Antimicrobial resistance
can affect **anyone**, at any **age**,
in any **country**

#AntimicrobialResistance

World Health
Organization

FACULTY OF VETERINARY MEDICINE
accredited by EAEVE

VETERINARY EPIDEMIOLOGY UNIT

ANTIMICROBIAL USE AND RESISTANCE IN ANIMALS, PROBLEMS AND SOLUTIONS!

Prof. Jeroen Dewulf

VETERINARY SCIENCES

ACADEMIC RANKING OF WORLD UNIVERSITIES SINCE 2003

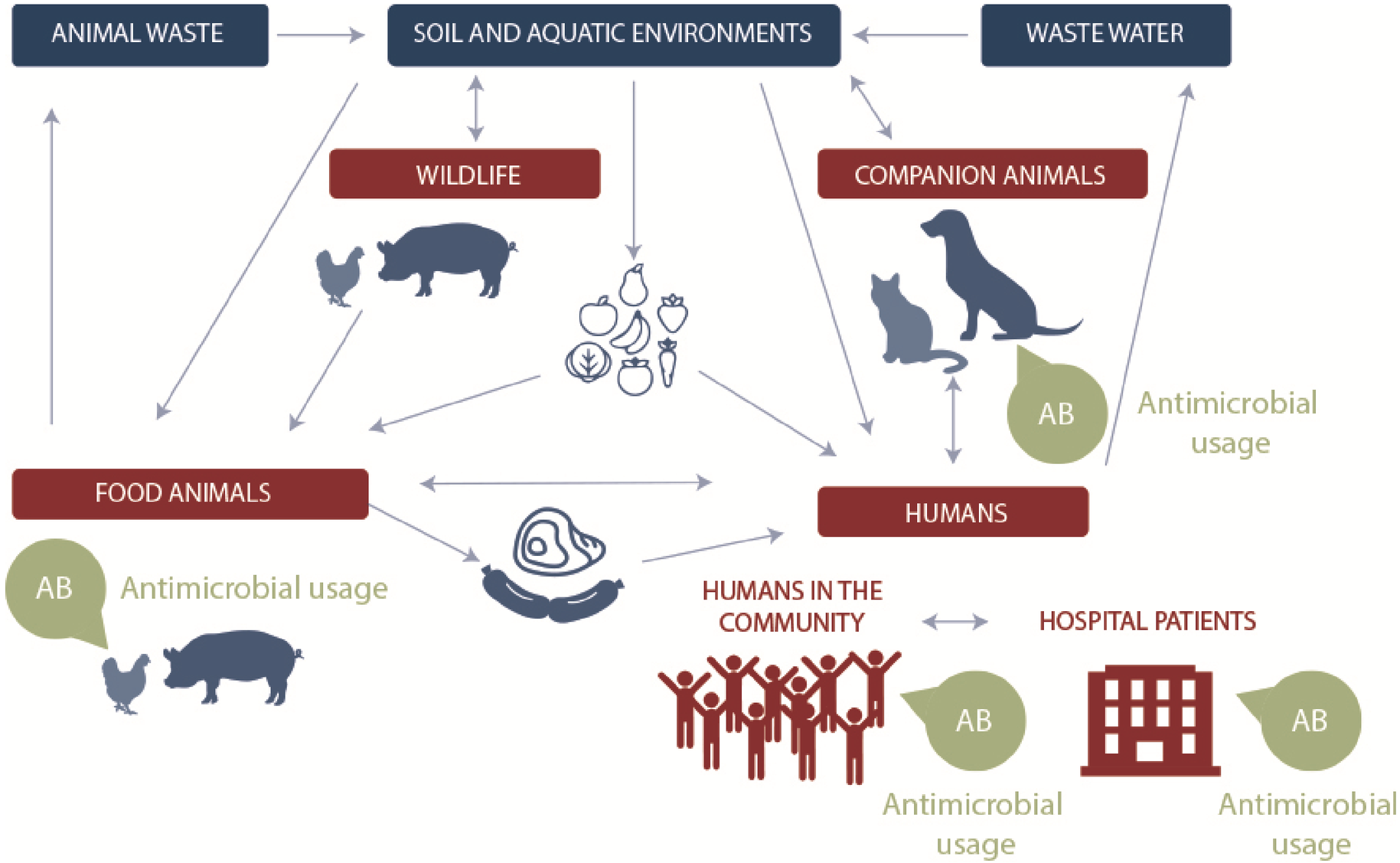
No.1 2018

GHENT UNIVERSITY

FACULTY OF VETERINARY MEDICINE
accredited by EAEVE

GHENT UNIVERSITY

One world, One health



GHENT UNIVERSITY

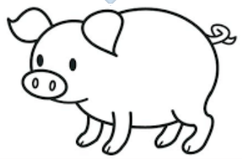
1 Residues in **fresh manure**

2 Residues in **stored** manure

3 Residues in **treated** manure

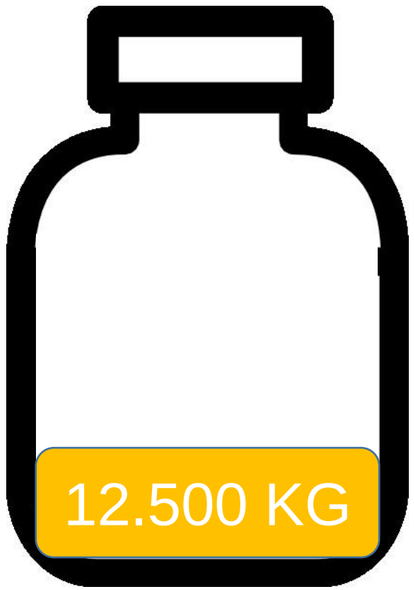
Mass AM oral treatments

Feed AM cross-contamination



Manure pit

BE: 47% of pig manure treated

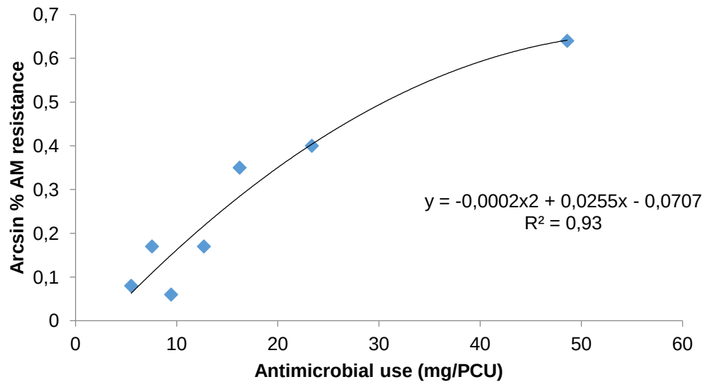


GHENT UNIVERSITY

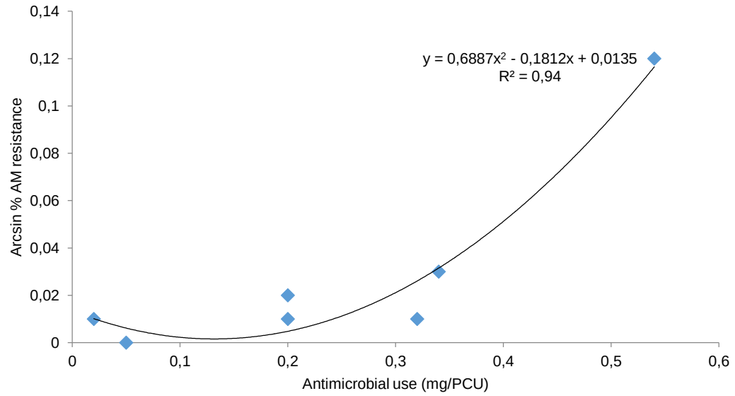
Filippitzi et al., Submitted to Chemosphere , 2018

Linking antimicrobial use to antimicrobial resistance in 7 EU countries based on monitoring data

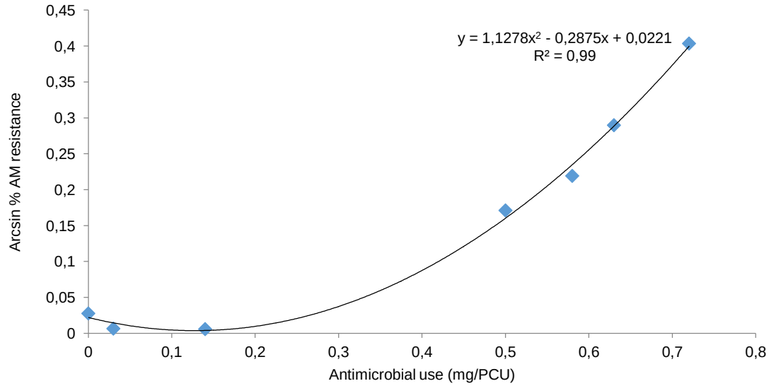
(a) Aminopenicillins (ampicillin)



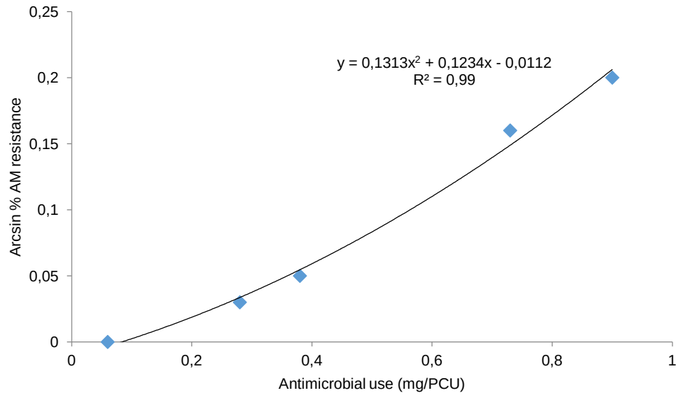
(b) Third generation Cephalosporins (cefotaxime)



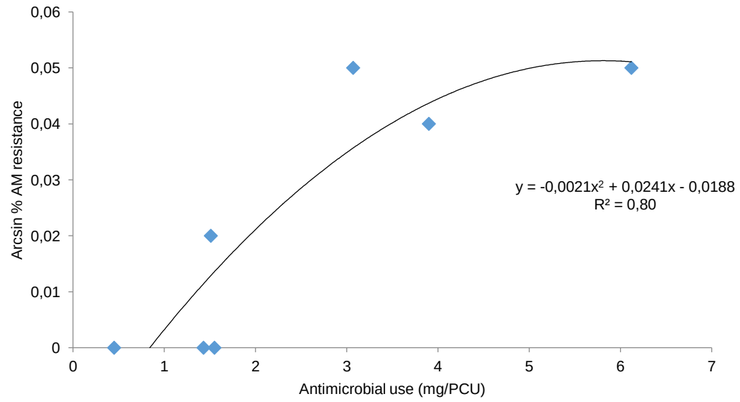
(c) Fluoroquinolons (ciprofloxacin)



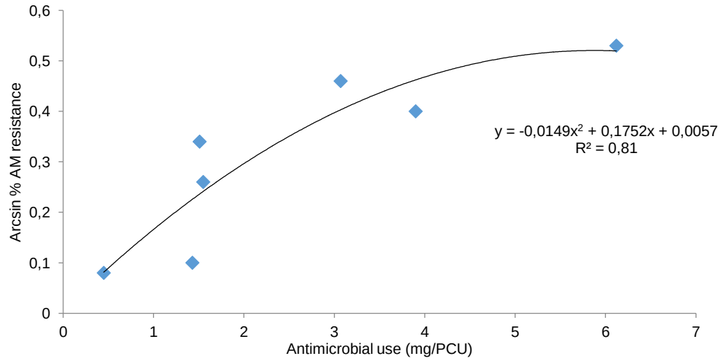
(d) Amphenicols (chloramphenicol)



(e) Aminoglycosids (gentamicin)



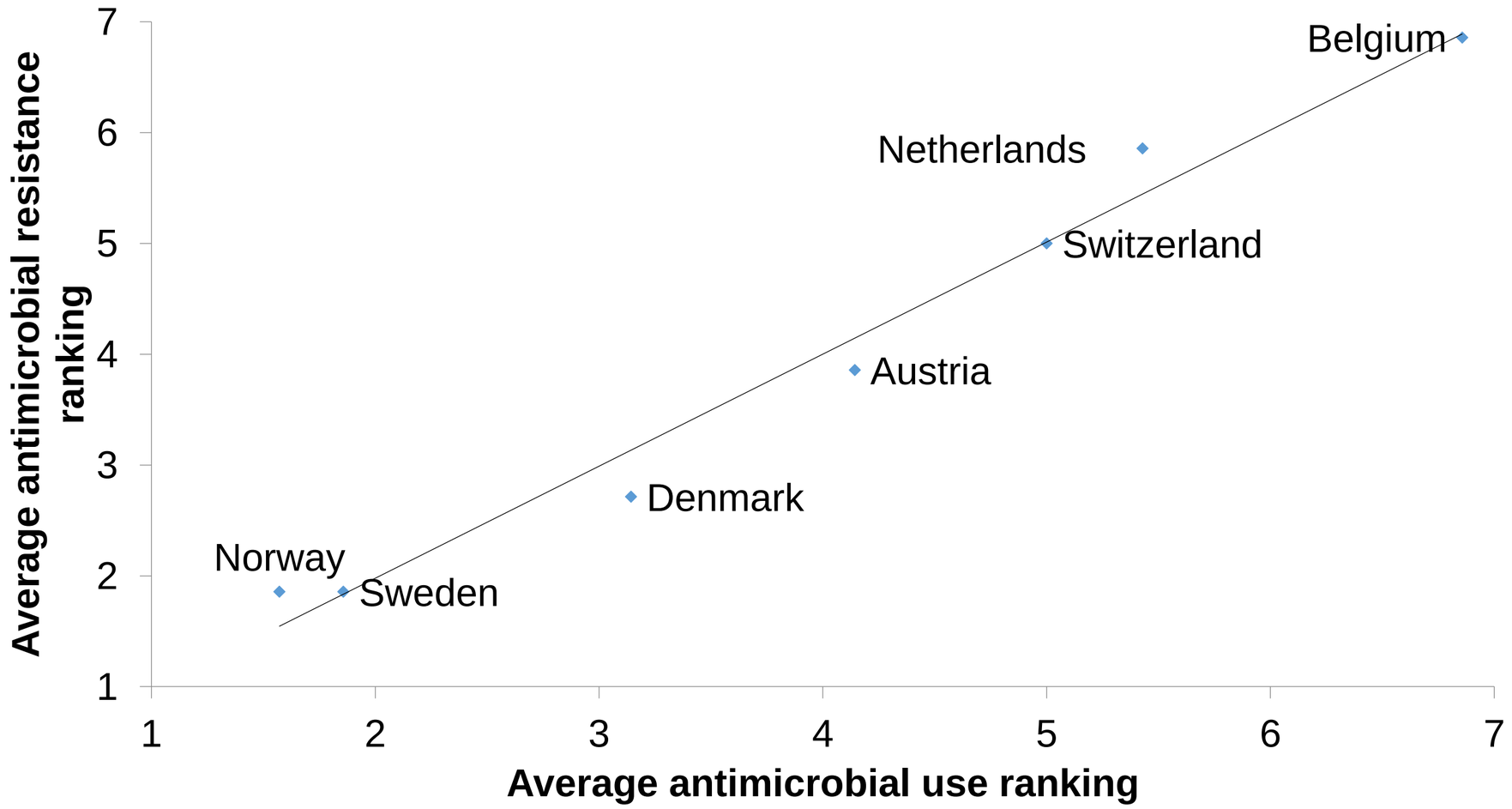
(f) Aminoglycosids (streptomycin)



GHENT UNIVERSITY

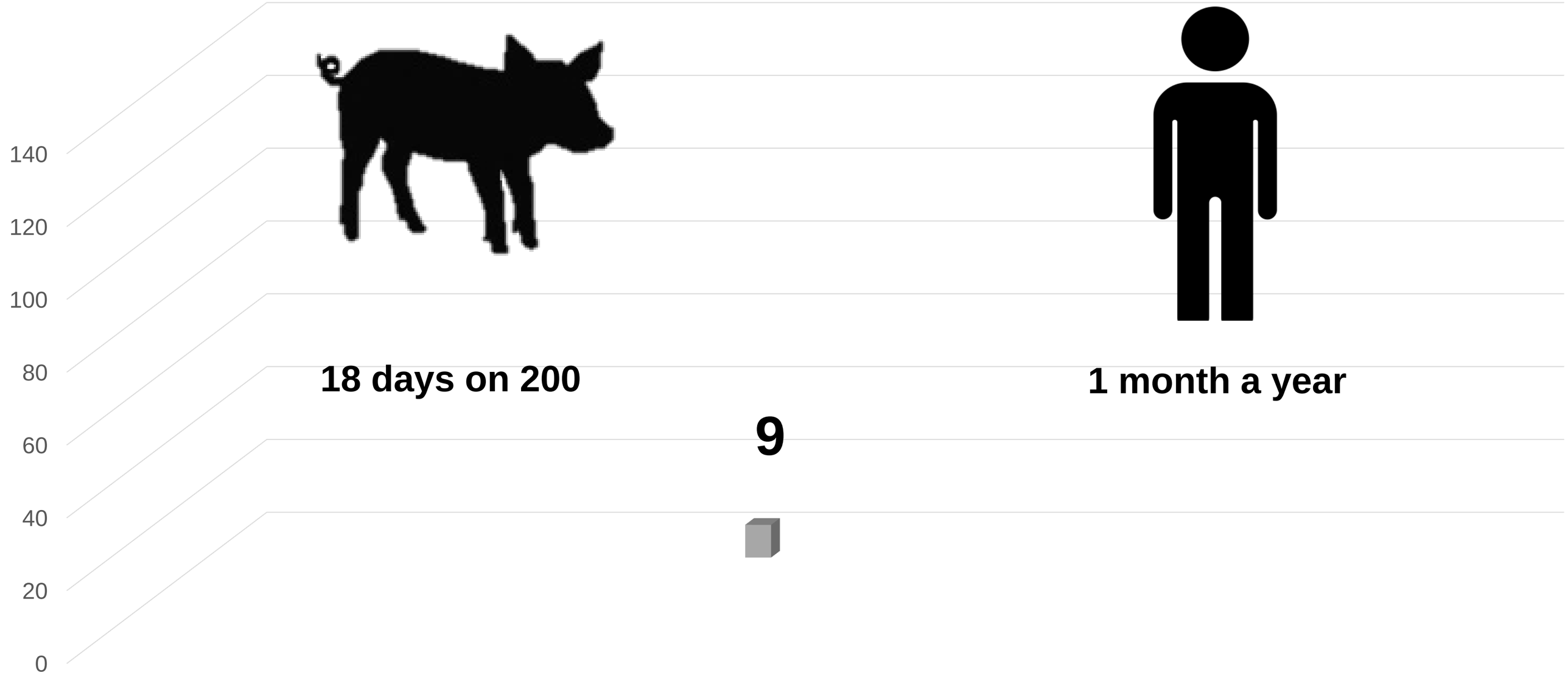
Chantziaras et al., J Antimicrob Chemother, 2014

