LE RENDEZ-VOUS avicole AQINAC

How to properly grow microbes on Québec poultry farms

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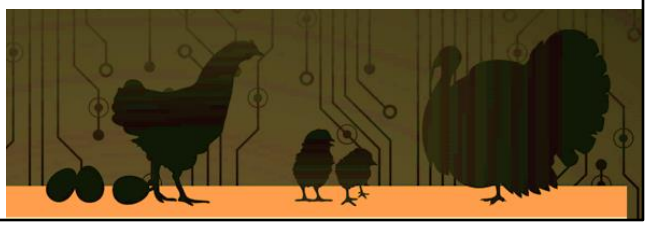


Rearing

Genetics

Breeders

Hatchery

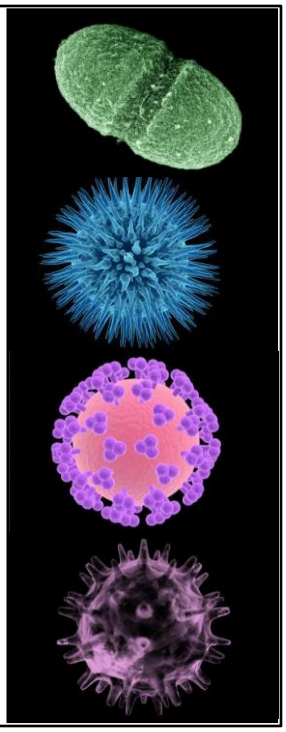
Brooding (1-10 d)

Growth

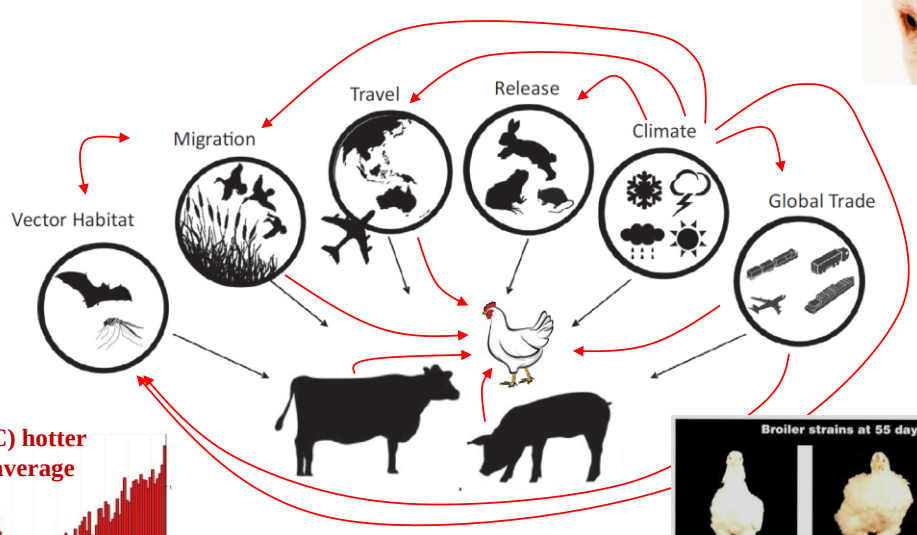
Nutrition

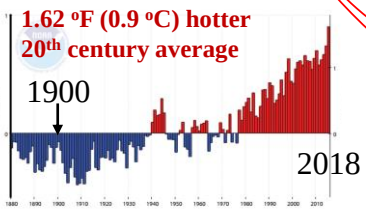
Environment

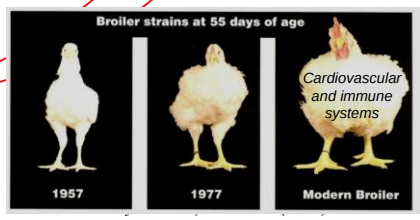
Birds origin
Visitors - vehicles
Inadequate hygiene
Water/feed
Litter - Old litter
Multi-age
Mortality management
Insects - Darkling Beetle
Rodents
Wild birds
Treatment abuse
Flock overcrowding
High regional density
Multi-species
Equipment sharing
Biosecurity breach
Growth conditions



Infectious pathogens transmission

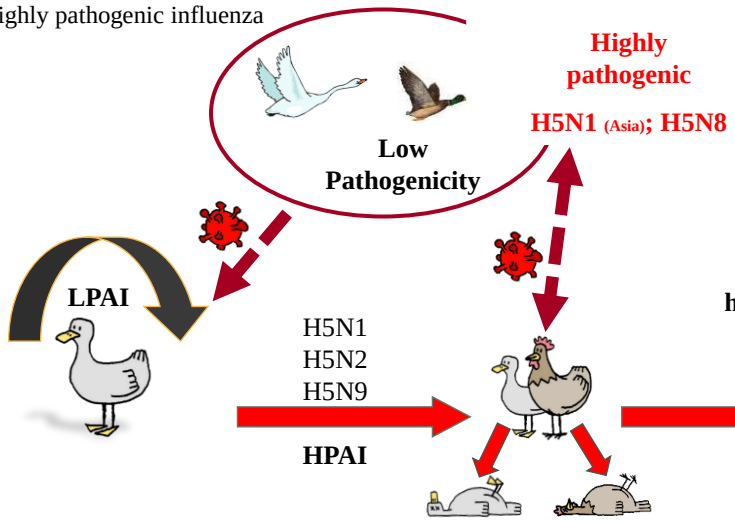


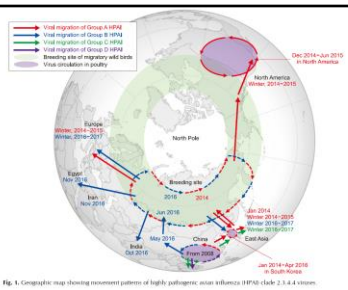




Outbreak scenario - update

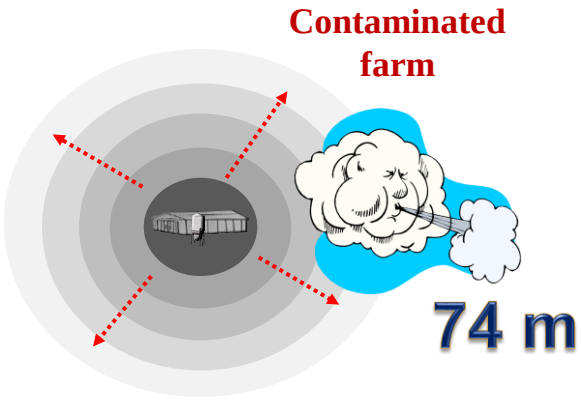
LPAI: Low pathogenic influenza
HPAI: Highly pathogenic influenza





