#1 BIOSECURITY

THE THINKING TOUR

Principi, Procedure, Motivazioni e Applicazioni di Biosicurezza nei «Nuovi» Scenari delle Produzioni Avicole: H5N8, Antibioticoresistenza, OneHealth, Sostenibilità e Riduzione dello Spreco

Con la partecipazione di

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Montreal University

Presentazione–Tipo Roadshow 10-13 Aprile 2018

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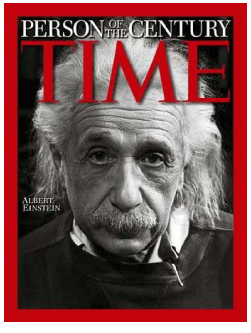
BIOSECURITY

THE THINKING TOUR

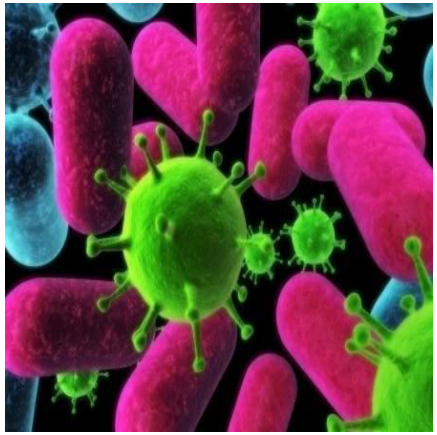
"We can't solve problems by using the same kind of thinking we used when we created them.“

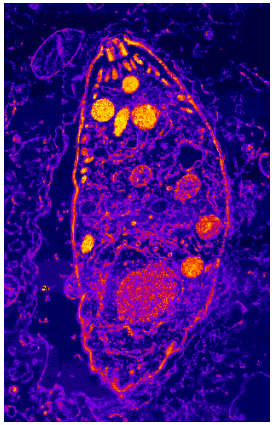


Infectious Diseases

Swine growers: O.R. 35.3 for H1N1 virus infection
Veterinarians: O.R. 17.8; abattoir workers: O.R. 6.5
Poultry workers: O.R. 32 for risk of carrying gentamicin-resistant *Escherichia coli*

- ~1461 infectious diseases affecting humans
  - Including 875 zoonoses (~60%)
- Animal Reservoir: 75% of emerging infectious diseases affecting humans





1978…2018

"…these disease agents insure their continued existence by adapting themselves to a broader host spectrum…" Dr James H. Steele, 1979

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6.
7. *Ornithobacterium rhinotracheale* infec
8. Angara Disease
9. Runting Stunting Syı
10. Chicken Infectious A
11. Trans. Viral Prevent
12. Variant Mycoplasma
13. Dermal Squamous C

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Rhinotracheitis
poridiosis
Mortality Syn.
rek's Disease
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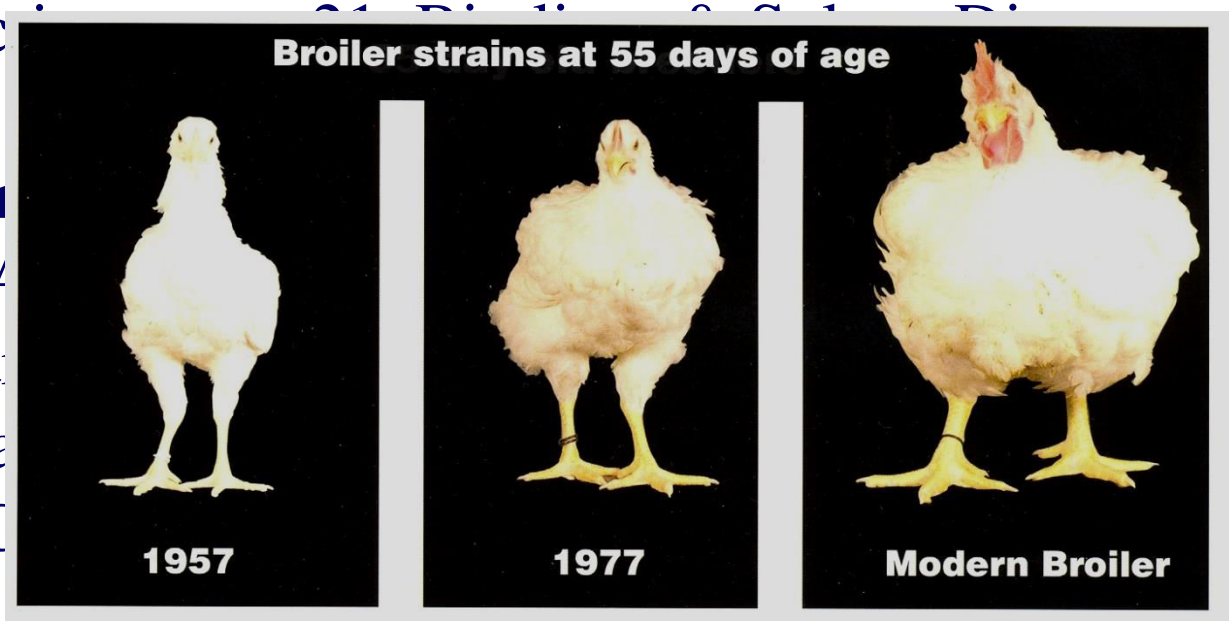
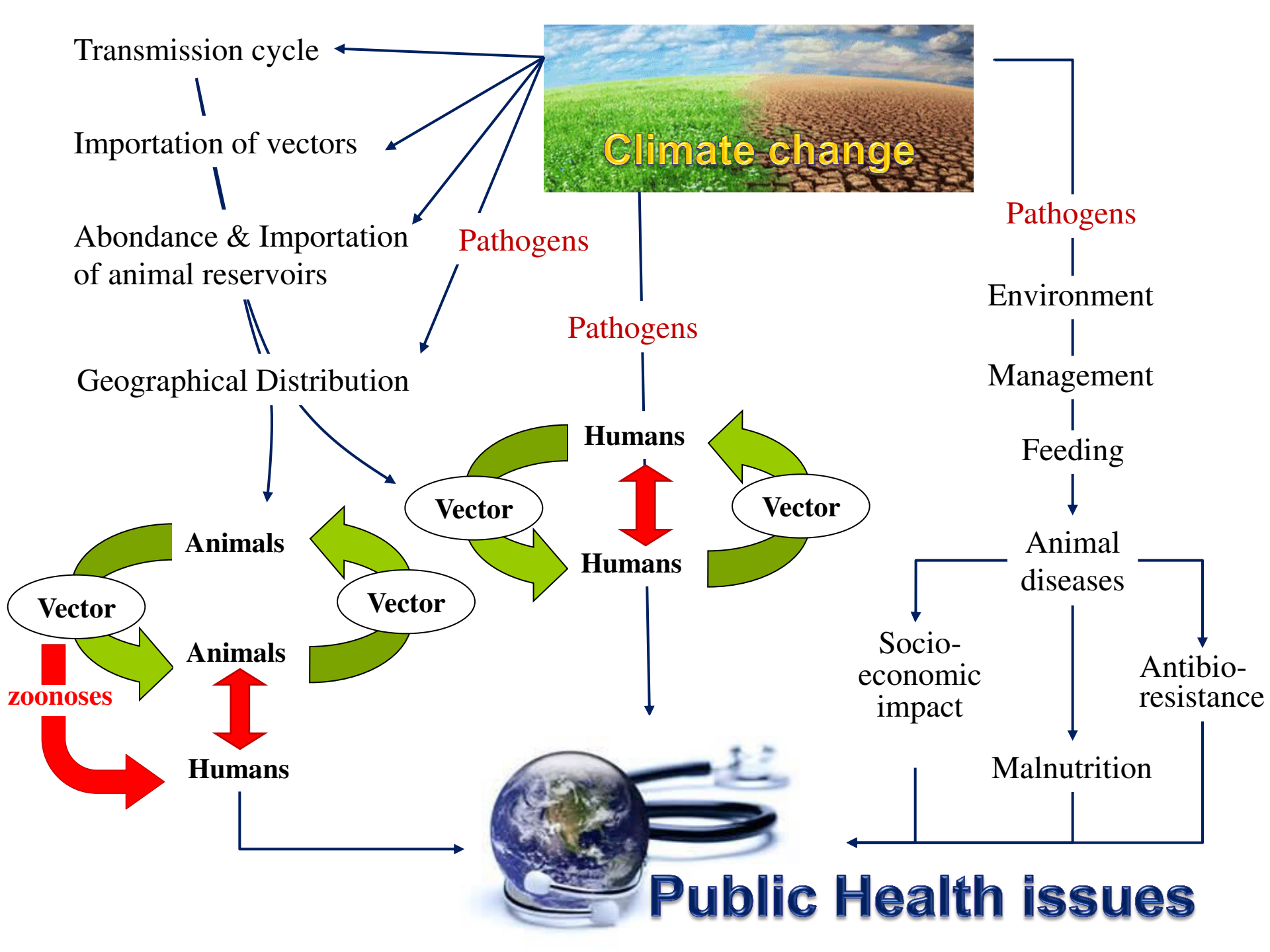
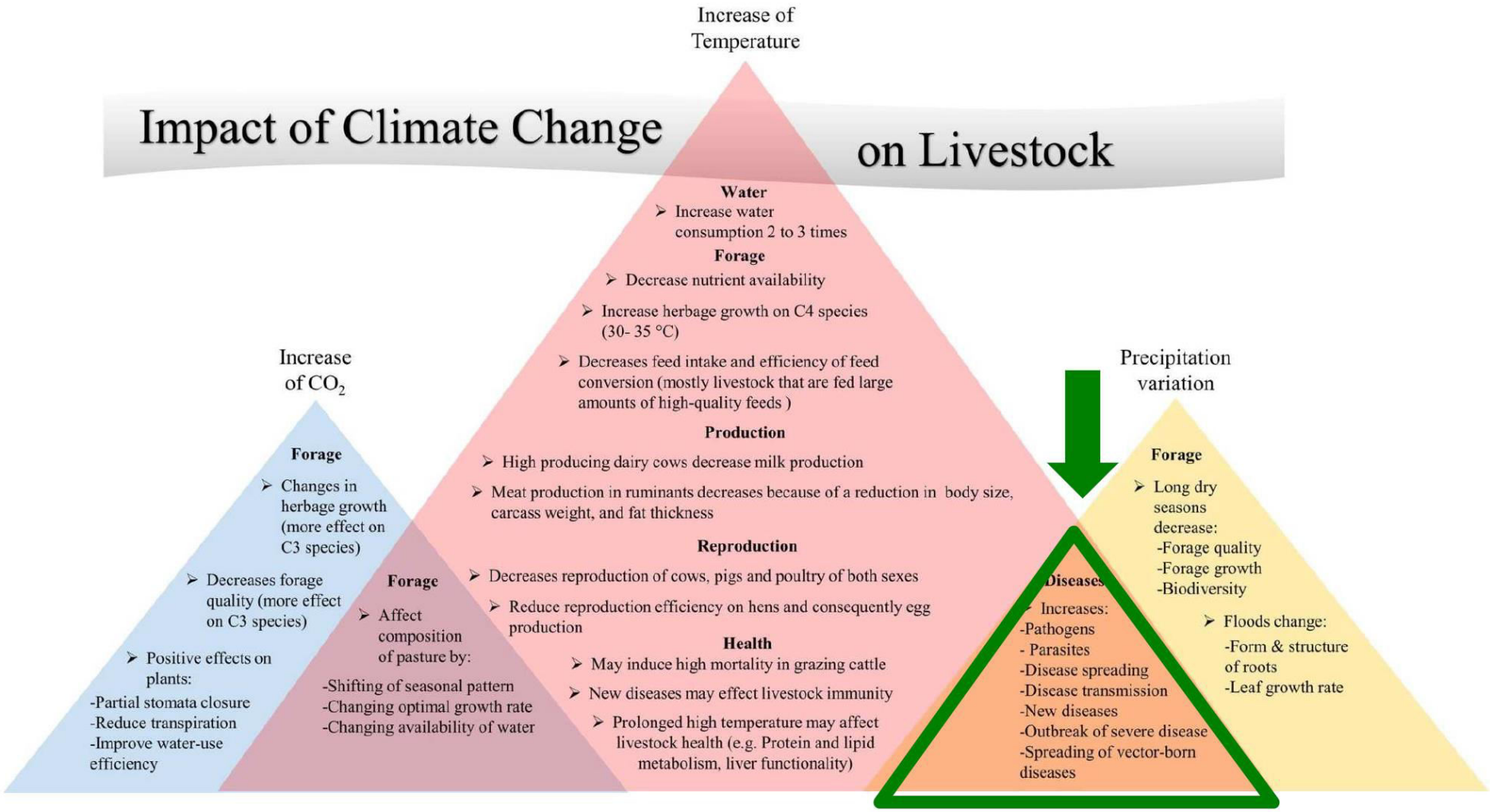
20. *Sal. Enteritidis* type 4



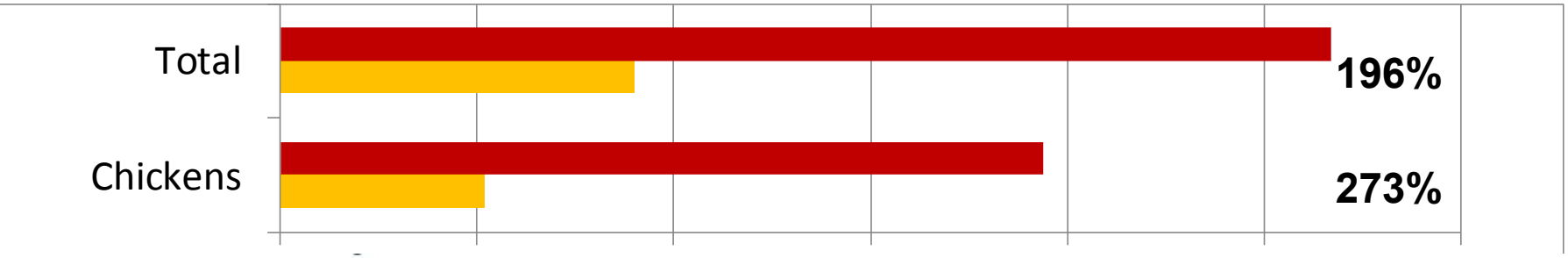

Transmission cycle
Importation of vectors
Abondance & Importation of animal reservoirs
Geographical Distribution
Climate change
Pathogens
Pathogens
Pathogens
Environment
Management
Feeding
Animal diseases
Socio-economic impact
Antibio-resistance
Malnutrition
Humans
Vector
Vector
Humans
Animals
Vector
Vector
Animals
zoonoses
Humans
Public Health issues

Increased temperature – increased climate extremes



Source: Rojas-Downing MM et al. Climate change and livestock: impacts, adaptation and mitigation (2017)

Growth of domestic animal populations (1970 – 2010)



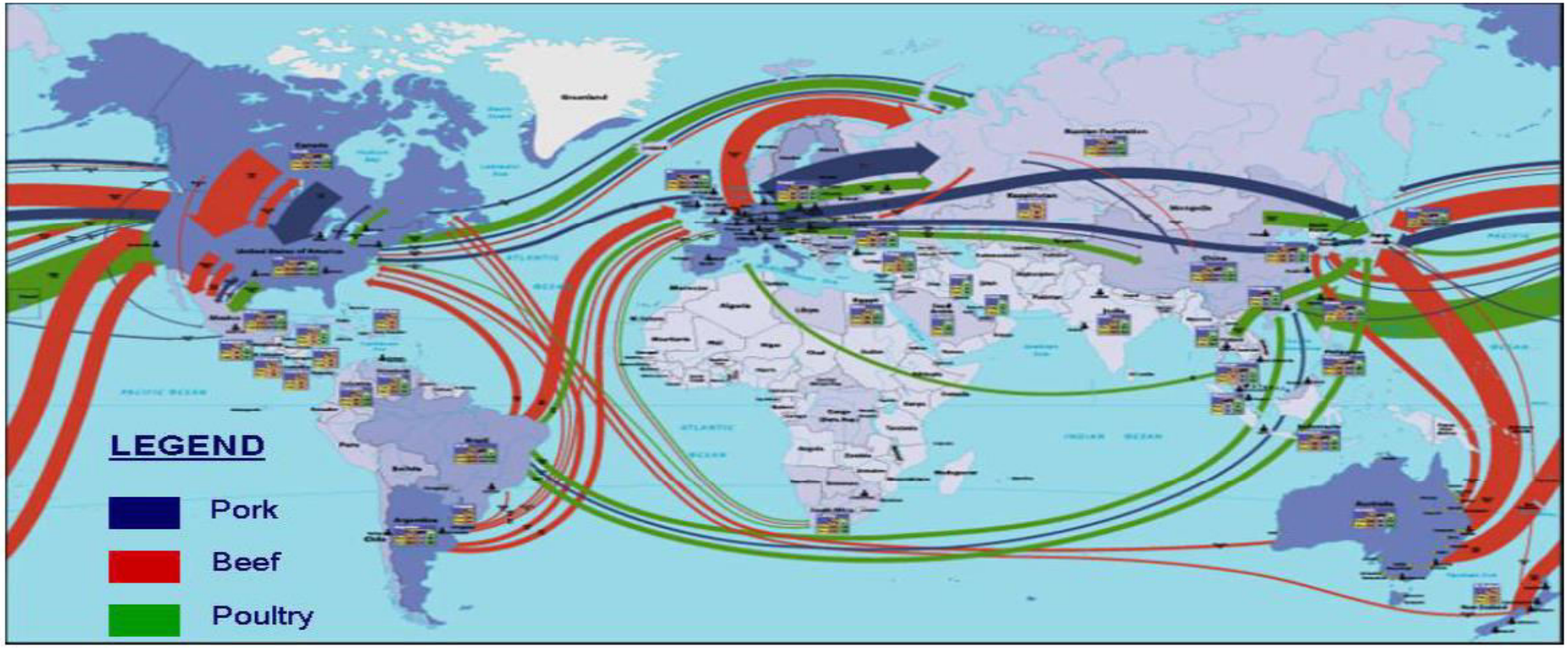


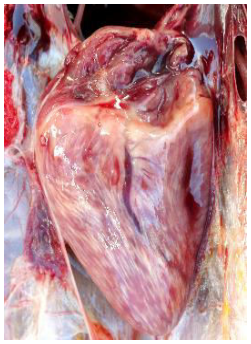
Image: Mapping of livestock animal exchange (source L. King 2008)

- Pathogens are now transported faster across the World than the average incubation period of most microbes.

- Climate change and human behavior favors the colonization of new territories by biological vectors and the pathogens they harbor.

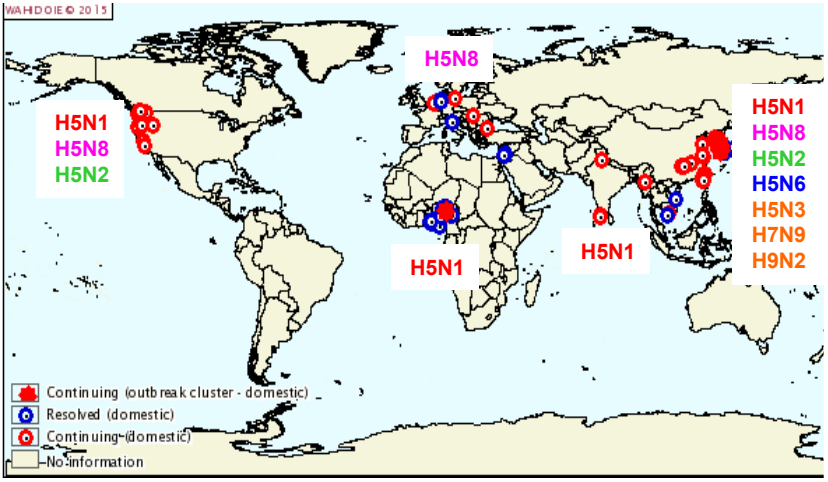
Nipah virus

H5N8 virus

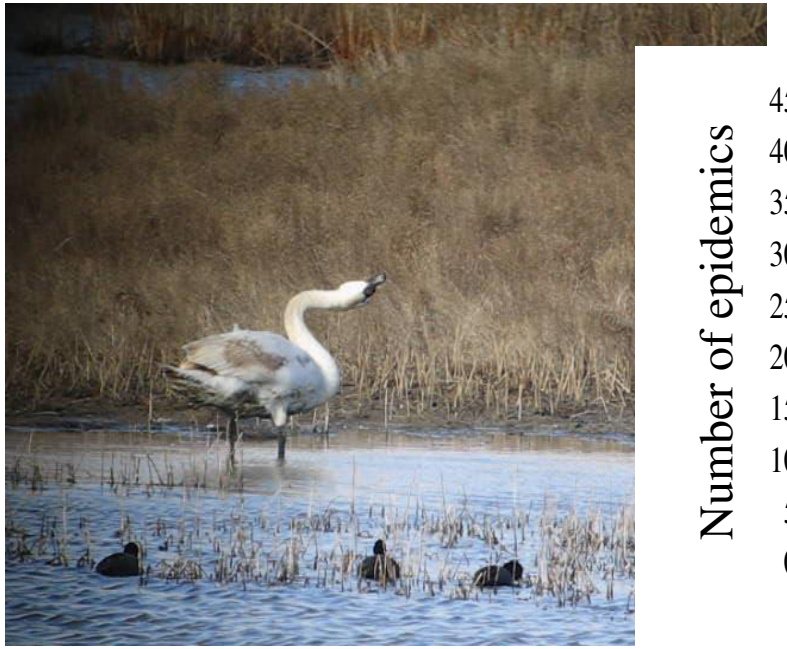


Bernard Vallat, Director of the OIE
St-Hyacinthe, 2011

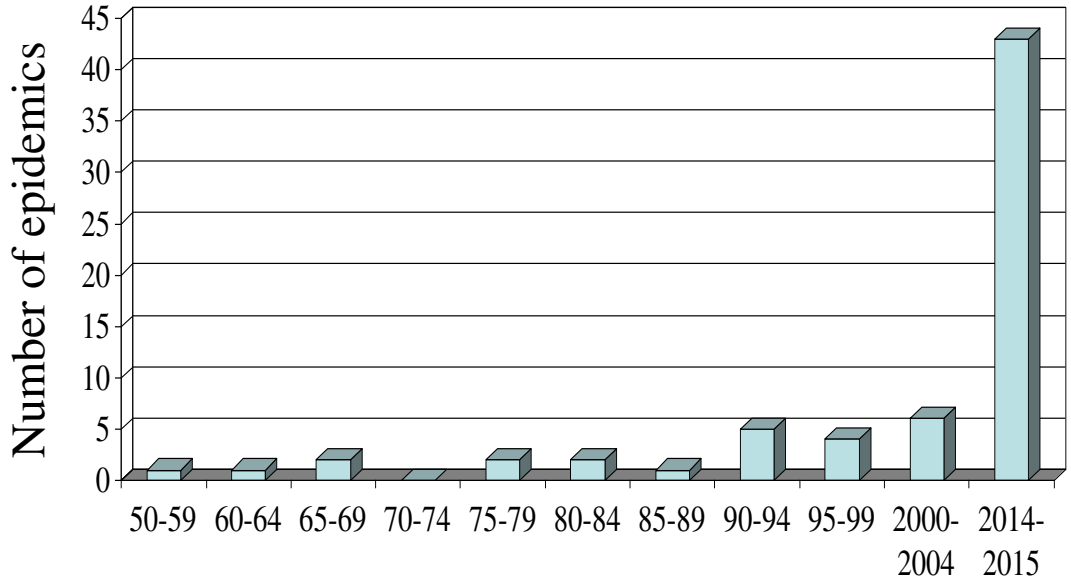
Avian Influenza in 2015

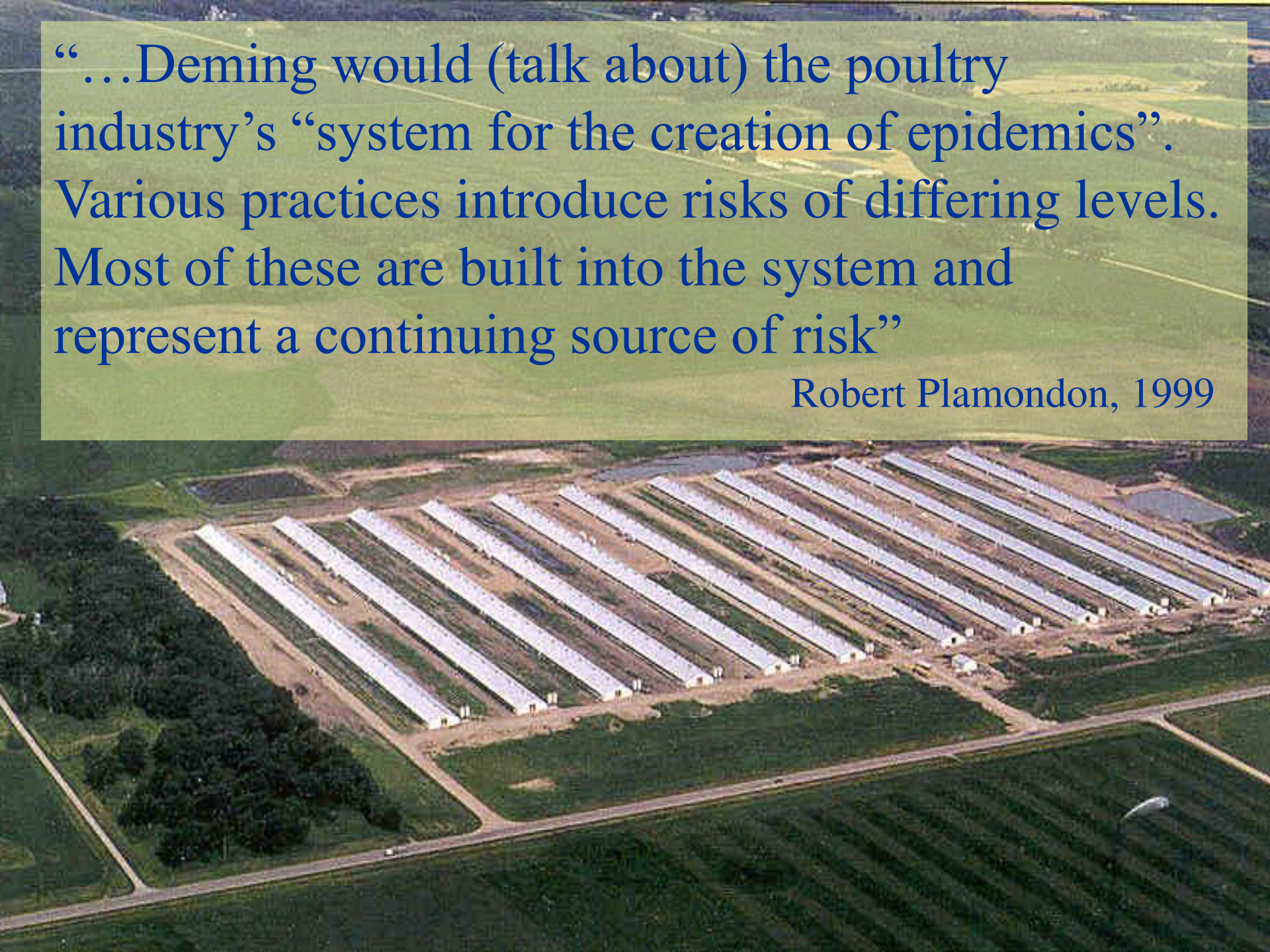


43 H5 and H7 outbreaks in birds involving 7 different viruses in 22 countries in Africa, the Americas, Asia, Australia, Europe, and the Middle East



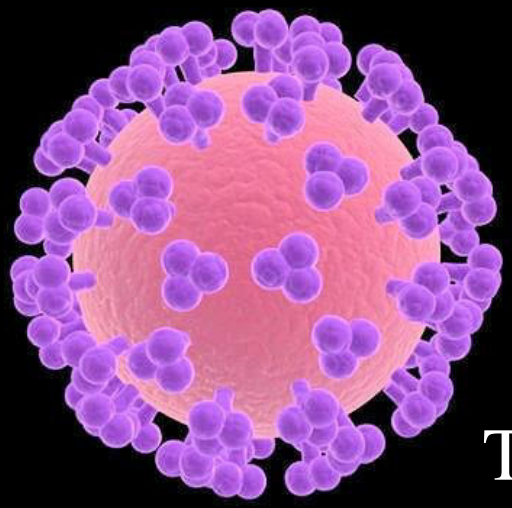
Royal Belgium Institute Nat. Sci.Vet.Agrochem. Res Centre



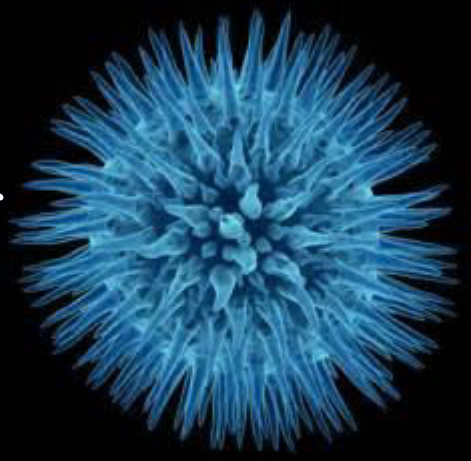


"…Deming would (talk about) the poultry industry's "system for the creation of epidemics". Various practices introduce risks of differing levels. Most of these are built into the system and represent a continuing source of risk"

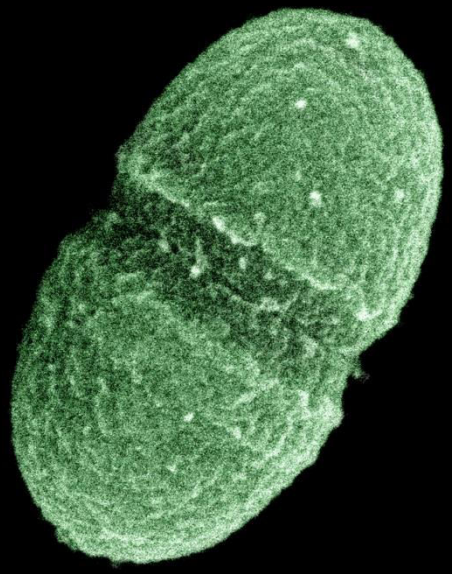
Robert Plamondon, 1999



Infection Pressure

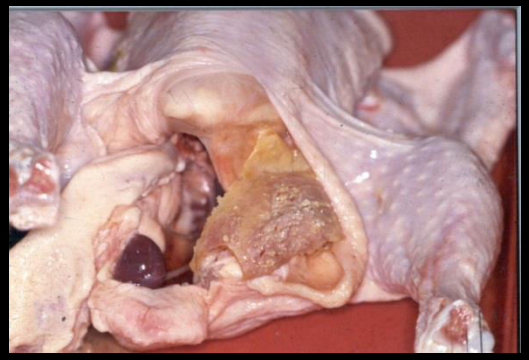


The quantity and diversity of microbes having an effective contact with a given host