Linking antimicrobial use to antimicrobial resistance in 7 EU countries based on monitoring data

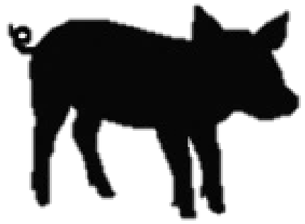


GHENT UNIVERSITY

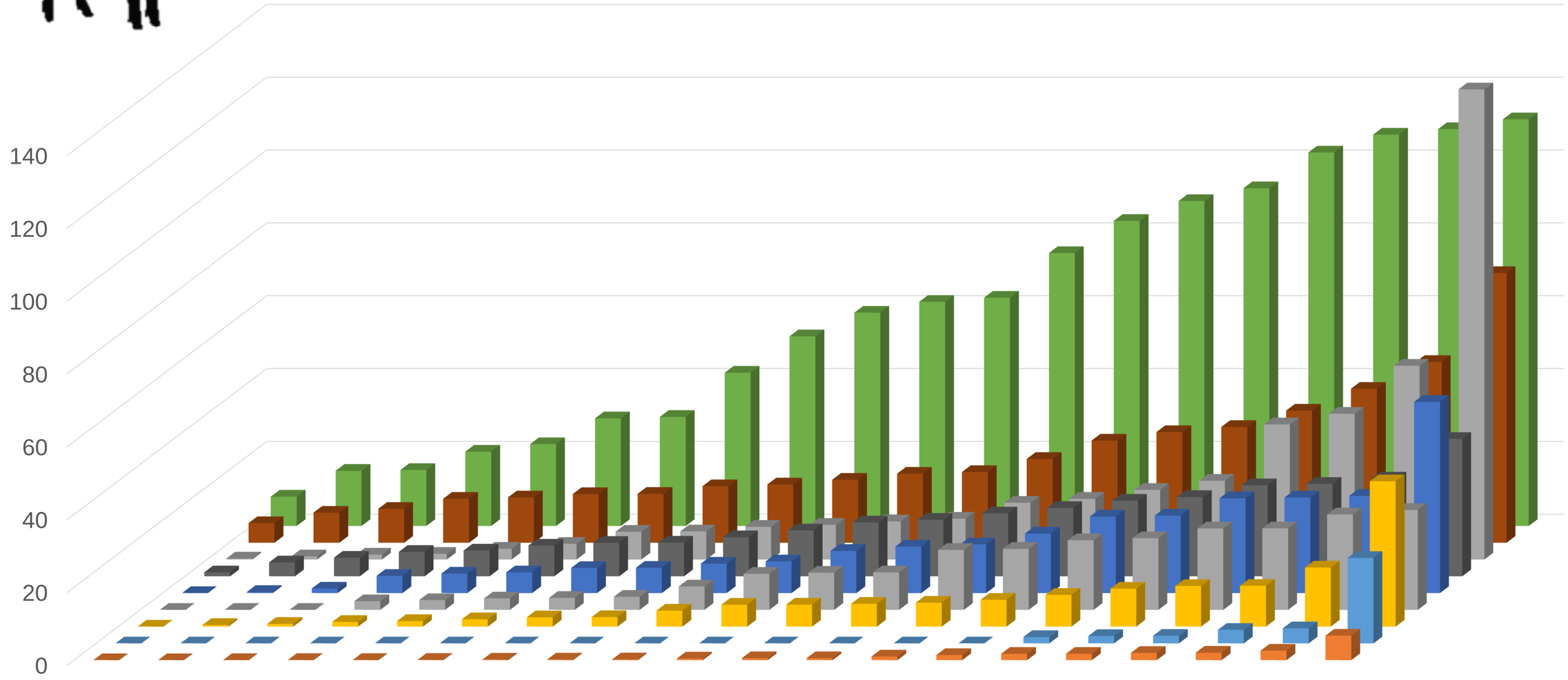
Chantziaras et al., J Antimicrob Chemother, 2014



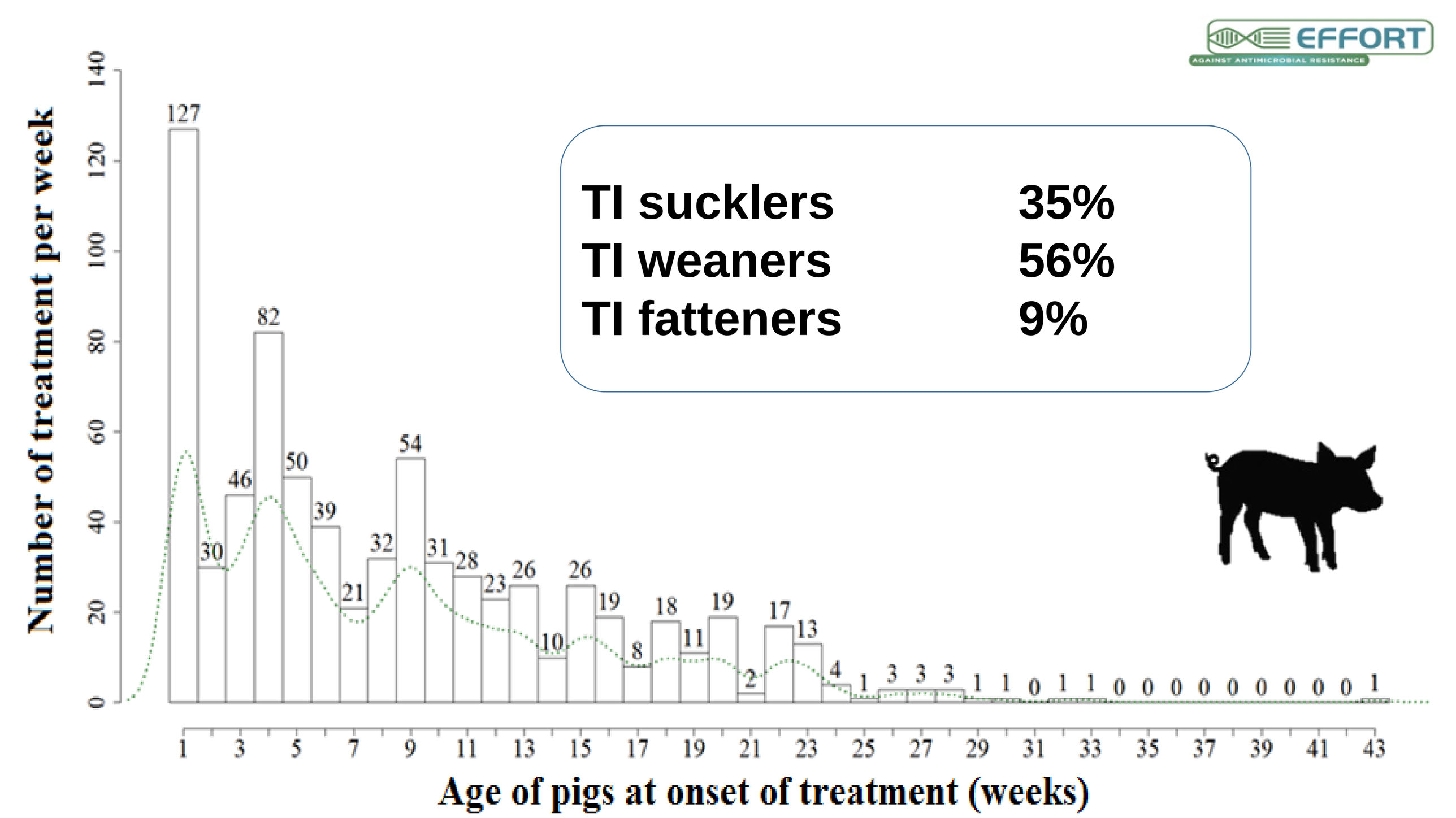
Sarrazin et al., J Antimicrob Chemother, 2019



EFFORT
AGAINST ANTIMICROBIAL RESISTANCE



Sarrazin et al., J Antimicrob Chemother, 2019



TI sucklers	**35%**
TI weaners	**56%**
TI fatteners	**9%**

GHENT
UNIVERSITY

FACTORS RELATED TO ANTIMICROBIAL USE

1. Total amount of antimicrobial agents

2. Treatment dose and duration

3. Choice of antimicrobials

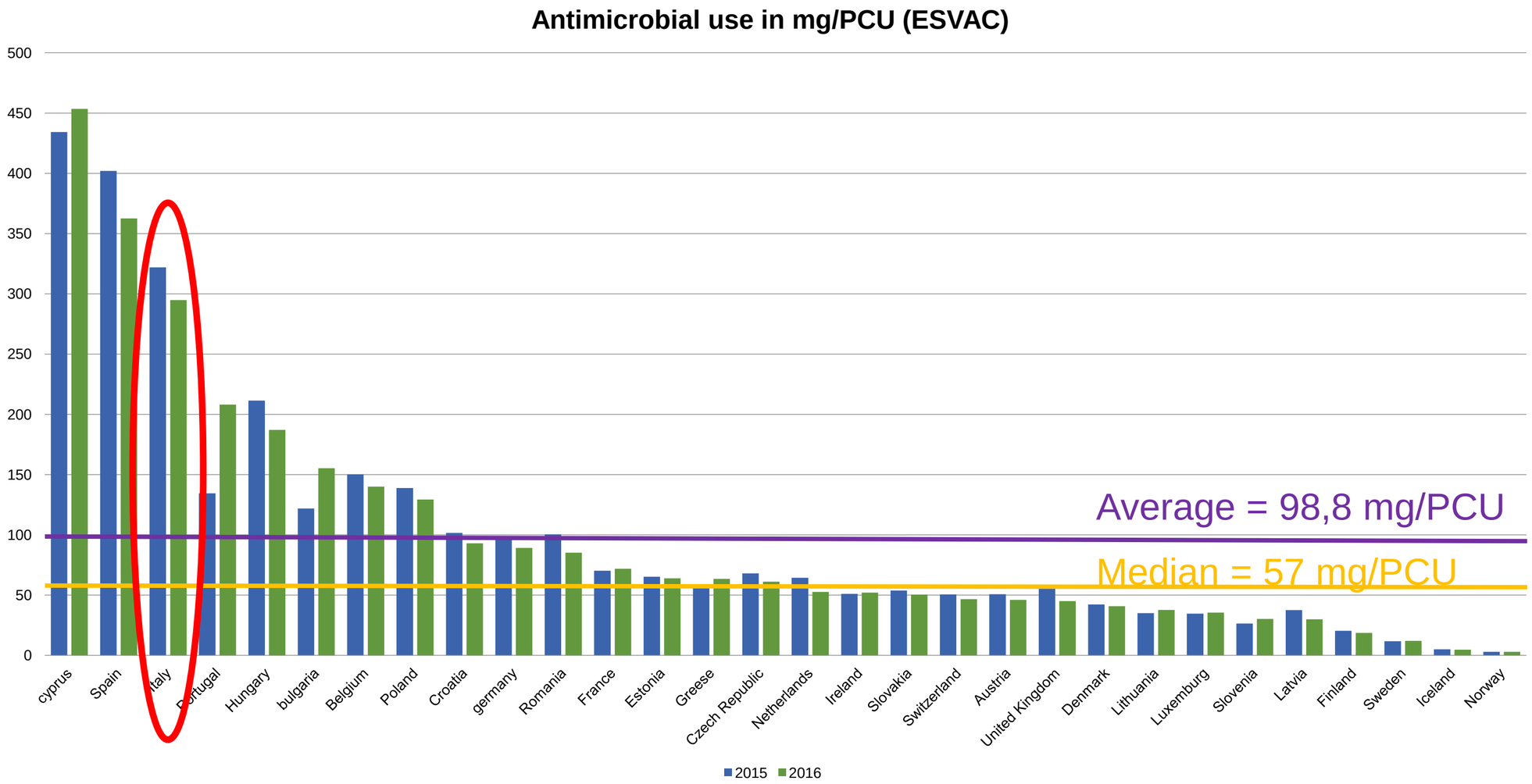
4. Administration route

GHENT UNIVERSITY

The pipeline for new antibiotics in veterinary medicine is dry!