LPAI progression ➔ Emergence/reassortments + spread

Journey of a pathogen

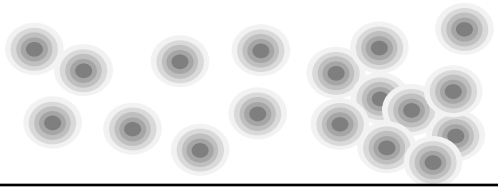


Determining factor - Distance

1. Topography
2. Temperature, humidity, wind
3. Vegetation
4. Rodent and insect populations
5. Farm traffic (staff, visitor)
6. Pathogen concentration (quantity of organic matter and pathogens; size)

Efficient transmission of the infection (sufficient infection pressure)

1. Distance between 2 sites
2. Farm regional density
3. Pathogen concentration



Proximity risks

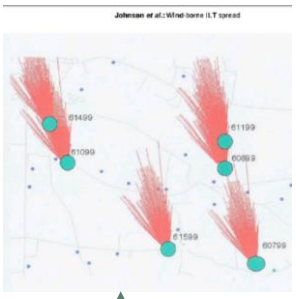
Diseases	Risk factor	Risk level	Reference
Salmonella	High density of flocks	OR 4.2	Snow et al., 2012; Great Britain
Newcastle		OR 4.2	East et al., 2006; Australia
E. Coli		OR 6.3	Vandekerchove et al., 2004; Belgium
Avian Influenza		OR 34,7	Boender et al., 2004, The Netherlands

Less than 1 km between farms

- *2 x more chance → Salmonella*
- *4 x more chance → Newcastle*
- *6 x more chance → E. Coli*
- *35 x more chance → Avian Influenza*

⇒ eggs, equipment, people, vehicles, wildlife

Racicot, 2014

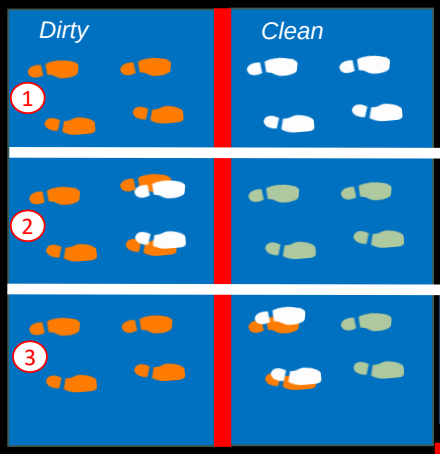


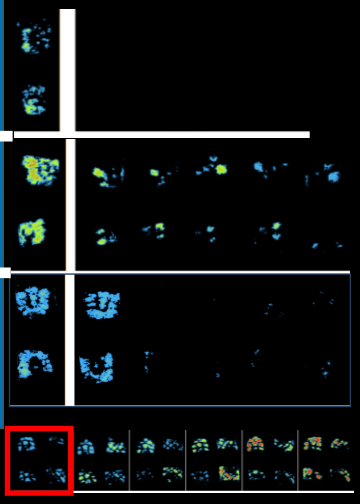
<u>10 x more chance</u> that a farm will test positive for infectious laryngotracheitis if located in a wind corridor from another infected farm

Risk factor - Avian Influenza

Risk factor	Risk (O.R.)	Reference
Visitors	8.3	Fasina et al., 2011; Nigeria
Clothing, footwear, hands	7.0	Nishiguchi et al., 2007; Japan
Equipment sharing	29.4	Nishiguchi et al., 2007; Japan
Birds > 10 weeks of age	2.0 – 4.9	Thomas et al., 2005; McQuiston et al, 2005
Rendering vs on-site disposition	7.3	McQuiston et al., 2005
Racoons or foxes seen near ~~from~~ the farm	2.0	McQuiston et al., 2005
Darkling beetles, flies (30% AI + at 2.3 km from positive flocks), Hauling		

Footwear changing



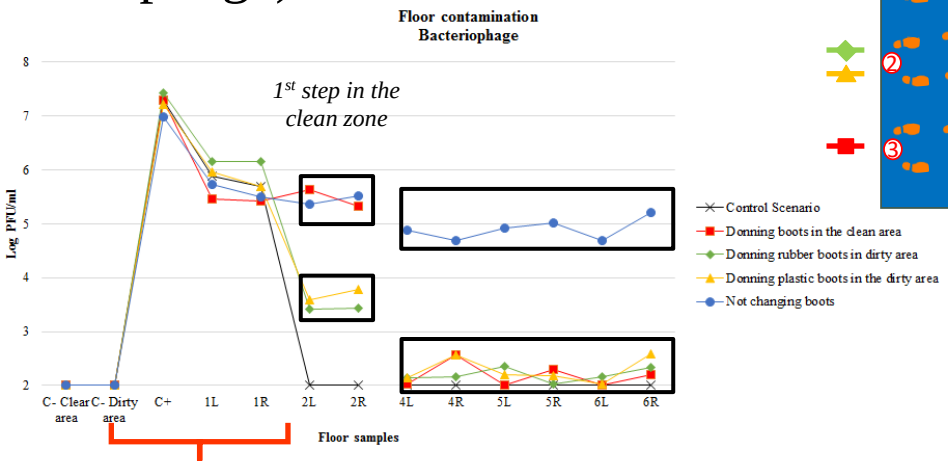


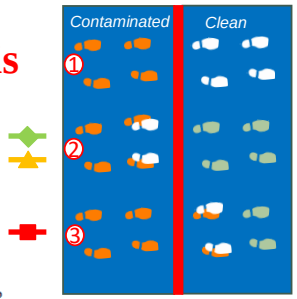
Contamination

Visualization – *E. coli* ATP bioluminescence

Failure to change footwear (Bacteriophage)