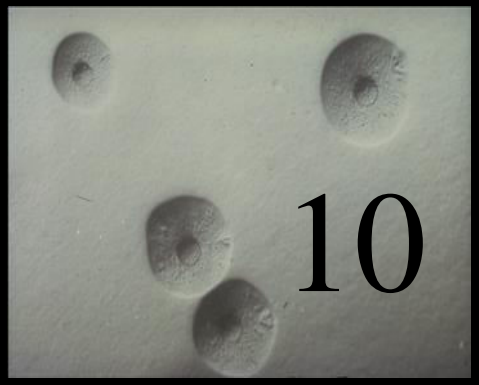


Infection pressure
How many?…

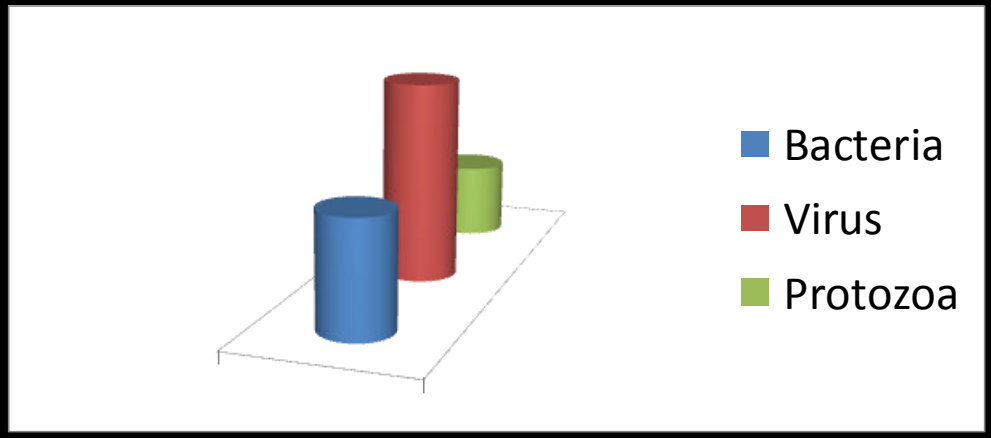
Escherichia coli



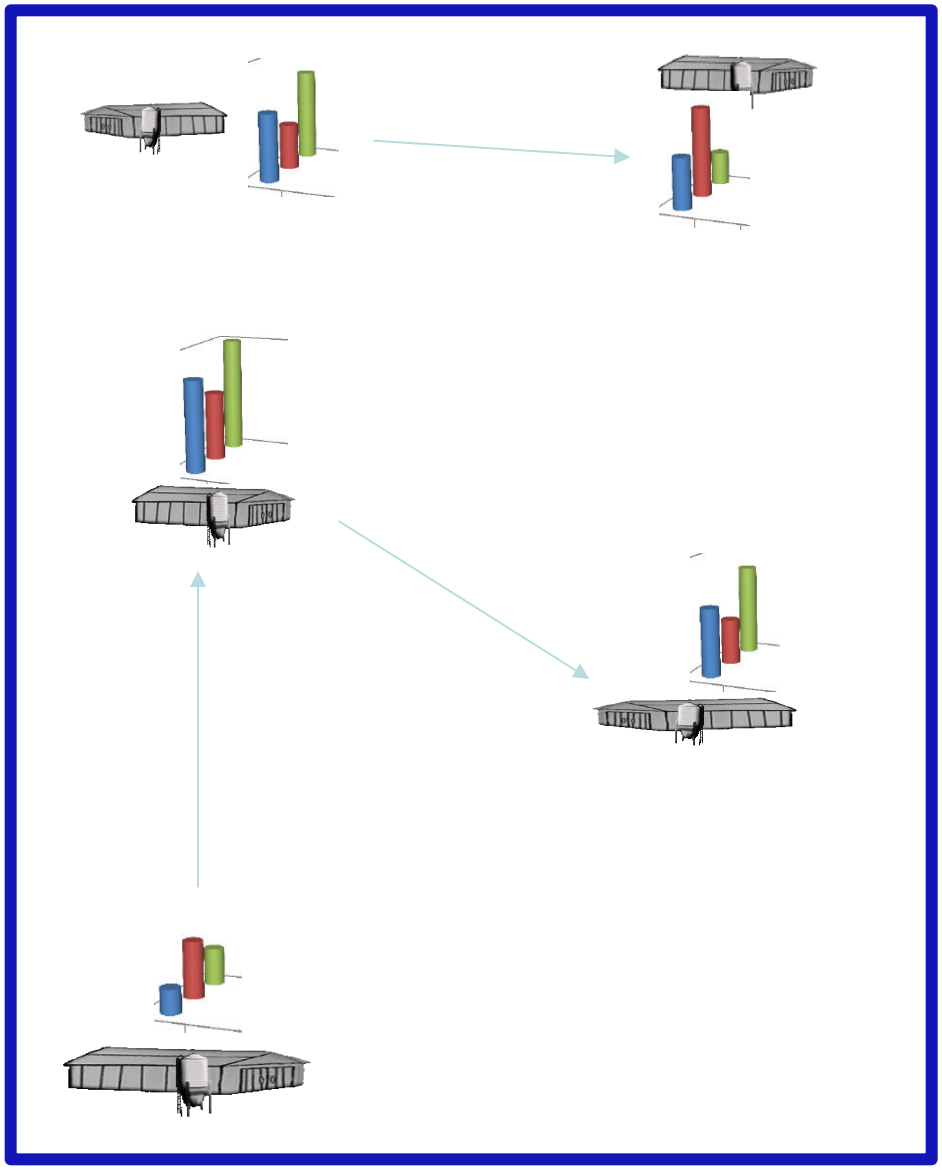
Mycoplasma gallisepticum

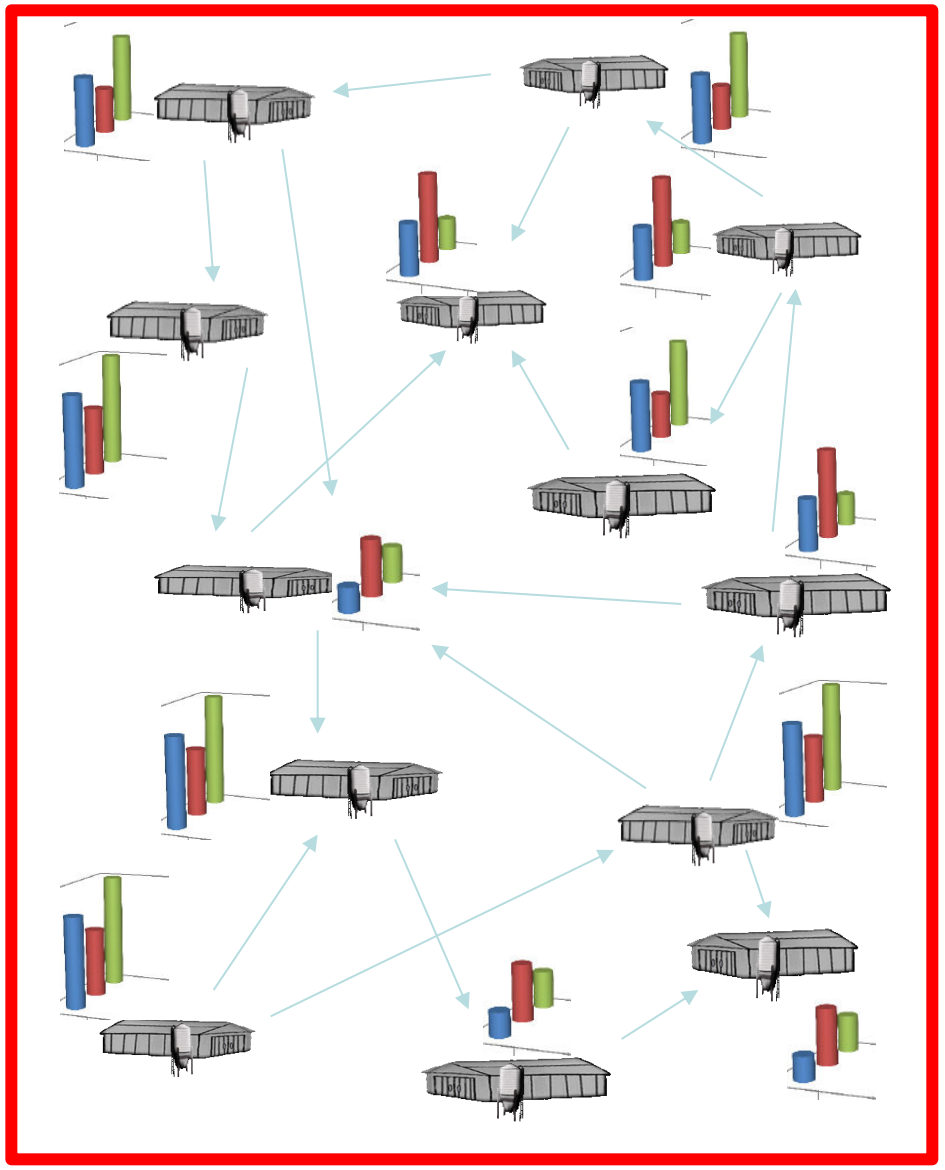


Infection pressure

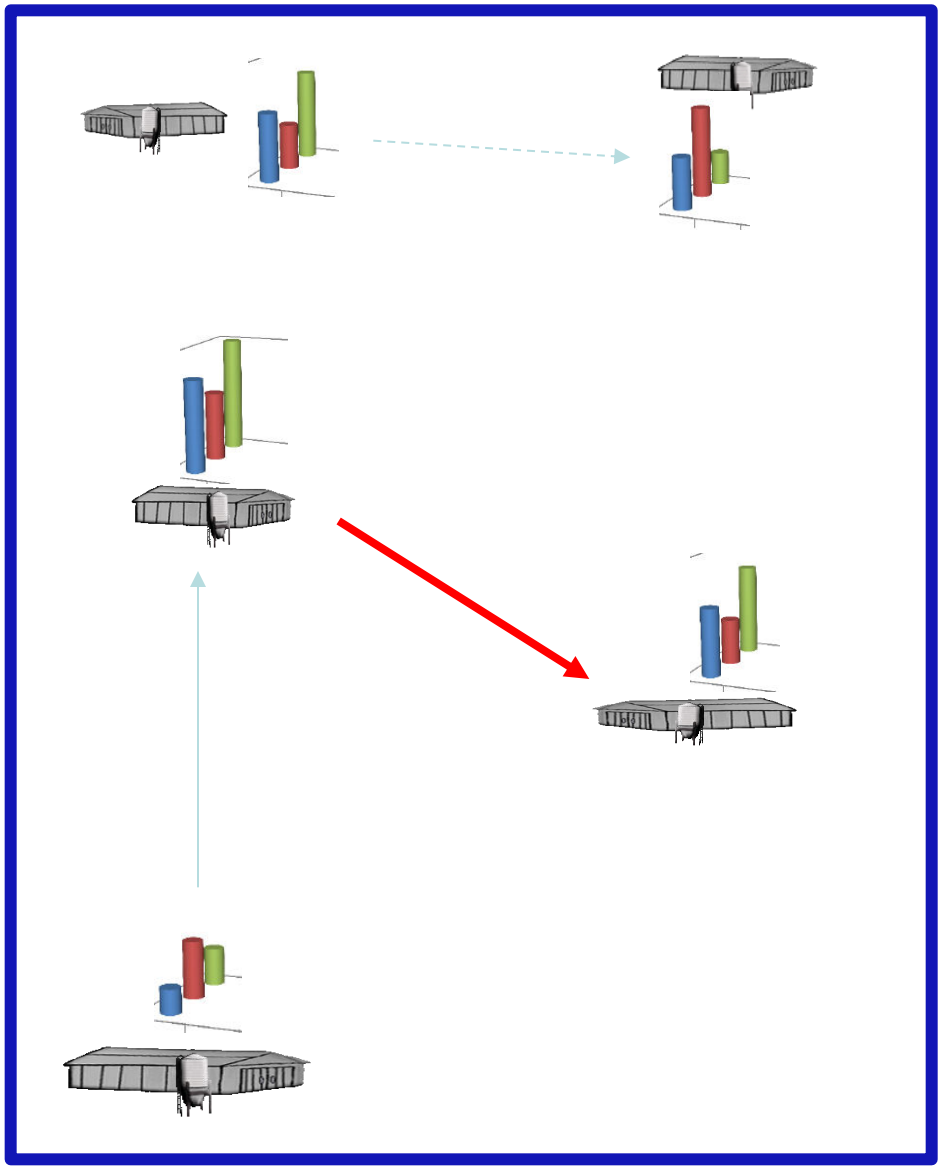


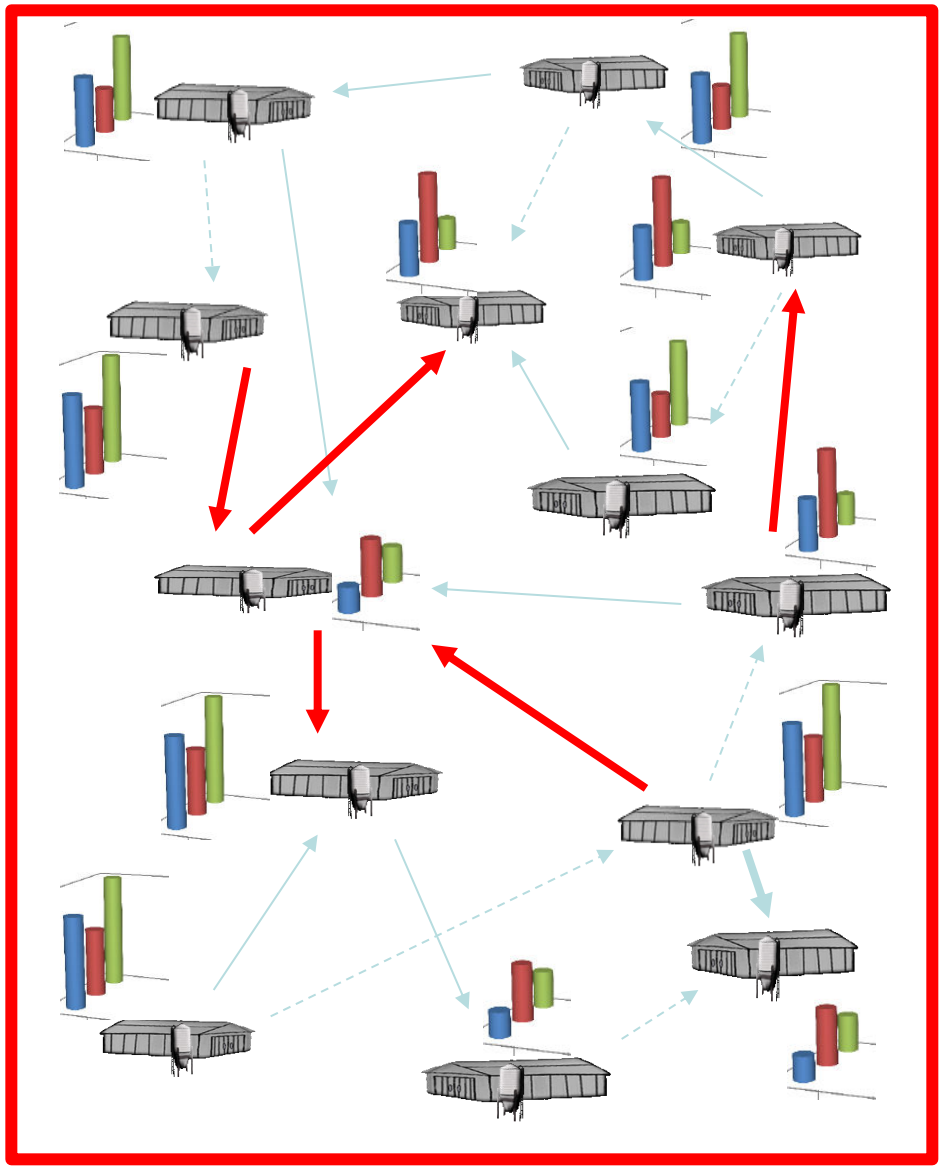
Distance & Regional Density – Infection Pressure





Distance & Regional Density – Infection Pressure





Mycoplasma: "Farm localization is the most important factor associated with reinfection…the second factor is the size of the neighboring farm"

RFW Goodwin, 1985

Entrance of barns

- Risk factor for *Campylobacter*:

Significant risk factor	Odds ratio
Absence of sanitary barrier (anteroom) at the entrance of barn	3.1 (1.1-9.3)
Absence of sanitary barrier and presence of animals nearby	7.0 (1.6-33.9)
Absence of sanitary barrier and presence of animals other than poultry on production site	7.6 (1.4-44.9)

Hald et al., 2000; Newell et al., 2003; Hansson et al. 2007

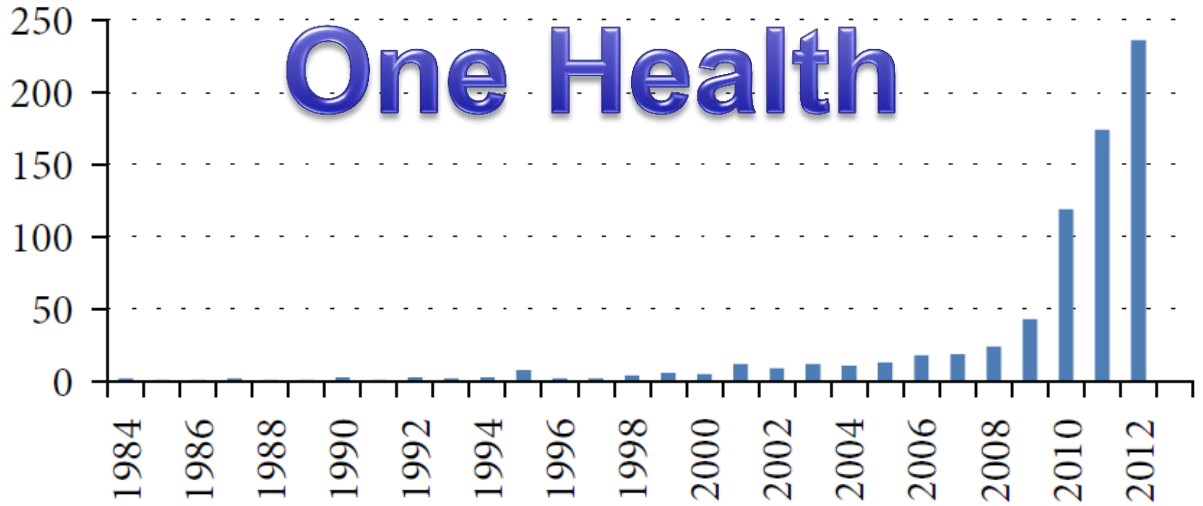


FIGURE 1: Frequency of recorded publications on one health between 1984 and 2012.

Journal of Parasitology Research
Volume 2014, Article ID 874345, 8 pages

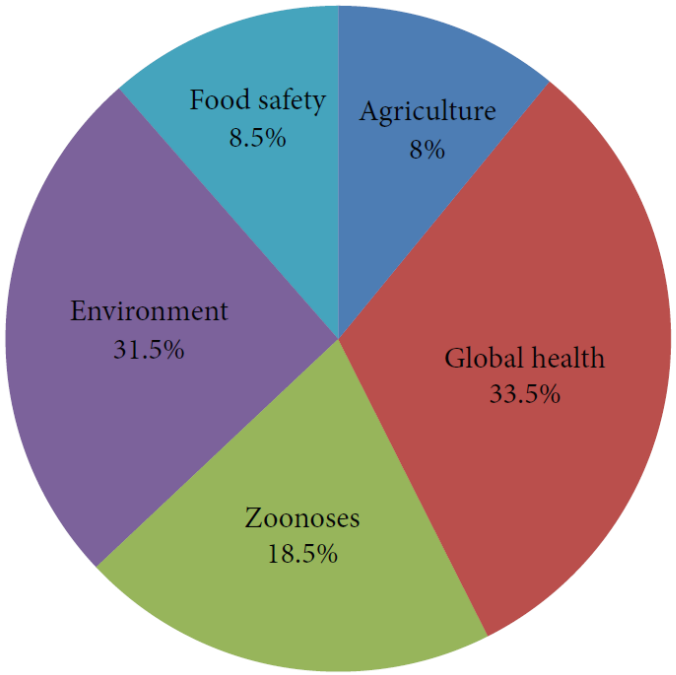


FIGURE 2: Distribution of reviewed published one health scopes.

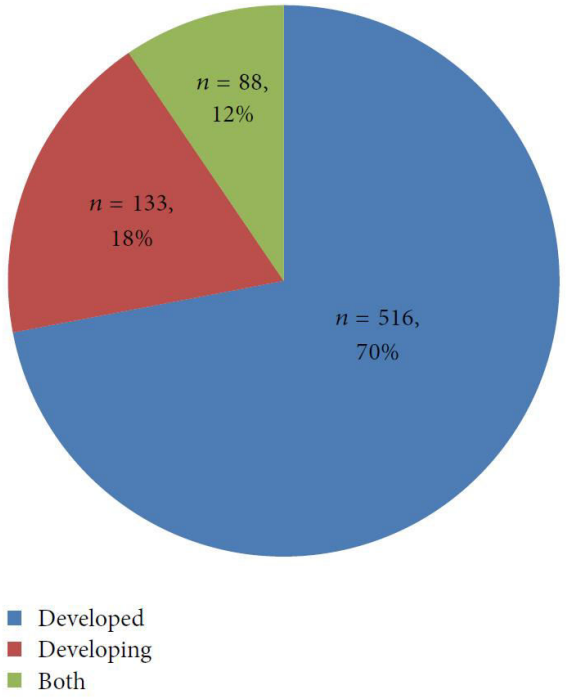
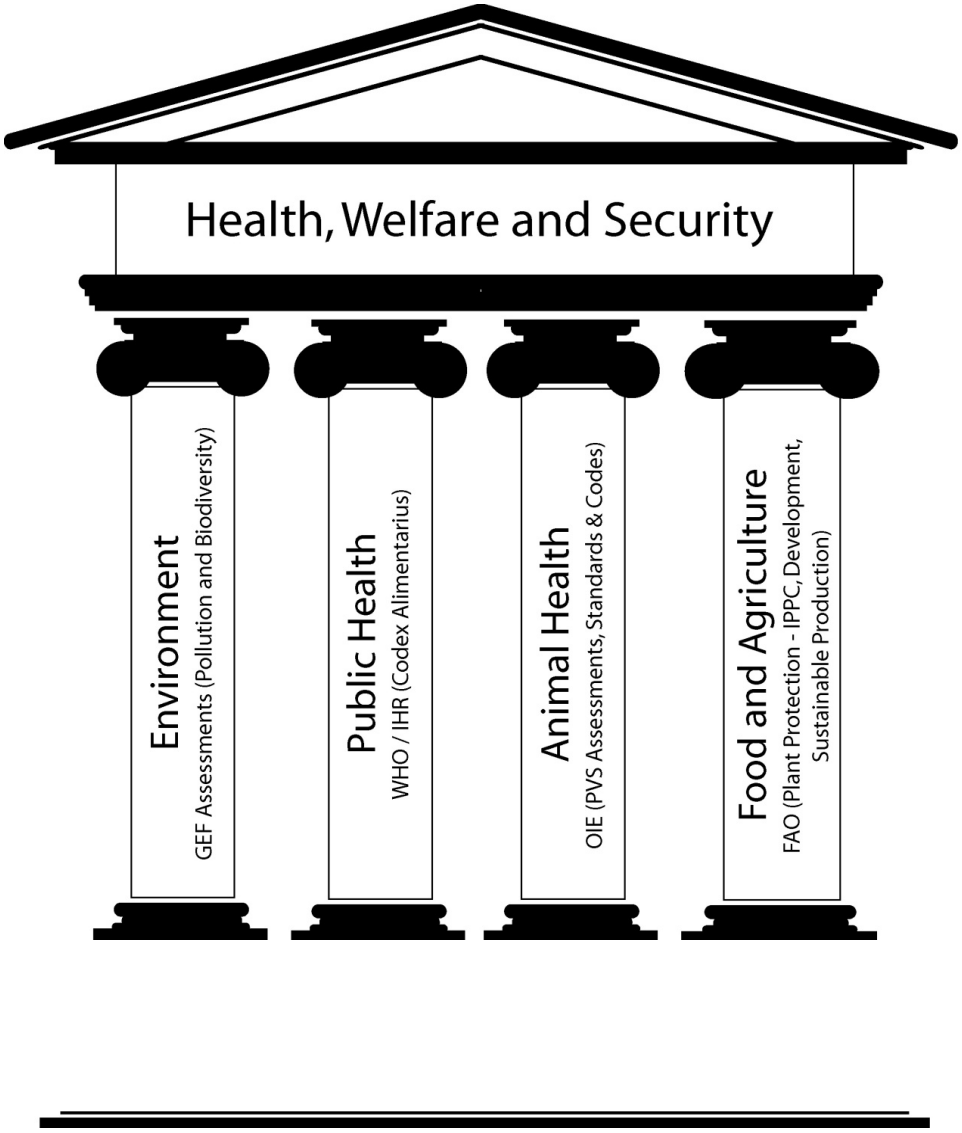


FIGURE 3: Distribution of the one health initiatives in developed versus developing countries.



Vision

Prevent, detect, circumscribe, eliminate diseases and respond to risks

Multisector cooperation

Solid partnerships

"Implementing One Health"
Craig Stephen DVM PhD

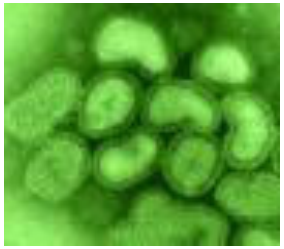
Barriers

M. Hansen, 2012
UC Berkeley

AVIAN DISEASES 54:176–178, 2010

Perspectives on the Global Threat: The Challenge of Avian Influenza Viruses for the World's Veterinary Community

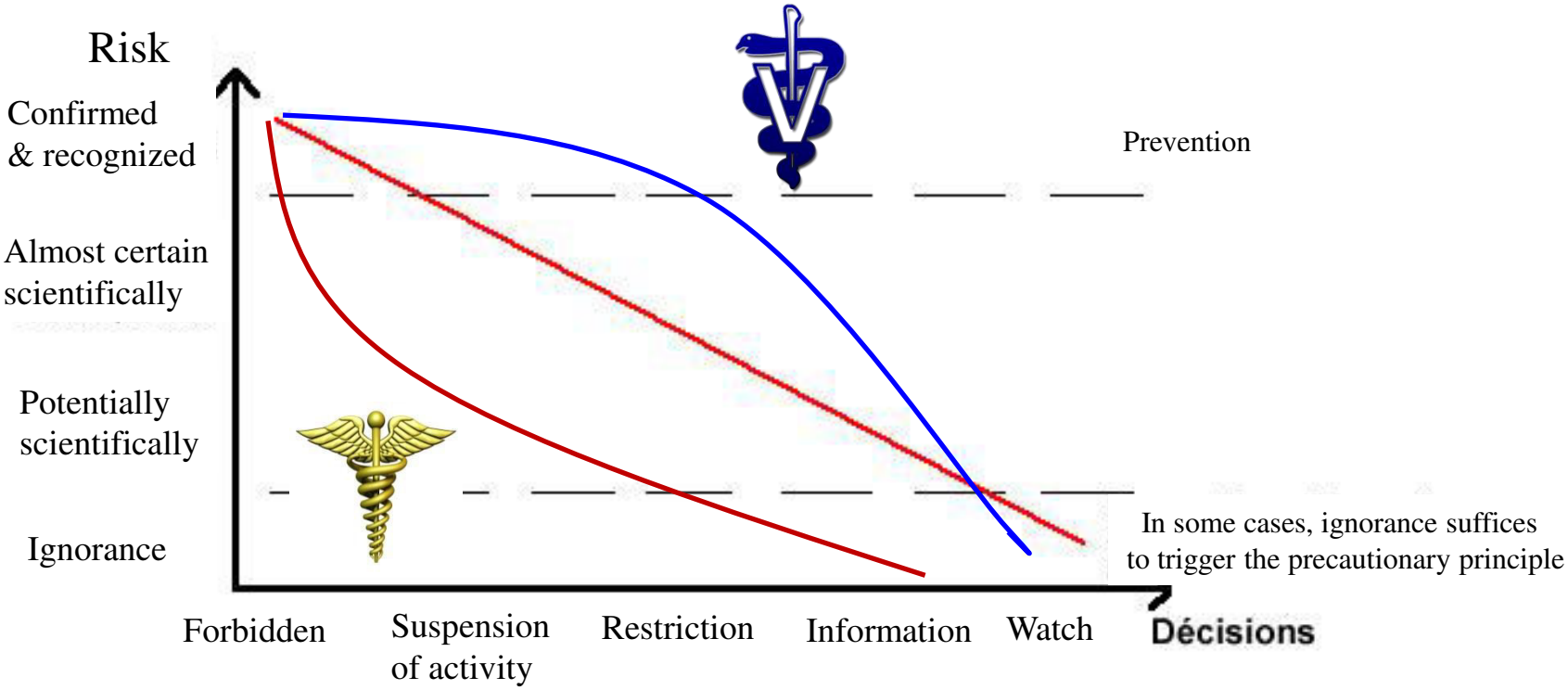
Ilaria Capua[AC] and Dennis Alexander[BD]



"the need for improved communication between the human and animal health sectors"

- Exploit the information we have from an animal health perspective to support public health policies.
- Find novel ways to maximize the use of information generated as a result of the improved networking and diagnostic capacities.
- Communication and analysis systems tailored to meet global health priorities, and used to develop and constantly improve novel systems for the exploitation of information to generate knowledge.
- Bringing relevant information to international discussion tables.

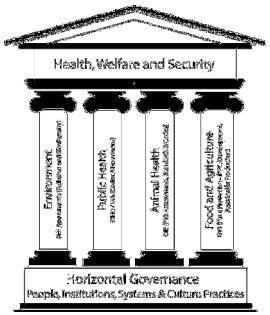
Precautionary principle applied to veterinary issues
Gap between human and veterinary medicine professionals



Demesmaeker Tony et Clément Eric http://lemondepolitique.free.fr/dossier/precaution/retraitindex.htm

“Faced with the choice between changing one's mind and proving that there is no need to do so, almost everyone gets busy on the proof.”

~John Kenneth Galbraith



WE NEED TO DESIGN A COLLABORATIVE APPROACH WITH THE INHERRENT ABILITY TO CHANGE

Need for change?