GHENT
UNIVERSITY

Veterinary antimicrobial use in Europe : ESVAC

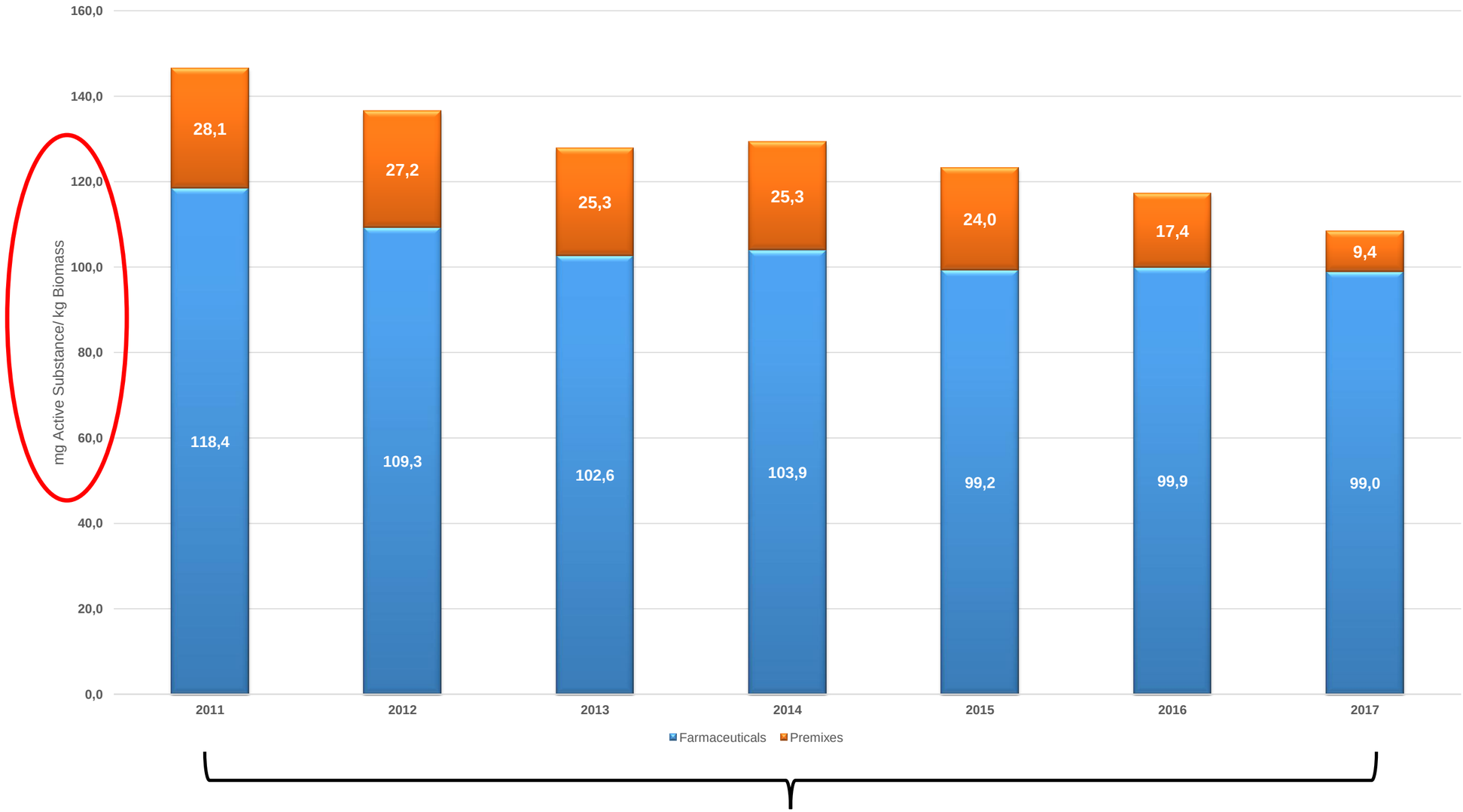


GHENT UNIVERSITY

Using less antimicrobials results in less resistance

GHENT UNIVERSITY

Antimicrobial use in animals in Belgium



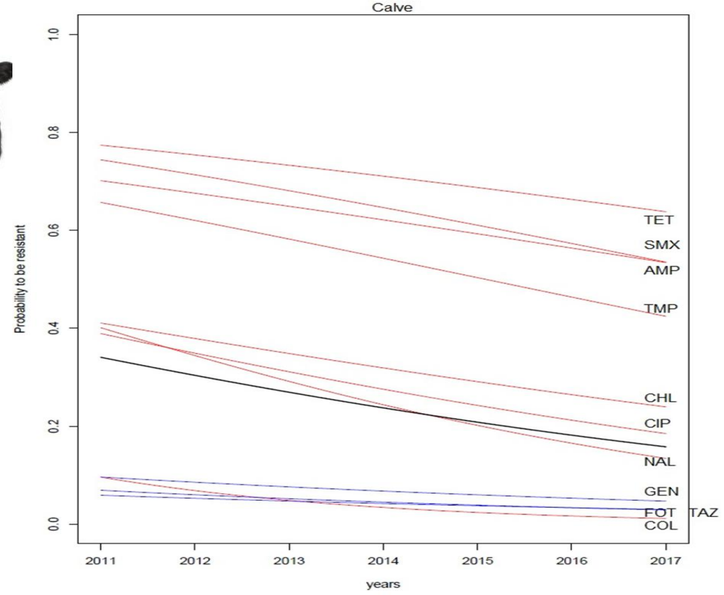
2011-2016: - 26%

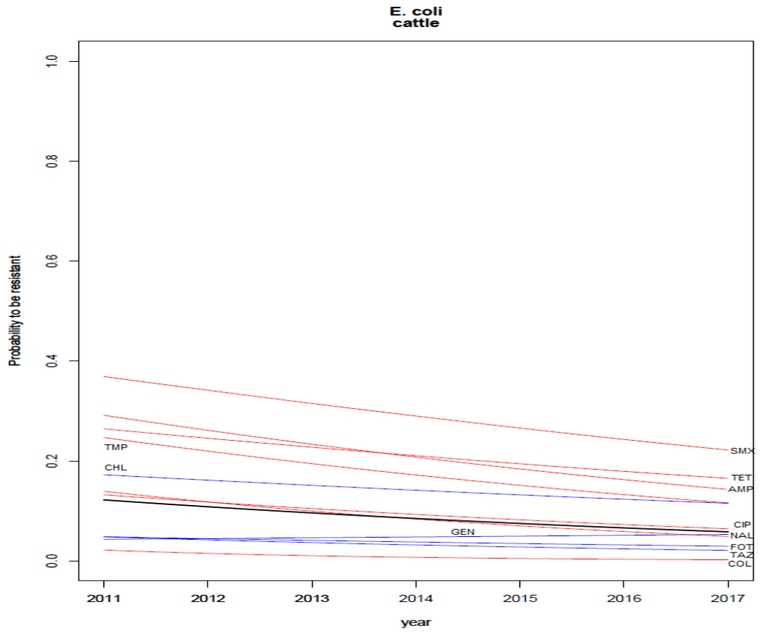
UNIVERSITEIT GENT

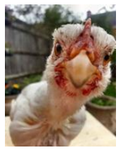
fagg federaal agentschap voor geneesmiddelen en gezondheidsproducten

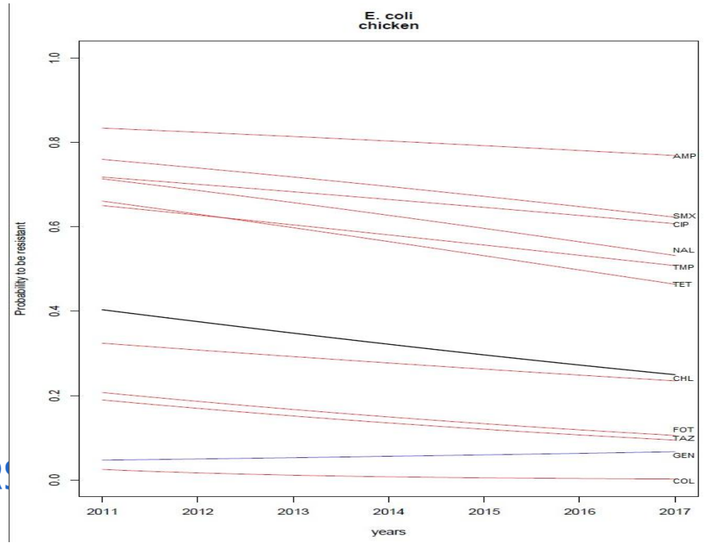
Antimicrobial Resistance in commensal *E. coli*

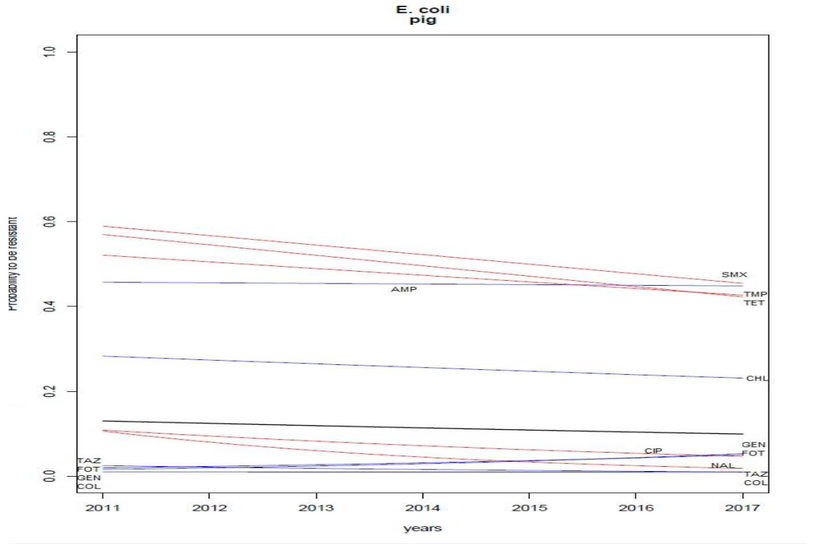
Trend analysis











What can we do about it?

GHENT UNIVERSITY

Replacing antimicrobials by:

- Improved feed
- Improved housing
- Feed additives
- Improved Biosecurity
- ….

GHENT
UNIVERSITY

What is biosecurity

BIOSECURITY

=

The combination of all measures taken to reduce the risk of introduction and spread of diseases on herd, region, country,… level

GHENT UNIVERSITY

What is biosecurity

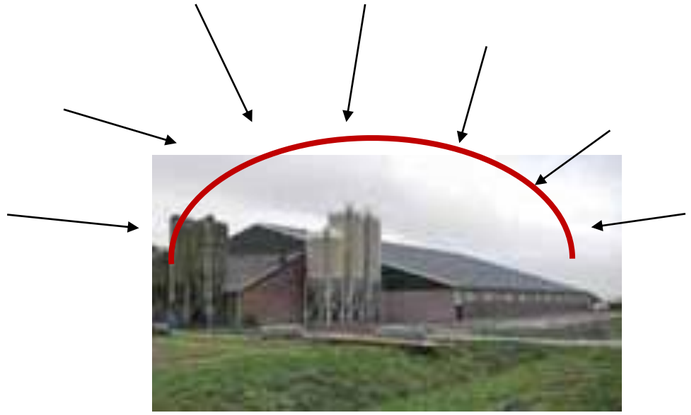
EXTERNAL BIOSECURITY

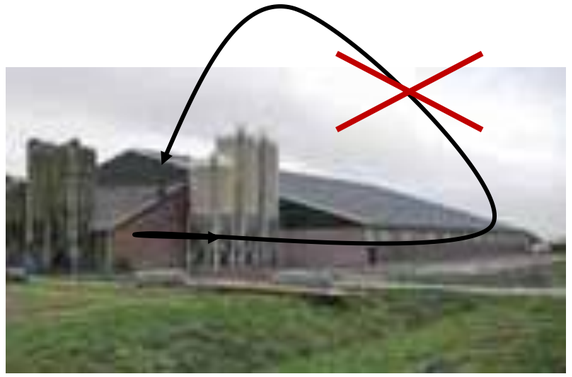
= Reduce introduction

- endemic diseases
- ”exotic” diseases

INTERNAL BIOSECURITY

= reduce spread





GHENT UNIVERSITY

biocheck .ugent

Why biosecurity

BIOSECURITY is (should be) the basis of any disease control program

GHENT UNIVERSITY

vbiocheck.ugent

PRINCIPLES OF BIOSECURITY

Separation of infectious and susceptible animals

→ avoid both direct and indirect contact!

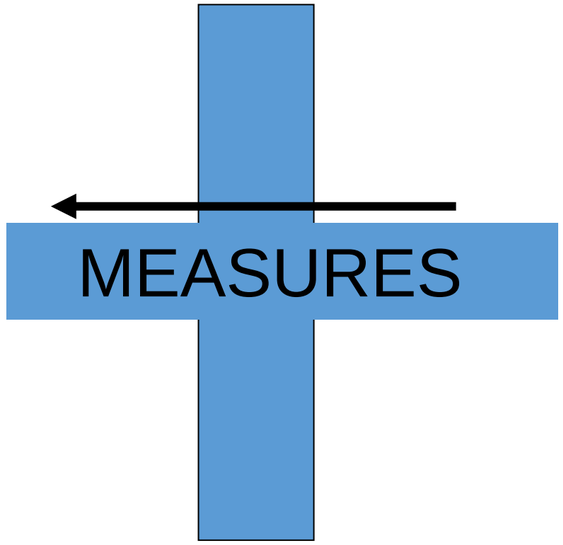
(all-in/all-out, working lines, hospital pen, …)

GHENT UNIVERSITY

biocheck.ugent

PRINCIPLES OF BIOSECURITY

CLEAN
(susceptible animals)



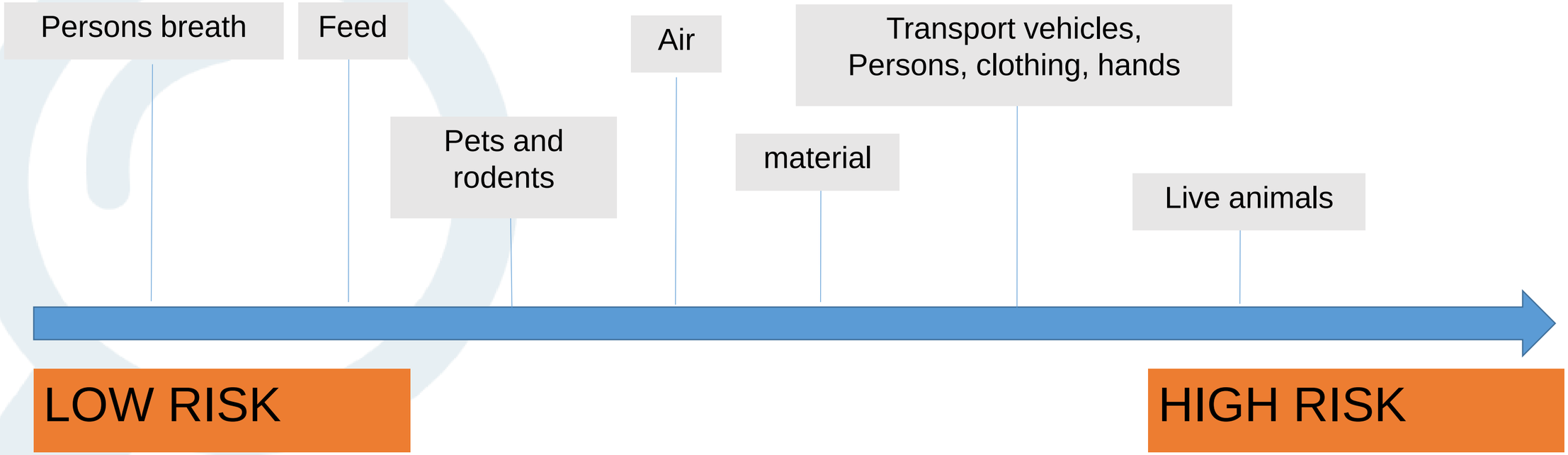
DIRTY
(direct and indirect
sources of infection)

- Dependent upon herd situation (status, type,…)
- Perform well and consequent

GHENT UNIVERSITY

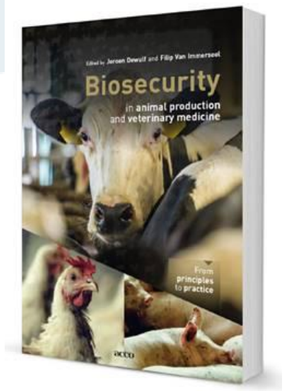
biocheck.ugent

PRINCIPLES OF BIOSECURITY



	Direct contact	Indirect contact									
		People	Semen	Manure	Domestic/feral animals	Rodents	Insects (Vectors)	Aerosol	Animal feed	Water	Fomites
Actinobacillus pleuropneumoniae	X				X			X		X	X
Bordetella bronchiseptica	X				X	X	X	X		X	X
Brachyspira hyodysenteriae	X	X		X	X	X	X		X	X	X
Brucella suis	X	X	X	X	X		X	X	X		
Classical swine fever virus	X	X	X	X	X		X	X	X		X
Clostridium perfringens	X			X			X	X		X	X
Erysipelothrix rhusiopathiae*	X			X	X	X			X	X	X
Escherichia coli	X	X		X	X	X	X	X	X	X	X
Foot-and-mouth disease virus	X	X	X	X	X			X	X	X	X
Haemophilus parasuis*	X				X						
Lawsonia intracellularis*	X			X	X	X	X				X
Leptospires	X	X	X		X	X				X	
Mycoplasma hyopneumoniae	X	X			X			X		X	X
Pasteurella multocida	X	X		X	X			X		X	X
Porcine circovirus type 2*	X		X	X	X	X	X		X	X	

	Direct contact	Indirect contact									
		People	Semen	Manure	Domestic/feral animals	Rodents	Insects (Vectors)	Aerosol	Animal feed	Water	Fomites
Porcine Epidemic diarrhea virus*	X	X		X	X			X	X		X
Porcine parvovirus	X		X	X	X	X				X	X
Porcine Reproductive and Respiratory Syndrome virus	X	X	X	X	X	X	X	X	X	X	X
Pseudorabies virus	X		X	X	X	X	X	X		X	X
Salmonella spp.	X	X		X	X	X	X	X	X	X	X
Streptococcus suis	X	X		X	X		X	X		X	X
Swine influenza virus	X	X		X	X			X			
Swine vesicular disease virus	X	X	X	X	X			X	X		X
Transmissible gastroenteritis virus	X	X		X	X		X				X



GHENT UNIVERSITY

Biosecurity in animal practice and Veterinary Medicine., 2018

biocheck.ugent

PRINCIPLES OF BIOSECURITY

Reduction of the general infection pressure

→ breaking the infection cycle, reducing the burden on the immune system↓

(cleaning, disinfection and empty period, vaccination, …)

PRINCIPLES OF BIOSECURITY

- Size matters

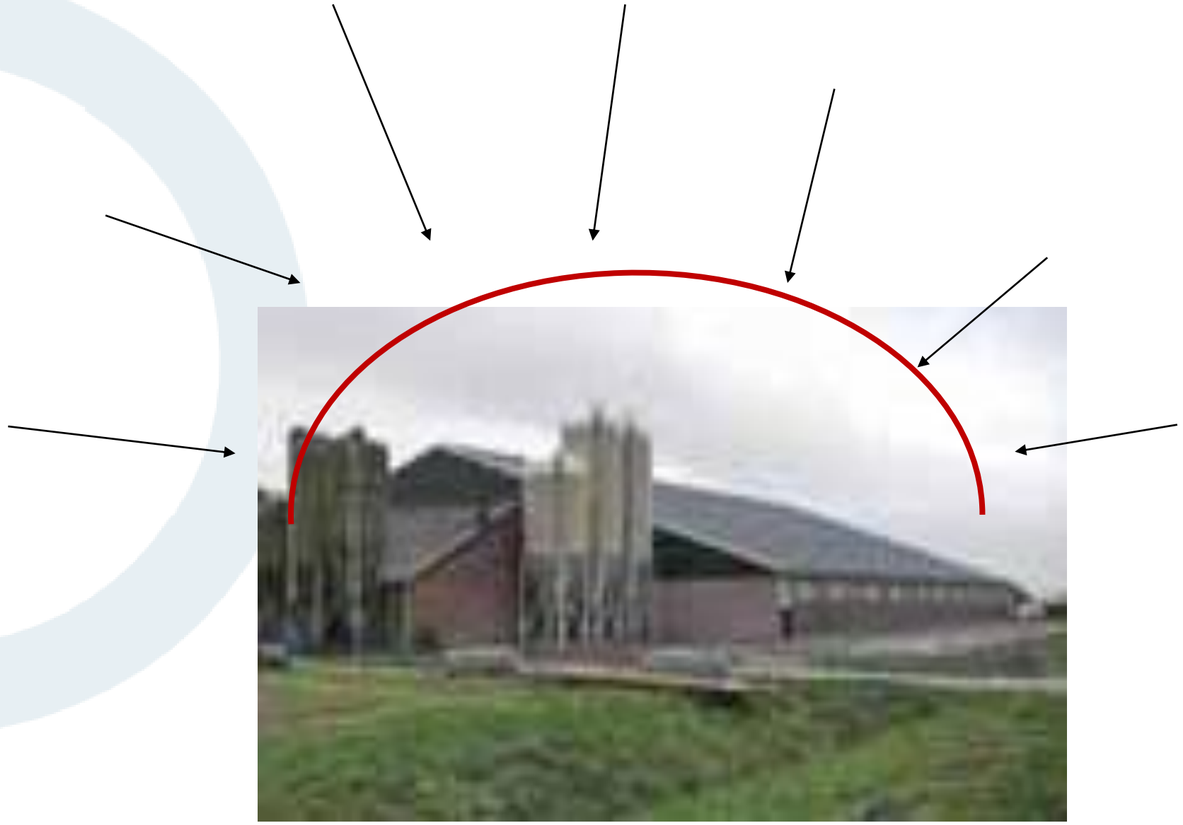
PRINCIPLES OF BIOSECURITY

- ‘Thousand times a small chance becomes a large chance’
  - Risk transmission route (p)
  - **Frequency transmission route (n)**
- $P = 1 – (1-p)^n$
  - p= 0.1% (1 out of 1000)
  - n= 52 (e.g. weekly)
    - **5,06%**= $1 – (1-0.001)^{52}$