10 x Bronchitis

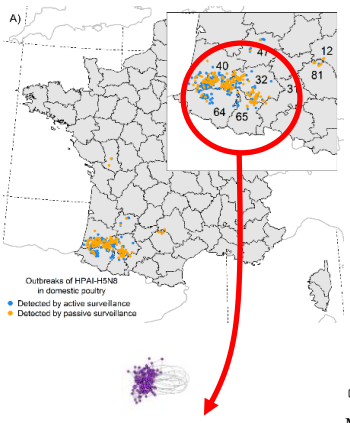


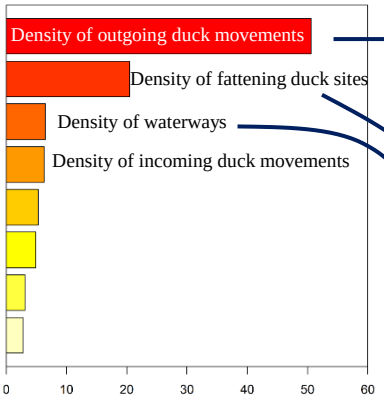


Contaminated zone

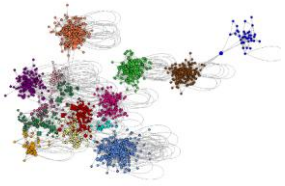
Huard et al., 2016

Risk factors associated with HPAI spread

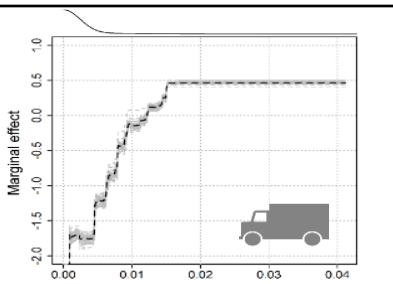




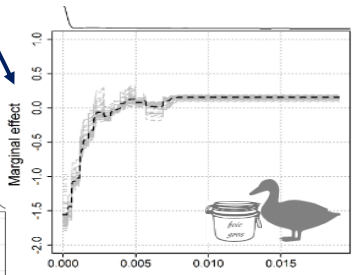
Mean relative contribution (%) per predictor variable



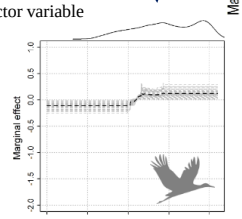
France
2015-2017



Density of outgoing duck movements (/ha)



Density of duck sites (/ha)

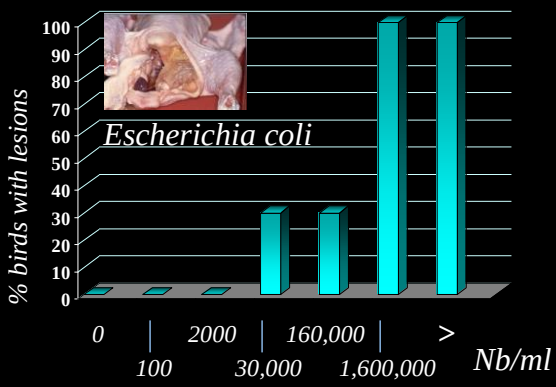


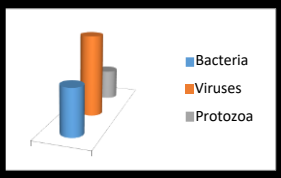
Density of waterways (/ha)

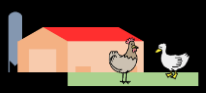
Paul, Guinat, Guérin, 2018

Infection pressure

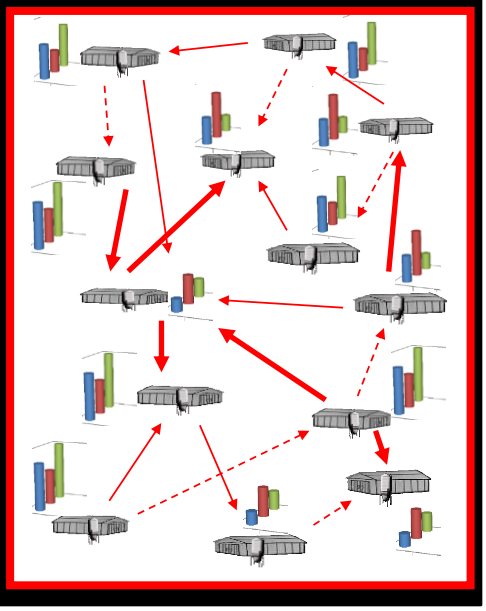
Quantity and diversity of microbes in efficient contact with the host







Contact probability between infected and healthy

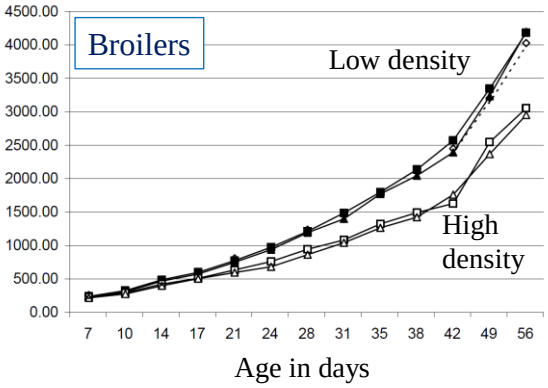


High regional density

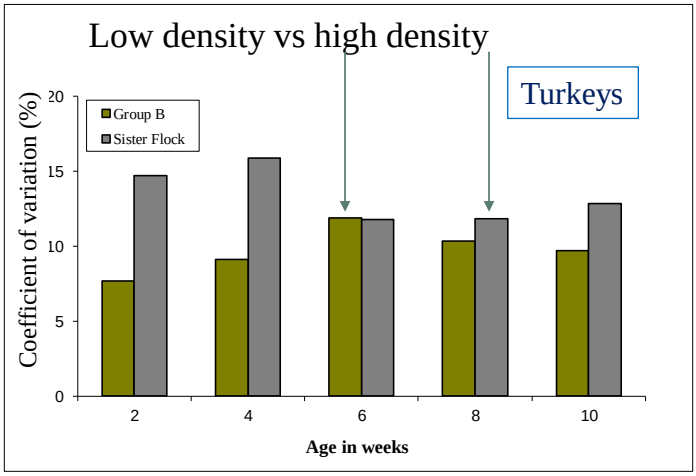
Same breeders
Same hatchery
Same feed
Same flock density