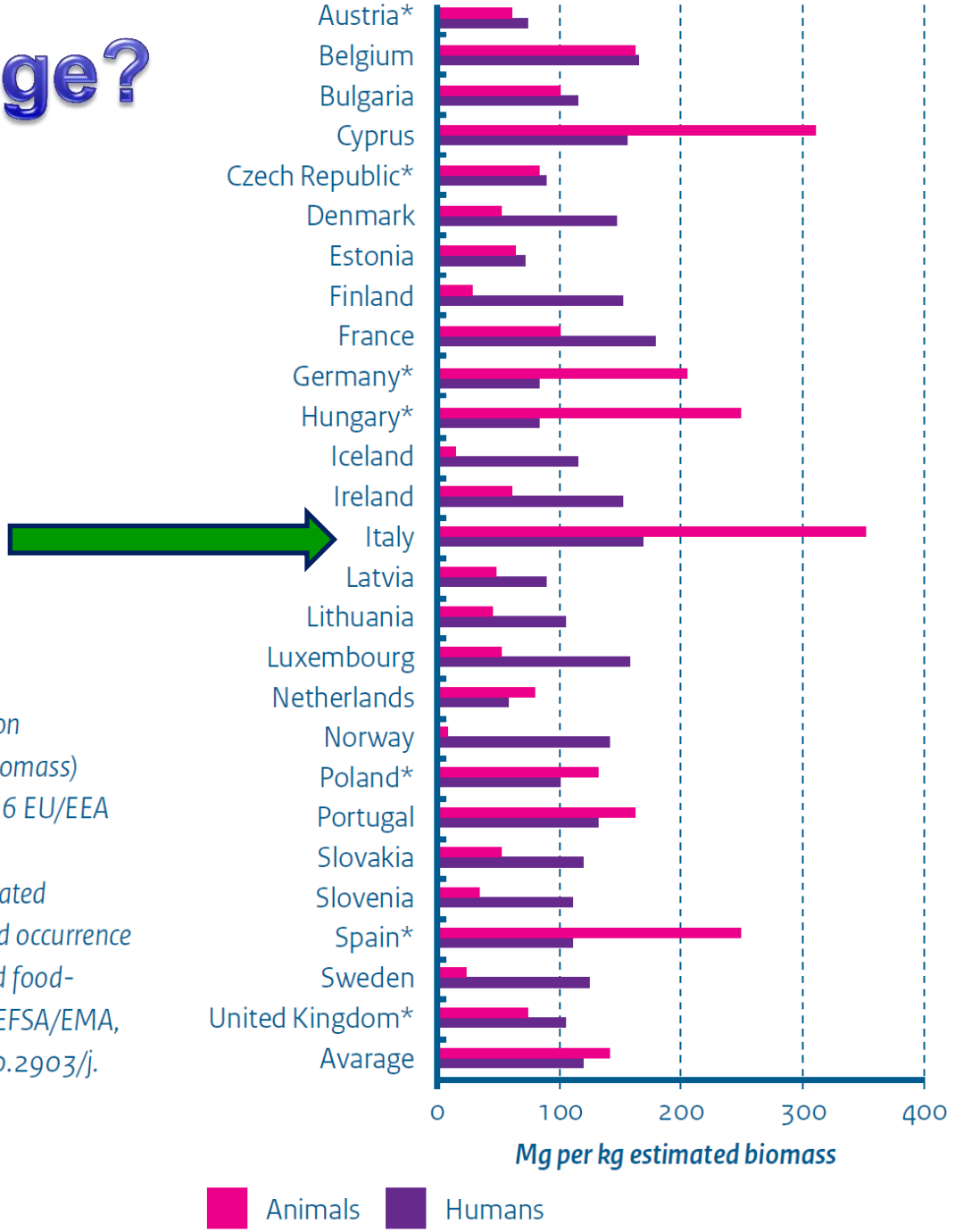
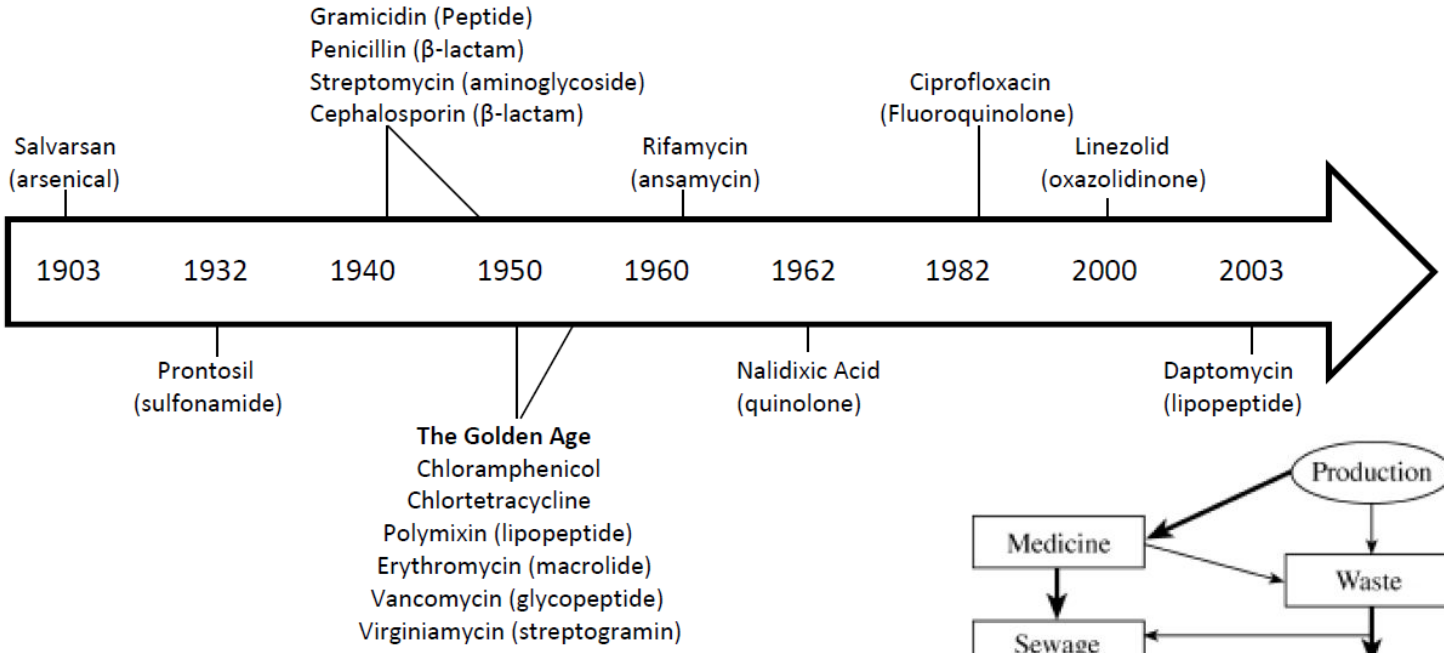


Figure 3: Comparison of biomass-corrected consumption of antimicrobials (milligrams per kilogram estimated biomass) in humans and food-producing animals by country in 26 EU/EEA countries in 2012.

Source: ECDC/EFSA/EMA first joint report on the integrated analysis of the consumption of antimicrobial agents and occurrence of antimicrobial resistance in bacteria from humans and food-producing animals. Stockholm/Parma/London: ECDC/EFSA/EMA, 2015. EFSA Journal 2015;13(1):4006, 114 pp. doi:10.2903/j.efsa.2015.4006

Major classes of antimicrobials and the year of their discovery:[21]



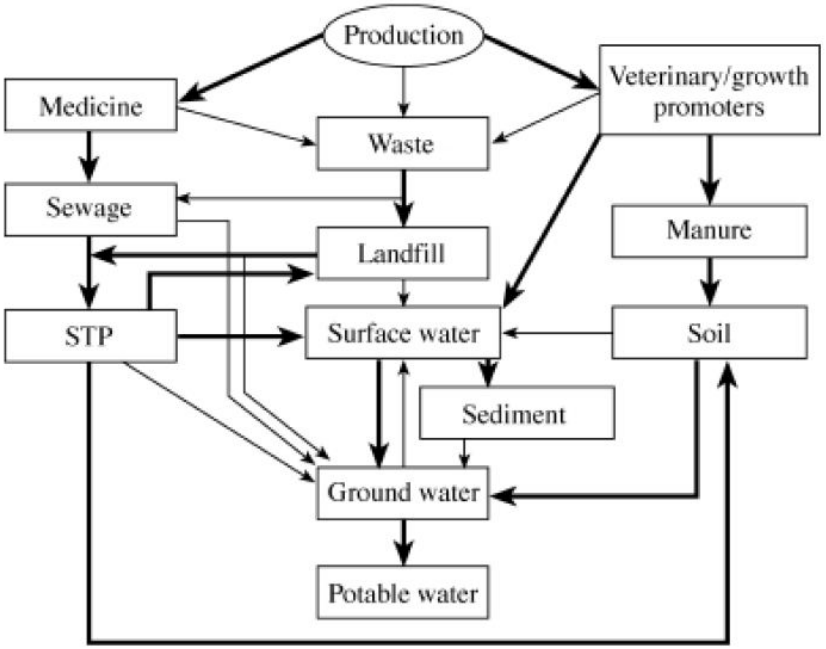


Figure 1. Sources and distribution of pharmaceuticals in the environment[1] (STP: sewage treatment plant).

www.animalagriculture.org

NATIONAL INSTITUTE FOR ANIMAL AGRICULTURE

Information synthesized from Nov. 13-15, 2012, symposium in Columbus, Ohio: "A One Health Approach to Antimicrobial Use & Resistance: A Dialogue for a Common Purpose"

Judicious use of antibiotics in poultry

Preventive strategy

Good management

Sanitation

On-farm biosecurity

Regional biosecurity

Health monitoring

Immunization

Integrity strategy

Veterinarian-client-patient relationship: validity of proposed measures &compliance

Respect withdrawal times

Maintain an accurate database

Minimize environmental contamination

Selection strategy

Therapeutic alternatives (environment; feed & water additives)

1st option: antibiotic approved for given species and disease
2nd: if not possible, 2nd choice based on available data

Therapy optimized based on pharmacological knowledge

Avoid prolonged oral therapy → impact on gut bacteria

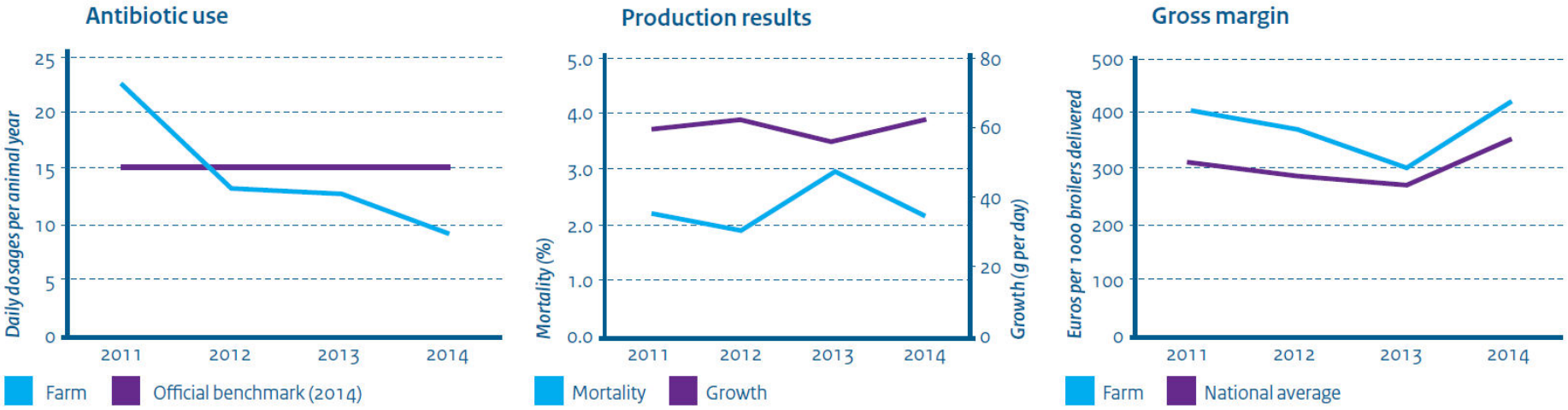
Narrow spectrum antimicrobials whenever possible
Based on culture and susceptibility results

Avoid antibiotics important in humans

Limit treatment to diseased or at risk birds

Example of success over a 4-year period

Farm with 153,000 broiler capacity with 5 traditional barns.
Farmer on his own, but has external help for cleaning, disinfecting and delivering birds



Sources: Antibiotic use: Avined; Gross margin and Production results: FADN/LEI Wageningen UR.
The official benchmark (2014) is laid down by the Netherlands Veterinary Medicines Authority (SDa).

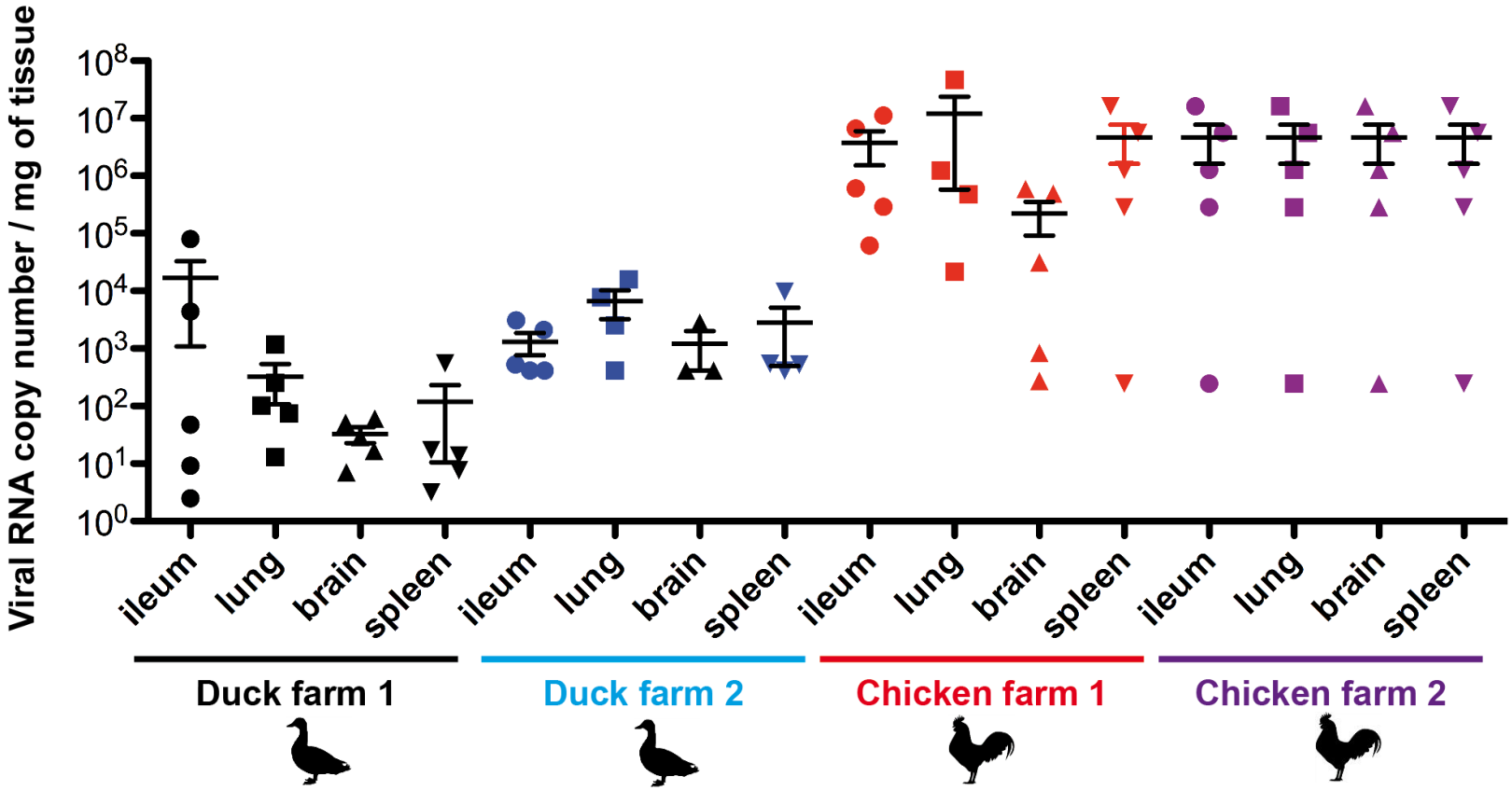
Challenge: lag time between effort and success….





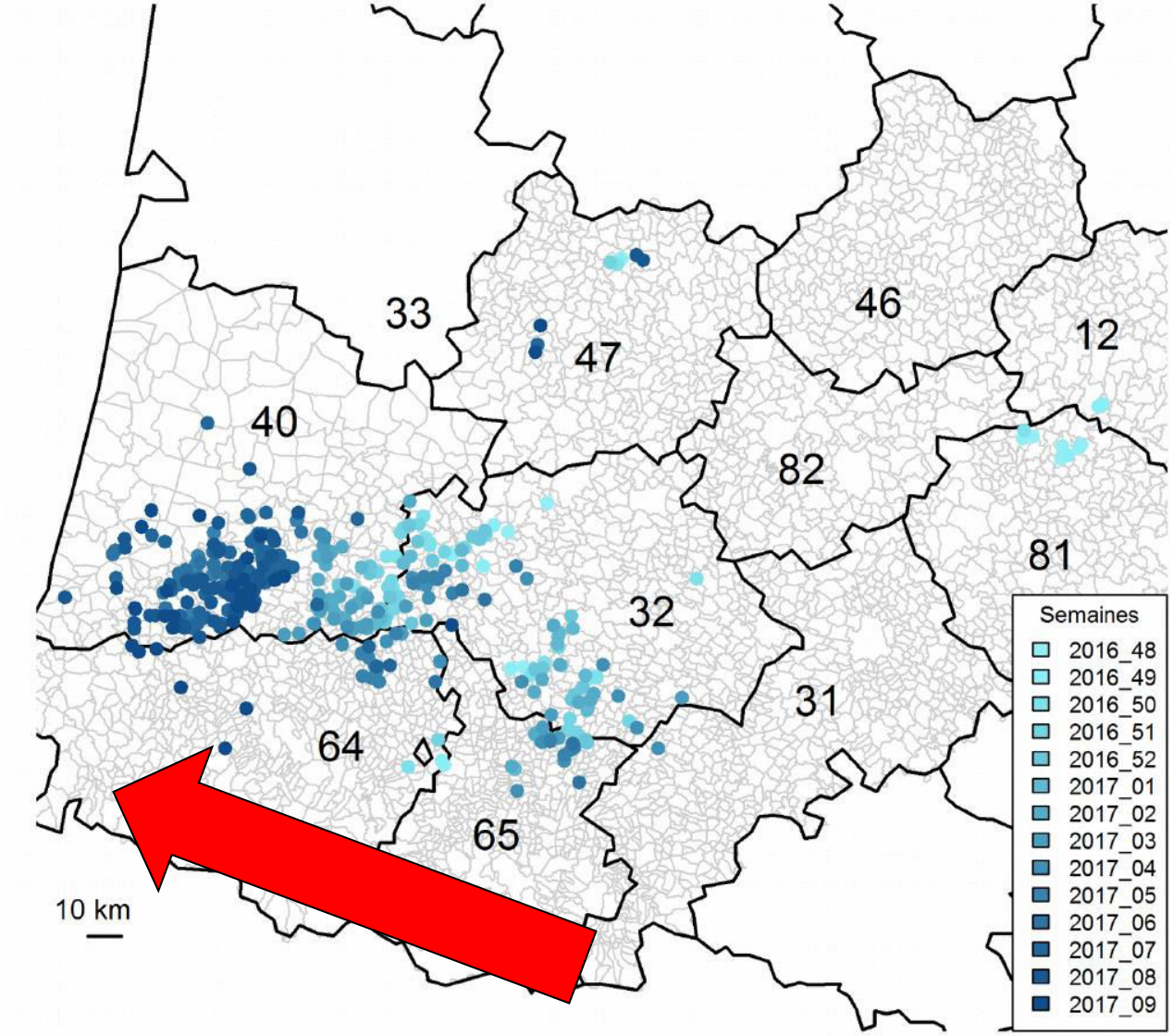
H5N8

H5N9 HPAI$_{2015}$: viral shedding Ducks vs Chickens

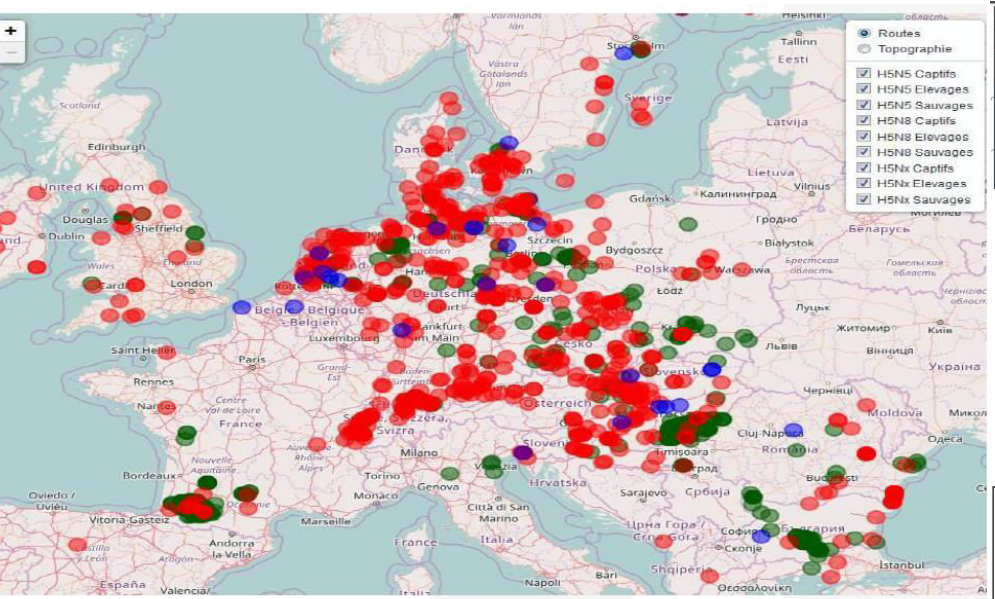


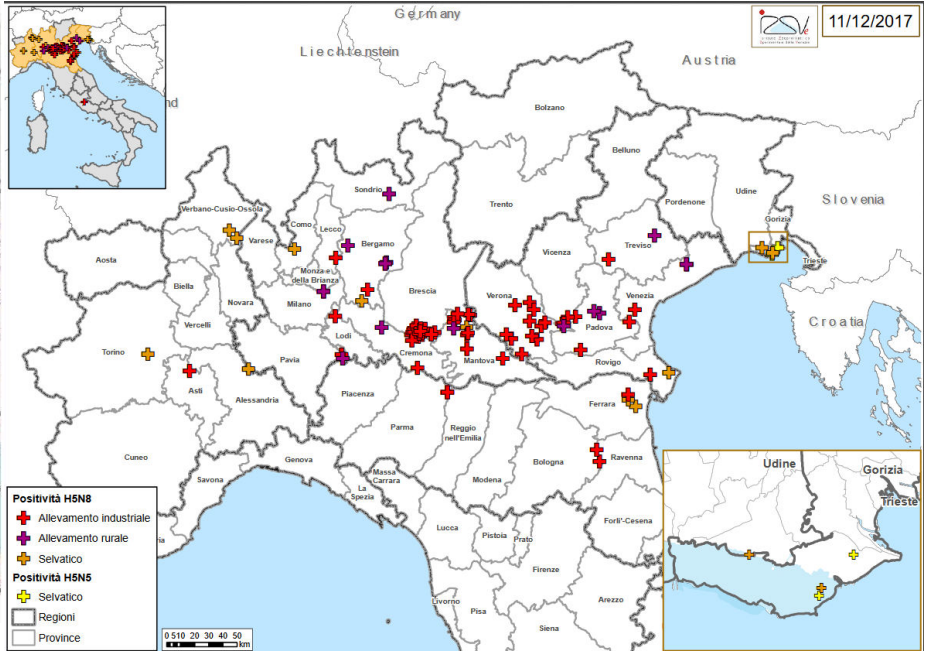
INP ECOLE NATIONALE VETERINAIRE INRA SCIENCE & IMPACT

Spread of outbreaks



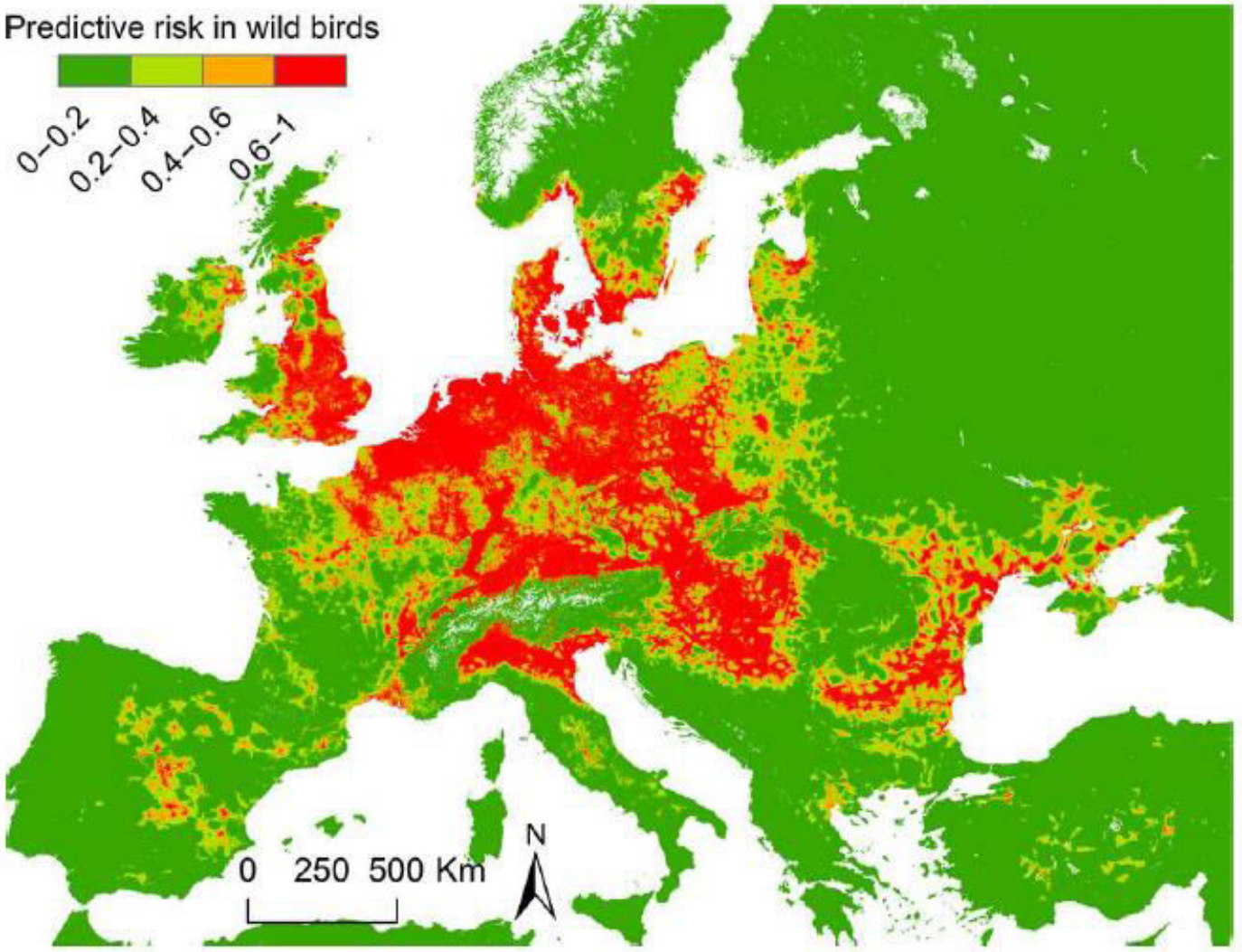
French Epidemiosurveillance platform





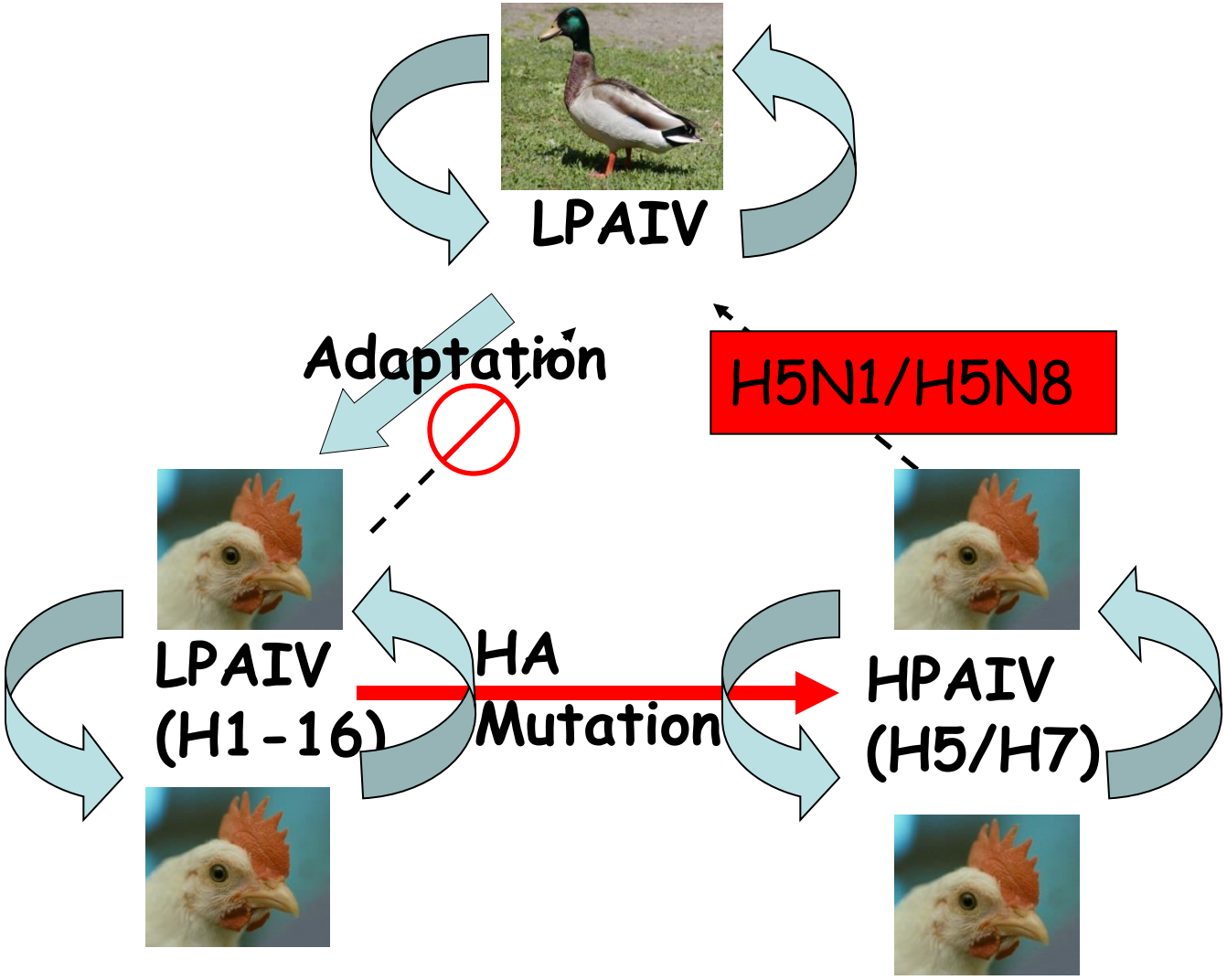
HPAI 2016-2018

Specie (indirizzo produttivo)	Numero capi	Data di Conferma	Sottotipo	Data estinzione	Misure Zona di Protezione in vigore fino a	Misure Zona di Sorveglianza in vigore fino a
Galline ovaiole	**95.000**	02/03/2018	H5N8	07/03/2018	28/03/2018	06/04/2018
Galline ovaiole	**30.700**	08/03/2018	H5N8	11/03/2018	01/04/2018	10/04/2018
Tacchini da carne	**155.000**	12/03/2018	H5N8	23/03/2018	13/04/2018	22/04/2018

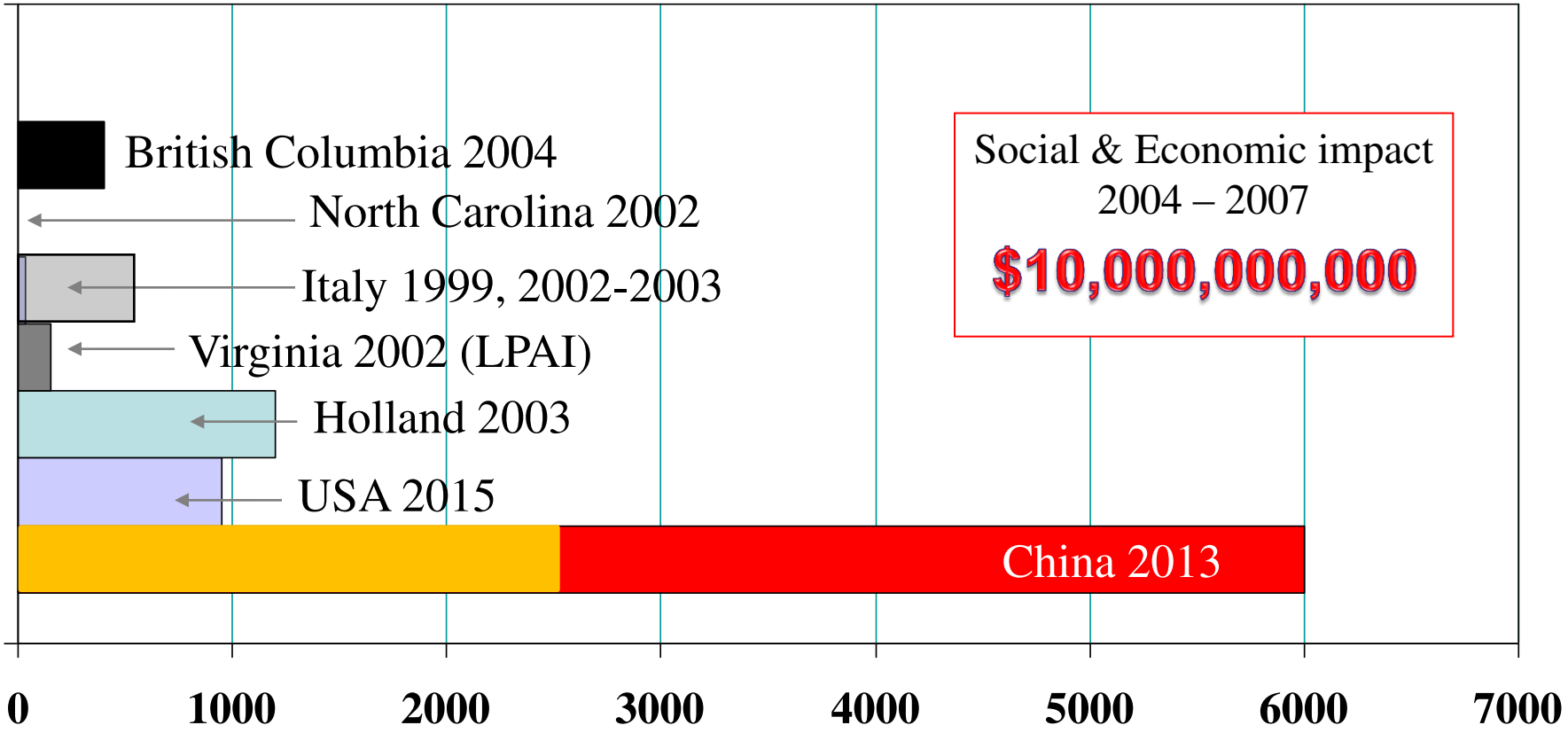


EFSA Journal
Volume 15, Issue 10, 16 OCT 2017 DOI: 10.2903/j.efsa.2017.4991
http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2017.4991/full#efs24991-fig-0013

Ecology & Epidemiology



The cost of epidemics
Avian Influenza



(1): FAO – Economic and social impact of Avian Influenza
(2): *BMJ Open* 2014; Xiaopeng Qi **and al.**
(3): Reuters – World News Tue May 21, 2013
(3): USDA APHIS – 2016 HPAI prepardness and response plan

x $1,000,000 US

AVIAN DISEASES 60:460–466, 2016

Factors Associated with Highly Pathogenic Avian Influenza H5N2 Infection on Table-Egg Layer Farms in the Midwestern United States, 2015

Lindsey Garber,[AC] Kathe Bjork,[A] Kelly Patyk,[A] Thomas Rawdon,[B] Maria Antognoli,[A] Amy Delgado,[A] Sara Ahola,[A] and Brian McCluskey[A]

Table 5. Results of multivariable logistic regression of farm-level analysis.