GHENT UNIVERSITY

biocheck.ugent

External biosecurity

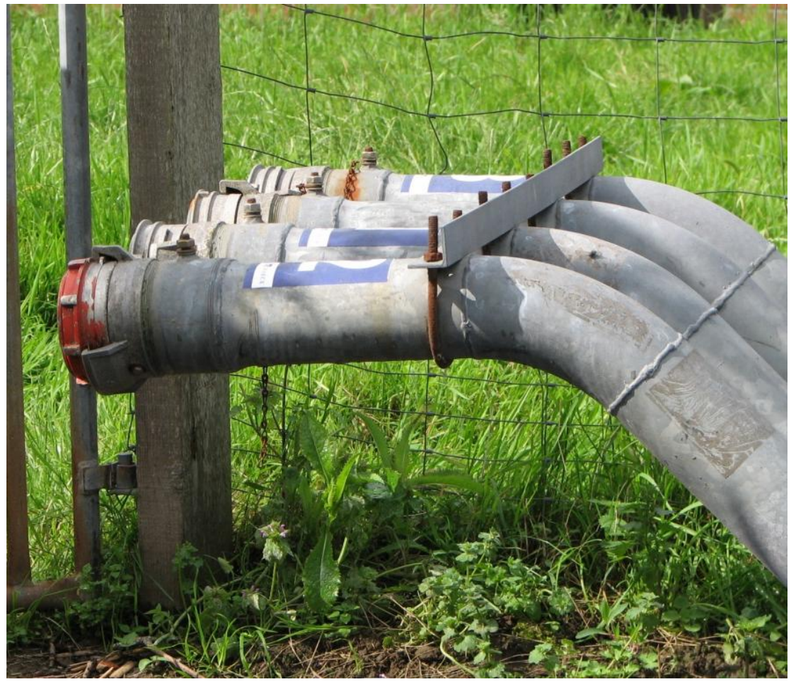


Structure of farm

GHENT UNIVERSITY

biocheck.ugent

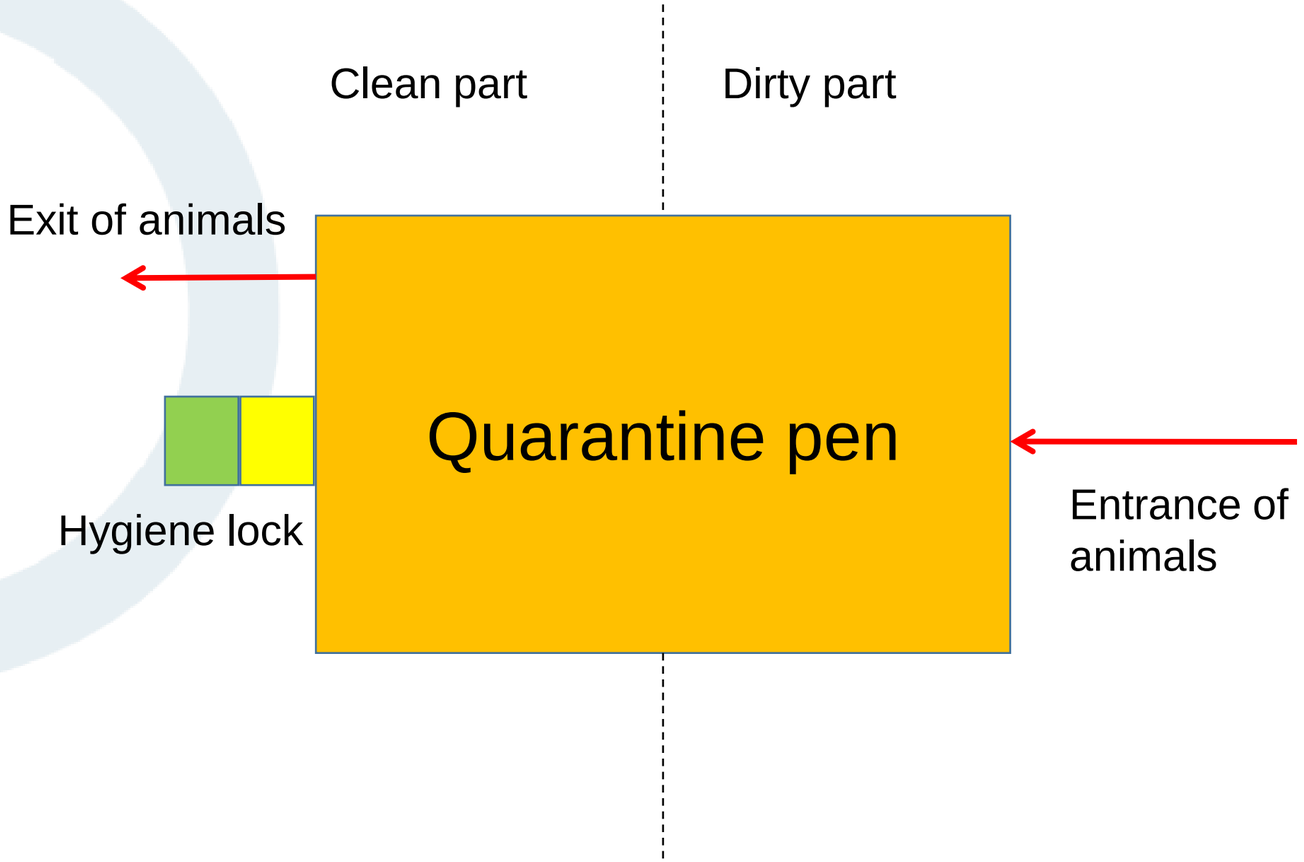
Structure of the farm



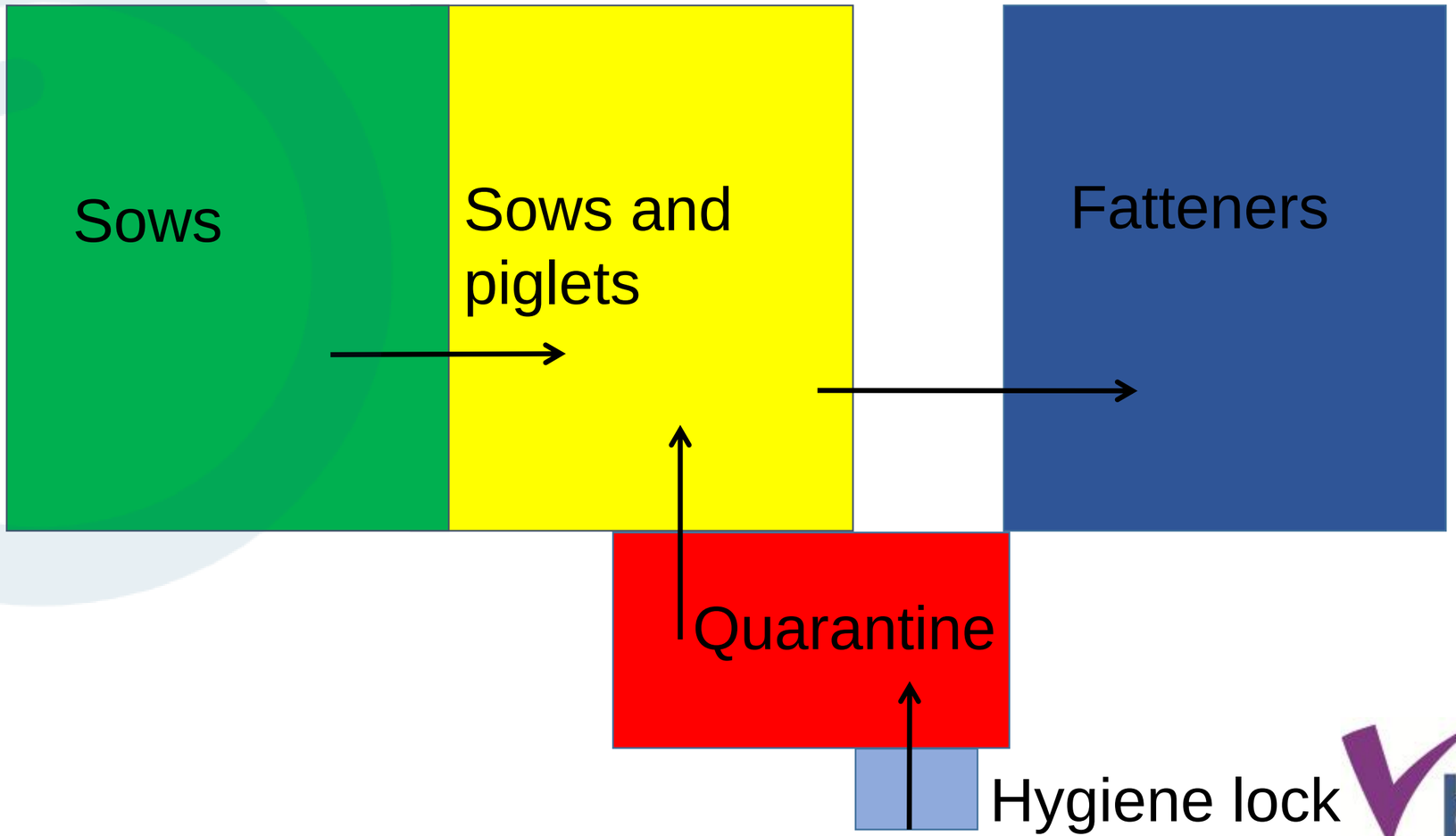
GHENT UNIVERSITY

biocheck .ugent

Quarentine


Clean part
Dirty part
Exit of animals
Quarantine pen
Hygiene lock
Entrance of animals

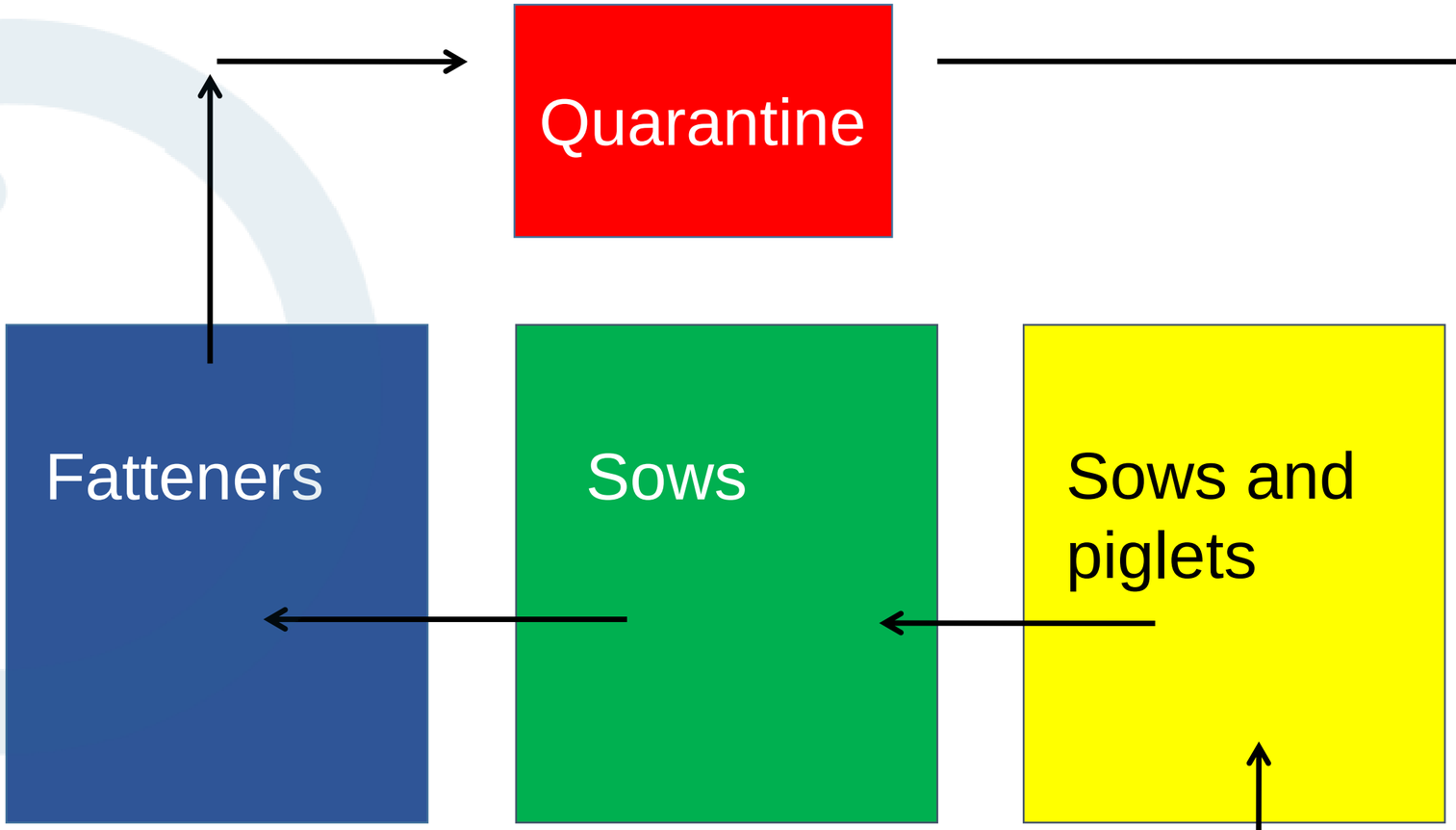
Quarantine



GHENT UNIVERSITY

biocheck.ugent

Quarentine



GHENT UNIVERSITY

biocheck.ugent

Purchase of semen

GHENT UNIVERSITY

biocheck.ugent

Disposal of animals and material

GHENT UNIVERSITY

biocheck.ugent

Manure

Storage of cadavers

GHENT UNIVERSITY

biocheck .ugent

Storage of cadavers

GHENT UNIVERSITY

biocheck.ugent

Supply of feed, water and goods

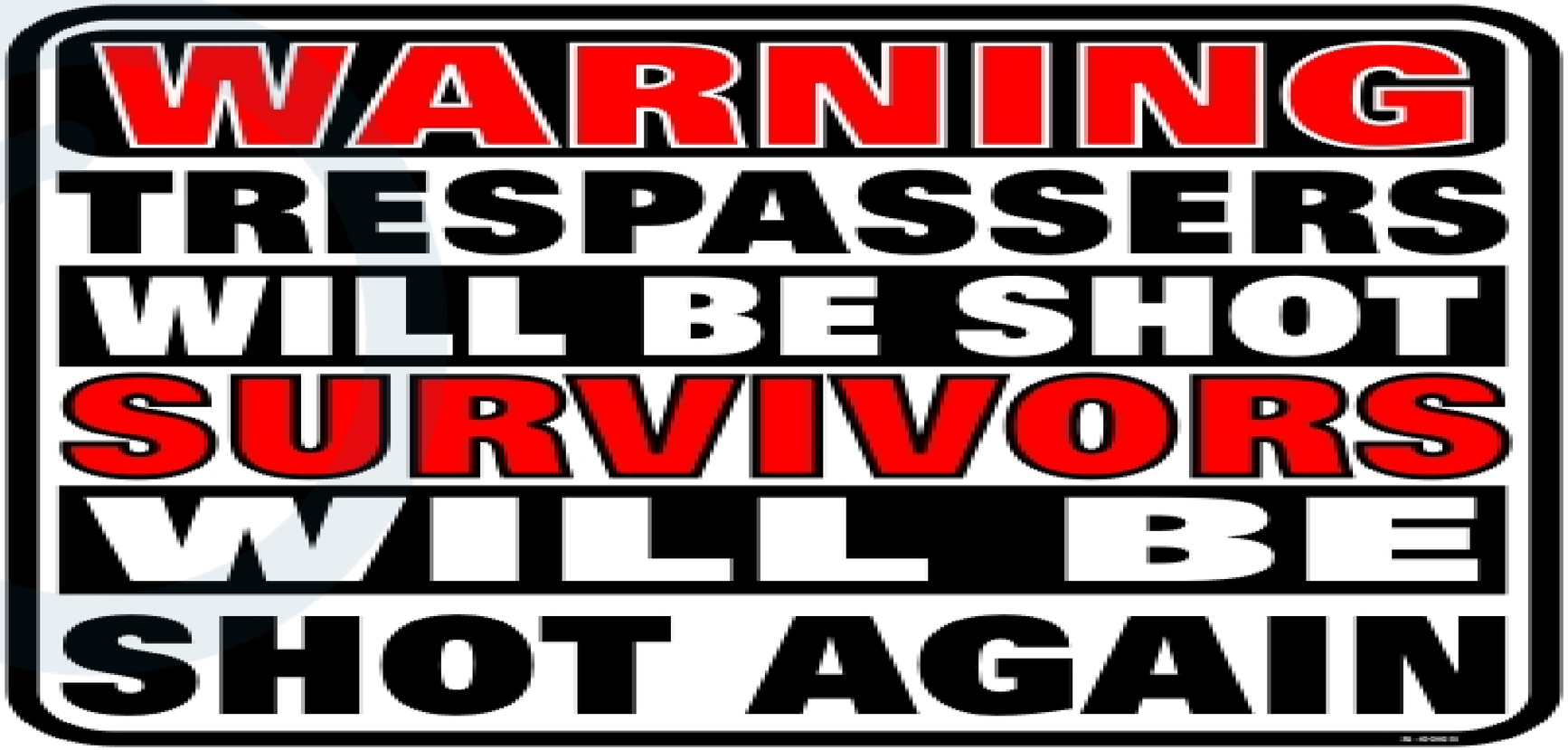
- Hygiene measures
- Control of drinking water