Feed conversion
Growth rate
Flock uniformity

Average weight in grams



Low density vs high density



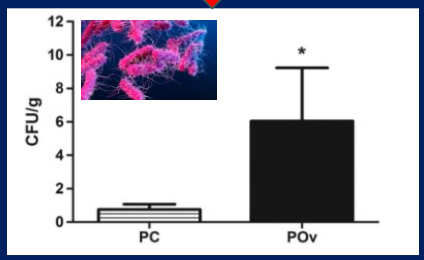
NCSU 2008

Flock Overcrowding

↓ Immunity

↓ Gut integrity

Gomes et al., 2014

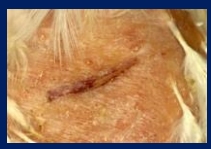


Liver invasion by *Salmonella* Enteritis

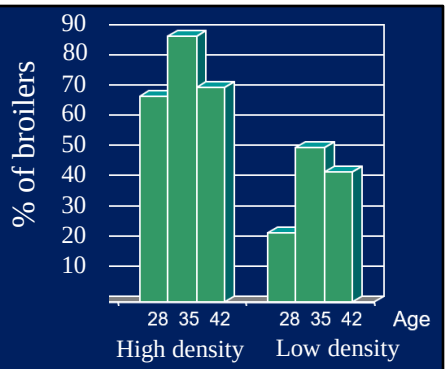
Presence

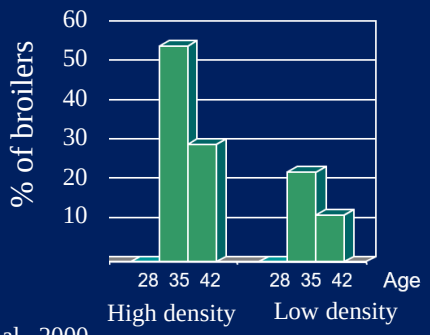
Scratch

Severity

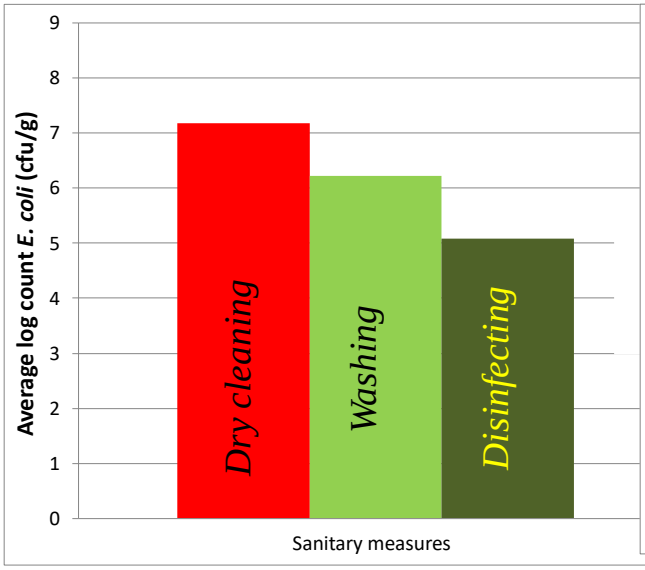


Elfadil et al., 2000

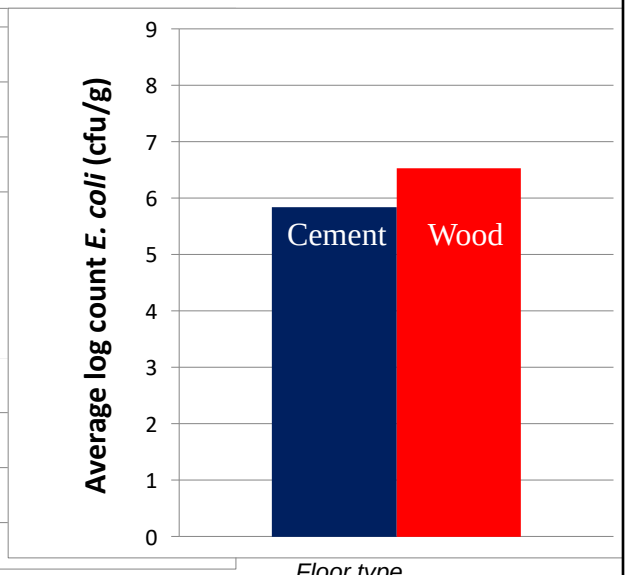




Sanitary measures



Floor type



Course, 2018

Impact of disinfection on virus

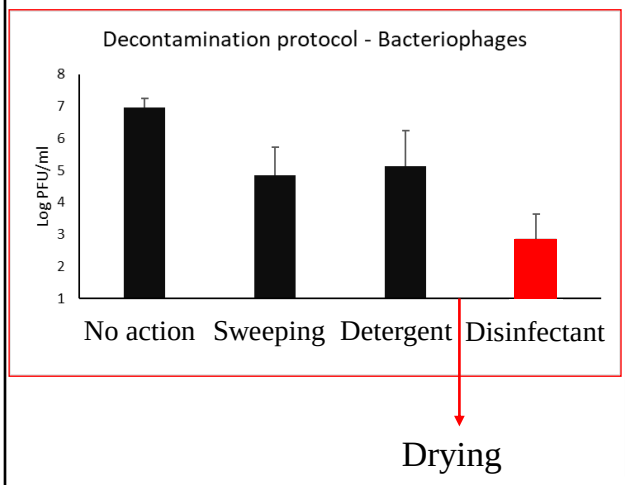
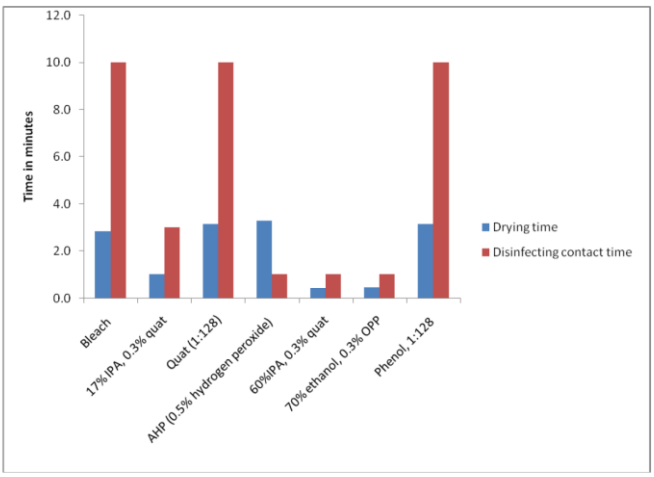


Table 1: Drying Time versus Disinfectant Label Contact Time

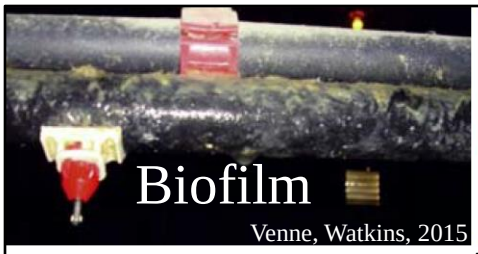


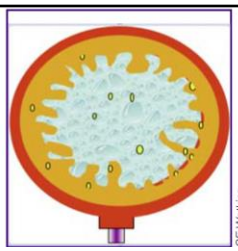
The Importance of Contact Times for Disinfectants
(Omidbakhsh, N. CJIC 2008; 23:49)

Source and water treatment

Risk

- Surface well> water well> aqueduct
- 3 X more risk of infection with *Campylobacter* when birds are given untreated water
- 3 X more risk of infection with *Campylobacter* in turkeys drinking unchlorinated water
- Chlorination + washing & disinfection of the water lines→ ↓ 81% to 7% of the birds colonized by *Campylobacter*