Characteristic[A]	% Case farms	% Control farms	Odds ratio	*P*-value	Average attributable fraction
In an existing control zone	50	10	32.0	0.002	31.7%
Rendering trucks near barns	29	3	22.3	<0.001	14.0%
Garbage trucks near barns	61	23	14.7	<0.001	28.1%
Visitors change clothes	77	93	0.08/12.6[B]	0.01	7.6%[B]
Company service person visit in past 14 days	50	19	5.0	<0.001	15.0%

[A]Reference level = absence of factor.
[B]Do not change clothes.

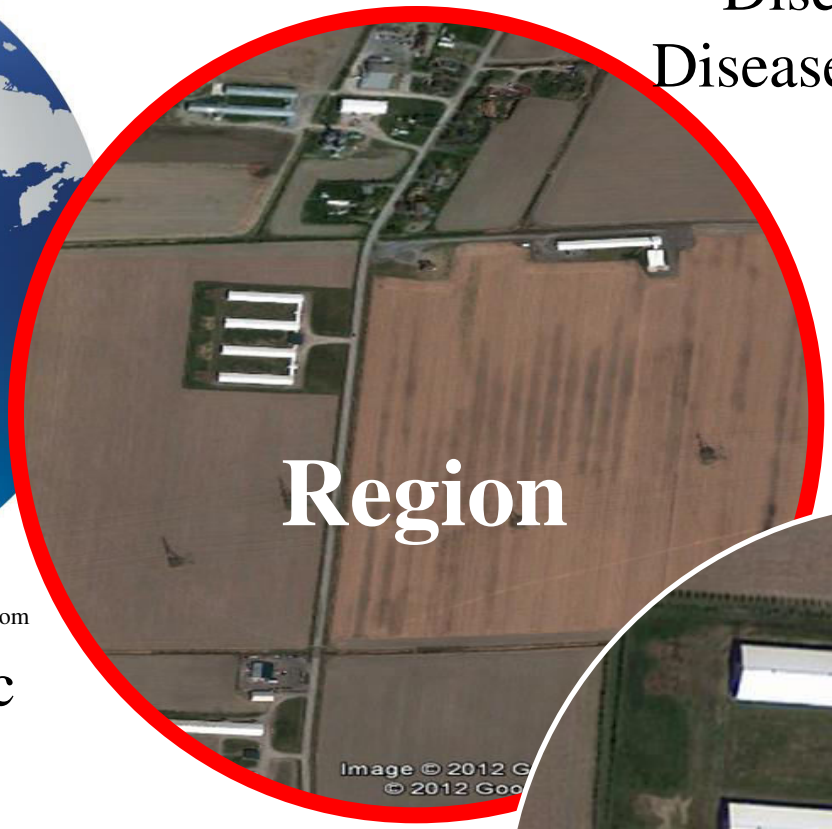
Table 7. Results of multivariable logistic regression of barn-level analysis.

Characteristic[A]	% Case barns	% Control barns	OR	*P*-value	Average attributable fraction
Barn entry with a hard-surfaced entry pad cleaned and disinfected	28.6	53.6	0.16/6.9[B]	0.01	33.7%[B]
Disposing of dead birds near a barn (within 27 m)	60.7	35.5	2.8	0.002	20.2%
Having ceiling or eaves inlet ventilation type (compared with curtain, sidewall, or tunnel types)	48.2	67.7	0.33/3.0[B]	<0.001	23.4%[B]

[A]Reference level = absence of factor.
[B]Absence of factor.

http://kandztravel.com

Disease surveillance
Disease control Strategies



Prevention of exotic diseases
Maintaining markets

Biosecurity levels

Maintain flock health
Reducing the impact of diseases

Disease = at least 2 x 6:

Probability ⇧ depending on:

Lack of compliance

Number of times you play

+

Number of dices

Risk factors

Compliance Biosecurity →


Risks

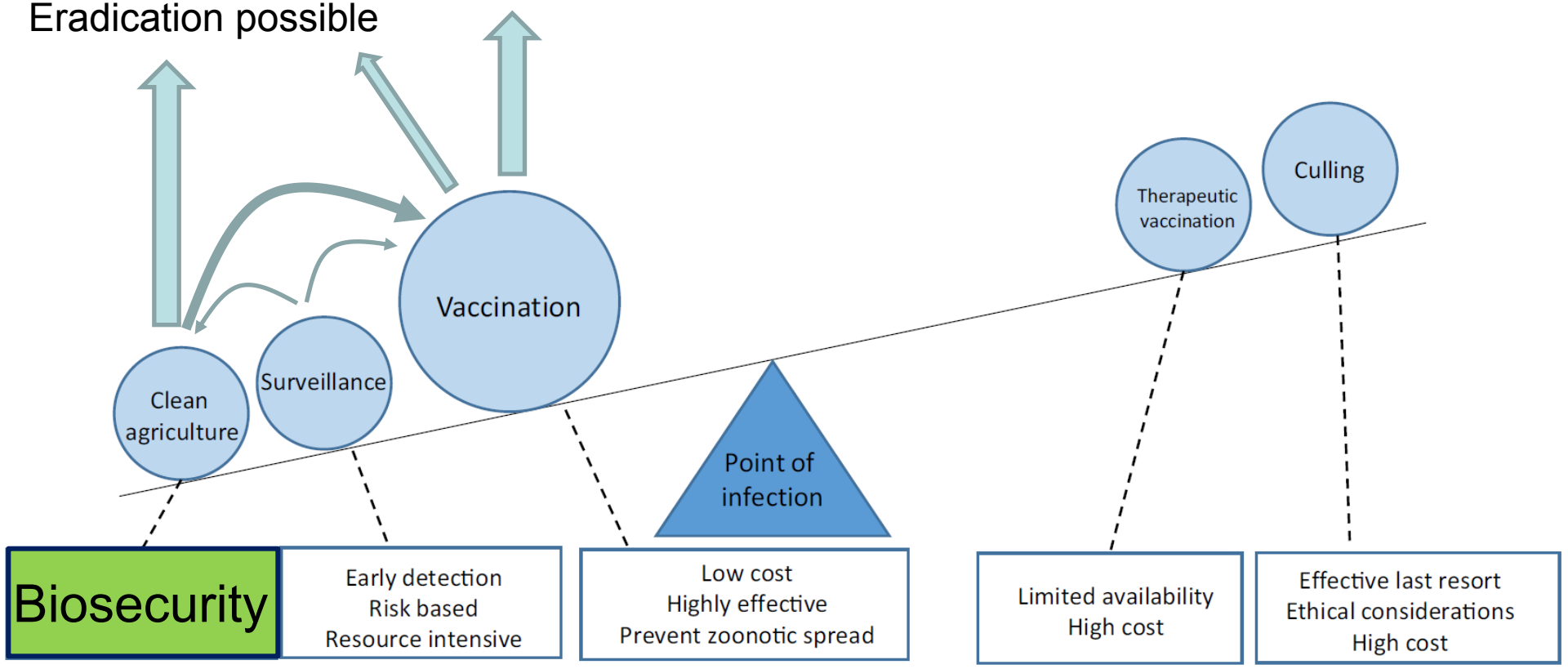

RISK PERCEPTION
RISK ANALYSIS
RISK MANAGEMENT

Sources of contamination

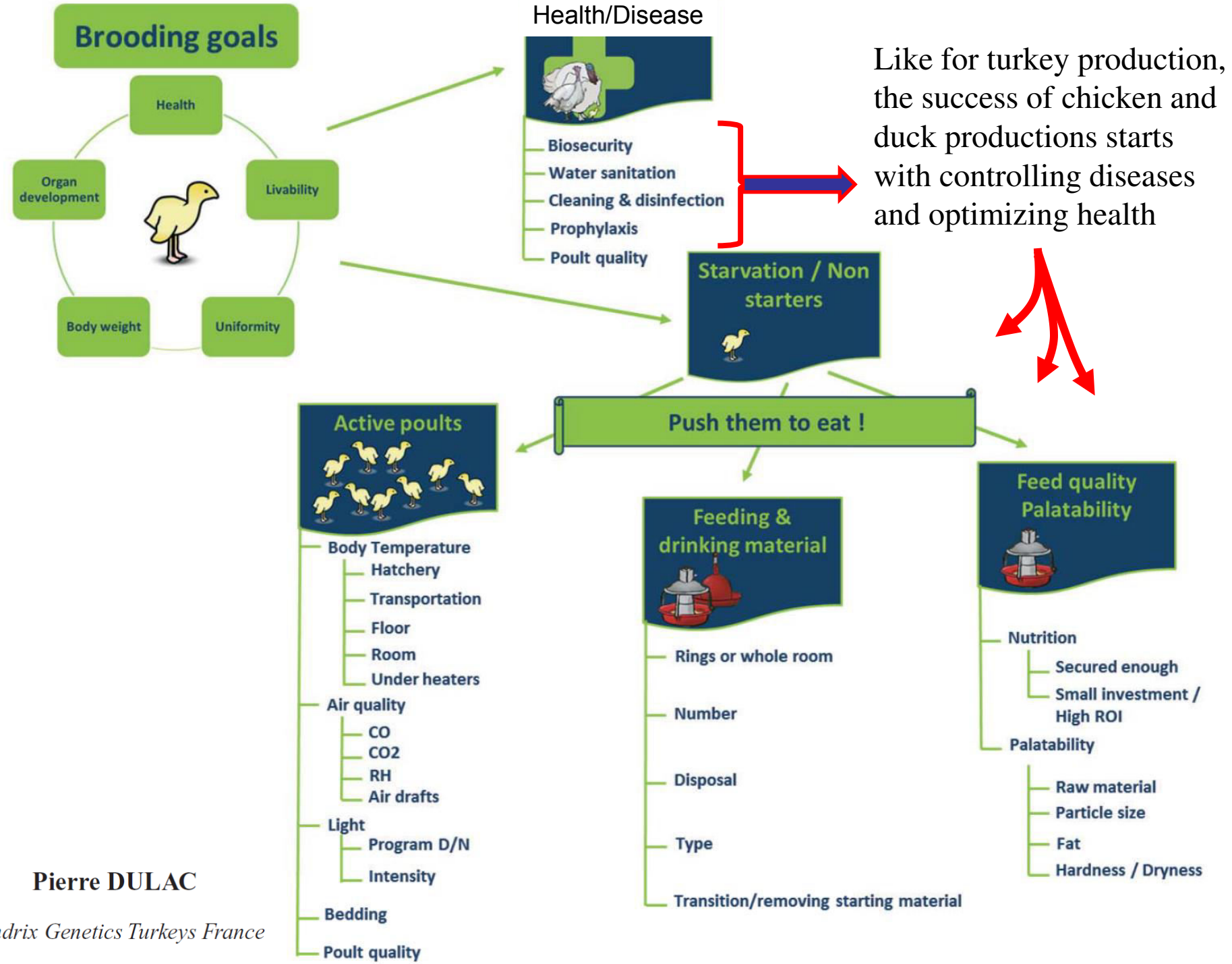
Best Disease Control Strategy

Exotic diseases
Endemic diseases
Eradication possible

Endemic diseases
Eradication not possible



D.S. Layton et al./Vaccine 35 (2017) 5967–5973



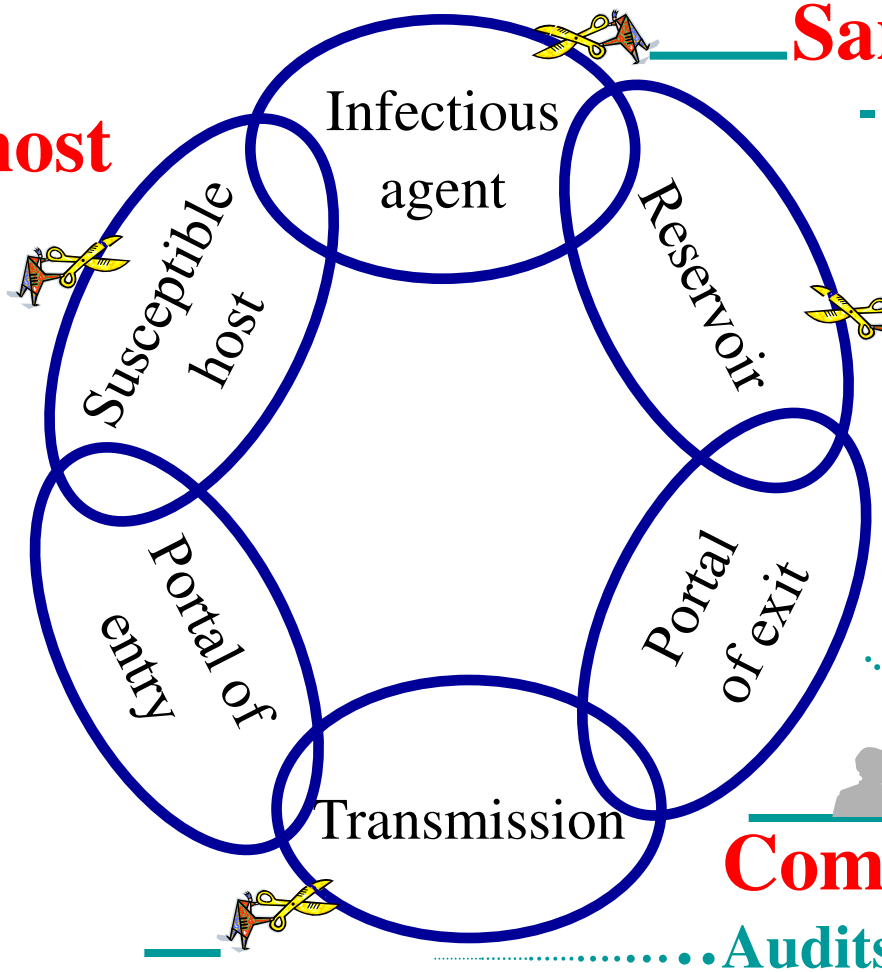
Pierre DULAC

Hendrix Genetics Turkeys France

Top biosecurity measures to break the chain of infection

Removing susceptible host

- All-in all-out
- Vaccination
- Down-time



Sanitation

- Buildings
- People

Pest control

- People
- Animals
- Equipment

Traffic control

Communication

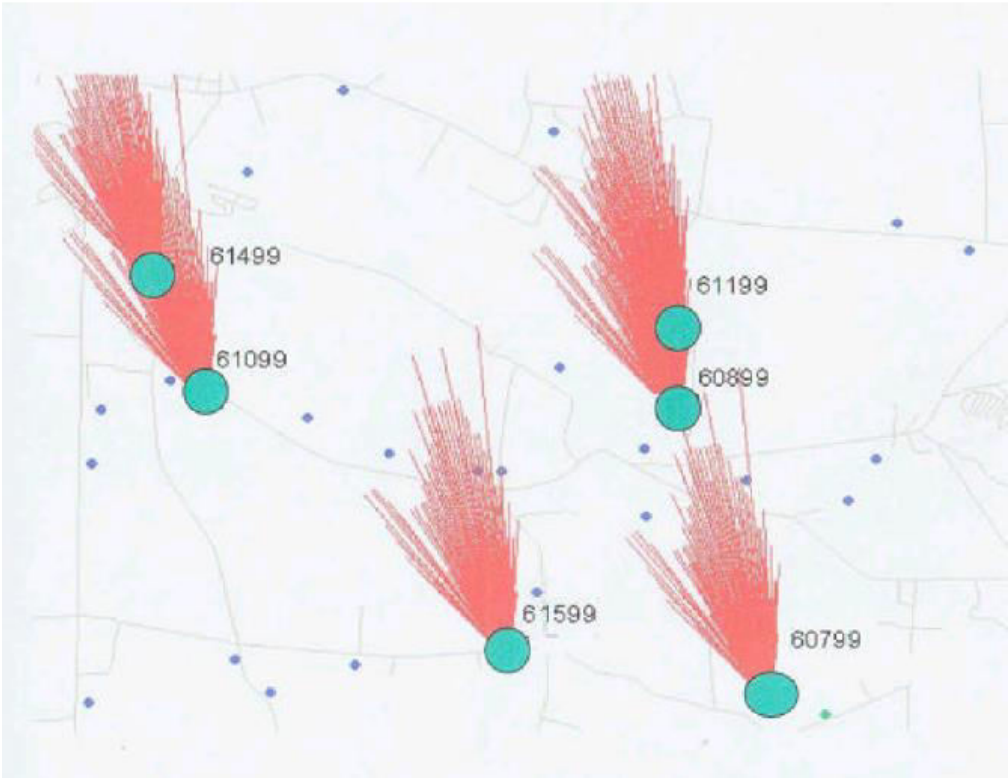
Audits, Education, & Regional networking

Airborne transmission

- **Risk**
  - 10 X more chances that an ILT positive farm will be directly located in a wind corridor from where there is a farm infected with the ILT virus
- **Risk management**
  - Windbreak vegetation
  - Regional coordination and biosecurity
  - Consideration when planning the construction of a new barn

Johnson *et al.*: Wind-borne ILT spread

Delaware



"HPAI virus was isolated from air samples collected inside, immediately outside, up to 70 m from infected facilities (RNA up to 1000 m)"

Farm ID	U.S. state	Species/type	Flock size	Number of barns
1	MN	Turkey/layer	28,000	4
1	MN	Turkey/layer	28,000	4
1	MN	Turkey/layer	28,000	4
2	MN	Turkey/grow	70,000	7
2	MN	Turkey/grow	70,000	7
2	MN	Turkey/grow	70,000	7
3	MN	Turkey/breeder	4205	2
3	MN	Turkey/breeder	4205	2
3	MN	Turkey/breeder	4205	2
4[B]	IA	Chickens/layers	575,000	6
4[B]	IA	Chickens/layers	575,000	6
4[B]	IA	Chickens/layers	575,000	6
5	NE	Chickens/layers	1.7M	18
5	NE	Chickens/layers	1.7M	18
6[B]	NE	Chickens/layers	1.8M	15
6[B]	NE	Chickens/layers	1.8M	15
6[B]	NE	Chickens/layers	1.8M	15

RT-PCR[A]	Inside ($n = 39$)	5 m ($n = 40$)	70–150 m ($n = 29$)	500–1000 m ($n = 30$)	Total ($n = 138$)
Turkeys					
Positive	14 (56)	7 (50)	0 (0)	NA	21 (42)
Suspect	7 (26)	7 (50)	5 (56)	NA	19 (38)
Negative	6 (22)	0 (0)	4 (44)	NA	10 (20)
Layers					
Positive	12 (100)	11 (42)	1 (5)	0 (0)	24 (27)
Suspect	0 (0)	4 (15)	18 (90)	11 (37)	33 (38)
Negative	0 (0)	11 (42)	1 (5)	19 (65)	31 (35)
Total					
Positive	26 (67)	18 (45)	1 (3.5)	0 (0)	45 (33)
Suspect	7 (18)	11 (27.5)	23 (79)	11 (37)	52 (38)
Negative	6 (15)	11 (27.5)	5 (17.5)	19 (63)	41 (30)

[A]Ct values: positive, <35; suspect, 35 to <40; negative, >40.

OPEN ACCESS Freely available online PLoS COMPUTATIONAL BIOLOGY

Risk Maps for the Spread of Highly Pathogenic Avian Influenza in Poultry

Gert Jan Boender[1], Thomas J. Hagenaars[1], Annemarie Bouma[2], Gonnie Nodelijk[1], Armin R. W. Elbers[3¤], Mart C. M. de Jong[1], Michiel van Boven[1*]

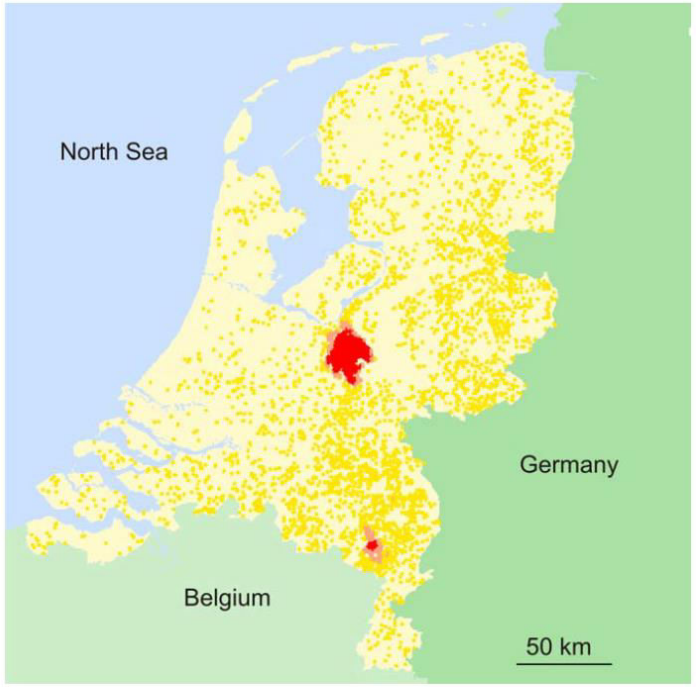


Figure 4. High-Risk Areas for Epidemic Spread of Avian Influenza Virus Based on the Transmission Kernel of Figure 3

See Table 1 for parameter estimates. For each farm, an individual reproduction number R_i is calculated on the basis of Equation 5. Infected farms with $R_i < 1$ infect, on average, less than one susceptible farm and pose no risk for epidemic spread (yellow dots). Infected farms with $R_i > 1$ are expected to infect more than one susceptible farm in the early stage of an epidemic and thus constitute a risk of epidemic spread (red dots). Pink dots represent farms with $R_i < 1$ for the maximum likelihood estimate of the transmission kernel, but with $R_i > 1$ for the upper boundary of the 95% kernel confidence area (Figure 3). Note that most of the farms that were infected during the epidemic in The Netherlands in 2003 (Figure 1) are classified as high-risk farms.

doi:10.1371/journal.pcbi.0030071.g004

The Netherlands 2003 – HPAI H7N7
241 commercial flocks
9 weeks
30 million birds

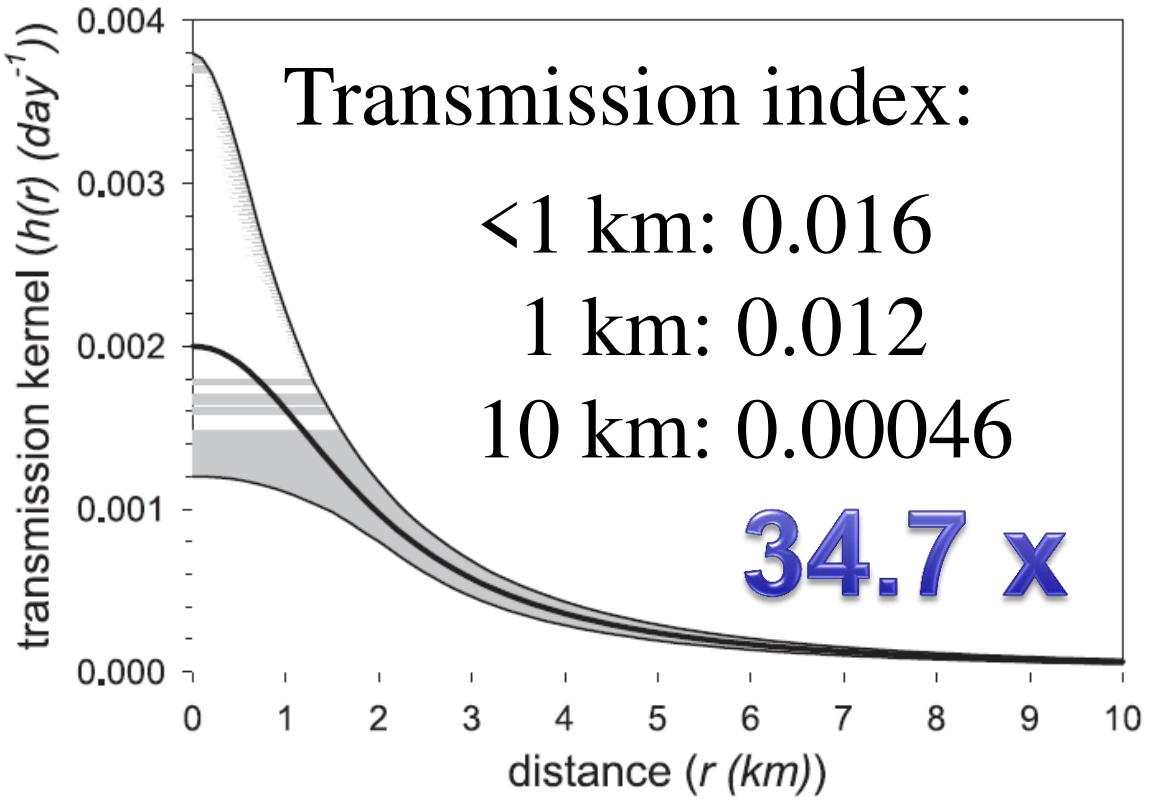


Figure 3. The Transmission Kernel as a Function of Interfarm Distance for the Parameter Estimates of Table 1

The 95% confidence areas of the transmission kernel are represented by the shaded area.