GHENT UNIVERSITY

biocheck.ugent

Entrance control

Entrance control



GHENT UNIVERSITY

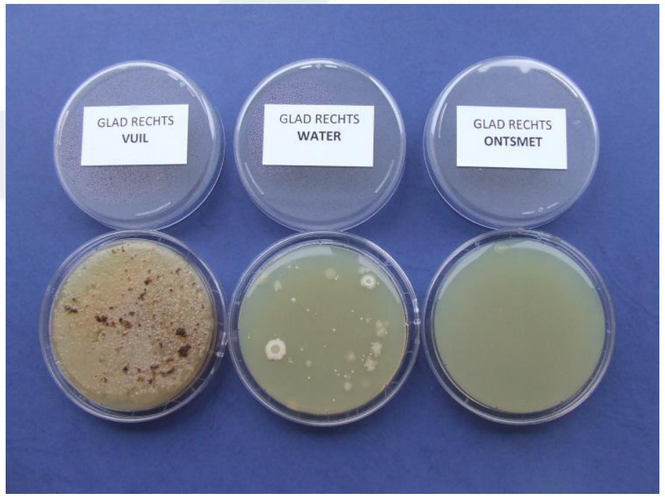
biocheck .ugent

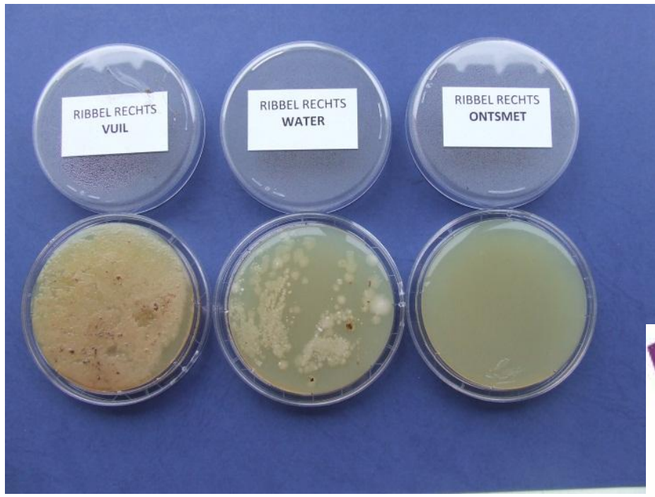
Footware and clothing

GHENT UNIVERSITY

bioscheck .ugent

Footware and clothing

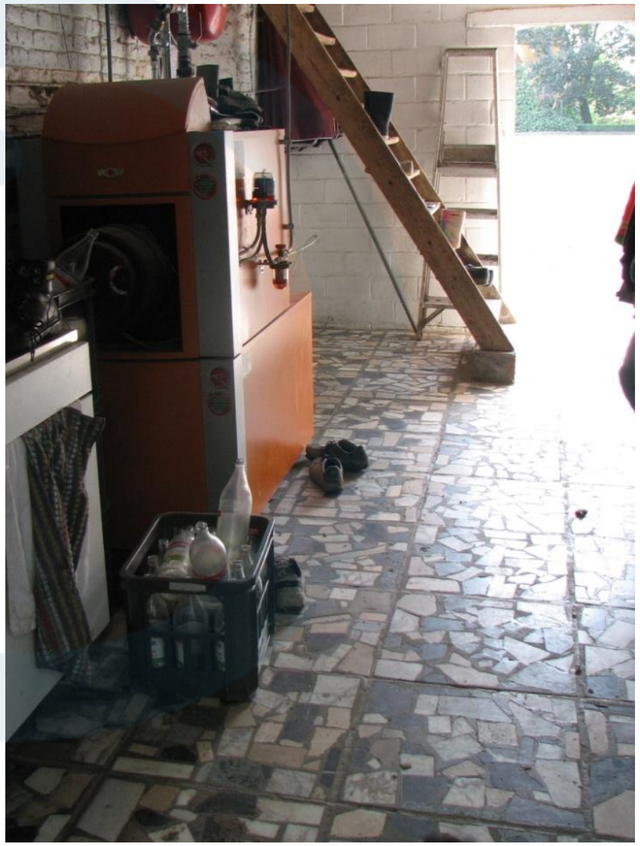




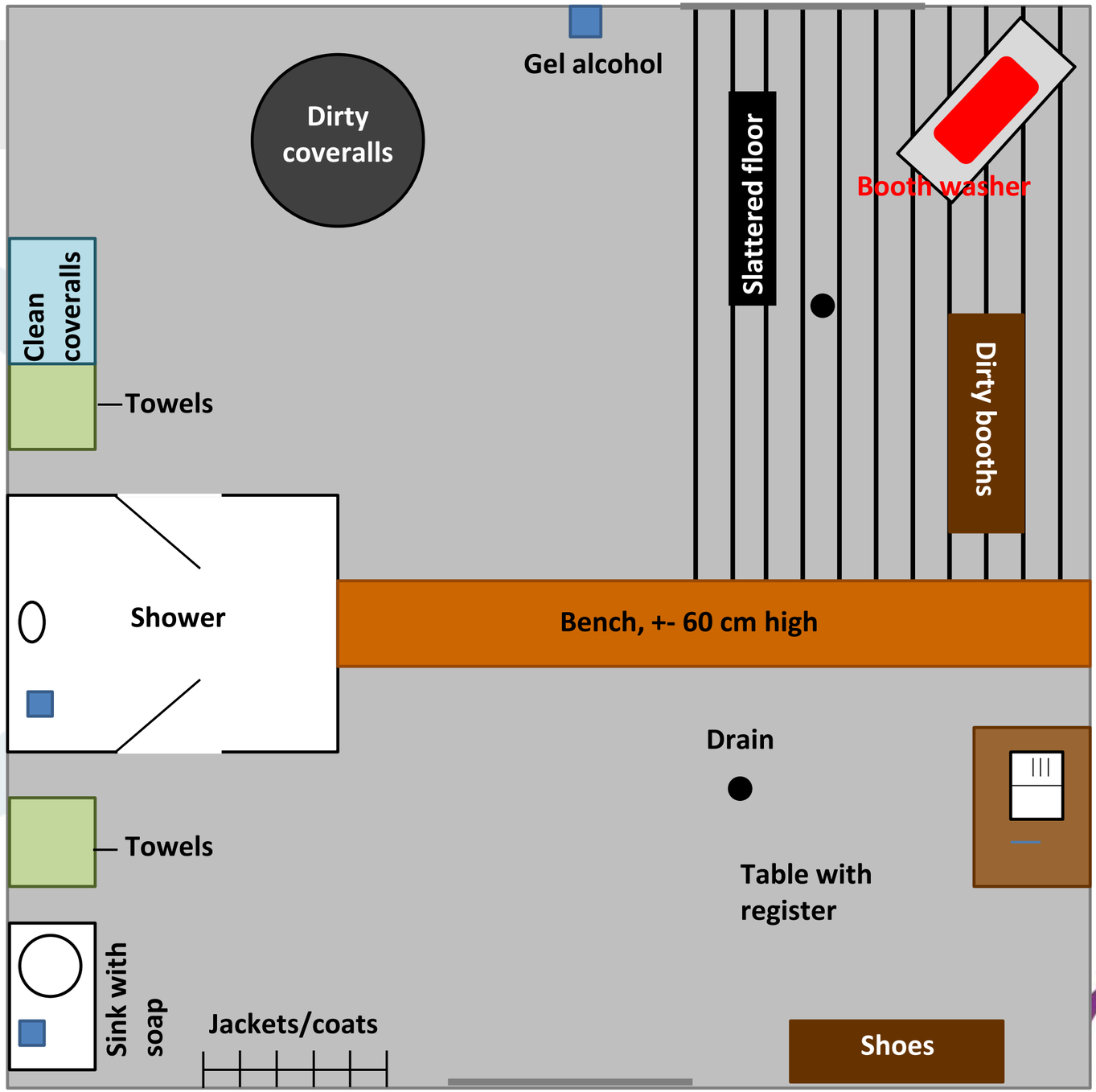
GHENT UNIVERSITY

biocheck.ugent

Hygiene lock



Hygiene lock

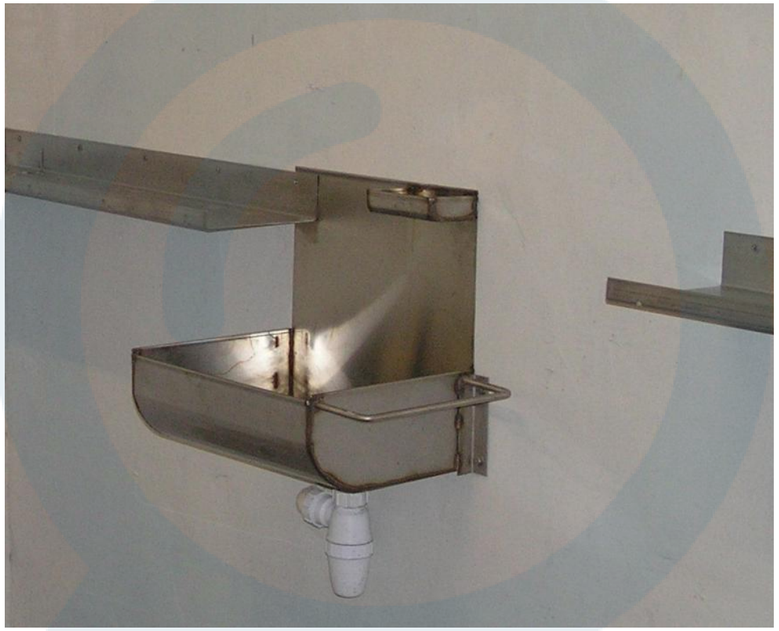


GHENT UNIVERSITY

biocheck.ugent

Hand washing

Hand washing



GHENT UNIVERSITY

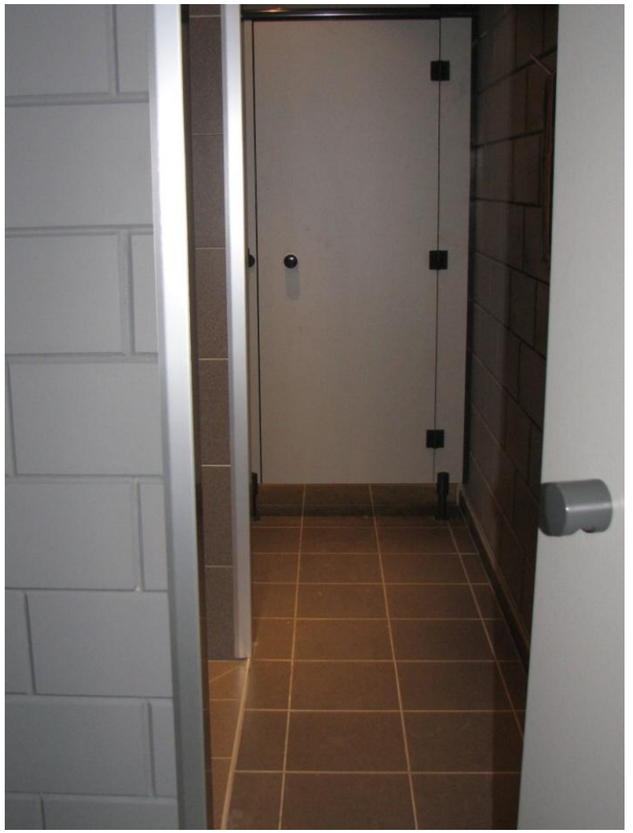
biocheck.ugent

Hygiene lock

GHENT UNIVERSITY

biocheck.ugent

Hygiene lock



GHENT UNIVERSITY

biocheck.ugent

Vermin and bird control

GHENT UNIVERSITY

biocheck.ugent

Vermin and bird control

GHENT UNIVERSITY

biocheck.ugent

Vermin and bird control

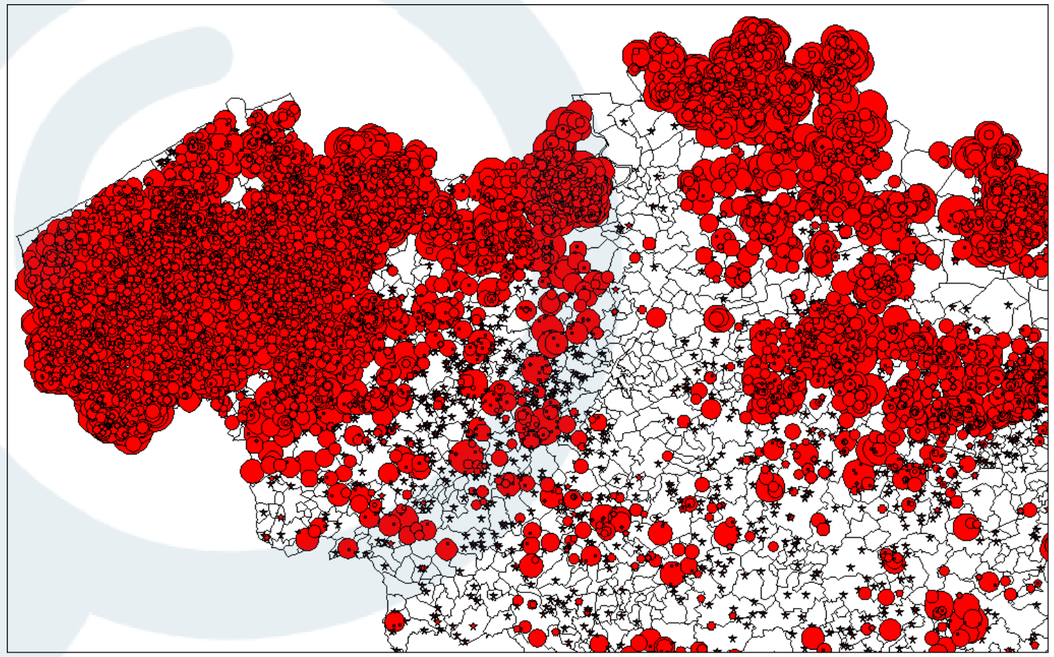
- Avoid shelter for rats close to the stables