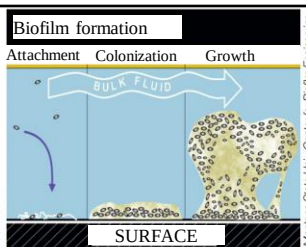
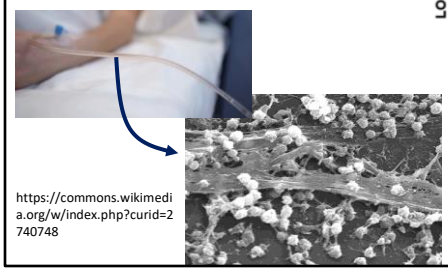
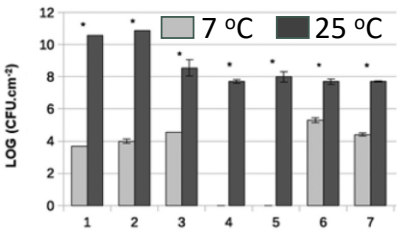


Fig.81.1 & 81.2: Biofilms formed in water lines can contain *Escherichia coli* and *Bordetella.*

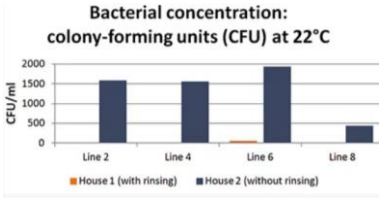
- ✓ Contaminated water
- ✓ Low flow
- ✓ High temperature
- ✓ Bacterial strain

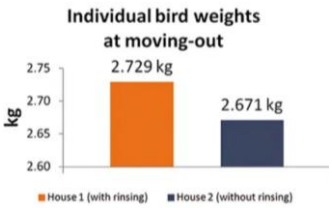


https://commons.wikimedia.org/w/index.php?curid=2740748



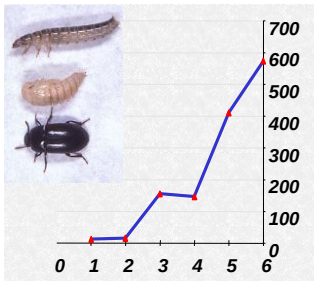
Different strains of *Campylobacter*
Klein Scheik et al., 2020



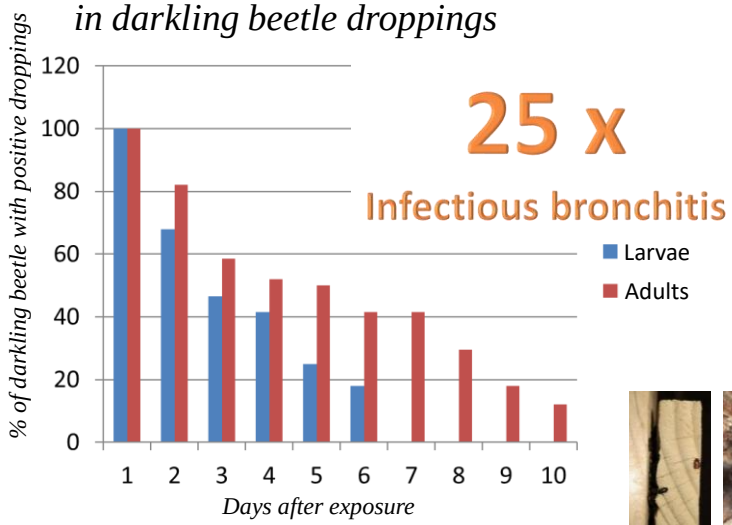


Linden, 2014

Darkling Beetles → *2-3 km/day*



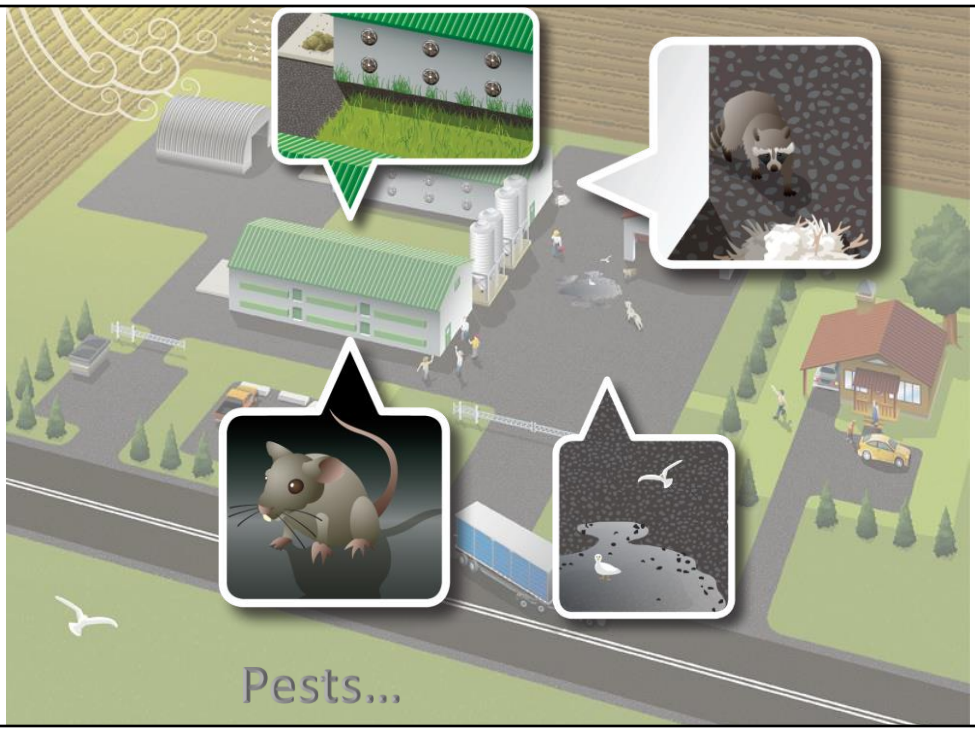
Percentage of E. coli excretion in darkling beetle droppings



25 x

Infectious bronchitis

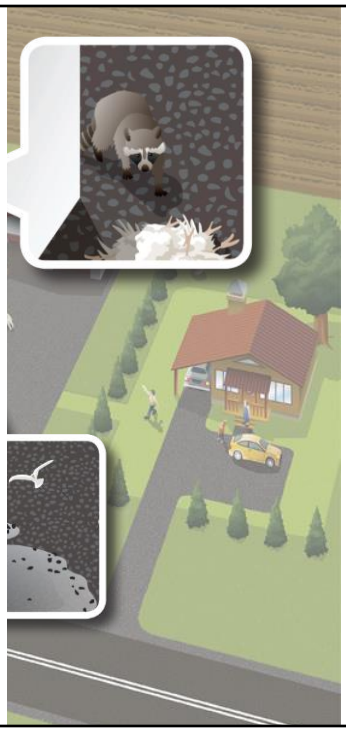
McAllister et al. 1996


Pests...


istock

Rodents and wildlife

- 3 X more at risk of infection with *Campylobacter* if pest droppings were seen on site
- 3 X more at risk of coccidiosis if pests are present on site
- 6 X more at risk of infection with *Salmonella* Enteritis if rodents are seen
- 8 X more at risk of infection with *Salmonella* Enteritis if rats are seen monthly or more frequently
- 2 X more at risk of low pathogenic avian influenza if the producer sees raccoons or foxes near the farm
- Significative link between the presence of squirrels on site and the presence of cholera (*Pasteurella multocida*) in the flock



Industries on wheel

- Producer/employee
- Cleaning crew
- Animal transportation
- Transportation (equipment)
- Litter transportation
- Rendering truck
- Service
- Veterinarian
- Tractors
- Vaccination crew
- Feed truck
- Fuel truck
- Service truck
- Snow removal truck
- Waste truck
- Tractor mixer
- etc.