doi:10.1371/journal.pcbi.0030071.g003

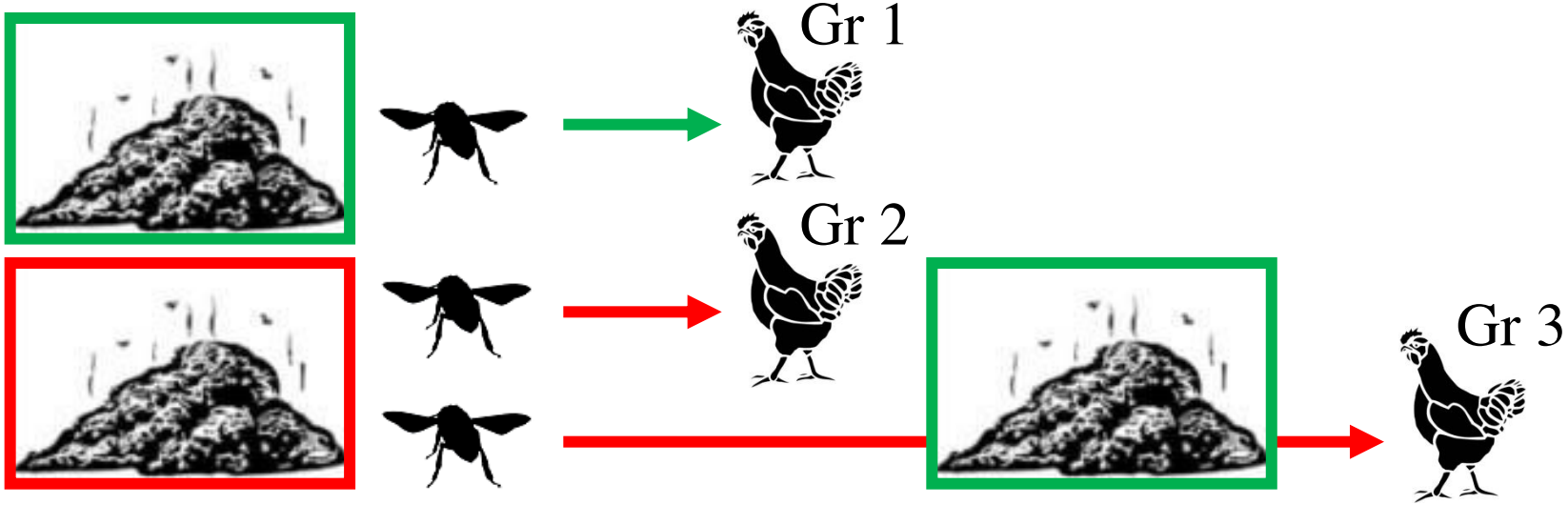
Case-control studies

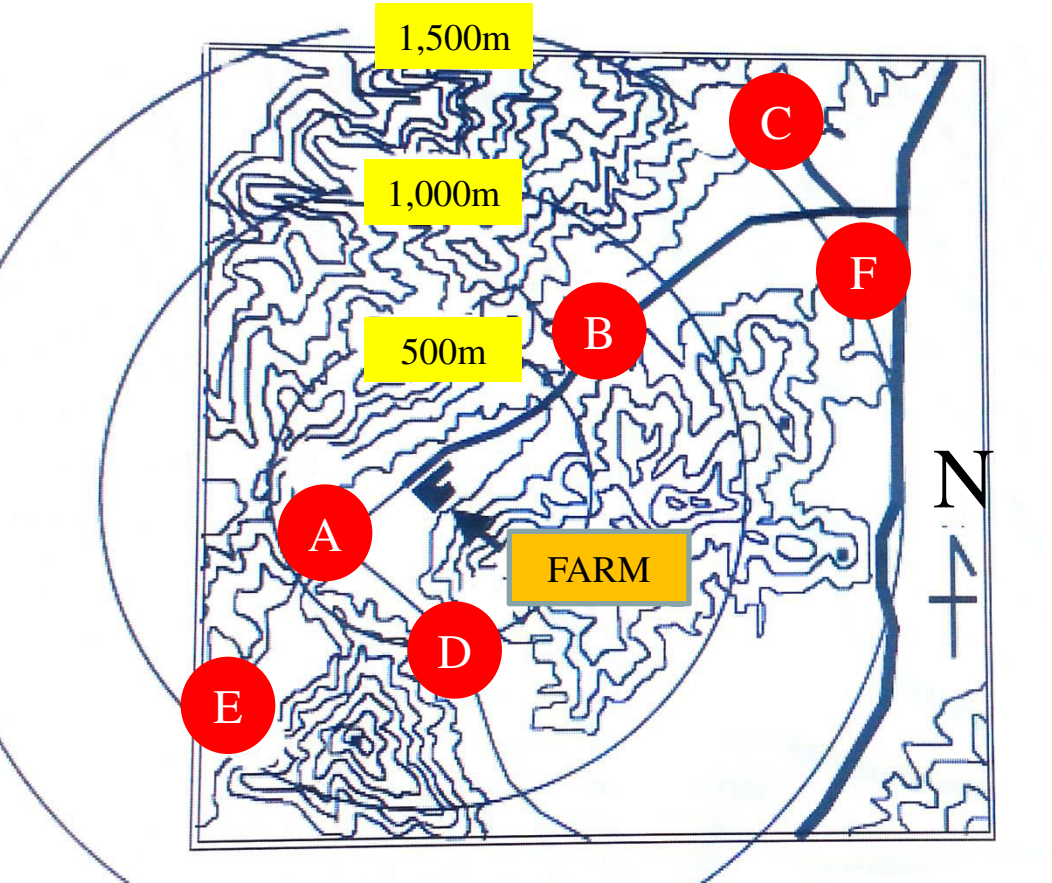
Diseases	Risk factor	Risk level	Reference
Salmonella Newcastle E. coli	High farm density	OR 2.2 OR 4.2 OR 6.3	Snow et al., 2012; Great Britain East et al., 2006; Australia Vandekerchove et al., 2004; Belgium

Less than 1 km (0.6 mile) between farms

- 2 x more chances → *Salmonella*
- 4 x more chances → Newcastle
- 6 x more chances → *E. Coli*

⇒ eggs, equipment, people, vehicles, wildlife



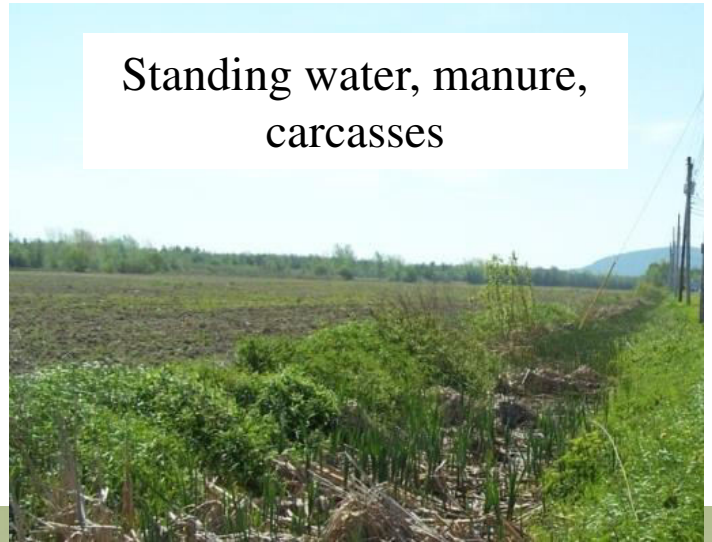


HPAI H5N1: isolated from 30% of flies captured in a 2.3 km radius from an infected farm

Jpn.J.Infect.Dis., 62,294-297,2009

Insects

- **Risk management**
  - Avoid standing water
  - Manure management
  - Dead bird disposal
  - baits, insecticides
  - Close doors
  - Mosquito screen
  - Keep site clean and dry inside and outside buildings
  - Where possible: let the building freeze



Standing water, manure, carcasses

Rodents and Other Wild Animals

Risk

- 3 X more chances of *Campylobacter* infection if rodent feces are observed on site
- 3 X more chances of having coccidiosis when rodents are detected on site
- 6 X more chances of *Salmonella enteritidis* infection if mice are observed
- 8 X more chances of *Salmonella enteritidis* infection if rats are observed at least monthly
- 2 X more chances of low pathogenic avian influenza if racoons or foxes are observed near the farm.
- Significant association between the presence of squirrels on the farm and *Pasteurella multocida* in a flock on the farm

Carcass disposal

- **Risk**
  - During the avianInfluenza epidemic of 2002 in Virginia, USA (LPAI H7N2):
    - 7 X more chances of viral contamination of farms using rendering for carcass disposal
- **Explanation**
  - Same vehicle used on many farms for the collect of dead birds → spreading of the virus via the vehicle, the driver, the equipment, etc.

Carcass disposal

- **Risk management**
  - Locate the container for dead birds away from the barns and close to the road (preventing access to the poultry site)
  - Communicate with the rendering company in order to schedule dead bird pick up from low risk to higher risk sites.

Spreading of manure

- **Risk**
  - Farms in high density areas are at greater risk that a neighboring farm spreads manure close to them
- **Explanation**
  - Transmission of pathogens via aerosol and vectors (rodents, insects, etc.)
- **Risk management**
  - Composting before spreading manure
  - When disease occurred, heat the litter before spreading

The most important vermin….

Industry on wheels…

- Grower/Employees
- Cleaning crew
- Livehaul (chickens)
- Livehaul (equipment)
- Poult trailer
- Shavings
- Rendering truck
- Servicemen
- Tractors
- Loading crew
- Feed truck
- Fuel truck
- Truck shop
- Snow plow
- Trash truck
- etc.

Infectious Laryngotracheitis in Niagara Peninsula

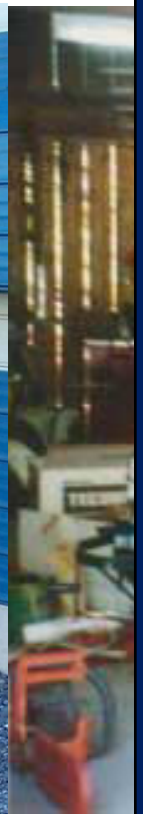
Logistic regression on "flock disease status"

Factor	Coefficient	p-value	OR (95%CI)
Vaccination crew	2.54	0.031	12.7 (1.3-126)
Litter handling	2.09	0.016	8.1 (1.5-45)

Case-Control Studies

Disease	Risk Factor	Risk	Reference
Avian Influenza	Visitors Clothing, boots, ha Sharing equipme	OR 8.3 OR 7.0	Fasina et al., 2011; Nigeria Nishiguchi et al., 2007; Japan

Racicot, 2013



Coveralls required to visitors

	MG status Pos.	Neg.
YES	**12**	**15**
NO	**22**	**2**

65% versus 12%

Vaillancourt & Martinez, 2003

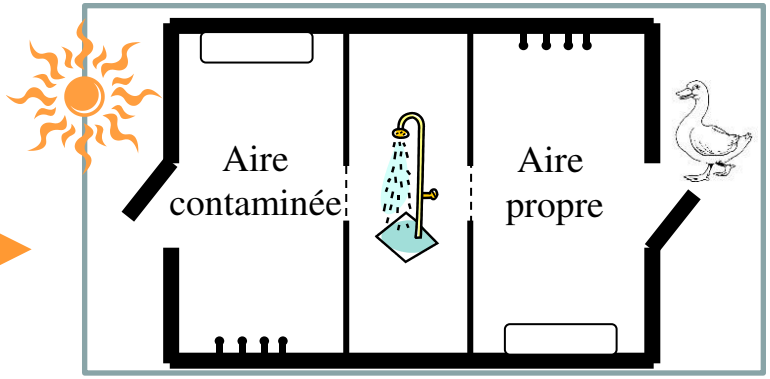
Fisher Exact Test
p = 0.0008

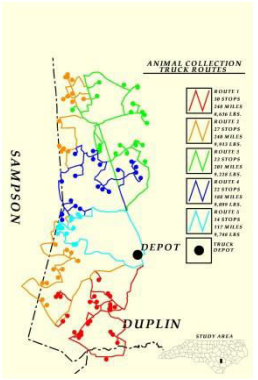
Basic Principles

Clean

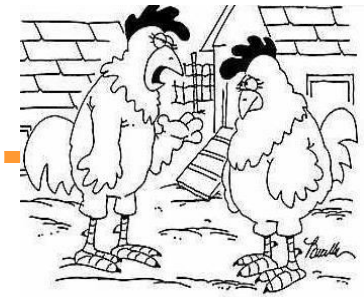
Reduce

Separate

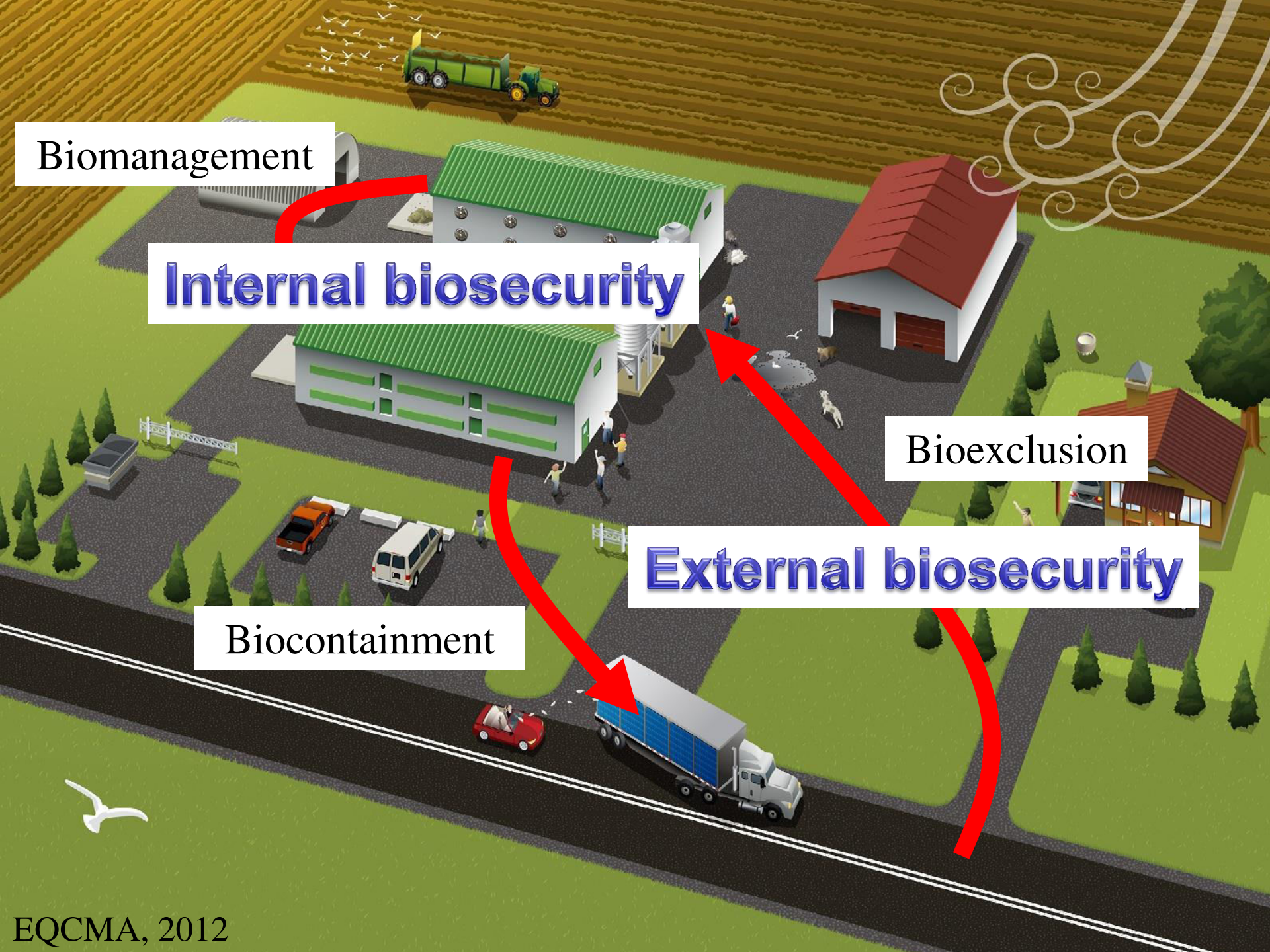




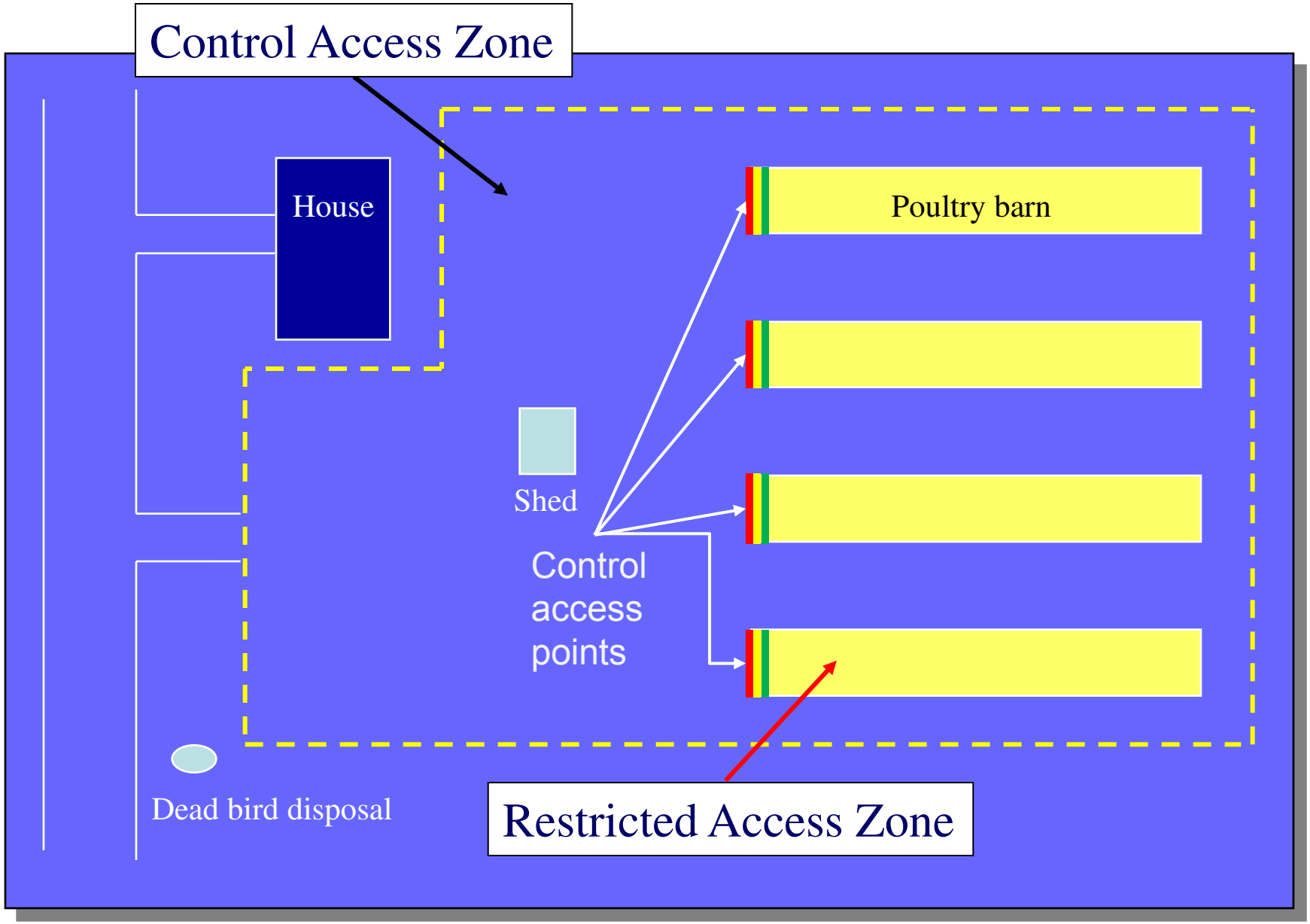
Organize



Communicate


Biomanagement
Internal biosecurity
Bioexclusion
External biosecurity
Biocontainment

EQCMA, 2012


Control Access Zone
House
Poultry barn
Shed
Control
access
points
Dead bird disposal
Restricted Access Zone


RAZ
CAZ

Outside door

Contaminated zone

- ✓ Remove coat
- ✓ Sign logbook
- ✓ Wash hands

<u>Plan to have</u>:

- Lockers or hooks
- Pen; paper
- Soap; alcohol gel
- Towels
- Garbage container & bags

BENCH

Changing footwear

Hand washing

Clean zone

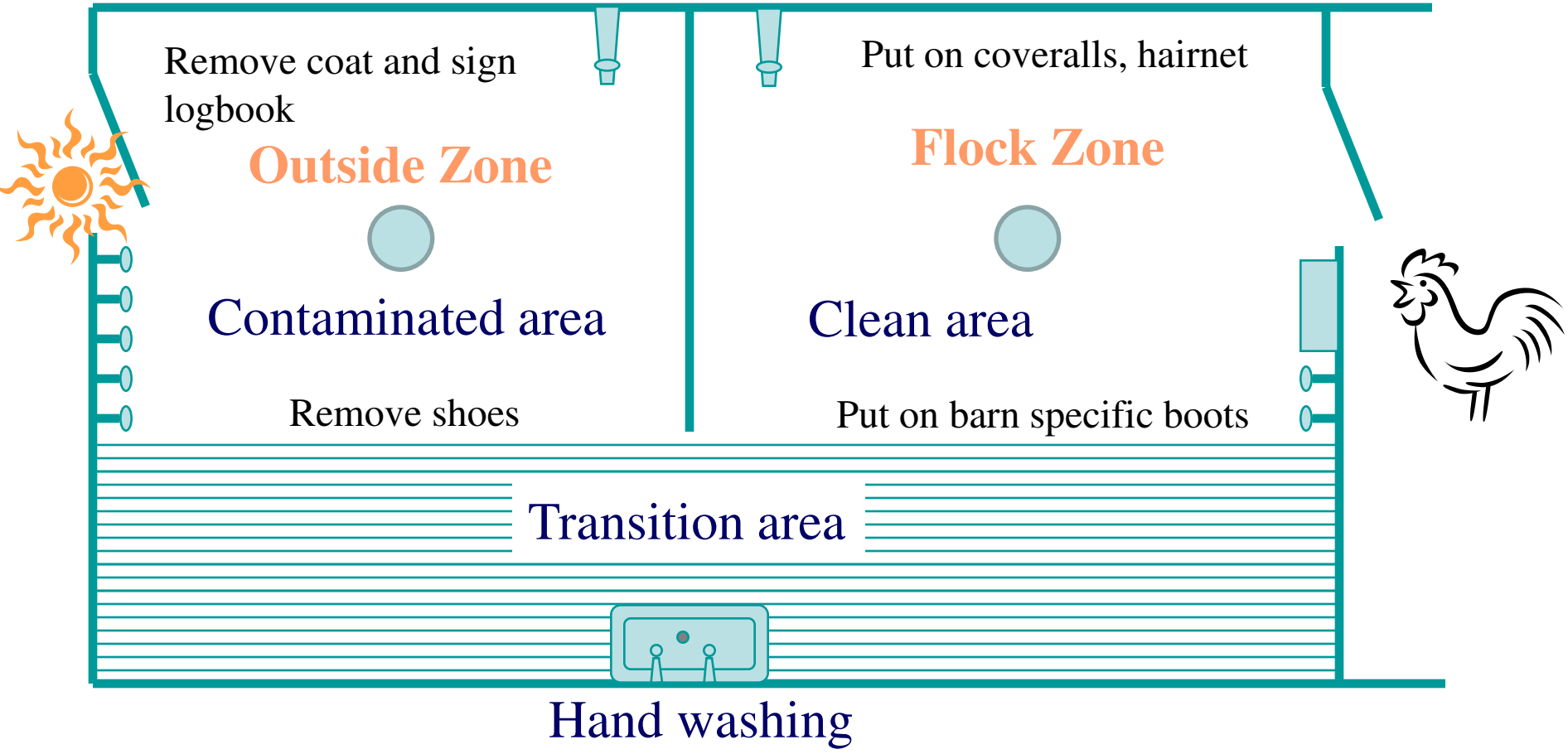
- ✓ Put on dedicated barn boots or disposable plastic boots

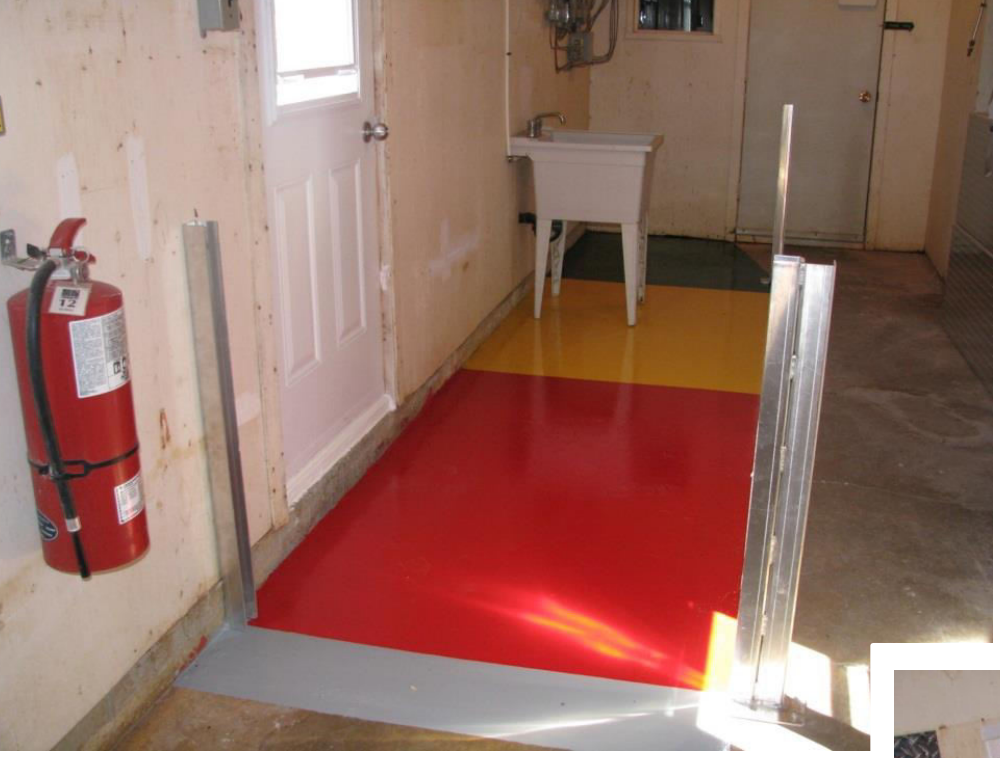
<u>Apply</u> any other biosecurity measures:

- Coveralls
- Head net
- Gloves

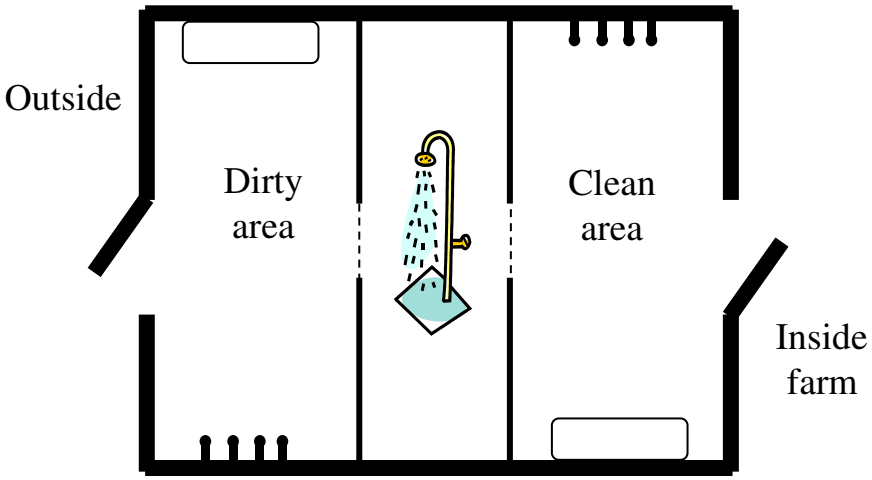
Birds

Danish entrance

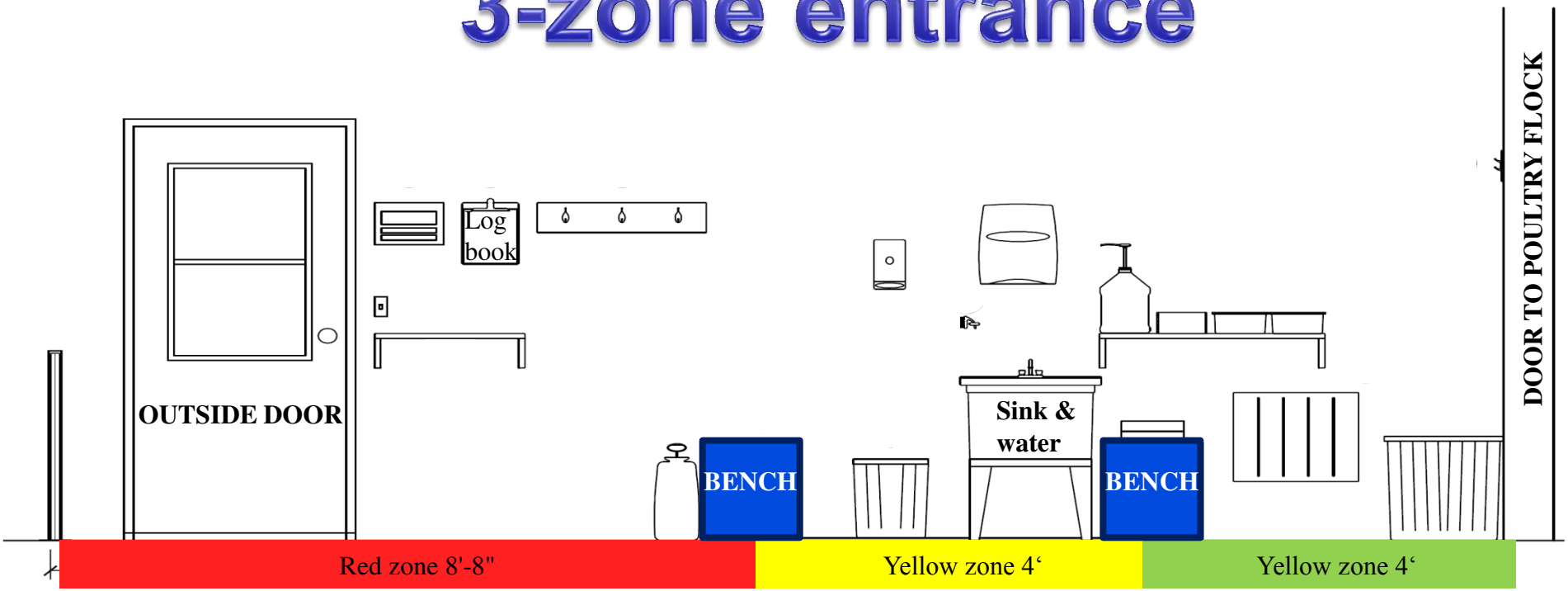




3-zone entrance



3-zone entrance



Footbaths research findings

Advantages

- May reduce the infection pressure
- Prevents or slows down the transmission of *Campylobacter*
- Efficacious against many pathogens if well done

Disadvantages

- All visible organic material must be removed from the boots prior to using the footbath
- If this is not done, the disinfecting solution must be changed after each use!
- Change only when visibly dirty... compliance!
- Source of contamination
- Development of resistance

Quinn, 1991; Humphrey, 1993; Evans et Sayers, 2000; Langsrud et al., 2003; Allen et al., 2005; Dee et al., 2005; Amass et al., 2000, 2001, 2002, 2003

Study on the usage of footbaths under field conditions

Farms

Total Bacterial Counts from Shoe Swabs

	Fresh Solution	After 3 hours of use
Active Ingredient	% Change in bacterial count	% Change in bacterial count
Phenol	-45.8	+130.5
Quaternary Ammonium	-57.5	+73.3
Water	+87.2	+44.8

Hatchery

Total bacterial count of the solution

	Fresh solution – Before and after ~25 exposures	3 hours old – Before and after ~25 exposures
Active ingredient	Change in Bacterial Count	Change in Bacterial Count
Phenol	36 → TNTC	TNTC → TNTC
Quaternary Ammonium	1 → 12	185 → TNTC
Water	19 → TNTC	TNTC → TNTC

Robert L. Owen and John Lawlor

Persistence of Highly Pathogenic and Low Pathogenic Avian Influenza Viruses in Footbaths and Poultry Manure

R. Hauck,[A] B. Crossley,[B] D. Rejmanek,[B] H. Zhou,[C] and R. A. Gallardo[AD]

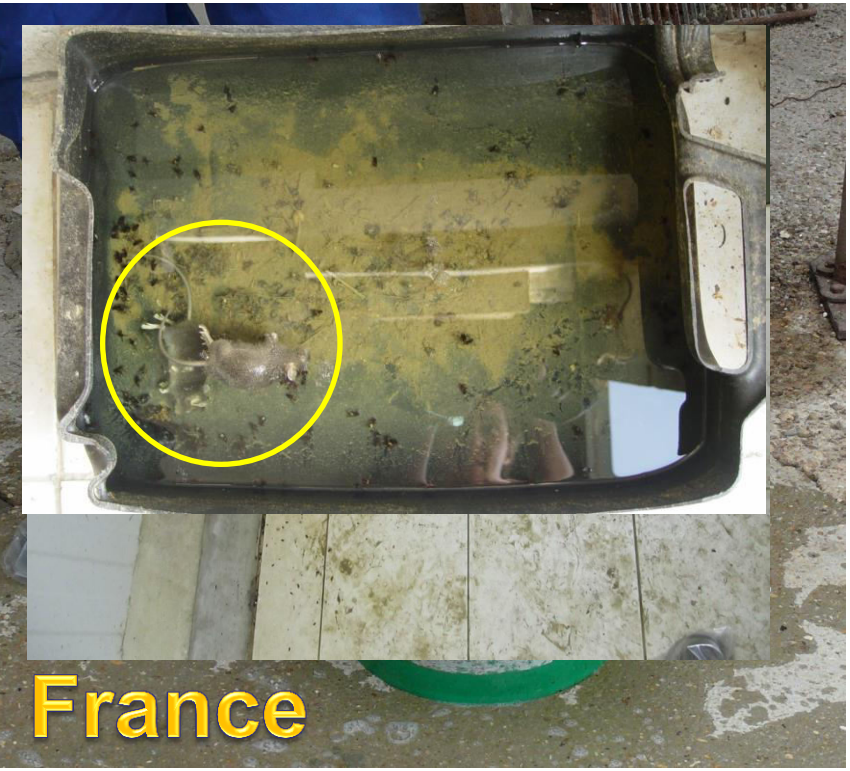
Fig. 1. (a) Manure accumulated in the boot crevices. (b) Sampl involved elimination of the excess of material in the surface a collection of the material inside the crevices.