GHENT UNIVERSITY

biocheck.ugent

Vermin and bird control

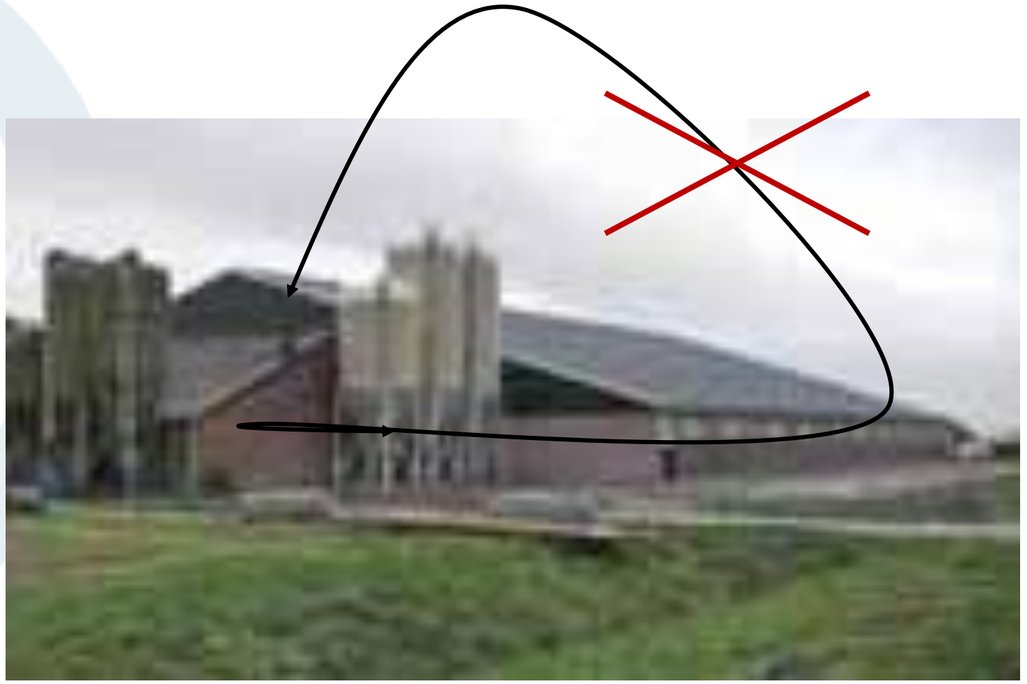
Location and surrounding



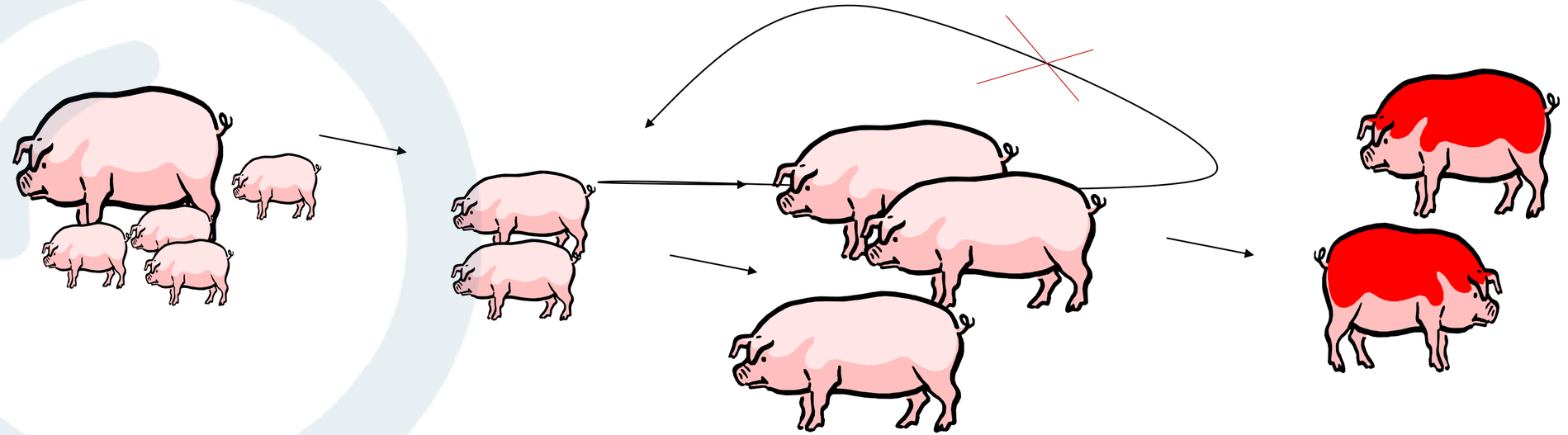
GHENT UNIVERSITY

biocheck.ugent

Internal biosecurity



Never put diseased animals back



Avoid mixing of piglets

Suckling pen

Suckling pen

1 week of age

Piglets after weaning

fatteners

12%

12%

90%

95%

GHENT UNIVERSITY

biocheck.ugent

Avoid mixing of piglets

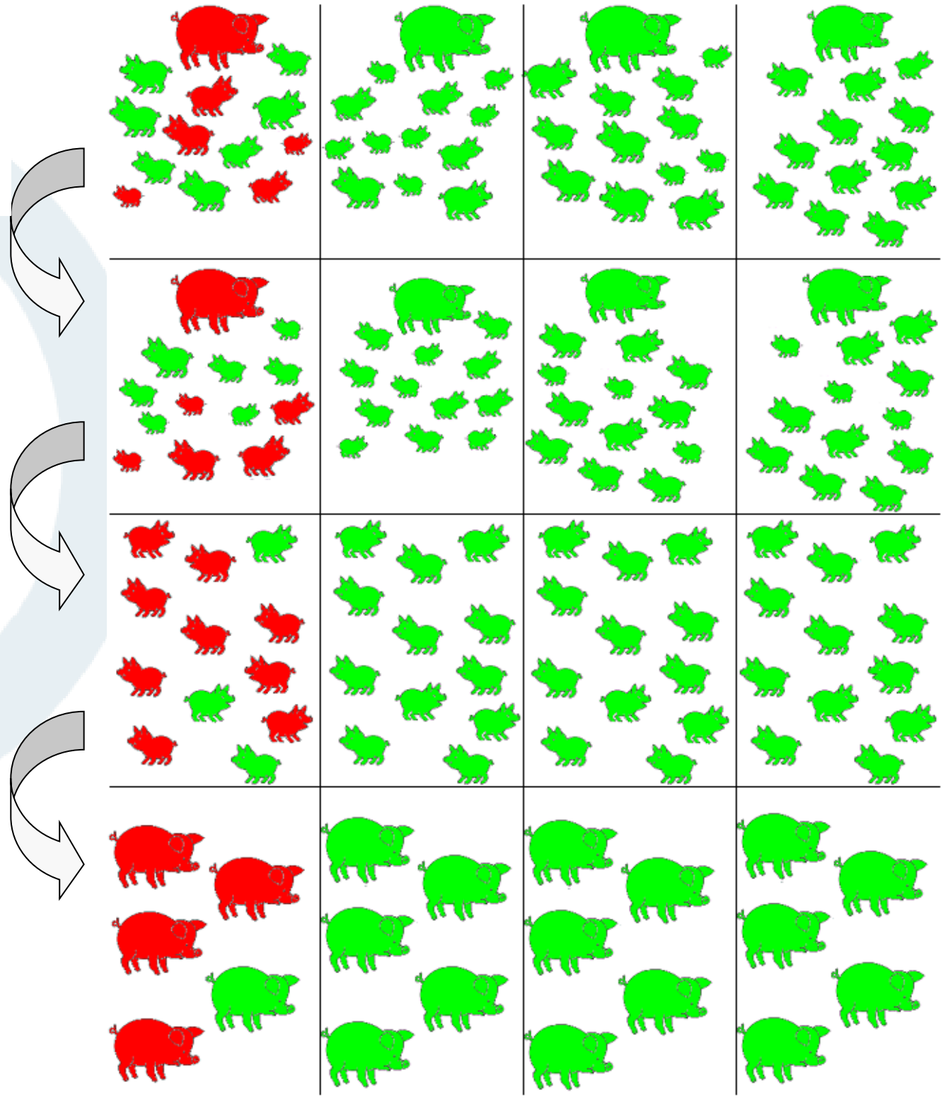
Suckling pen

Suckling pen

1 week of age

Piglets after weaning

fatteners



12%

12%

19%

20%

GHENT UNIVERSITY

biocheck.ugent

Avoid mixing

GHENT UNIVERSITY

biocheck.ugent

All-in / All-out

GHENT UNIVERSITY

biocheck.ugent

Stocking density

Average animal weight(kg)	Min according to the EU legislation (in m²) per animal (Council directive 18/12/08)	Requirements in the Netherlands (in m²) per animal	Optimal stocking density (in m²) per animal (EFSA report 2005*)
< 10 kg	0,15	Up to 15 kg: 0,2	0,17
10 to 20 kg	0,20	15-30 kg: 0,3	0,27
20 to 30 kg	0,30		0,35
30 to 50 kg	0,40	0,5	0,49
50 to 85 kg	0,55	0,65	0,70
85 to 110 kg	0,65	0,8	0,83
>110 kg	1	1	1

GHENT UNIVERSITY

bioccheck .ugent

Compartments and working lines

GHENT UNIVERSITY

biocheck .ugent

Compartments and working lines

GHENT UNIVERSITY

biocheck.ugent

Compartments and working lines

GHENT UNIVERSITY

biocheck.ugent

Pets

GHENT UNIVERSITY

biocheck.ugent

Materials

GHENT UNIVERSITY

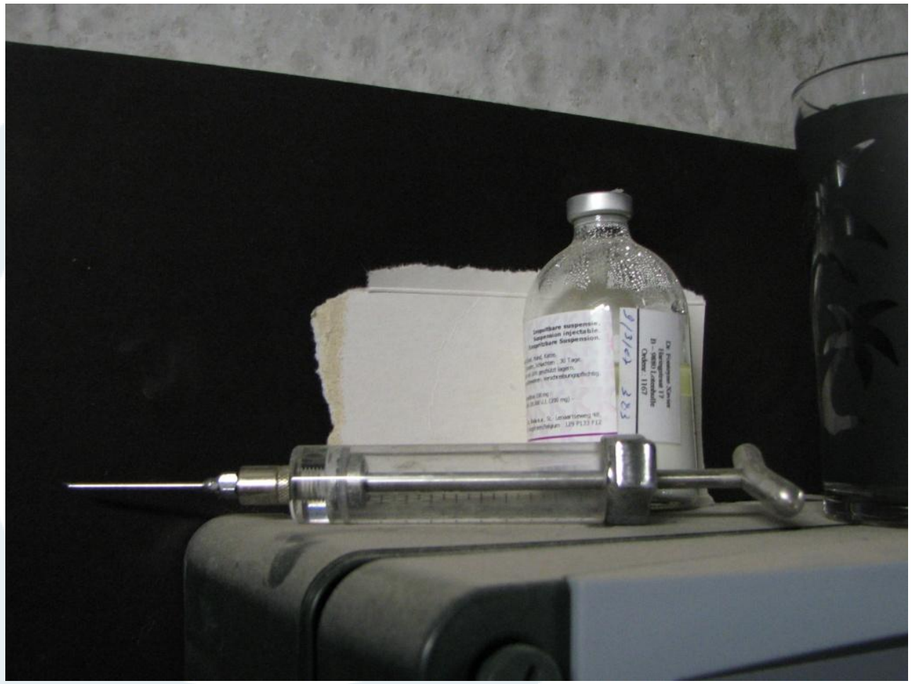
biocheck .ugent

Materials

GHENT UNIVERSITY

biocheck.ugent

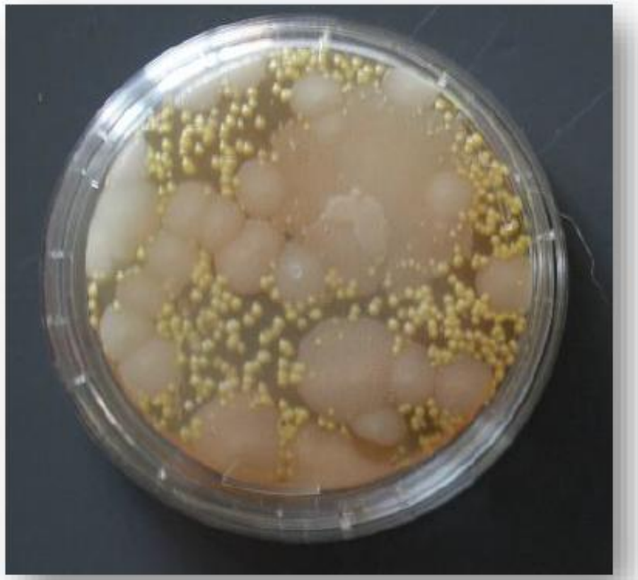
Medicines and needles



Medicines and needles

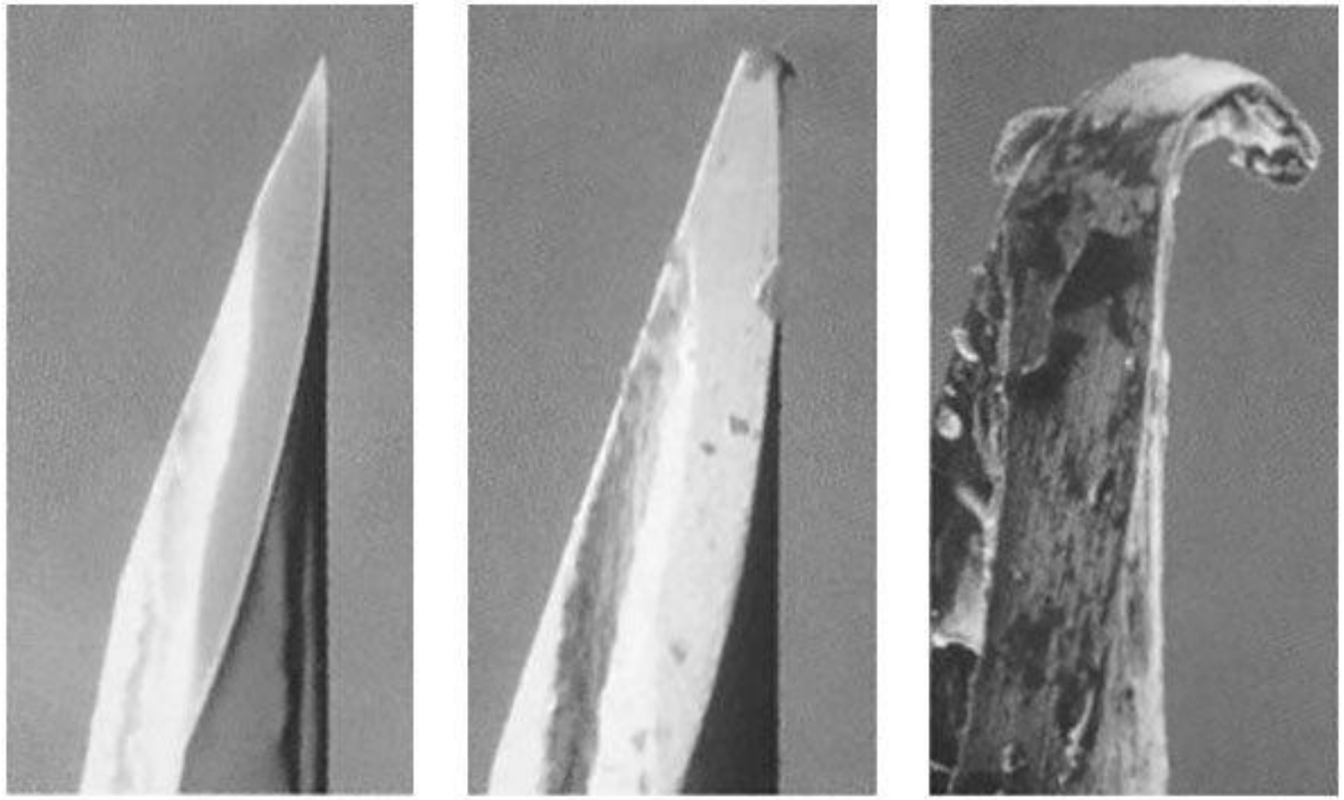
MATERIAAL & METHODEN

- 5 nieuwe vaccinatie spuiten
- 79 gebruikte vaccinatie spuiten (BE 51, NL 28)
- Spuiten doorspoelen met 5 ml *aqua ad iniectabilia* (solvent Gestavet 600®)
- Uitplaten DGZ Vlaanderen → Kiemtelling 37°C & gisten/schimmel telling (KVE/ml)



Bron: Annelies Michiels

Medicines and needles



https://www.pig333.com/articles/drugs-and-needle-sticks-present-unintended-health-hazards_12915/

GHENT UNIVERSITY

bioscheck .ugent

Medicines and needles

GHENT UNIVERSITY

biocheck.ugent

Cleaning and desinfection

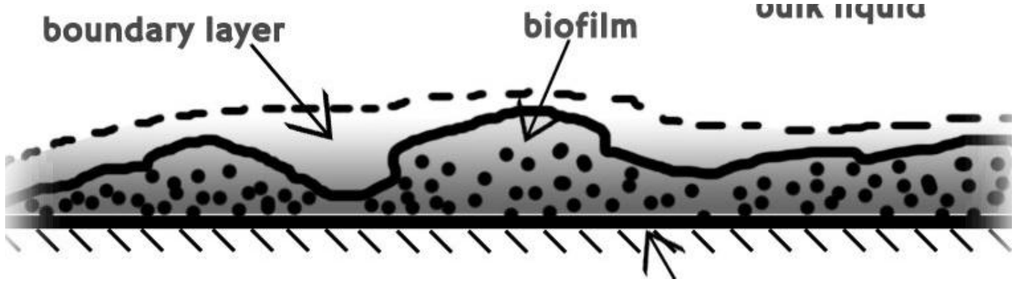
Good cleaning and disinfection requires a full protocol!

