>describe</u> host genetic effects
= optimizing !

Identification of animals coping with immunosuppressive effects of stress





Ex: clinicial cases of mastitis : underlying issues of immunosuppression (early lactations)

NEED OF HEALTH DATA FOR RESEARCH : FOR AN INTEGRATED APPROACH OF DISEASE CONTROL

Breeding for disease resistance

Preventi on

Control

Novel vaccine development

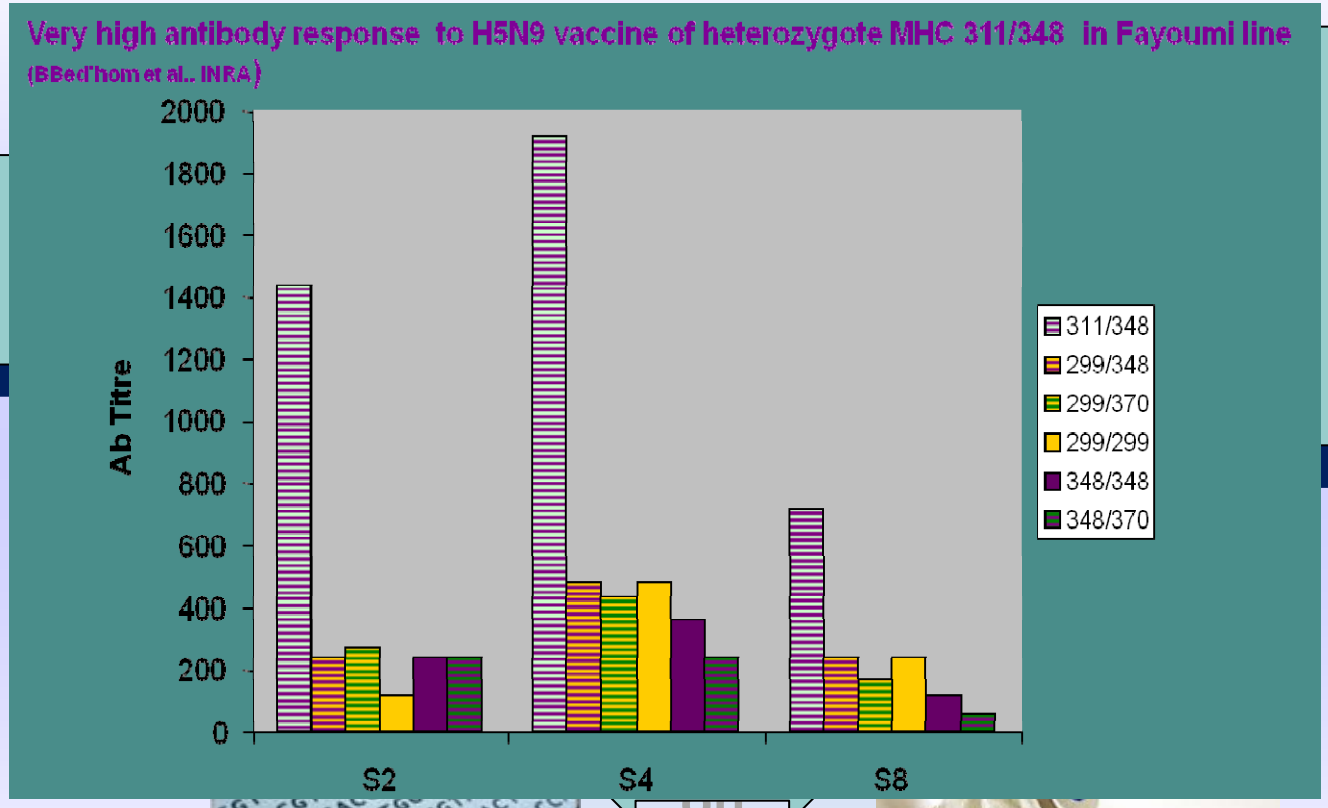
HEALTH DATA

Eradicati on

Individual assessment of

- Efficient response to Vaccination
- Improved response to the disease

NEED OF HEALTH DATA FOR RESEARCH : FOR AN INTEGRATED APPROACH OF DISEASE CONTROL



HEALTH DATA

Individual assessment of

- Efficient response to Vaccination
- Improved response to the disease

NEED OF HEALTH DATA FOR RESEARCH : FOR AN INTEGRATED APPROACH OF DISEASE CONTROL

Novel vaccine development

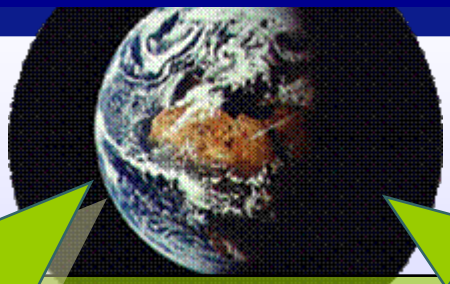
⇒ **Study vaccine requirements**
⇒ **Measure vaccine effectiveness**

Ex: PRSV, BRSV, FMDV...

Field health data

HEALTH DATA

A NEW DIMENSION FOR INTEGRATION OF HEALTH DATA



ENVIRONMENT

HOST

MICROBIOTA

Interactions

PATHOGEN

Gut health, Respiratory health....

Research : Understand the interactions
=> to use them
=> Integrate in monitoring of health status

HEALTH DATA : AS KEY COMPONENTS OF TRADE-OFFS

- Environment
- Economic

Equilibrium

- Health
- Welfare

Really New selection traits

KEY CHALLENGES FOR HEALTH DATA : TOWARDS INNOVATION

- Integrate health related traits in existing multi-trait selection programmes
- Use (most) the same health traits for breeding & management
- Development of cost effective tools to analyse field disease outbreaks and develop predictive diagnostics
- Initiatives integrating genomic approaches to vaccine development
- Research including collaborations between animal health research institutions, commercial breeding & pharmaceutical companies
  - **Joint acquisition of health data**
    - **Generating new knowledge & innovation**

THANK YOU FOR YOUR ATTENTION





Health Data Conference
"Challenges and benefits of health data recording in the context of food chain quality, management and breeding"
30-31 May, 2013, Aarhus, Denmark