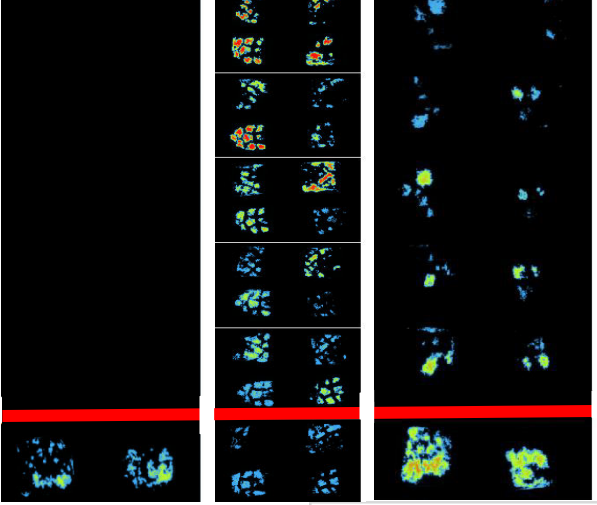
Table 1. Detection of HPAI and LPAI by RT-qPCR and virus isolation in spiked bedding material scraped from boots treated with quaternary ammonia + glutaraldehyde–, quaternary ammonia only–, or bleach powder–based footbaths.

	Hours after preparation of footbath							
	0		24		48		72	
	HPAI	LPAI	HPAI	LPAI	HPAI	LPAI	HPAI	LPAI
Control (feces no disinfectant)								
RT-qPCR	+[A]	+	+	+	+	+	+	+
Isolation	+	+	+	+	+	+	+	+
Quaternary ammonia + glutaraldehyde								
RT-qPCR	+	+	+	+	+	+	+	+
Isolation	+	+	+	+	+	+	+	+
Quaternary ammonia								
RT-qPCR	+	+	+	+	+	+	+	+
Isolation	+	+	+	+	+	+	+	+
Bleach powder								
RT-qPCR	–[B]	–	–	–	–	–	–	–
Isolation	–	–	–	–	–	–	–	–

[A]Virus detected.
[B]Virus not detected.

Footbaths



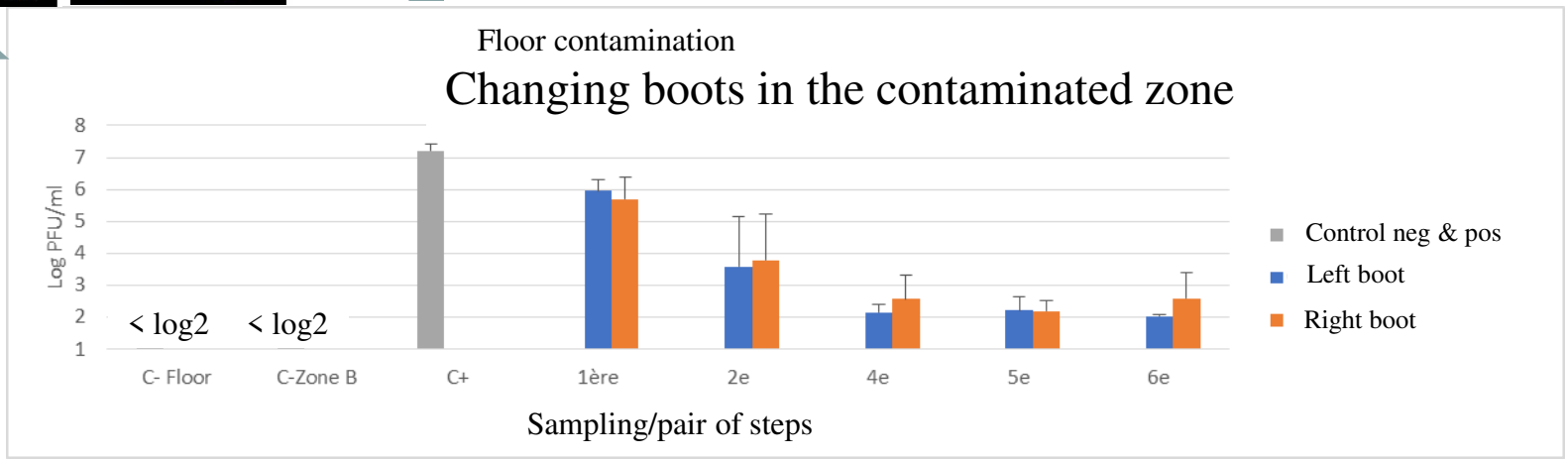


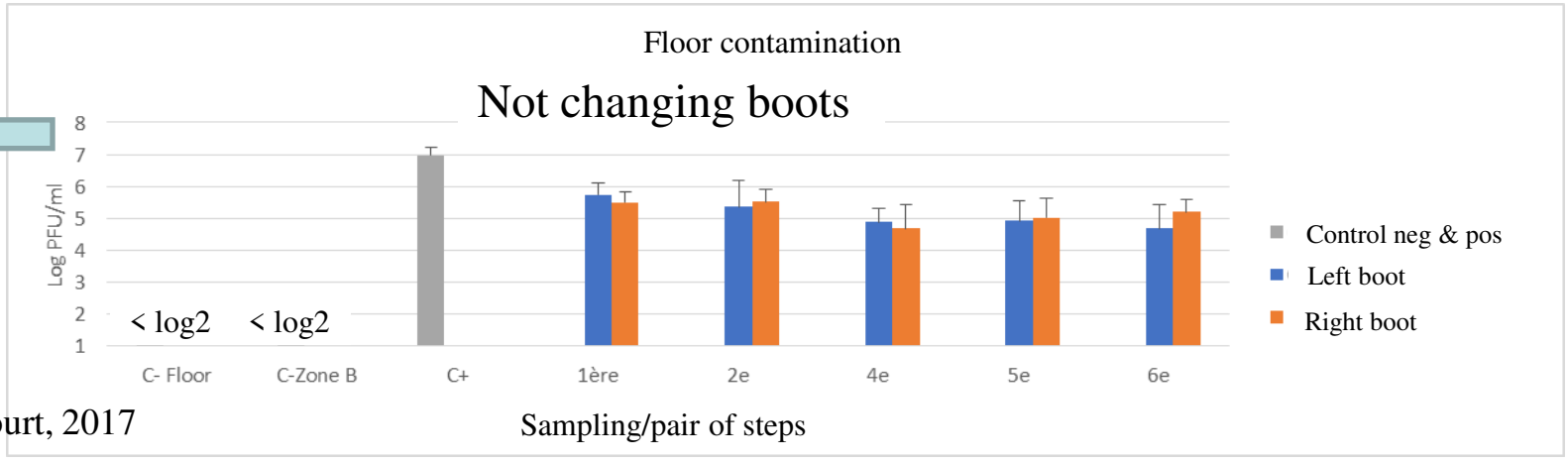
Changing boots

(phage contamination)

Control

Changing boots while passing from one zone to the other one



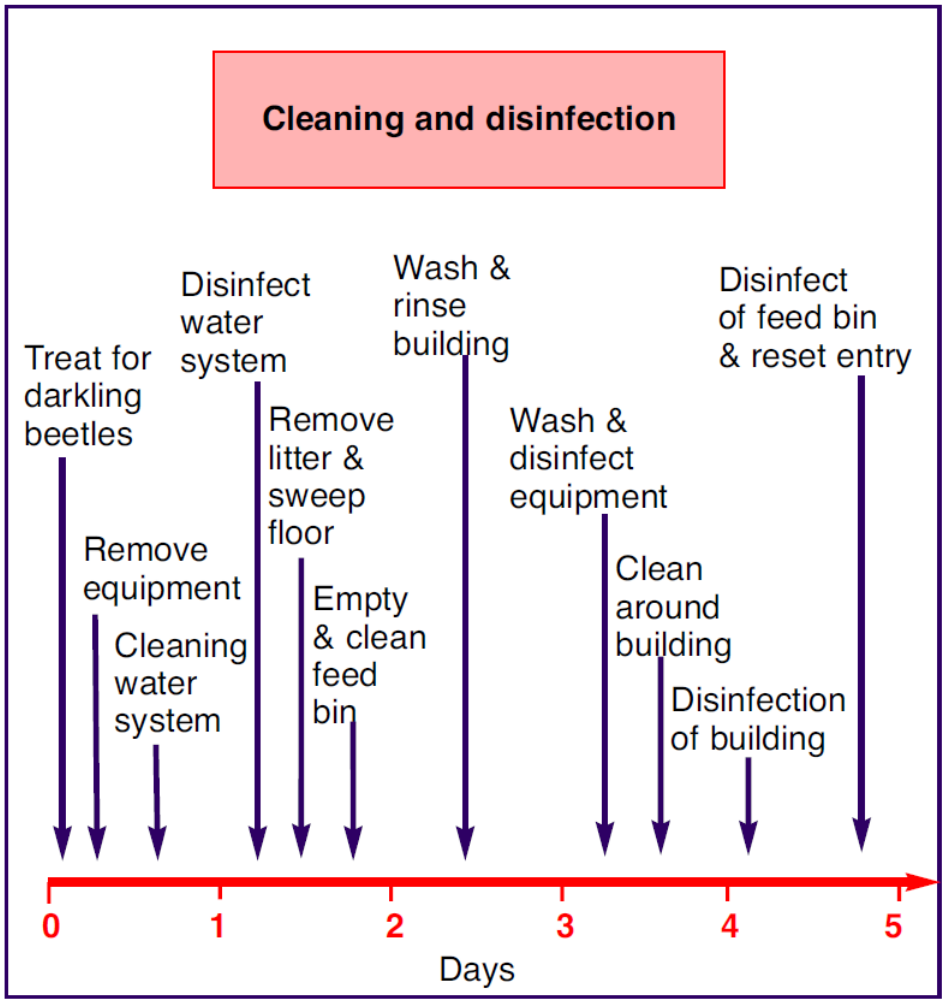


Huard et Vaillancourt, 2017

Properly cleaning poultry buildings

- Cleaning, disinfection/fumigation
  - Between each flock, if health issue observed
  - Essential after a flock is confirmed S. Enteritidis positive
  - Monitoraging after procedures
- Dry litter;
  - Control humidity!
  - Consider composting
- Treating litter with acid products
  - Variable results, but won't hurt

J. Smith, 2017



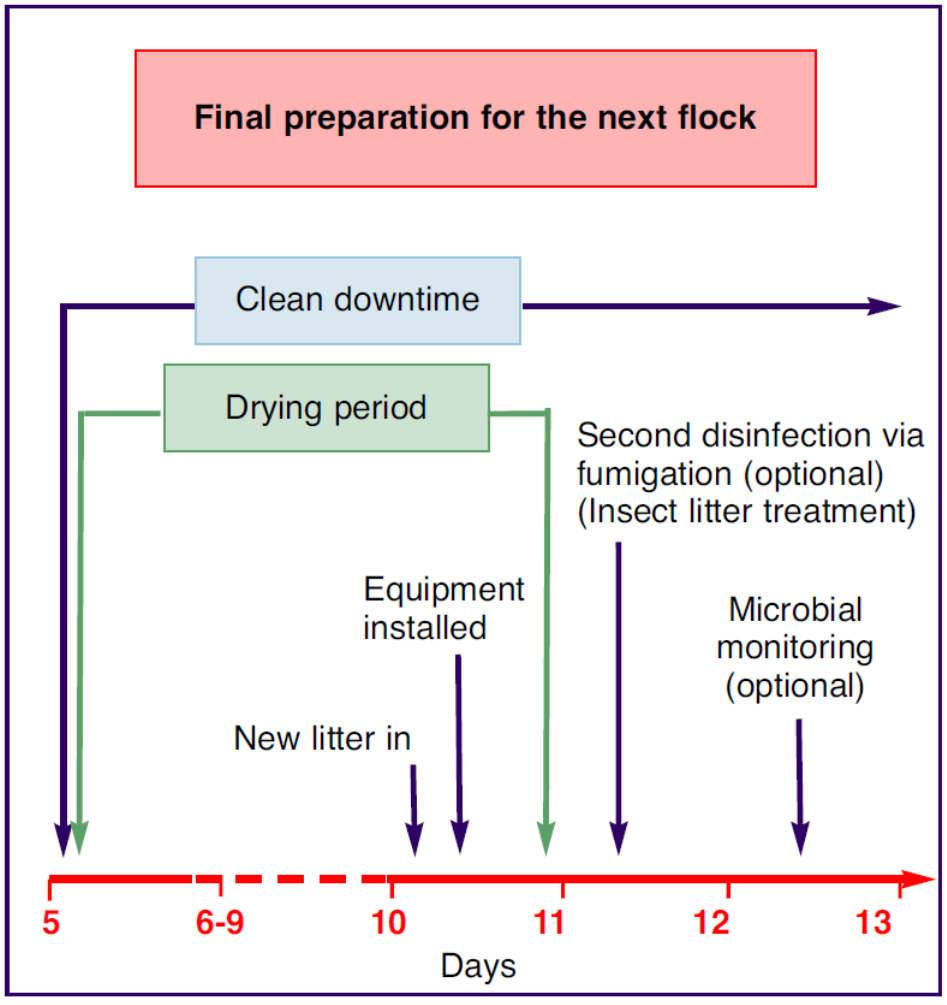


Fig.80.41 & 80.42: Schematic presentation of the different steps of biosecurity measures before the arrival of a new flock. Cleaning and disinfection (Fig.80.41) and final preparation for the next flock (Fig.80.42).

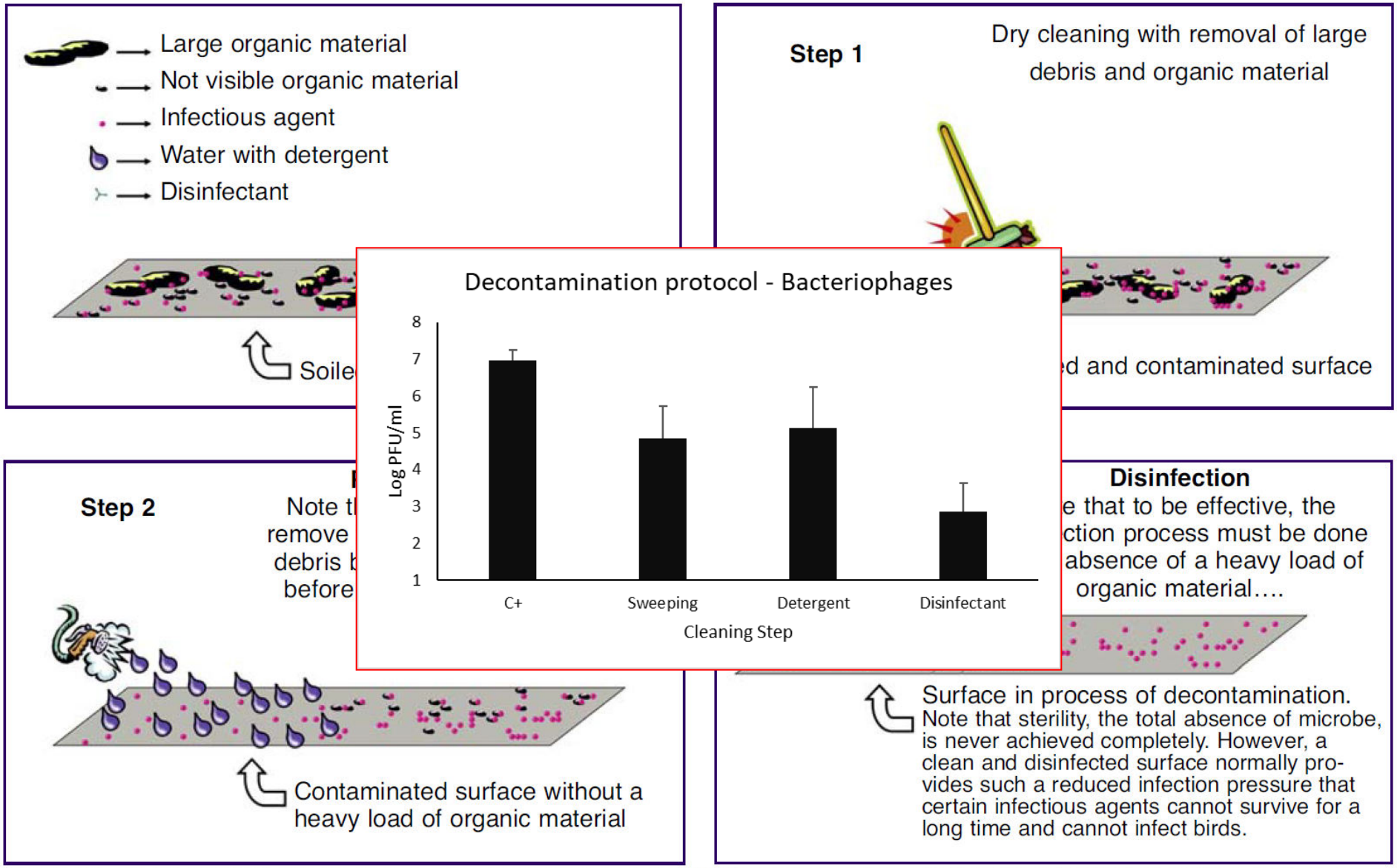


Fig.80.37, 80.38, 80.39 & 80.40: Schematic of washing and disinfection process for soiled and contaminated surface in 3 steps. (*Adapted from* "Manual de bioseguridad en Granjas Porcinas", Pecuarias, 2001).

Get organic material out

Brush

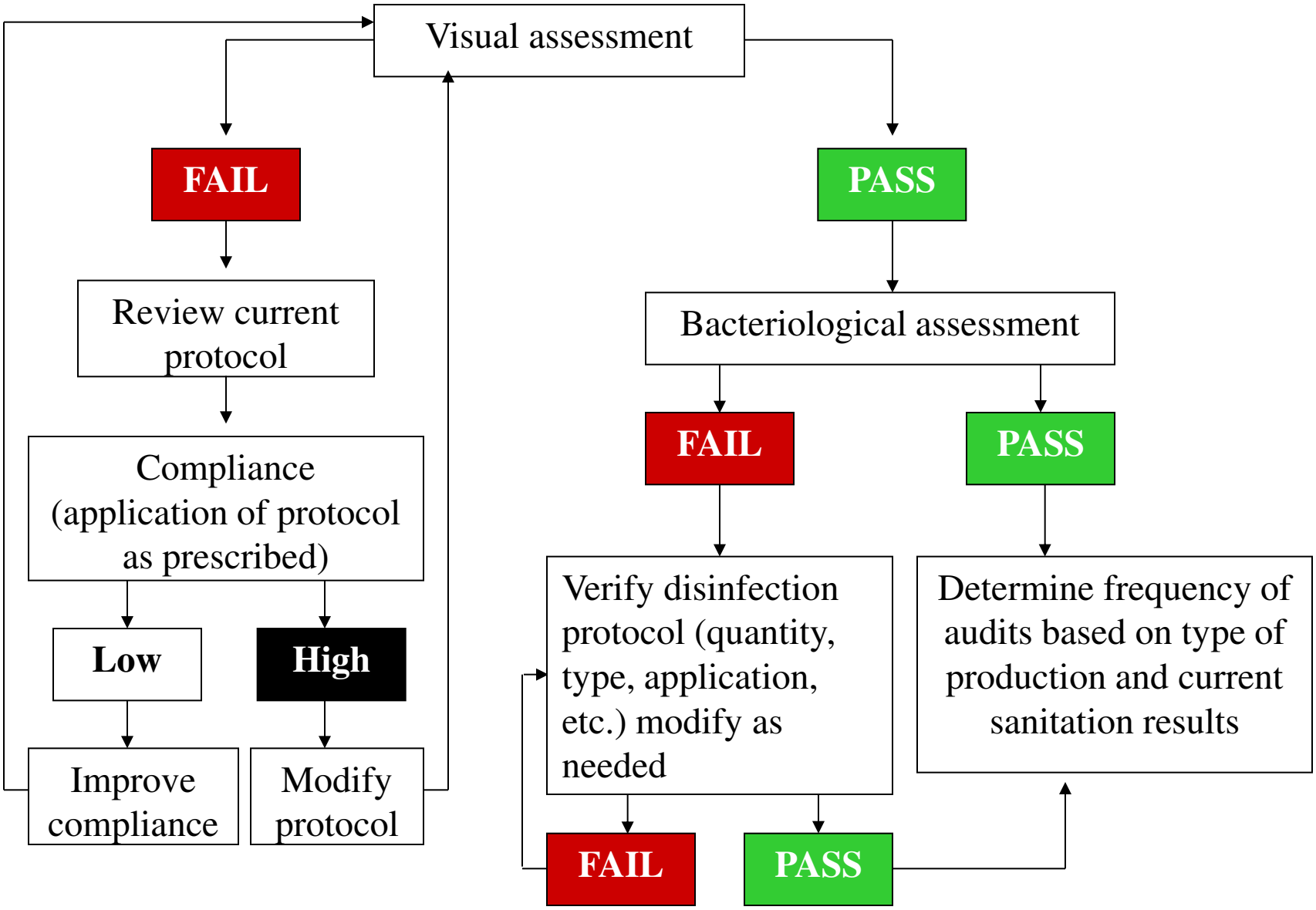
Remove dust

← Apply detergent

Scouring →

Fumigation →

Monitoring of sanitation



If testing for Salmonella: Difference in probability of detection depending on sampling procedure

Environmental sampling method	Probability of detection
One pair boots and One pooled dust sample 	0.727
Dust 	0.671
5 pairs of boots 	0.668
1 pair of boots 	0.590
Litter	0.527
Commercial polywipe drag sponge  	0.439

Carrique-Mas JJ and R.H. Davies 2008

Compliance: Biosecurity's limiting factor

The extent to which a person's behavior coincides with medical or health advice

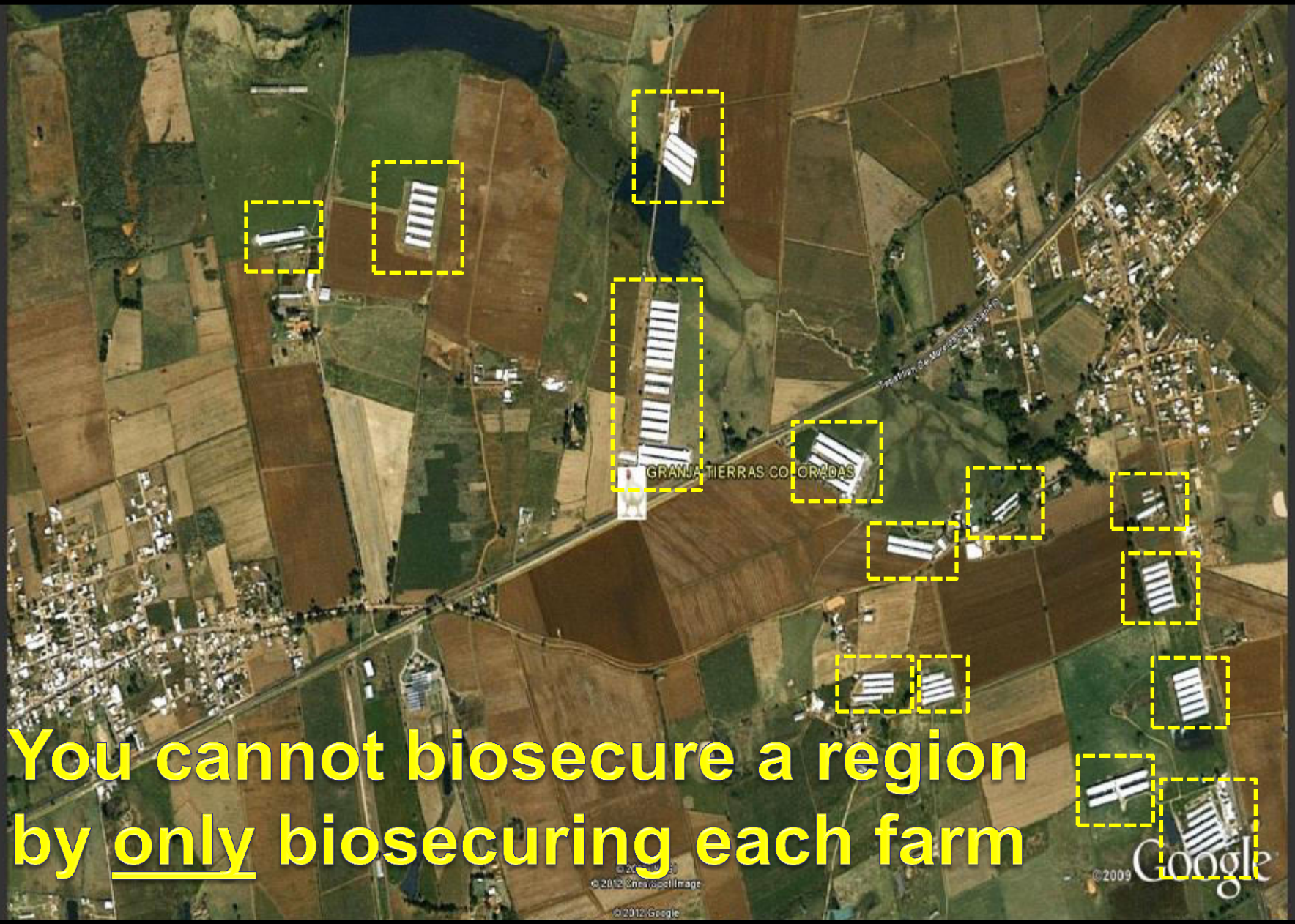
Top 5 errors

Error	% of visits
Not washing hands at entry	79.3
Zones ignored	67.4
Not wearing farm boots	56.3
Not wearing coveralls	43.3
Doors kept opened	14.4

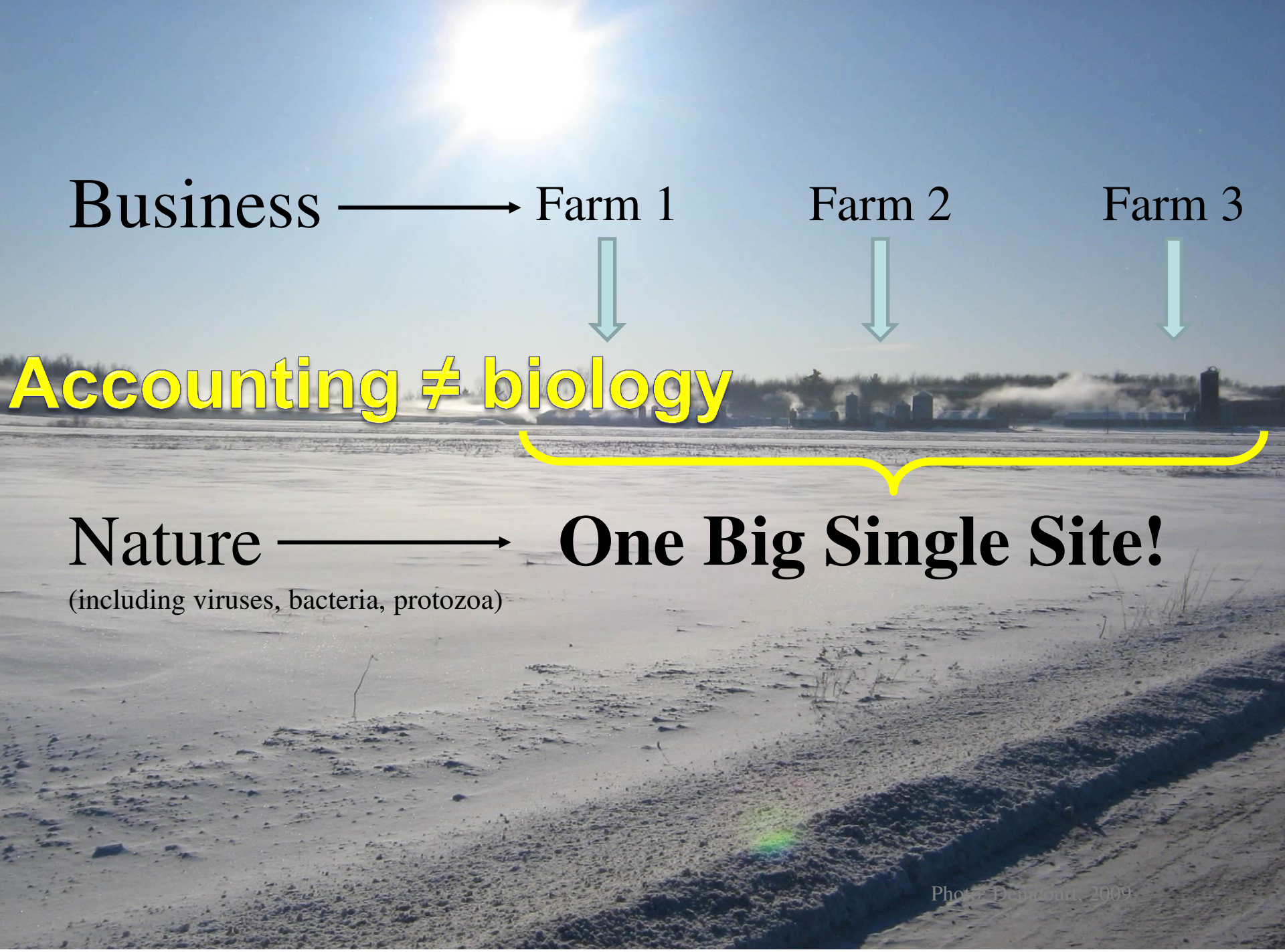
- ✓ Difficulty to apply suggested measures
- ✓ Absence of biosecurity program audits
- ✓ Lack of coherence of available information (Jardine & Hurdey, 1997; Moore & al., 2008)
- ✓ Beliefs, attitudes, perceptions, education, experience, personality traits (Delabbio & al. 2003 et 2005)