Cleaning and disinfection

1. dry cleaning and removal of all organic material

Cleaning and disinfection

2. soaking of all surfaces to loosen all remaining organic material



GHENT UNIVERSITY

biocheck.ugent

Cleaning and disinfection

3. high pressure cleaning with water to remove all dirt

GHENT UNIVERSITY

biocheck.ugent

Cleaning and disinfection

4. drying of the stable to avoid dilution of the disinfectant

GHENT UNIVERSITY

biocheck .ugent

Cleaning and disinfection

5. disinfection of the stable

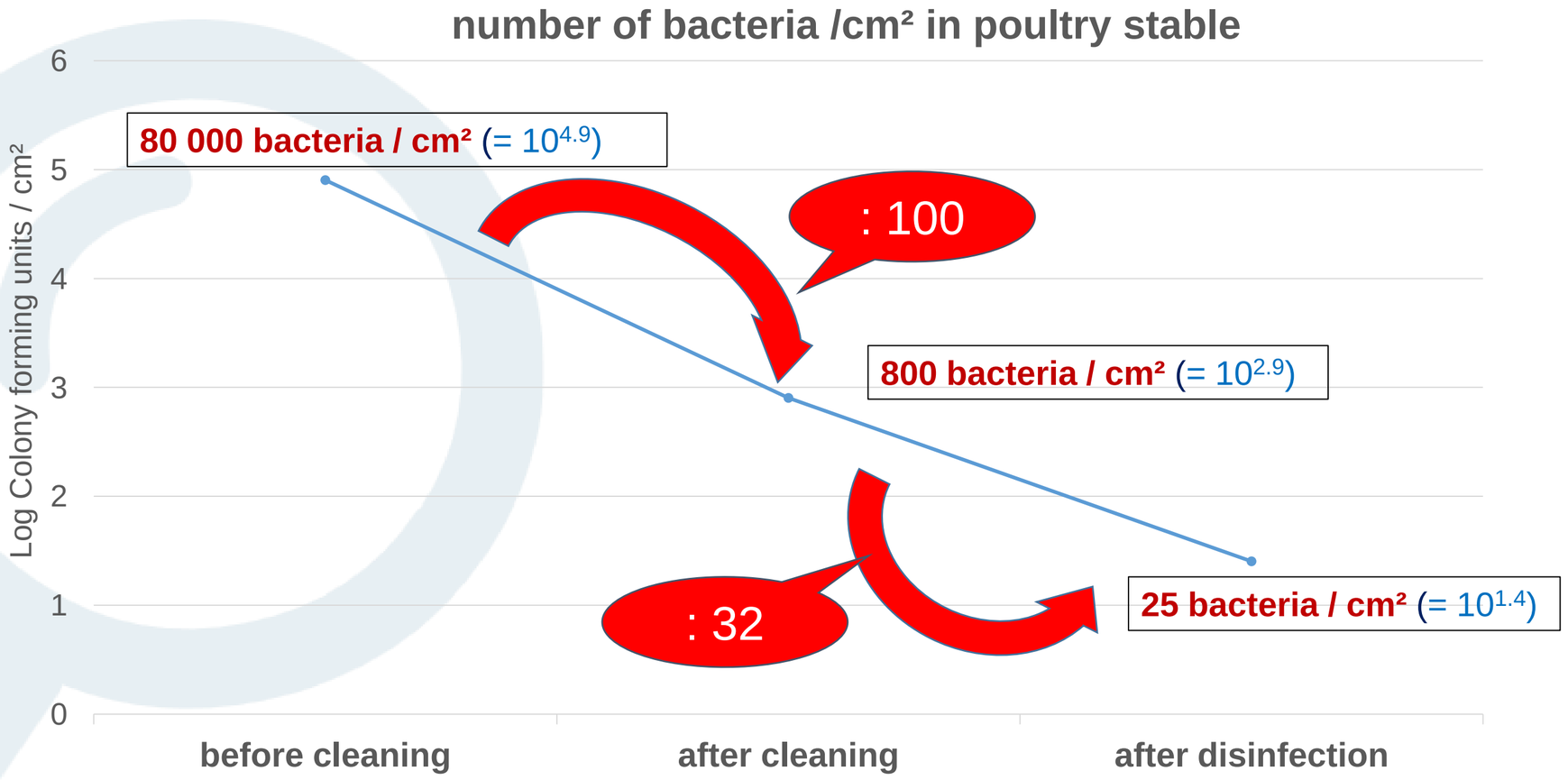
Cleaning and disinfection

6. drying of the stable

GHENT UNIVERSITY

biocheck .ugent

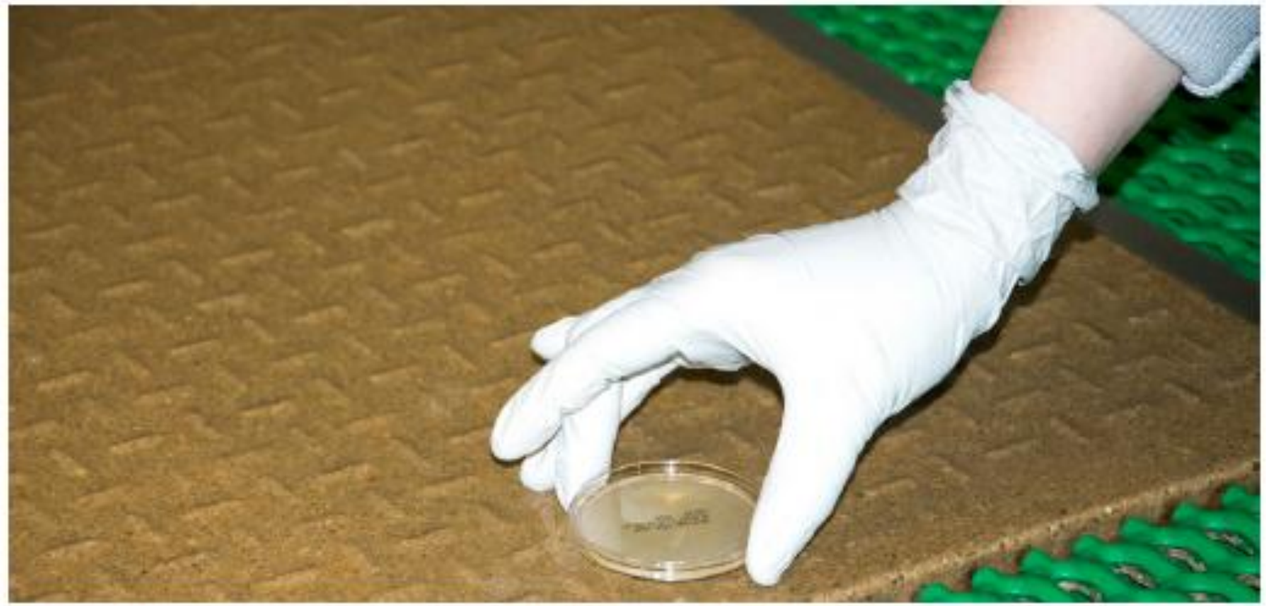
Cleaning and disinfection



Luyckx et al. 2015

Cleaning and disinfection

7. Testing of efficacity



Score	KVE per plaat
0	0
1	1-40
2	41-120
3	121-400
4	> 400
4	ontelbaar

GHENT UNIVERSITY

bipocheck .ugent

Biosecurity = complex

- No protocol suitable for every herd
- Balance biosecurity – management
- Tool?

→ **Scoring System**

GHENT UNIVERSITY

Scoring system and website Pigs and Poultry

GHENT UNIVERSITY

GHENT UNIVERSITY

biocheck .ugent

Home UGent | In het Nederlands | 中文

MY BIOCHECK | START THE BIOCHECK | ABOUT BIOCHECK | NEWSLETTER | WORLDWIDE | AUDIT | RESEARCH | INFO & LINKS | CONTACT

BIOCHECK.UGent, prevention is better than cure!

Welkom!

Biocheck.UGent is a risk-based scoring system to evaluate the quality of your on-farm biosecurity in an scientific and independent way.

Fill in the online **questionnaire** for free and receive valuable feedback about the biosecurity level of your farm. You get a summarizing and personal report with detailed results. These findings can help you to choose your own suitable biosecurity pathway.

Don't hesitate and get started to lift your farm to a higher biosecurity level!

Start the Biocheck.UGent! | How to use Biocheck.UGent?

The Biocheck.UGent was filled in **11498** times around the world to evaluate the on-farm biosecurity level!

8309 # 2716 # 473

In the spotlight

07-02-2018
"Biosecurity in animal production and veterinary medicine (from principles to practice)" now available for purchase!

20-11-2018
New presentation available about the Biocheck.UGent tool!

Agenda

APRIL 02 — Webinar MSD on the importance of biosecurity in control of pig diseases

Biocheck.UGent considers the data provided by you, after this referred to as your data, as confidential information. Filling in this questionnaire gives implicit permission to the Faculty of Veterinary Medicine of Ghent University to use your data, analyzed anonymously, for scientific cause. All services offered can be used without disclosing personal information (e.g.

GHENT UNIVERSITY

BIOCHECK.UGENT = ONLINE QUESTIONNAIRE

D. PURCHASE OF PIGLETS

10. Are piglets being purchased?
    - Yes
    - No *(go to question 15)*

11. Are the piglets coming from the same supplier or from different suppliers?
    - Always same supplier
    - Different suppliers

12. Is attention paid to the health status of the farm, where the animals are originating from, to be equal or higher than the own farm?

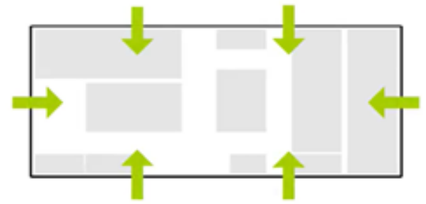
    Herd with a known health status = herd that is free of a number of important diseases (e.g. Scabies, PRRS, …) and therefore guarantees that the delivered products (animals/semen) are also free of these diseases.

    - Yes, always higher or equal
    - No

13. Are hygienic criteria (e.g. cleaning and disinfection) posed on the transport vehicle that brings the animals to the farm?
    - Yes
    - No
    - Not known

GHENT UNIVERSITY

EXTERNAL BIOSECURITY (50)



Subcategory	Weight factor
Purchase of animals and semen	24
Transport of animals, removal of manure and dead animals	23
Feed, water and equipment supply	15
Personnel and visitors	17
Vermin and bird control	11
Environment and region	10

GHENT UNIVERSITY

biocheck .ugent

INTERNAL BIOSECURITY (50)

Subcategory	Weight factor
Disease management	10
Farrowing and suckling period	14
Nursery unit	14
Fattening unit	14
Measures between compartments and the use of equipment	28
Cleaning and disinfection	20

GHENT UNIVERSITY

biocheck.ugent

GHENT UNIVERSITY

BIOCHECK.UGENT

ID: *20388/691653/v2_1/F*
Entry date: *2019-03-10 13:22:08*
Identification:

PIG

Nr	Description	Score	Country average	Global average
External biosecurity				
A	Purchase of animals and semen	100 %	88 %	89 %
B	Transport of animals, removal of manure and dead animals	41 %	70 %	70 %
C	Feed, water and equipment supply	27 %	38 %	50 %
D	Personnel and visitors	41 %	64 %	68 %
E	Vermin and bird control	50 %	64 %	67 %
F	Environment and region	60 %	53 %	64 %
	Subtotal External biosecurity:	***57 %***	***66 %***	***70 %***
Internal biosecurity				
A	Disease management	40 %	56 %	67 %
B	Farrowing and suckling period	64 %	59 %	56 %
C	Nursery unit	36 %	65 %	66 %
D	Fattening unit	N/A	72 %	67 %
E	Measures between compartments and the use of equipment	39 %	44 %	48 %
F	Cleaning and disinfection	20 %	48 %	59 %
	Subtotal Internal biosecurity:	***38 %***	***55 %***	***58 %***
N/A = Not applicable	**Total:**	**48 %**	**61 %**	**64 %**

GHENT UNIVERSITY

GHENT UNIVERSITY

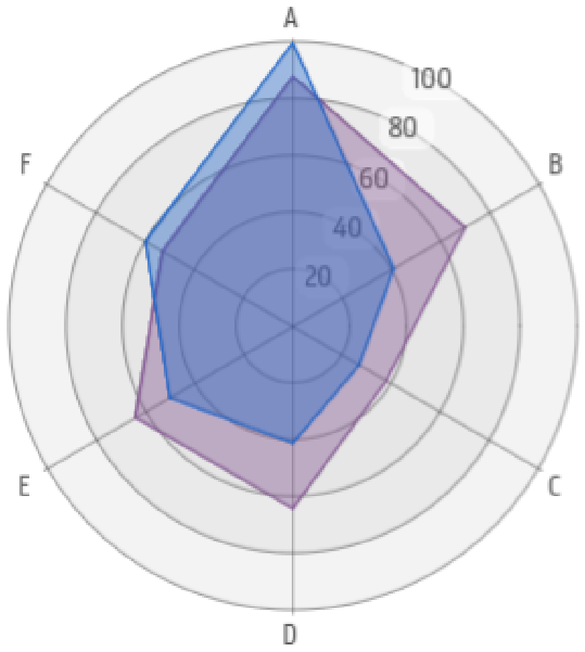
BIOCHECK.UGENT

ID: 20388/691653/v/2_1/F
Entry date: 2019-03-10 13:22:08
Identification:

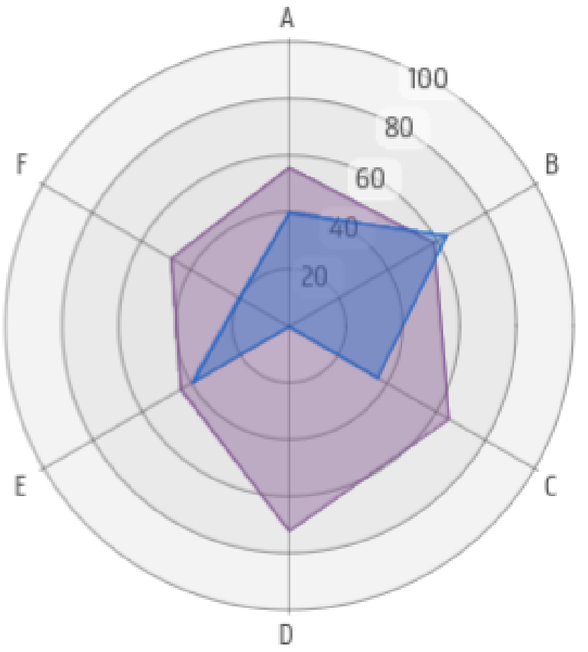
PIG

These figures show **your results** graphically compared to the **average scores**. The bigger the blue area, the better your result. The letters of the axes correspond to the numbering in the report above.

External biosecurity



Internal biosecurity

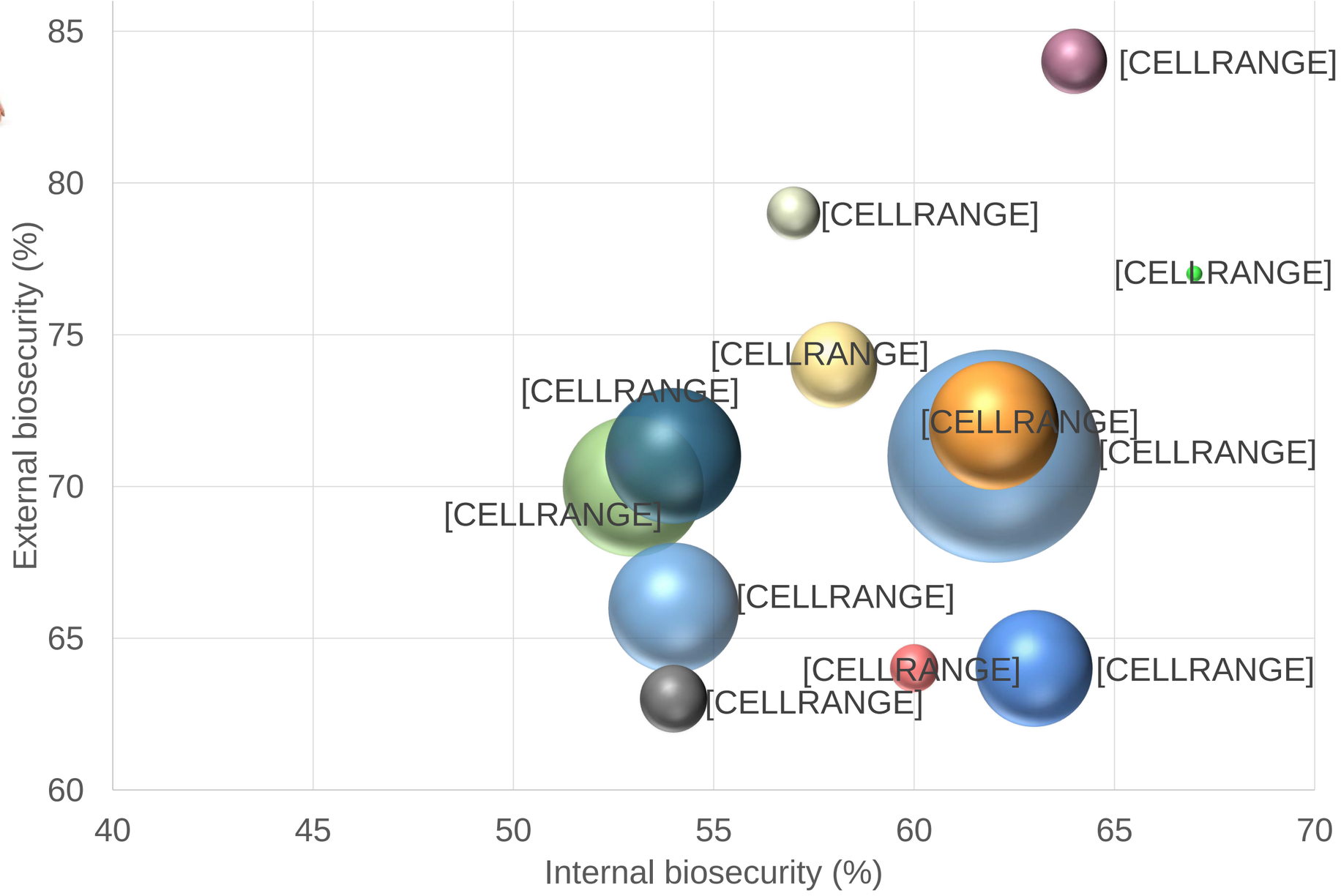


% Score *% Average*

GHENT UNIVERSITY

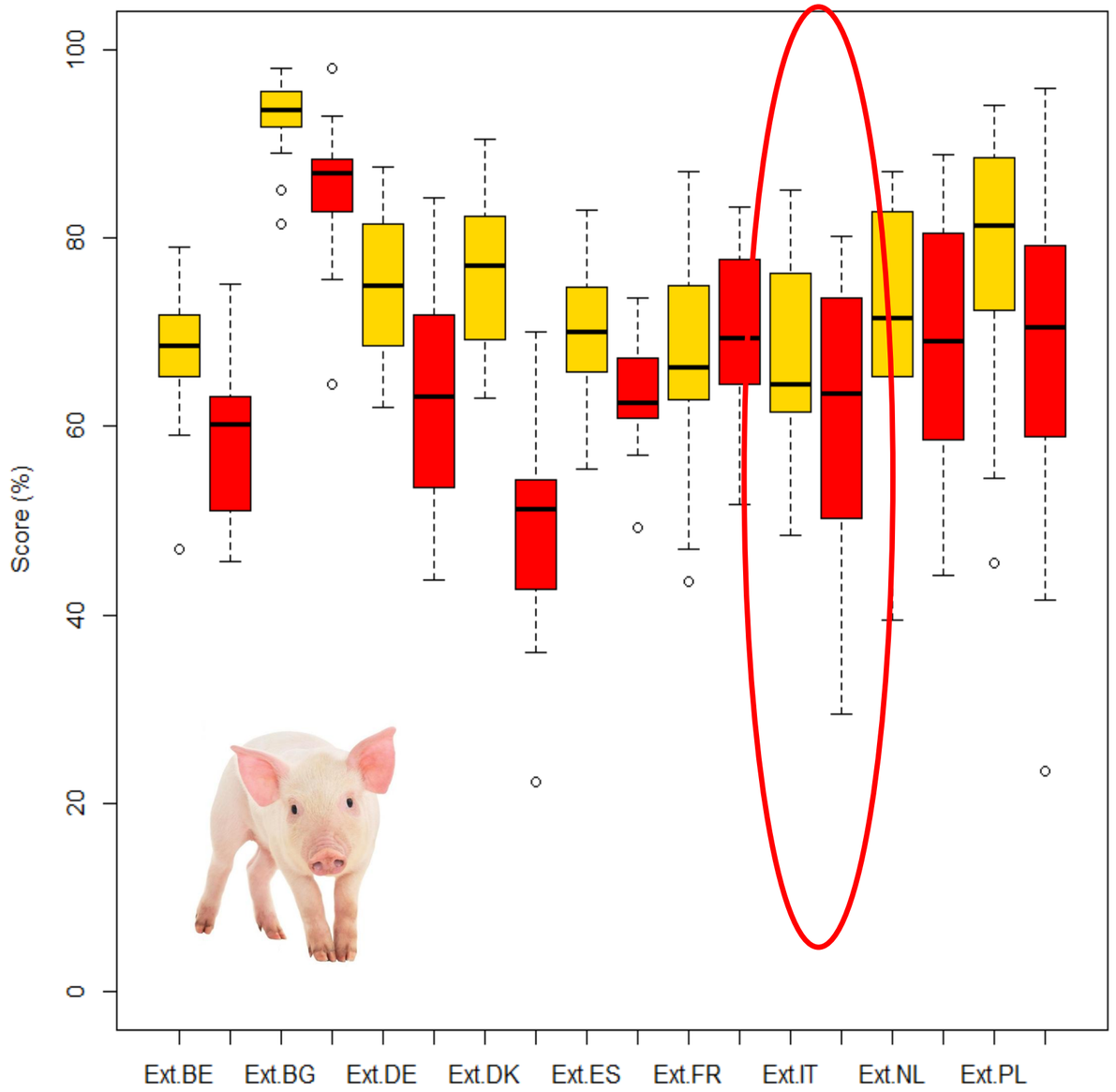
For more information about biosecurity on a pig farm and how to improve this, you can always look at the extensive information available on the **Biocheck.UGent website** in the sections "about biocheck" and "downloads and links". You can also contact your veterinarian for advice on biosecurity measures on your farm.