The biggest rodent

Laryngotracheitis
Infectious
Niagara peninsula

Factor	Odds Ratio
Vaccination crew	12.7
Manure disposal	8.1

Antibiotic resistance: The egg or the hen

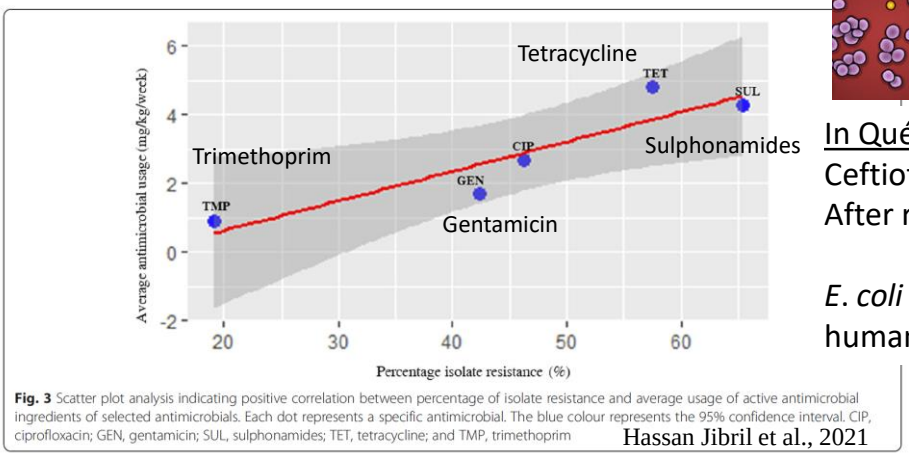
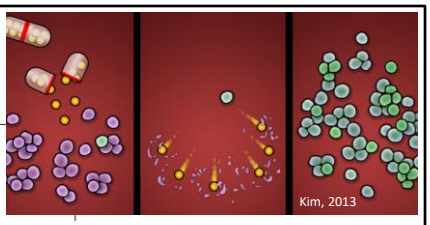


Fig. 3 Scatter plot analysis indicating positive correlation between percentage of isolate resistance and average usage of active antimicrobial ingredients of selected antimicrobials. Each dot represents a specific antimicrobial. The blue colour represents the 95% confidence interval. CIP, ciprofloxacin; GEN, gentamicin; SUL, sulphonamides; TET, tetracycline; and TMP, trimethoprim

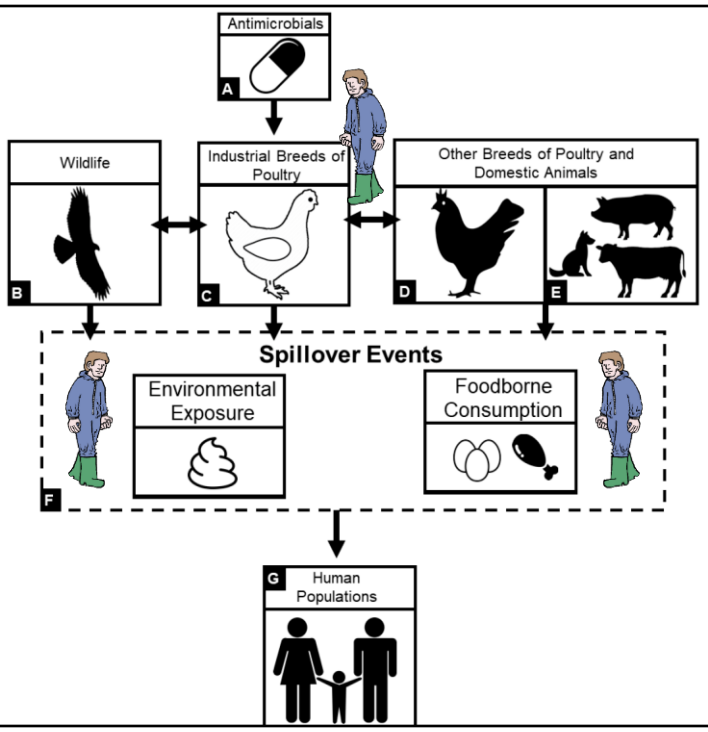
Hassan Jibril et al., 2021



<u>In Québec</u>
Ceftiofur at the hatchery: 65%
After removal: 7%

E. coli strain resistance in humans: 31% → 8%

Poultry workers:
32 x more at risk to be a carrier of the gentamycin-resistant *Escherichia coli*



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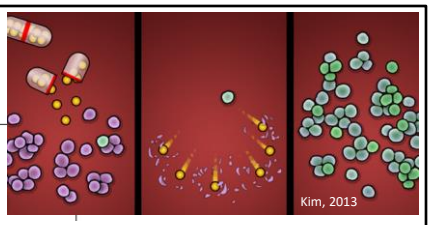


s

In Québec

Ceftiofur at the hatchery: 65%

After removal: 7%

E. coli strain resistance in humans: 31% → 8%

timicrobial
interval. CIP,
l., 2021

istant *Escherichia coli*

Inadequate dead bird disposal

Sharing pathogens between flocks via:

Rendering + farm biosecurity breach → 7.3 x HPAI (McQuiston et al. 2005)
→ 22.3 x HPAI if near buildings (Garber et al., 2016)

Dead bird carcasses available to animals:

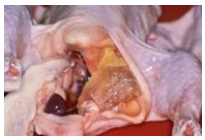
↑ x 3.3 the risk of HPAI (Fallah Mehrabadi et al., 2016)

If covered: ↓ x 5 the risk of contamination to *Salmonella* (Huneau-Salaün et al., 2009)

(Payne *et al*. 2011; Popoff 1989; Relun *et al*. 2017; Souillard, Le Maréchal, Ballan, Mahé *et al*. 2017)