Increasing compliance

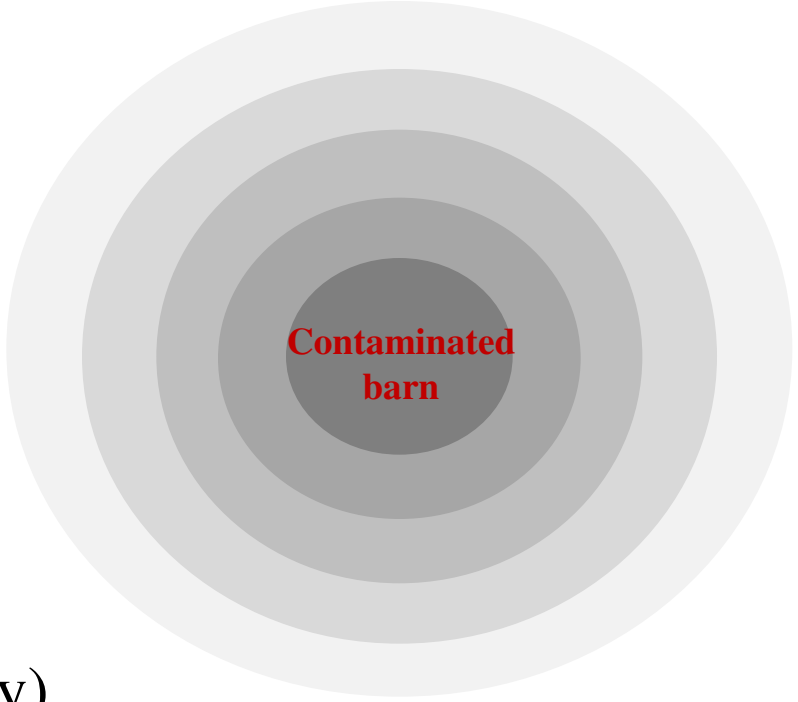
- Buy in
- Communication
- Education/Training
- Incentives
- Realistic game plan
- Verification (markers)
- Regional perspective



You cannot biosecure a region by only biosecuring each farm


Business
Farm 1
Farm 2
Farm 3
Accounting ≠ biology
Nature
(including viruses, bacteria, protozoa)
One Big Single Site!
Photo: Denwood, 2009

Pathogen travel

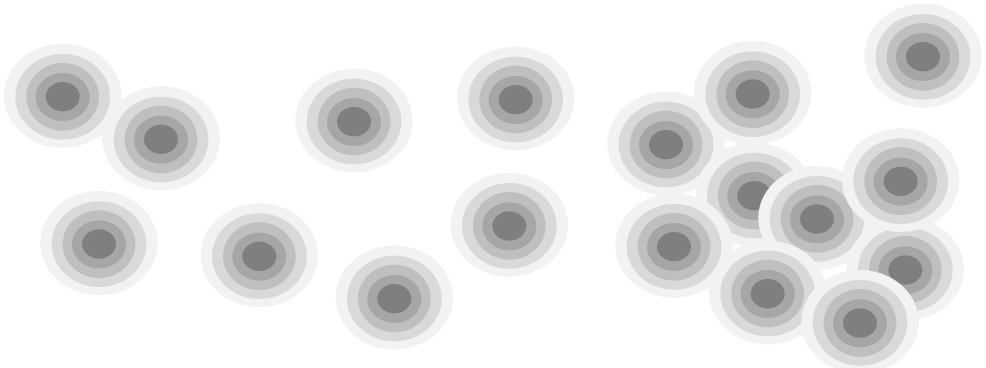


Distance Determinant Factors

1. Topography
2. Temperature, humidity, wind
3. Vegetation
4. Rodent and insect populations
5. Farm traffic (poultry, non-poultry)
6. Concentration of pathogen (quantity organic mat./pathogen; particle size)

Effective Infection Transmission (adequate infection pressure)

1. Distance between 2 sites
2. Regional farm density
3. ???



Meg Scott Phipps
Commissioner

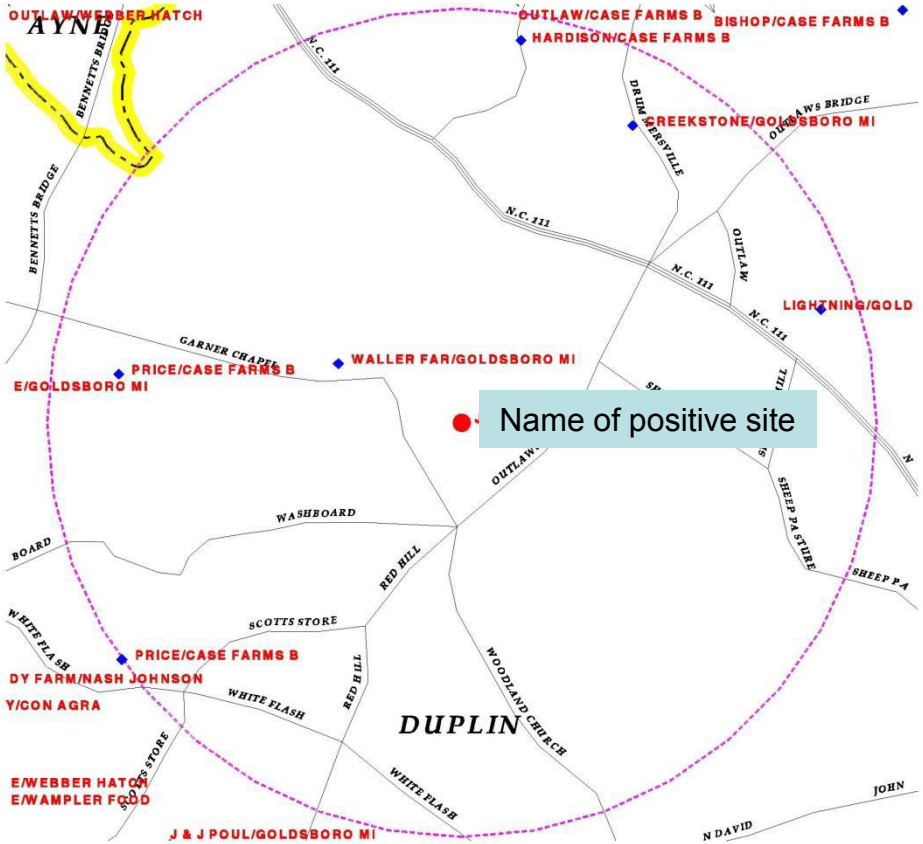
North Carolina
Department of Agriculture
Veterinary Division
March 15, 2001

Dr. David T. Marshall
State Veterinarian

TO: North Carolina Turkey Producers
FROM: Jo Anna Quinn
Director of Diagnostic Laboratories
RE: MG CIRCULATION

This is to inform you that this office has reviewed a recent test chart and results are consistent with the presence of MG on the CARROLL'S FOODS, 'JONES farm in' DUPLIN county (16-122-14-06-0).
The map below shows producers located within 2 miles of newly infected flocks.

CARROLL'S FOODS / JONES / 16-122-14-06-0



OWNER LAST NAME	GROWER LAST NAME	BIRD TYPE	QBSP	MILES	AGE	DATE QT	PROCESSING DATE	RELEASE DATE
C		TURK	16-122-14-06-0	0.0		03/09/2001		
GOLDSBORO	WALLER FAR		16-122-13-03-0	0.7				
CASE FARMS	PRICE		16-122-12-02-0	1.7				
GOLDSBORO	CREEKSTONE		16-122-09-05-0	1.7				
GOLDSBORO	LIGHTNING		16-122-10-25-0	1.8				
CASE FARMS	HARDISON		16-122-04-17-0	1.9				

ZOOM IN AREA OF COLOR INFRARED ORTHOPHOTO

Jean-Pierre Vaillancourt

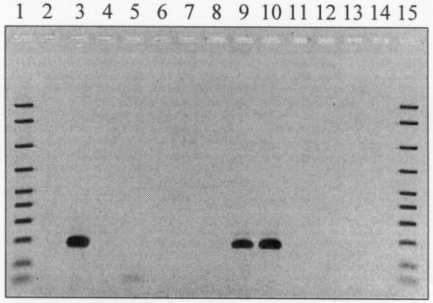
From: Jean-Pierre Vaillancourt [JP_Vaillancourt@ncsu.edu]
Sent: Tuesday, August 29, 2000 11:41 AM
To: Jean-Pierre Vaillancourt; david_ley@ncsu.edu; David.Anderson@Perdue.com; Roger.Phillips@Perdue.com; Charles.Pridgen@Perdue.com; Bryan.Hensley@Perdue.com; Bruce.Stewart-Brown@Perdue.com; Donna_carver@ncsu.edu; Turkeydoc@aol.com; Van_dao@ncsu.edu; egonder@gmcom.net; jenningss@carrollsfoods.com; Krushinb@wirfoods.com; Algis_martinez@ncsu.edu; jparsons@duplin.ces.state.nc.us; JoAnna.Quinn@ncmail.net; Drives@intrstar.net; Alan.Sharpton@Perdue.com; btilley@gmcom.net; kscott@gmcom.net; casefarms@earthlink.net; garciam@wirfoods.com; davef@mozart.cuddy.com; elite@dasia.net; Dennis
sam.christenberry@Perdue.com; bennyl@mozart.c
jhelm@CLEMSON.EDU; Barnes, H. John; david.wr
Andrew.R.Rhorer@usda.gov; CIRS1604@aol.com; monroevet@vnet.net
Subject: FW: MG / PCR Results attached

082200C.doc 082200B.doc 082200A.doc 082100B.doc

>From Dr Ley's desk. Please find PCR results presented in
if you have problems opening these files. Thank you. Jean-

Jean-Pierre Vaillancourt DVM, MSc, PhD
Poultry Health Management
Department of Farm Animal Health & Resource Management
College of Veterinary Medicine
North Carolina State University
4700 Hillsborough St.
Raleigh, NC, USA 27606
Phone: 919-513-6330; FAX: 919-513-6383
Beeper: 507-2531
e-mail: jp_vaillancourt@ncsu.edu

MG PCR of ADRL Case 2000.103



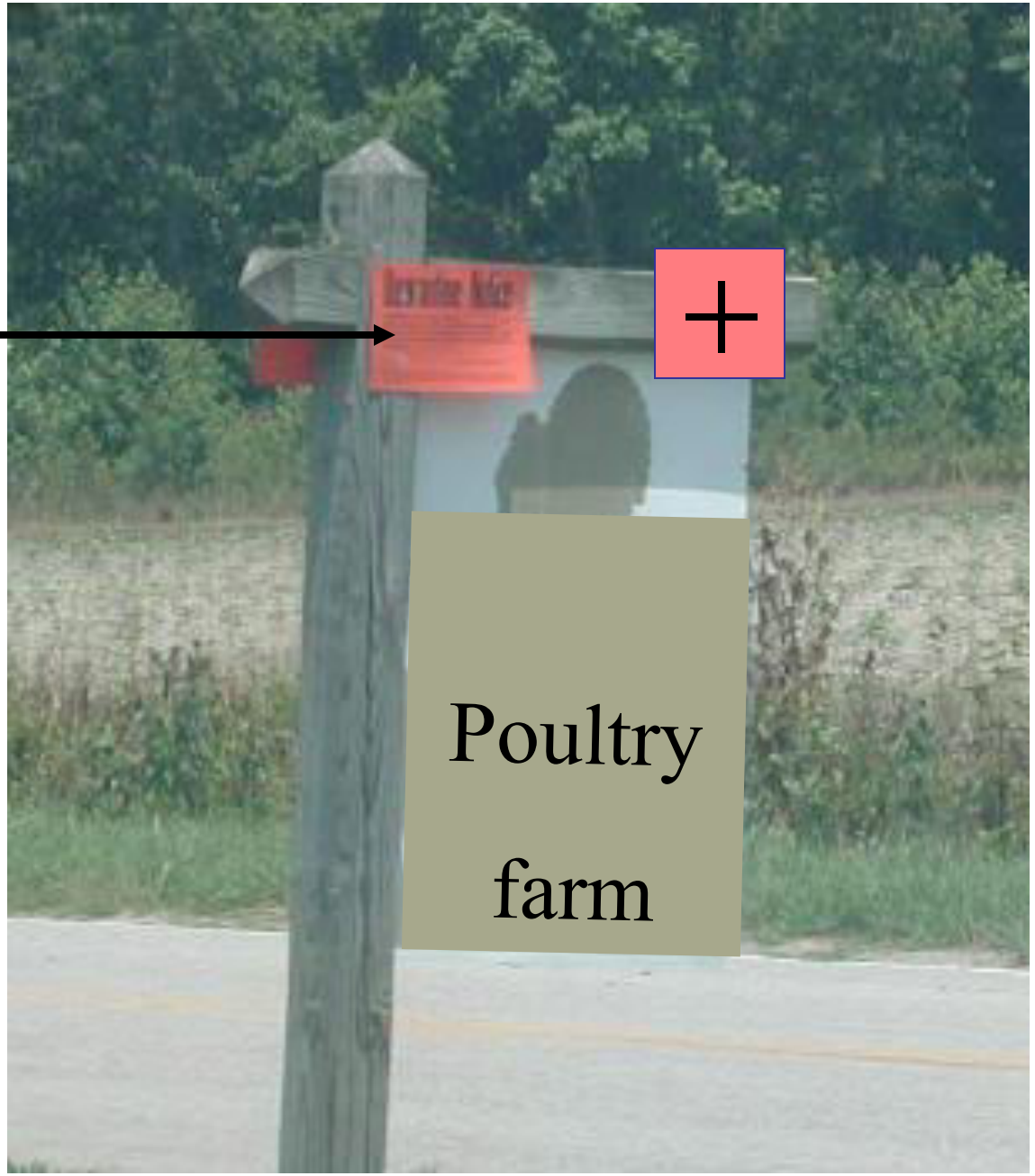
Lane 1: DNA bp ladder
Lane 2: **Negative Control**
Lane 3: Y419 (MG R-strain) **Positive Control**
Lane 4: Y596 (ADRL 2000.103 pool 1/Dail)
Lane 5: Y597 (ADRL 2000.103 pool 2/Dail)
Lane 6: Y598 (ADRL 2000.103 pool 3/Lanier)
Lane 7: Y599 (ADRL 2000.103 pool 4/Lanier)
Lane 8: Y600 (ADRL 2000.103 pool 5/Lanier)
Lane 11: Y603 (ADRL 2000.103 pool 8/Brinson)
Lane 12: Y604 (ADRL 2000.103 pool 9/Brinson)
Lane 13: Y605 (ADRL 2000.103 pool 10/Horne)
Lane 14: Y606 (ADRL 2000.103 pool 11/Horne)
Lane 15: DNA bp ladder

Gel ID: 081700B-2
Primers Lauerman MG-13, MG-14

MG-specific PCR results appear reactive (positive) for test samples in lanes 9 and 10.
David H. Ley 08/29/00

			LAB RESULTS FROM NCDA	(8/17/00 TO 8/21/00) SORT BY TWO MILE RADIUS			
OperationType	PremisesLast	PremisesFirst	OwnerLast	QBSP	County	Quarantined	Testing since April/00
COMM HENS	**BATCHELOR**	**MARK**	**NASH JOHNSON**	**24-017-22-08-0**	**ONSLOW**	11/08/1999	7/10
BREEDERS(M)	**BEDDINGFIELD**	**LARRY**	**CASE FARMS BREEDERS**	**16-121-25-12-0**	**DUPLIN**	10/22/1999	4/19, 5/19, 6/7, 7/6, 8/2
EXHIBITION	**TORRES**	**ANTONIO**		**16-121-25-04-0**	**DUPLIN**	03/24/2000	4/5, 5/4, 5/19
BROILERS	BEST FARM	SETH W BEST	CASE FARMS BROILERS	15-106-14-11-0	WAYNE		7/3
BROILERS	HOOD DAIRY FARM	MANFORD HOOD JR	CASE FARMS BROILERS	15-106-10-25-0	WAYNE		
BROILERS	ROSE FARM	BOB ALLAN ROSE	CASE FARMS BROILERS	15-106-14-20-0	WAYNE		8/2
COMM HENS	STEVENS	ED	DIAMOND POULTRY	15-107-07-11-0	WAYNE		5/23, 5/26, 7/12, 7/20
COMM HENS	THORNTON BROTHERS	THORTON	DIAMOND POULTRY	15-106-15-20-0	WAYNE		7/5
COMM HENS	WEAVER FARM	BRIAN	DIAMOND POULTRY	15-106-05-24-0	WAYNE		
	BOWDEN		NASH JOHNSON	15-117-21-21-0	SAMPSON		
COMM HENS	**BUTLER**	**KEITH**	**PRESTAGE FARMS**	**15-127-23-17-0**	**SAMPSON**	03/16/2000	
COMM HENS	DANIELS	JE	PRESTAGE FARMS	15-126-14-21-0	SAMPSON		5/18
	DOUBLE T FARMS		CASE FARMS	15-125-10-12-0	SAMPSON		
BREEDERS	**HONEYCUTT**	**JUDY 568-100**	**TYSON FOODS**	**15-126-22-15-0**	**SAMPSON**	6/22/00	6/8, 6/22
BREEDERS	HONEYCUTT	JUDY 547-104	TYSON FOODS	15-126-22-15-0	SAMPSON		7/5
BREEDERS	HONEYCUTT	JUDY 552-104	TYSON FOODS	15-126-22-15-0	SAMPSON		7/5
BREEDERS	HONEYCUTT	JUDY 547-105	TYSON FOODS	15-126-22-15-0	SAMPSON		7/5
BREEDERS	**HOWARD**	**LINOARD 544-105**	**TYSON FOODS**	**15-126-11-04-0**	**SAMPSON**	7/19/00	4/5, 5/19, 6/22, 6/28, 7/18, 7/20
BREEDERS	HOWARD	LINOARD 530-1-105	TYSON FOODS	15-126-11-04-0	SAMPSON		7/20
BREEDERS	HOWARD	LINOARD 530-2-105	TYSON FOODS	15-126-11-04-0	SAMPSON		7/20
BREEDERS	HOWARD	LINOARD-541-105	TYSON FOODS	15-126-11-04-0	SAMPSON		7/20
COMM HENS	HOWARD	TOM 1979/1980	PRESTAGE FARMS	15-126-16-23-0	SAMPSON		7/12
BROILERS	MEDLIN	LYNN	NASH JOHNSON C	15-127-19-14-0	SAMPSON		
COMM HENS	REYNOLD'S		PRESTAGE FARMS	15-138-02-16-0	SAMPSON		4/27, 5/9, 5/25
BREEDER HENS	REYNOLD'S FARM		PRESTAGE FARMS	15-139-03-16-0	SAMPSON		
BREEDERS (M)	TYNDALL FARMS 542-105	JONNY & LARRY	TYSON FOODS	15-126-21-04-0	SAMPSON		6/28
COMM HENS	WILLIAMS	E&C 3871	PRESTAGE FARMS	15-126-23-23-0	SAMPSON		5/18, 6/8
COMM HENS	**WILLIAMS**	**H 3902**	**PRESTAGE FARMS**	**15-126-23-25-0**	**SAMPSON**	08/23/2000	8/17
BREEDER HENS	**BRITT FARM**		**DIAMOND POULTRY TB**	**16-097-06-02-0**	**WAYNE**	03/21/2000	7/6
BREEDER HENS	**CARROLL WILLIAMS FM**	**HOUSE 1&2**	**DIAMOND POULTRY TB**	**16-097-07-15-0**	**WAYNE**	02/22/2000	4/12
BREEDER HENS	GRADY FARM DP		DIAMOND POULTRY TB	16-097-08-21-0	WAYNE		4/5, 5/1, 7/13, 7/18
BREEDER HENS	GRAY TOM FARM DP	HOUSE1	DIAMOND POULTRY TB	16-086-20-22-0	WAYNE		7/4
BREEDER HENS	POULT PARIDISE	HOUSE 1	DIAMOND POULTRY TB	16-086-20-24-0	WAYNE		5/30, 7/28
BREEDERS(M)	SMITH	JIMMY	CASE FARMS	16-097-06-16-0	WAYNE		6/7, 6/21
COMM HENS	**CARTER**	**JERRY**	**PRESTAGE FARMS**	**23-047-11-05-0**	**SAMPSON**	04/10/2000	
COMM HENS	**STRAUGHN**	**CLAYTON**	**CARROLL'S FOODS**	**15-142-11-13-0**	**SAMPSON**	02/22/2000	4/14, 4/28
BROILERS	BLAND	C. F.	PERDUE FARMS K	15-128-04-09-0	SAMPSON		
COMM HENS	BRADSHAW	S & J 1970/1971	PRESTAGE FARMS	15-128-10-04-0	SAMPSON		5/18, 6/5, 7/7
COMM HENS	BRADSHAW	KENNETH	NASH JOHNSON T	15-128-10-15-0	SAMPSON		4/12, 6/20
BROILERS	BRADSHAW	HAMPTON	CASE FARMS BROILERS	15-128-10-23-0	SAMPSON		4/10, 4/14,8/15
BREEDERS(M)	CREASH	JERRY	CON AGRA	15-128-08-15-0	SAMPSON		
BREEDERS(M)	**CREECH**	**JERRY**	**PERDUE ENC BREEDERS**	**15-128-09-21-0**	**SAMPSON**	04/28/2000	7/19
BROILERS	**DARDEN FARMS**	**ANDY DARDEN**	**CASE FARMS BROILERS**	**15-128-09-13-0**	**SAMPSON**	03/07/2000	8/15
COMM HENS	**DAVIS**	**JERRY 1981**	**PRESTAGE FARMS**	**15-128-02-12-0**	**SAMPSON**	04/10/2000	5/17, 6/6, 7/5
COMM HENS	DAVIS	JERRY 1982	PRESTAGE FARMS	15-128-02-12-0	SAMPSON		7/12
BROILERS	GODWIN FARM	THOMAS GODWIN	CASE FARMS BROILERS	15-128-03-21-0	SAMPSON		7/25
BROILERS	HONEYCUTT	L.F.	NASH JOHNSON C	15-128-09-23-0	SAMPSON		4/13

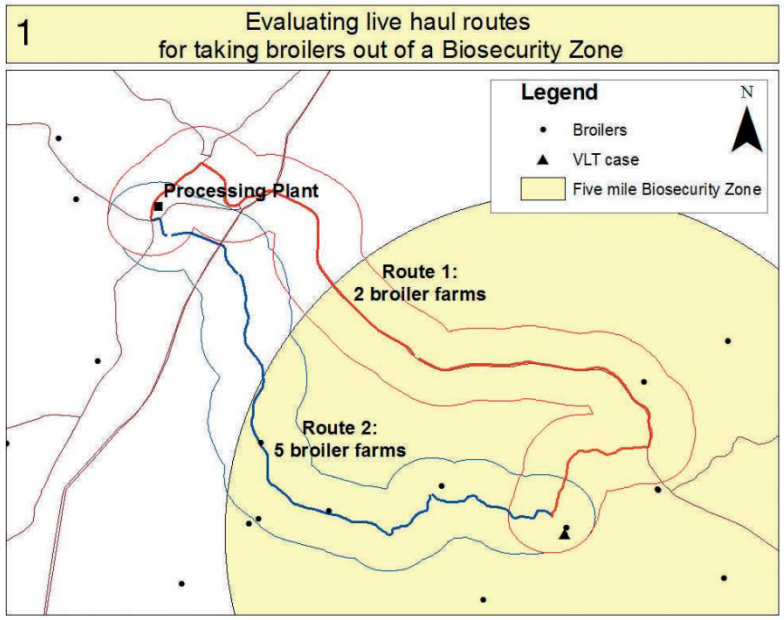
Quarantine notice

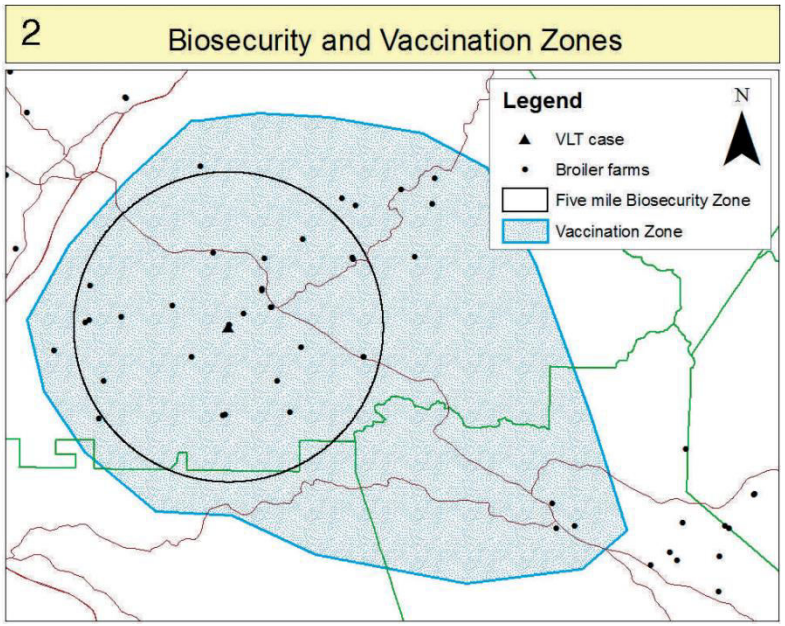


Control Measures
ILT Outbreaks in Georgia

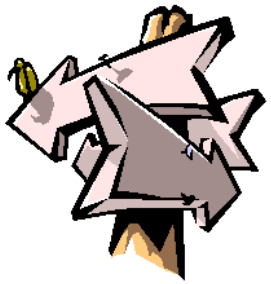
Use of geographic information systems (GIS) for:

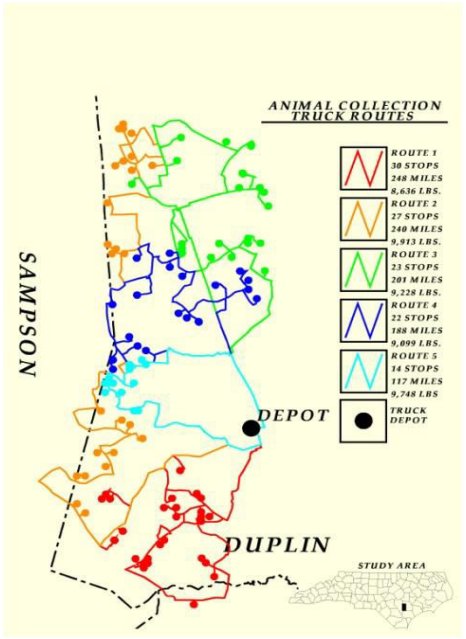
- disease surveillance
- outbreak control
  - routing of live haul trucks
  - creation of quarantine, vaccination, and surveillance zones
- emergency management

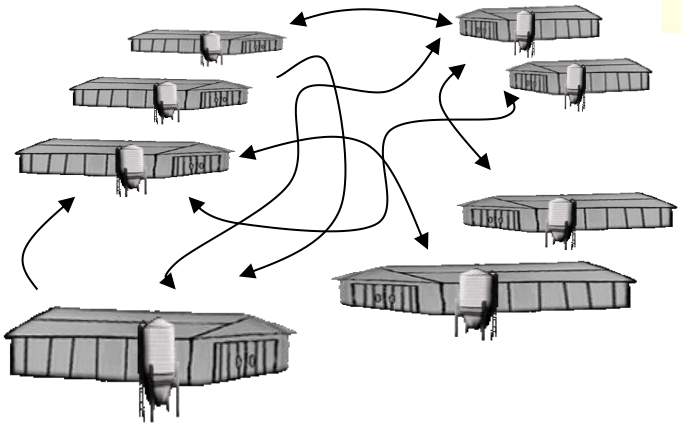


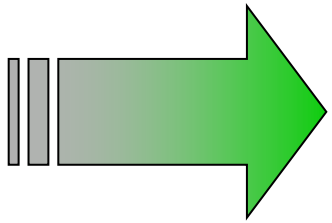


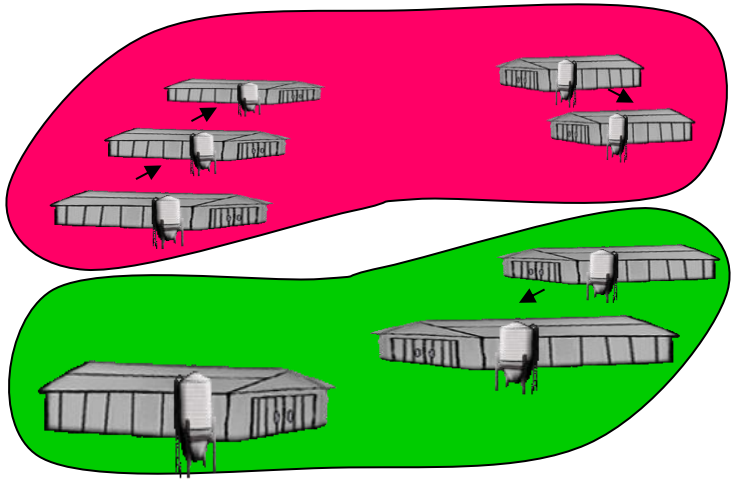
Dufour-Zavala, 2008





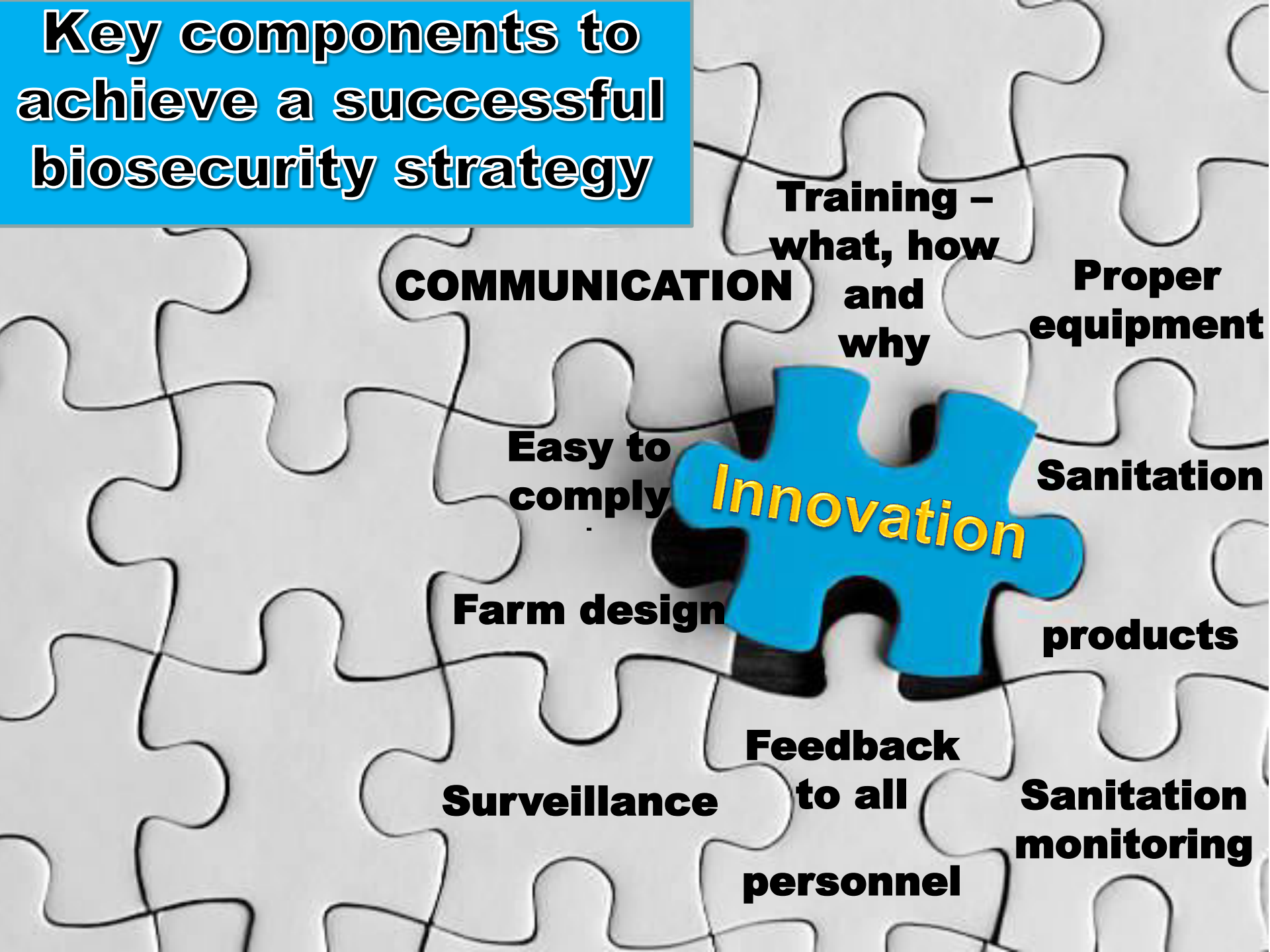




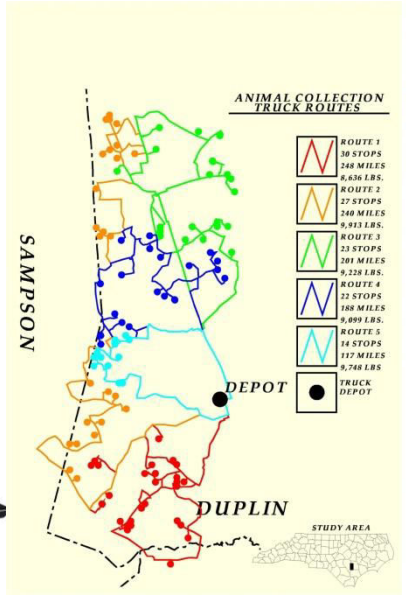


- ✓ Individual farm measures
- ✓ Variable traffic flow
- ✓ Minimal communication

- ✓ Integrated farm measures
- ✓ Managed traffic flow
- ✓ Established communication
- ✓ Compliance assessment


Key components to achieve a successful biosecurity strategy
Training – what, how and why
COMMUNICATION
Proper equipment
Easy to comply
Innovation
Sanitation
Farm design
products
Feedback to all
Surveillance
Sanitation monitoring
personnel

…and the present



Diagnostics, interventions, etc.