Popoff 1989

Elfadil & Vaillancourt, 1996



After taking into account:

- ✓ Genetic line and sex
- ✓ Lighting program
- ✓ Size of flock
- ✓ Litter type

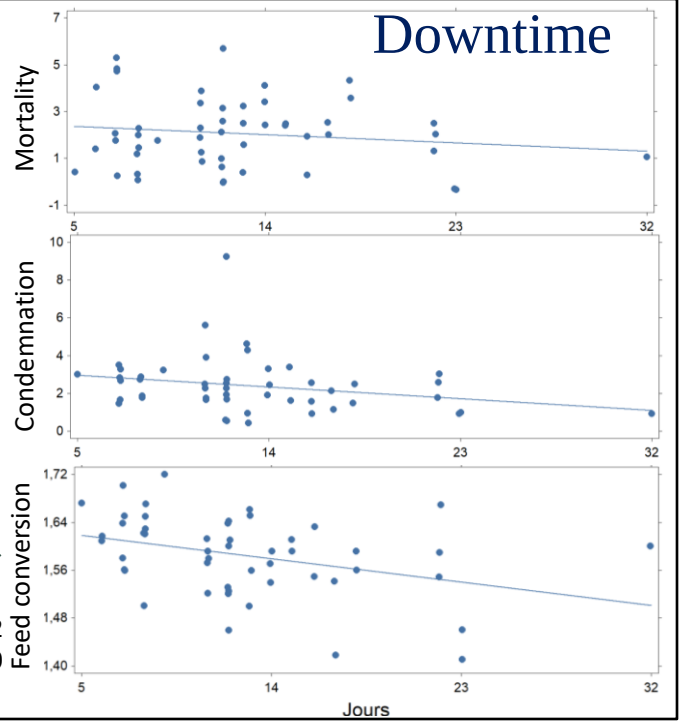
A long downtime helps lower the cellulitis condemnation rate

P < 0.0001

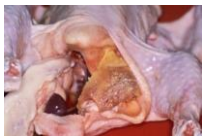
16 flocks → Downtime < 10 d = 1.62

29 flocks → Downtime < 10 d = 1.59

P = 0.004



Elfadil & Vaillancourt, 1996



After taking into account:

- ✓ Genetic line and sex
- ✓ Lighting program
- ✓ Size of flock
- ✓ Litter type

5 x more *Campylobacter* if < 14 days

Hald et al., 2000

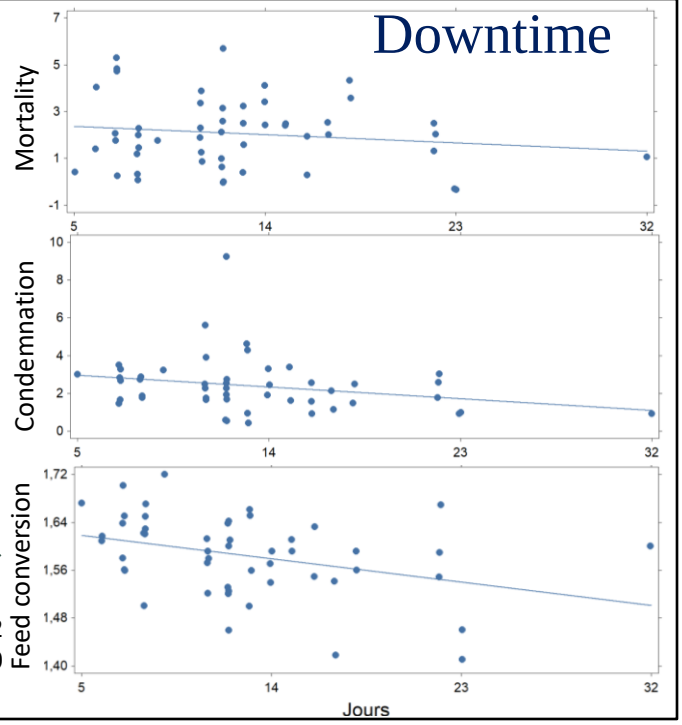
16.7 x less salmonella if All-in All-out

Snow et al., 2010

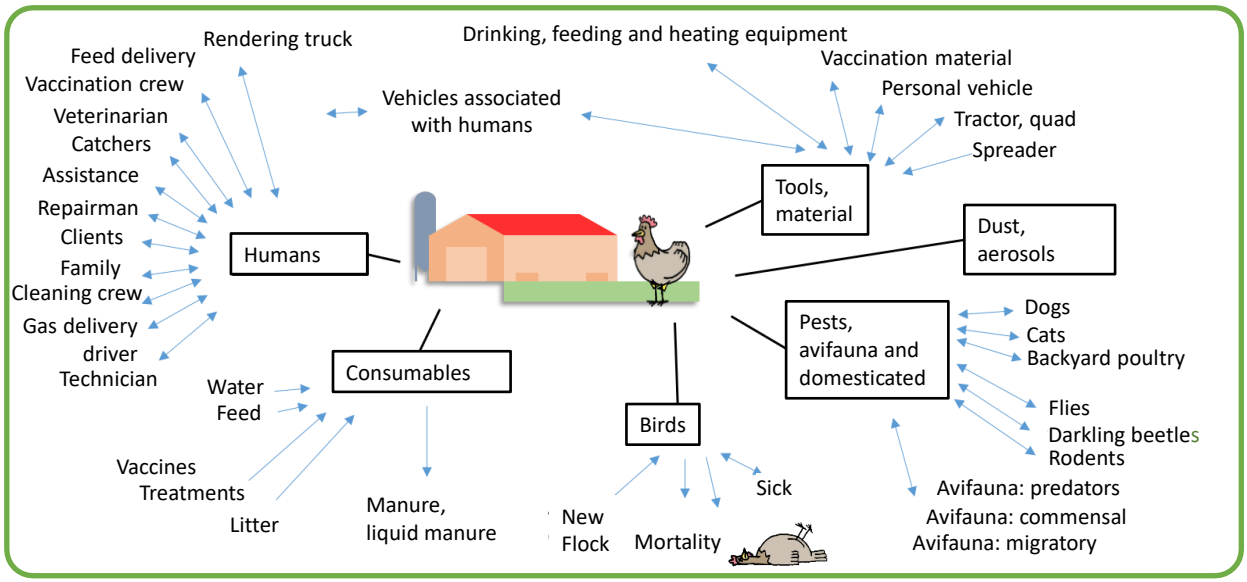
16 flocks → Downtime < 10 d = 1.62

29 flocks → Downtime < 10 d = 1.59

P = 0.004

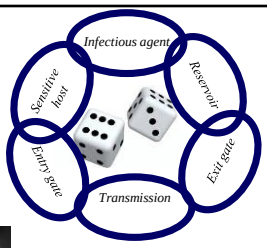


Contamination source - pressure sources



Delpont, 2018

Disease = having at least 2 x 6:



Odds ⬆ according to:

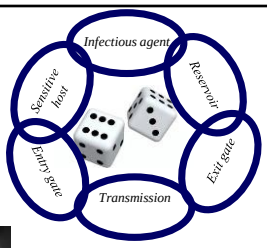
Lack of compliance

Number of times played

# of dices

Risk Factors

Disease = having at least 2 x 6:



Odds ⬆ according to:

Lack of compliance

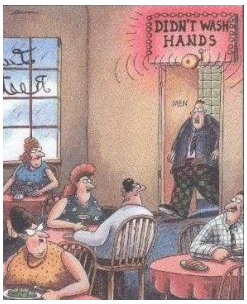
Number of times played

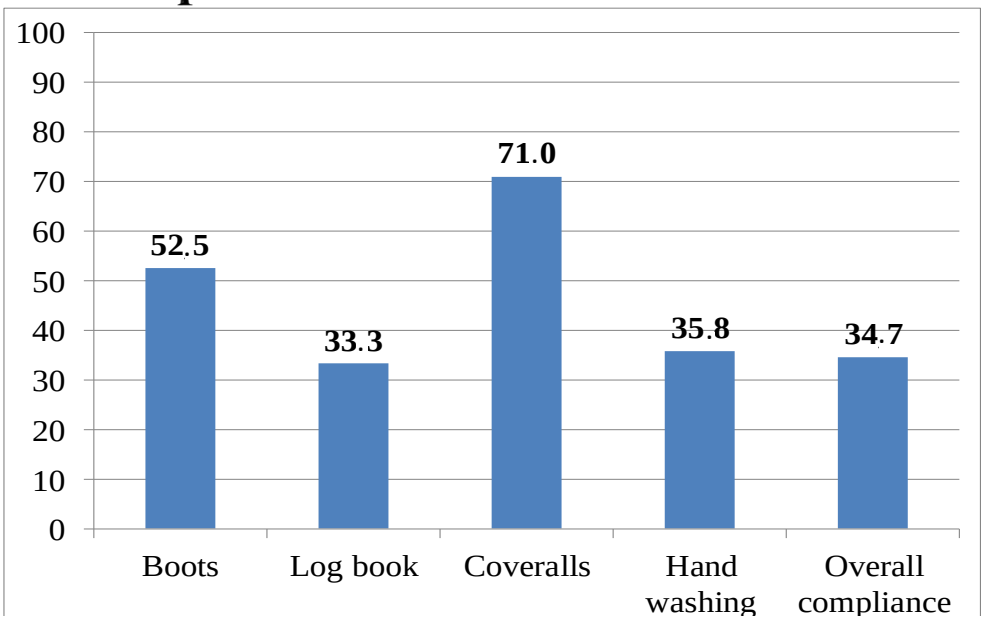
# of dices

Risk Factors

Compliance Biosecurity ➡

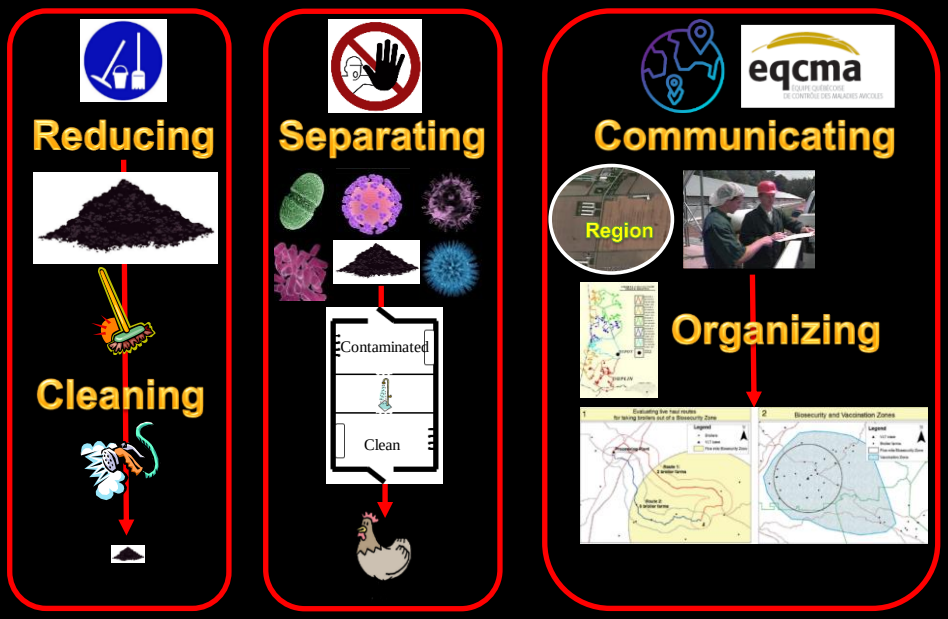
Compliance -Human nature



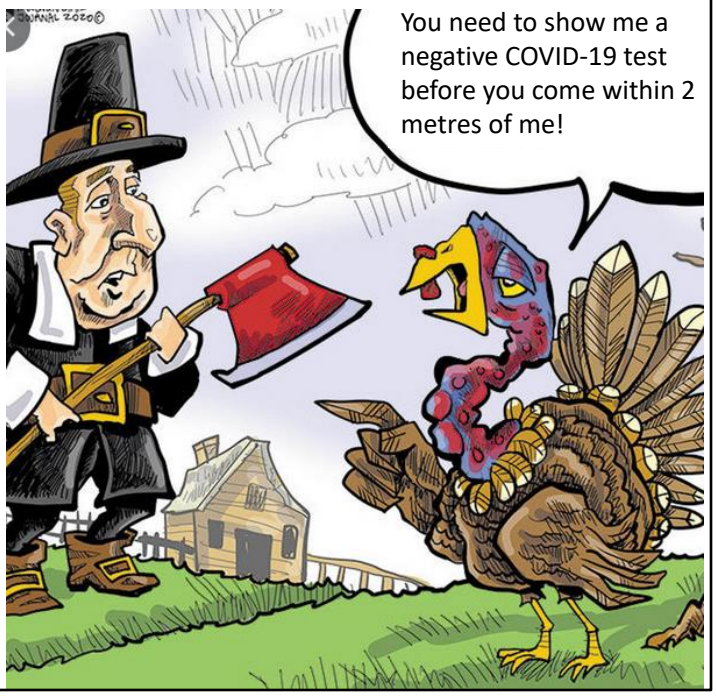


Racicot et al. 2012

Basic biosecurity principles



Thank you!


You need to show me a negative COVID-19 test before you come within 2 metres of me!