Review

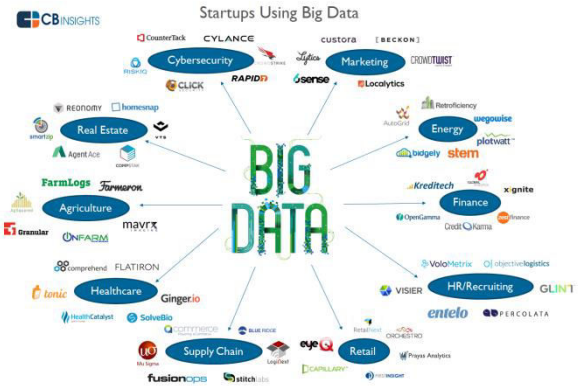
CellPress

Omics: Fulfilling the Promise

Supersize me: how whole-genome sequencing and big data are transforming epidemiology

Rowland R. Kao[1], Daniel T. Haydon[1], Samantha J. Lycett[1], and Pablo R. Murcia[2]

[1] Boyd Orr Centre for Population and Ecosystem Health, College of Medical Veterinary and Life Sciences, University of Glasgow, G61 1QH, UK
[2] Medical Research Council (MRC) Centre for Virus Research, College of Medical, Veterinary and Life Sciences, University of Glasgow, G61 1QH, UK



"A confluence of this technology with sophisticated mathematical and statistical approaches has the potential to produce a paradigm shift in our understanding of infectious disease transmission and control."

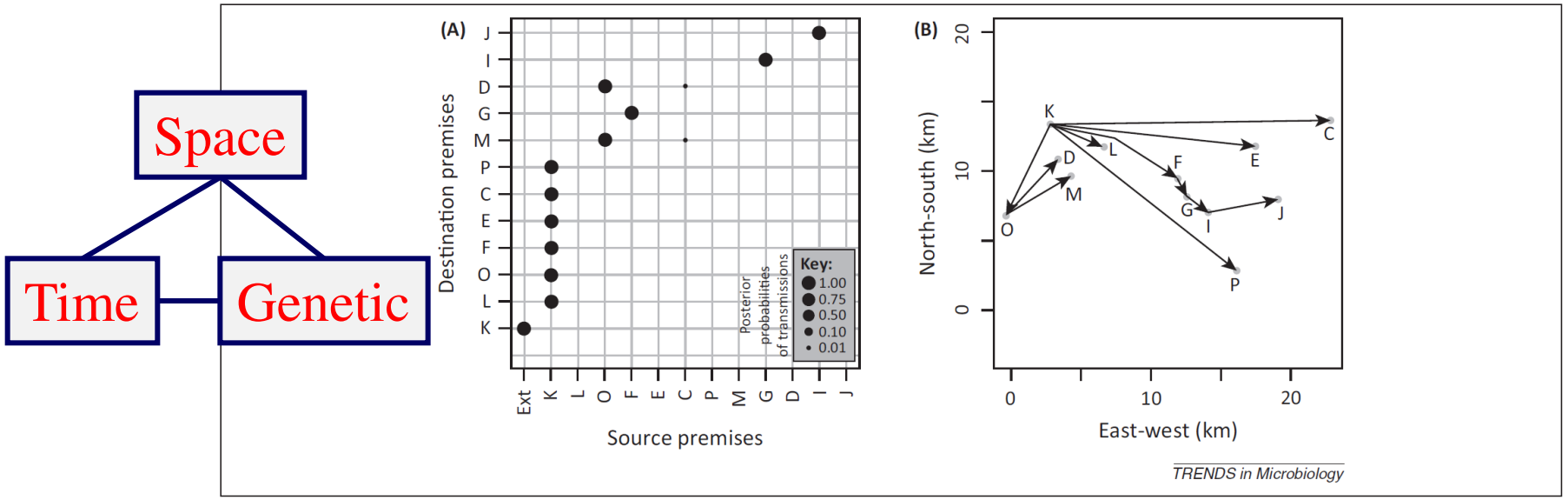


Figure 2. Phylodynamic reconstruction of a foot-and-mouth disease (FMD) epidemic. (A) Identified likelihood that a particular infected premises was the source of another infected premises based on a space–time–genetic model. Circle size is proportional to the relative likelihood of that event. (B) Spatial relationships among premises in the dataset. Reproduced from [11], with permission of the corresponding author.

Compartment

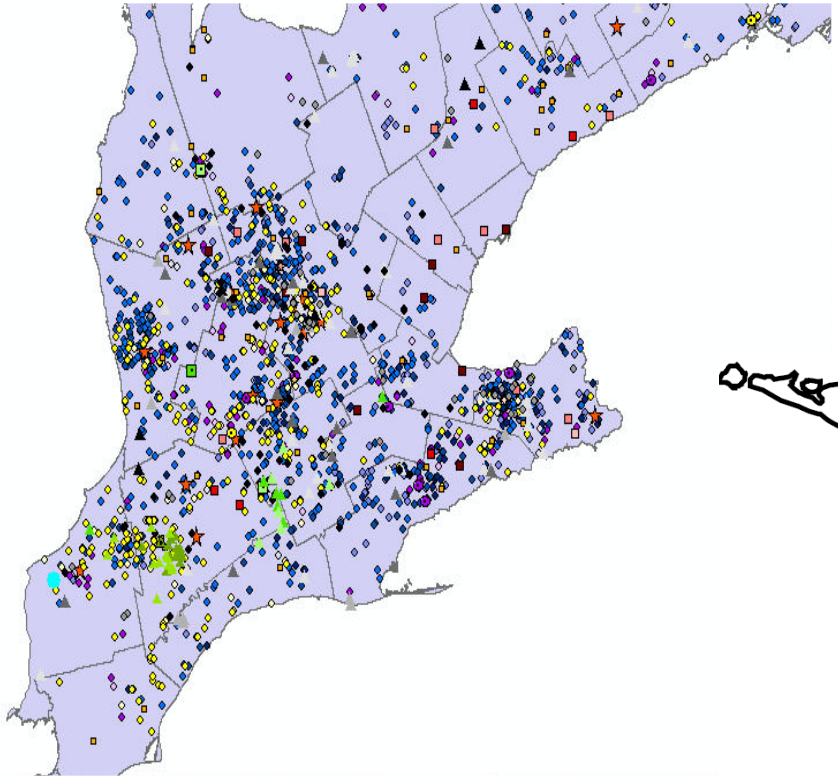
means ***one or more establishments*** under a common biosecurity management system containing an animal sub-population with a distinct health status with respect to a specific disease for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.

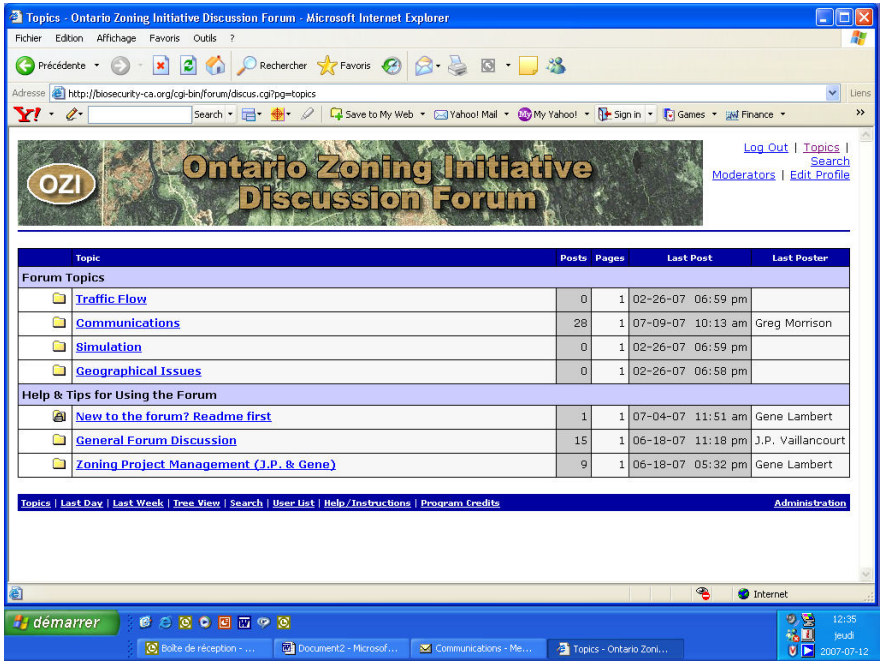
Zone/Region

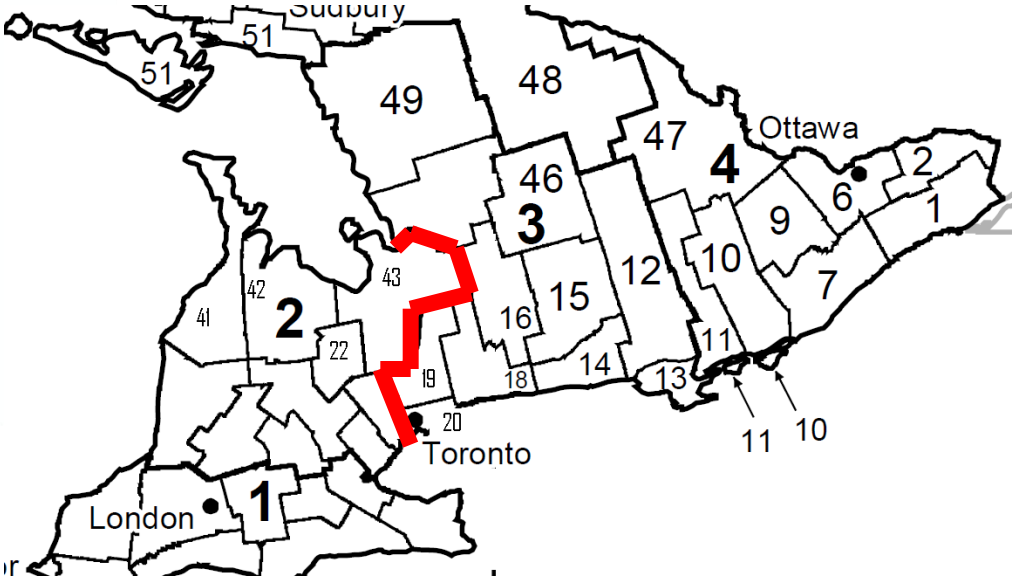
means ***a clearly defined part of a country*** containing an animal sub-population with a distinct health status with respect to a specific disease for which required surveillance, control and biosecurity measures have been applied for the purpose of international trade.

Zoning

Network analysis

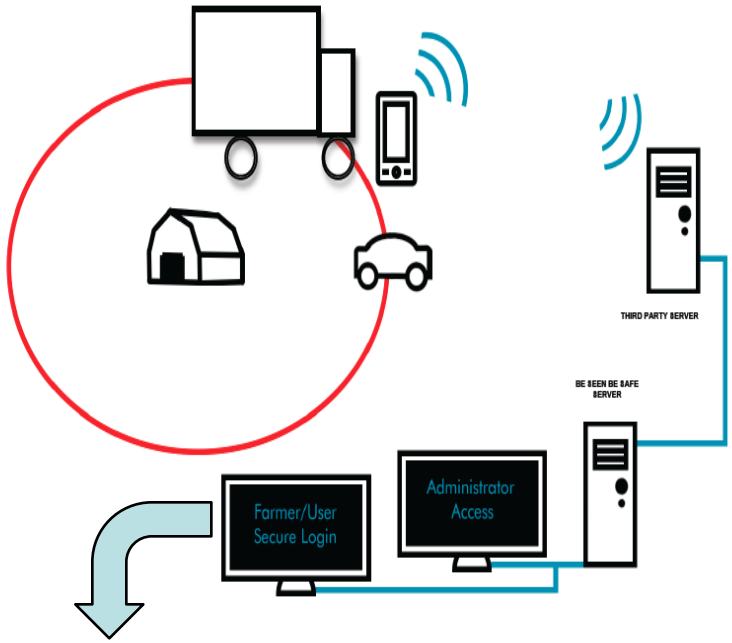


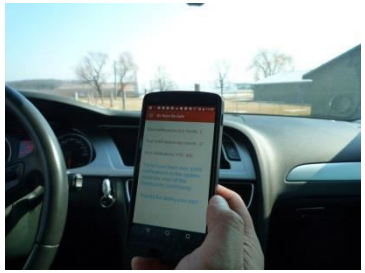




BE SEEN • BE SAFE

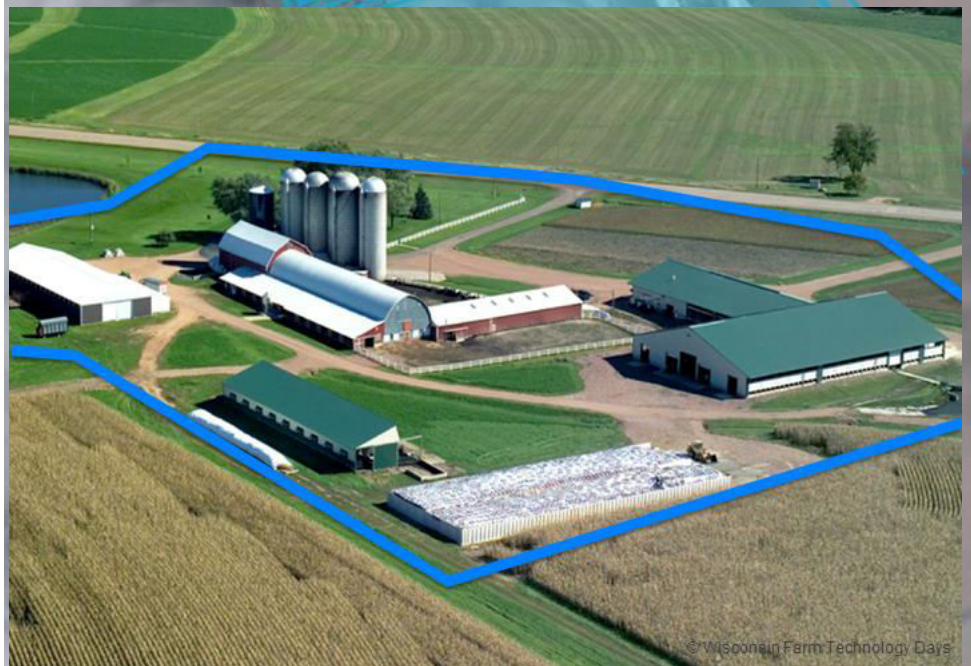
FARM HEALTH MONITOR





"To win wars, one must know where and how to concentrate efforts…quickly" Napoleon

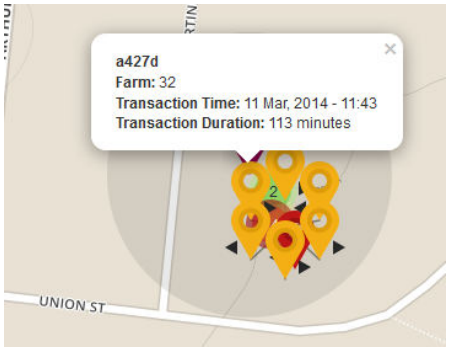
Geo-fencing



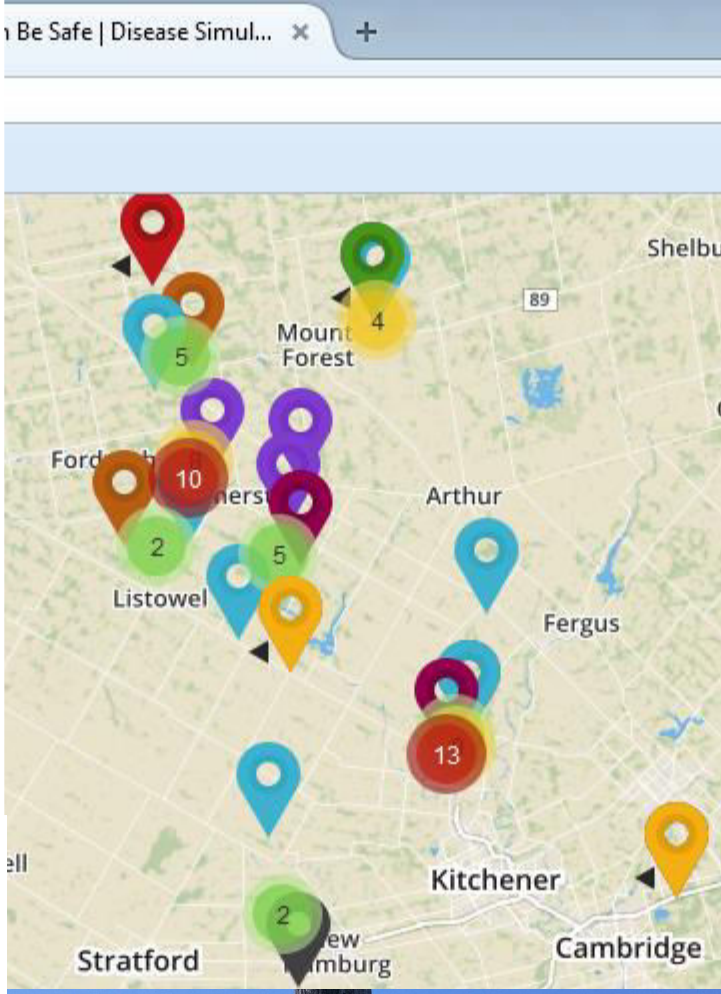
Property Profile – encrypted/password

- Property type (farm/abattoir/hatchery)
- Owner details – name, cell no., email.
- For farms: Livestock/poultry on farm
- Physical address

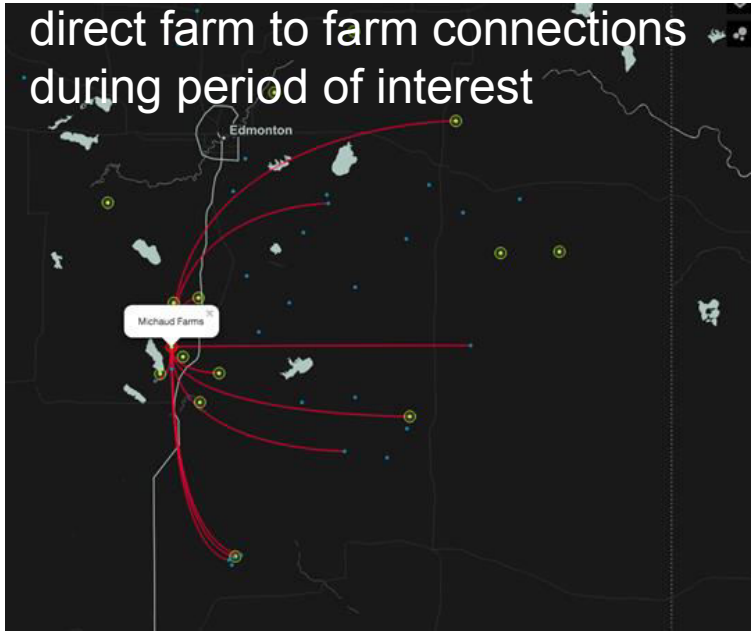
User Profile – encrypted/password



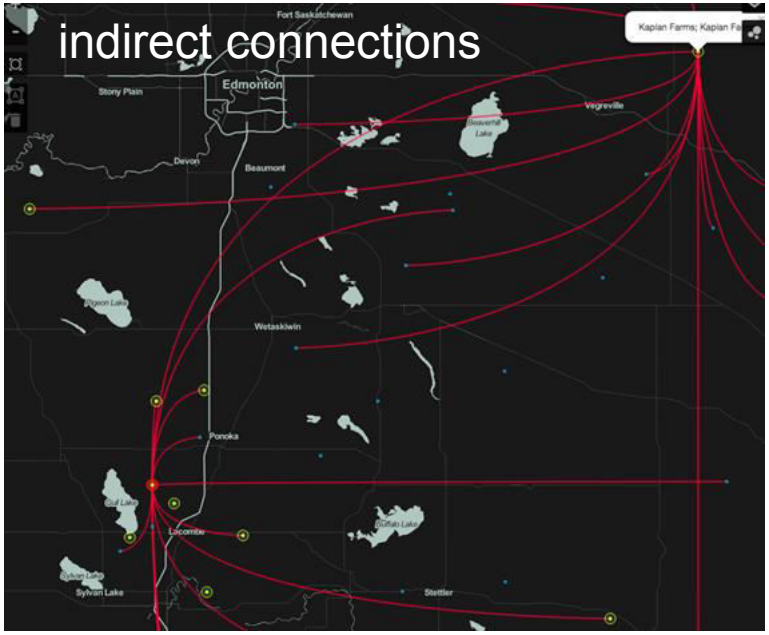
- Name
- Cell No.
- Email address
- What you do (dropdown box)
- What you come into contact with (risk assessment)



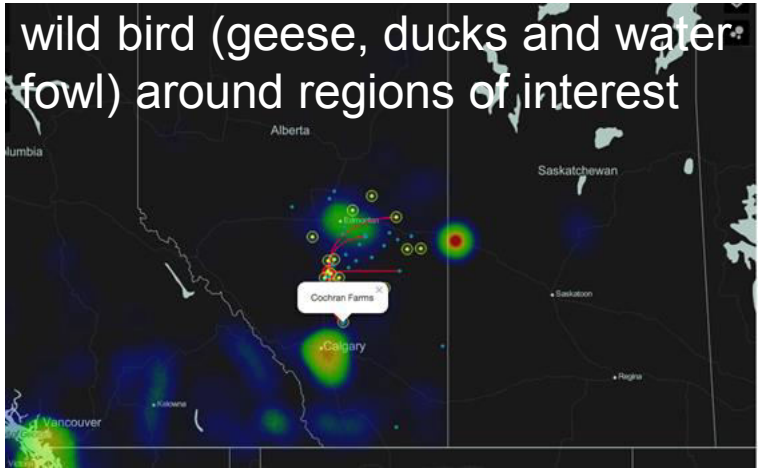
direct farm to farm connections during period of interest



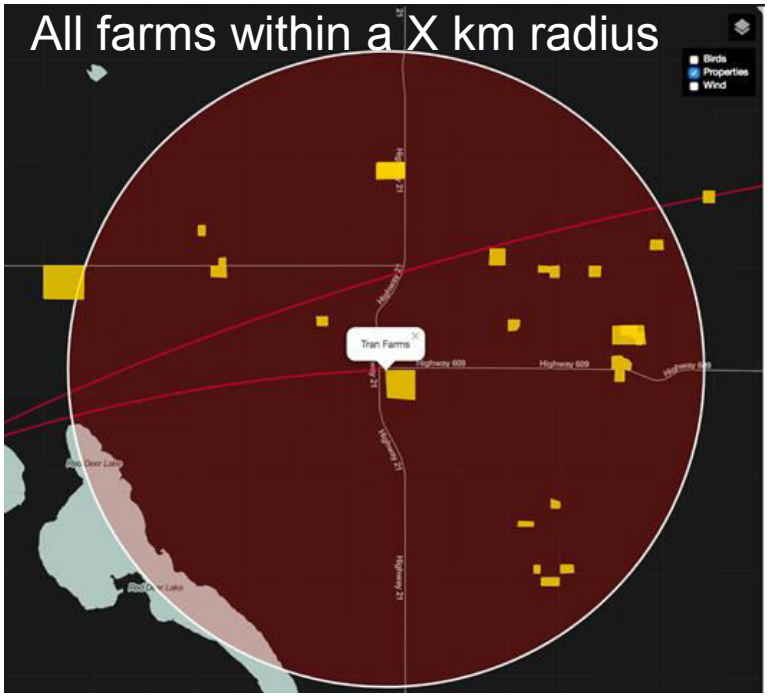
indirect connections



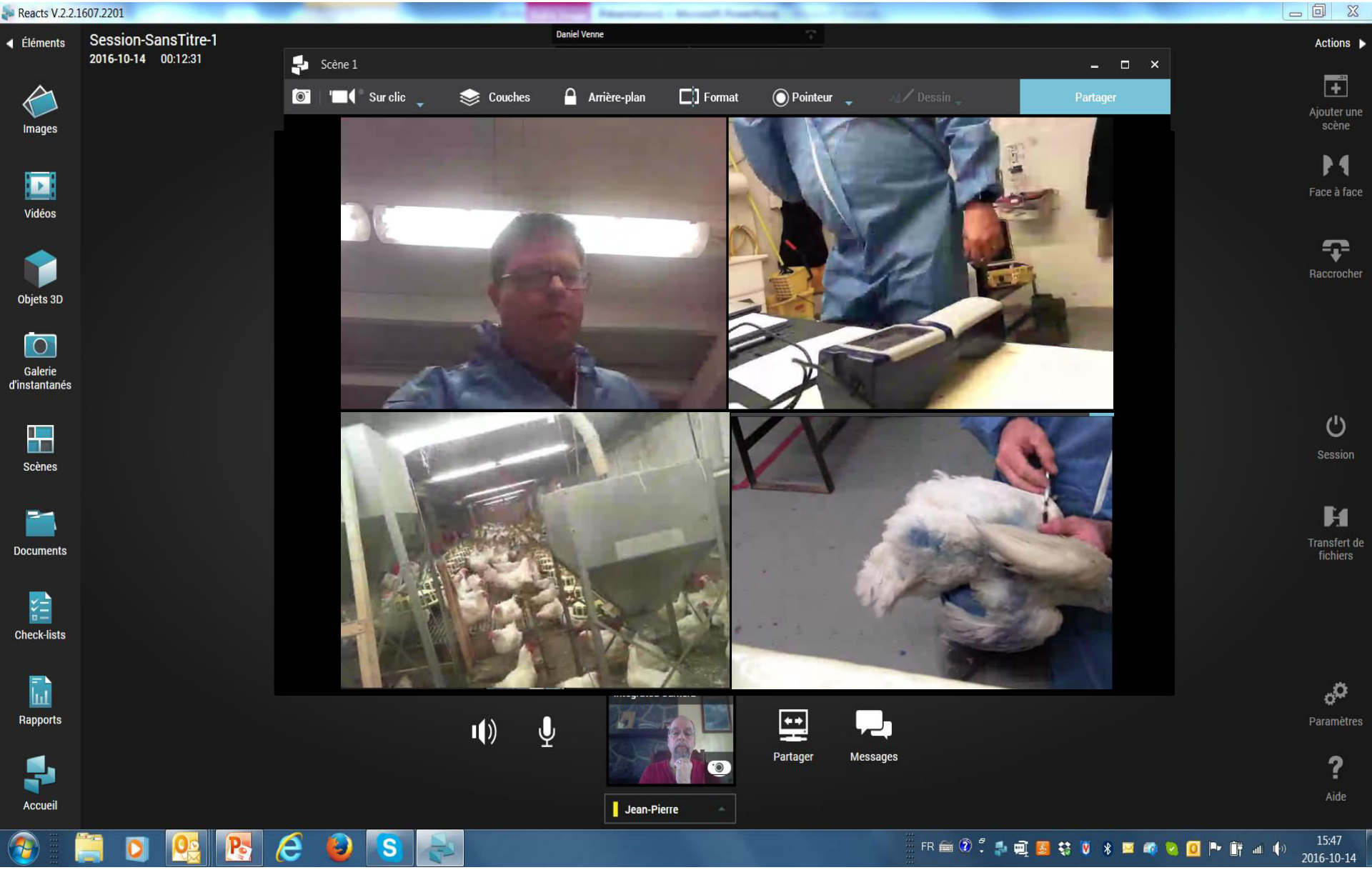
wild bird (geese, ducks and water fowl) around regions of interest



All farms within a X km radius



Telemedicine - Telediagnosis



Conclusion

- ✓ The world is changing whether you like it or not
- ✓ Change is also a component of progress
- ✓ Being reactive and active….innovation
- ✓ Multi-layer approach to biosecurity is essential
- ✓ Compliance strategy is also very important

Avian influenza, antibiotic resistance, consumer concerns…

…require optimization of disease control strategies…via **communication**

…require leadership from industry

…require partnerships, including with government

Leadership

Thank you!

Questions?