Biocheck.UGent Worldwide



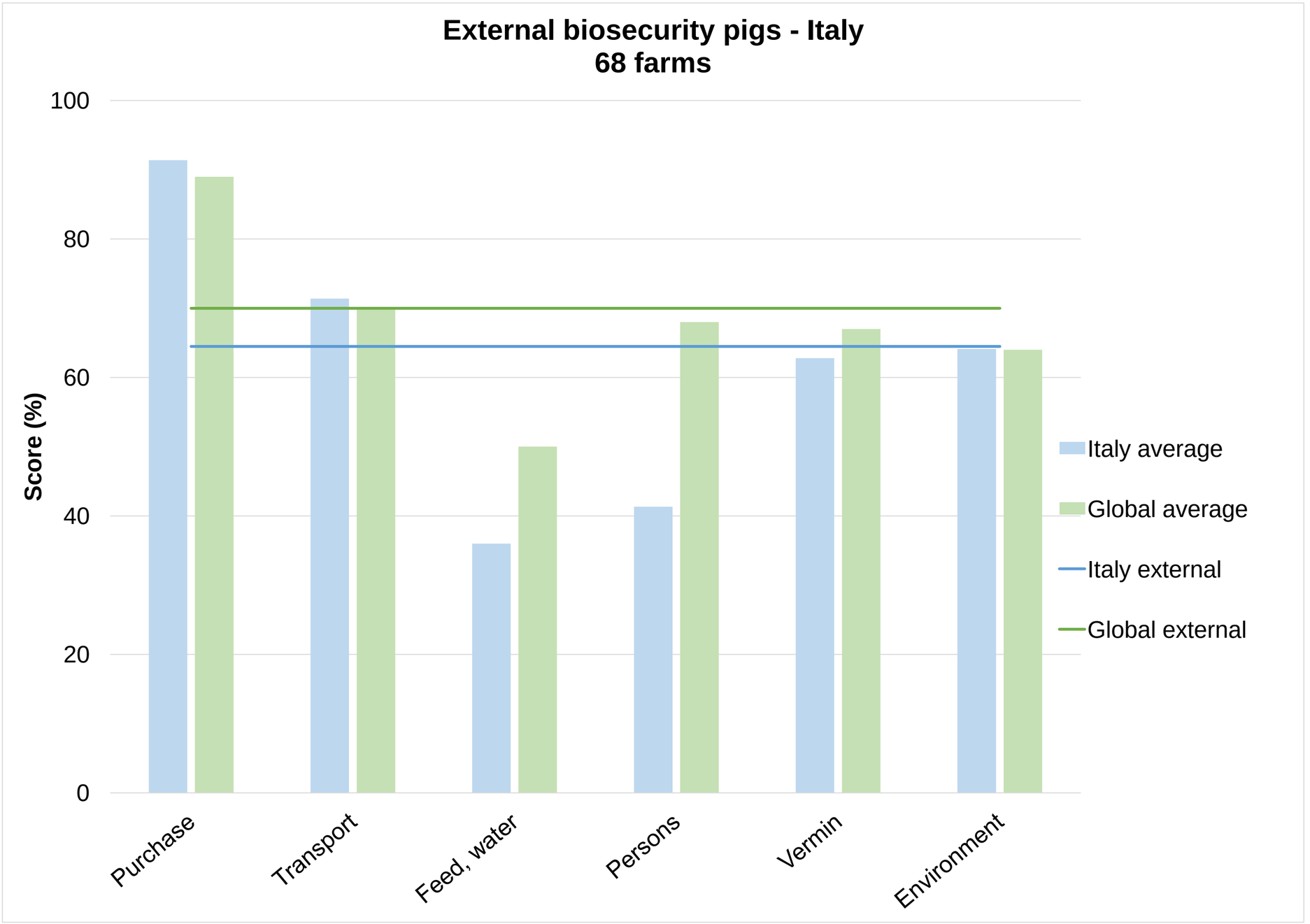
GHENT UNIVERSITY

COUNTRY-LEVEL COMPARISON OF EXTERNAL AND INTERNAL BIOSECURITY

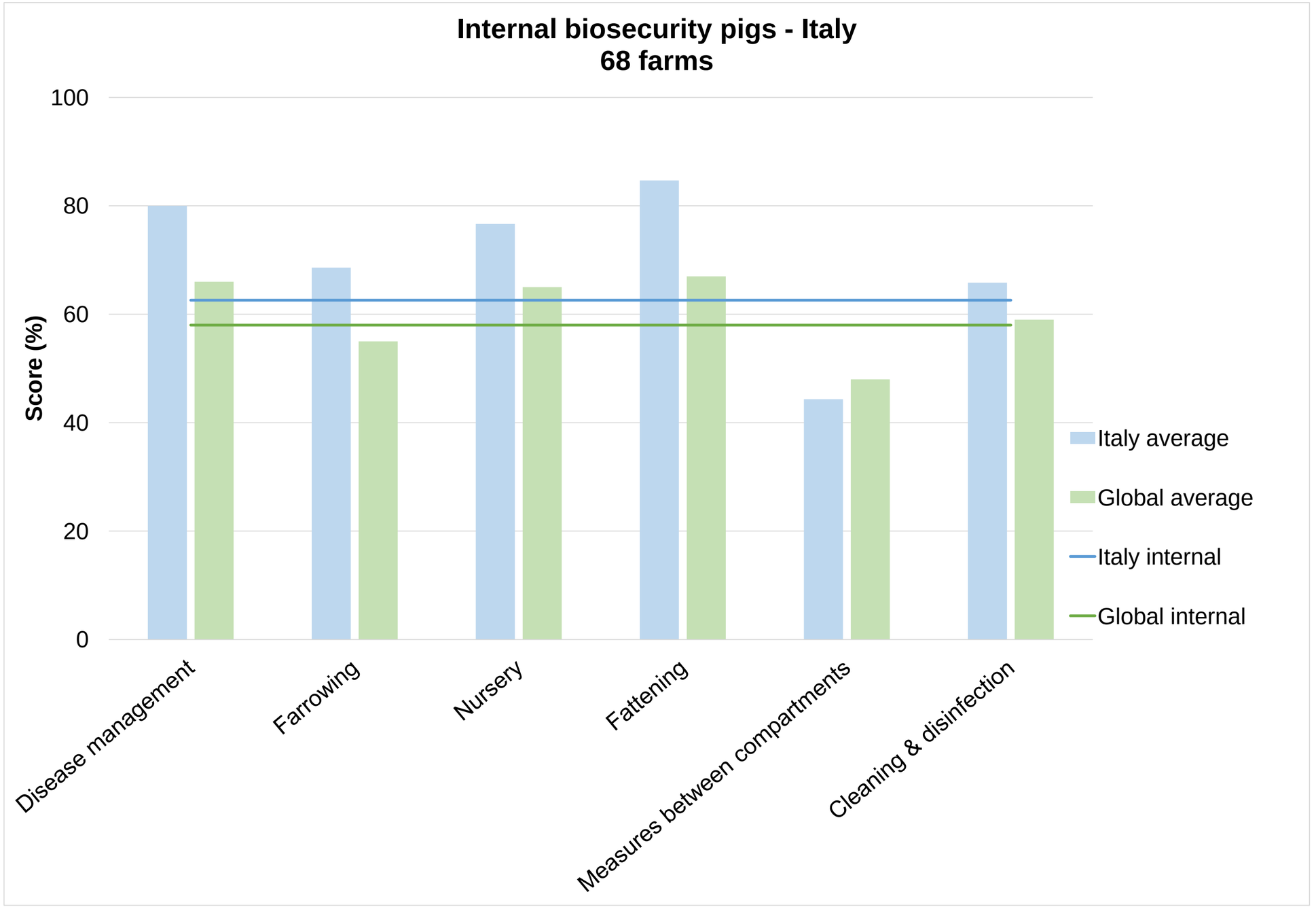


GHENT UNIVERSITY

EFFORT
AGAINST ANTIMICROBIAL RESISTANCE



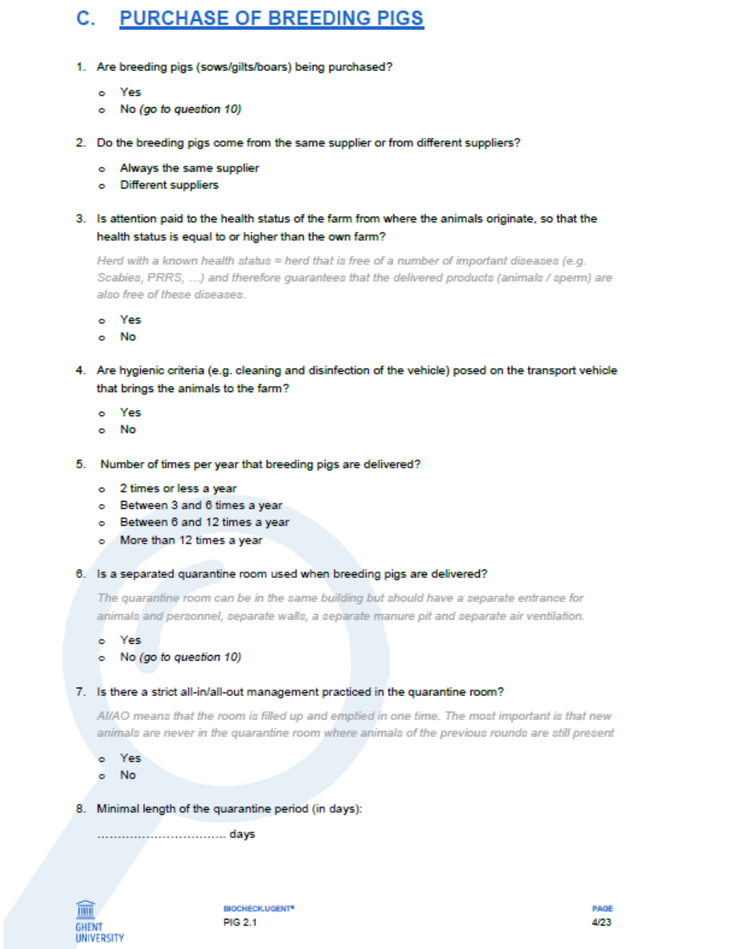
GHENT UNIVERSITY



GHENT UNIVERSITY

How to use Biocheck.Ugent

1. Make appointment
2. Do a farm visit
3. Go trough the questionnaire (paper)
4. Fill in the online version at home
5. Generate advice
6. Follow up visit



C. PURCHASE OF BREEDING PIGS

1. Are breeding pigs (sows/gilts/boars) being purchased?
   - o Yes
   - o No *(go to question 10)*
2. Do the breeding pigs come from the same supplier or from different suppliers?
   - o Always the same supplier
   - o Different suppliers
3. Is attention paid to the health status of the farm from where the animals originate, so that the health status is equal to or higher than the own farm?

   Herd with a known health status = herd that is free of a number of important diseases (e.g. Scabies, PRRS, ...) and therefore guarantees that the delivered products (animals / sperm) are also free of these diseases.
   - o Yes
   - o No
4. Are hygienic criteria (e.g. cleaning and disinfection of the vehicle) posed on the transport vehicle that brings the animals to the farm?
   - o Yes
   - o No
5. Number of times per year that breeding pigs are delivered?
   - o 2 times or less a year
   - o Between 3 and 6 times a year
   - o Between 6 and 12 times a year
   - o More than 12 times a year
6. Is a separated quarantine room used when breeding pigs are delivered?

   The quarantine room can be in the same building but should have a separate entrance for animals and personnel, separate walls, a separate manure pit and separate air ventilation.
   - o Yes
   - o No *(go to question 10)*
7. Is there a strict all-in/all-out management practiced in the quarantine room?

   AI/AO means that the room is filled up and emptied in one time. The most important is that new animals are never in the quarantine room where animals of the previous rounds are still present
   - o Yes
   - o No
8. Minimal length of the quarantine period (in days):

   ..... days

GHENT UNIVERSITY BIOCHECK.UGENT® PIG 2.1 PAGE 4/23

GHENT UNIVERSITY

biocheck.ugent

How to use Biocheck.Ugent

GHENT UNIVERSITY

biocheck .ugent

Home UGent | In het Nederlands | 中文

MY BIOCHECK | START THE BIOCHECK | ABOUT BIOCHECK | NEWSLETTER | WORLDWIDE | AUDIT | RESEARCH | INFO & LINKS | CONTACT

BIOCHECK.UGent, prevention is better than cure!

Welkom!

Biocheck.UGent is a risk-based scoring system to evaluate the quality of your on-farm biosecurity in an scientific and independent way.

Fill in the online **questionnaire** for free and receive valuable feedback about the biosecurity level of your farm. You get a summarizing and personal report with detailed results. These findings can help you to choose your own suitable biosecurity pathway.

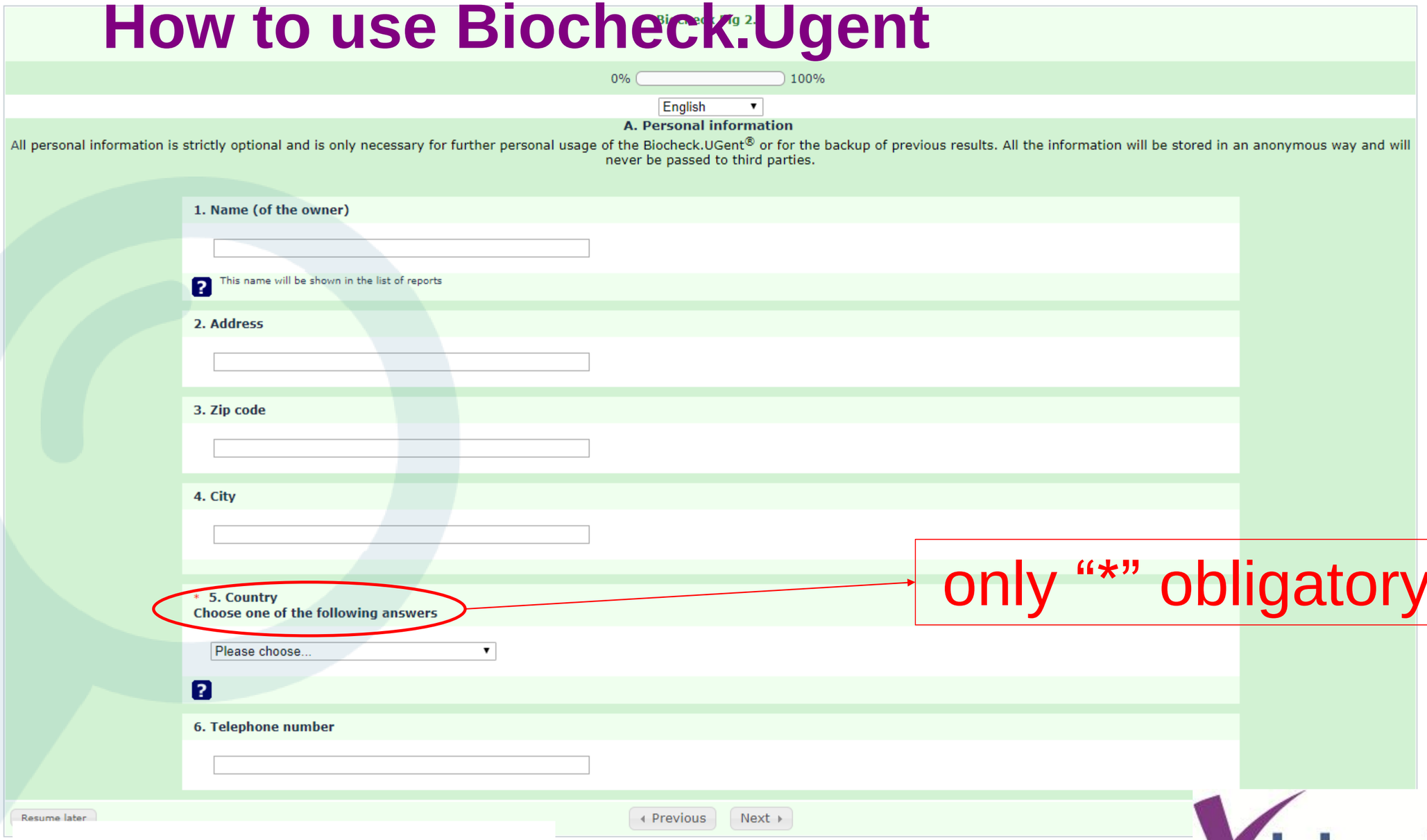
Don't hesitate and get started to lift your farm to a higher biosecurity level!

Start the Biocheck.UGent!

GHENT UNIVERSITY

biocheck .ugent

How to use Biocheck.Ugent

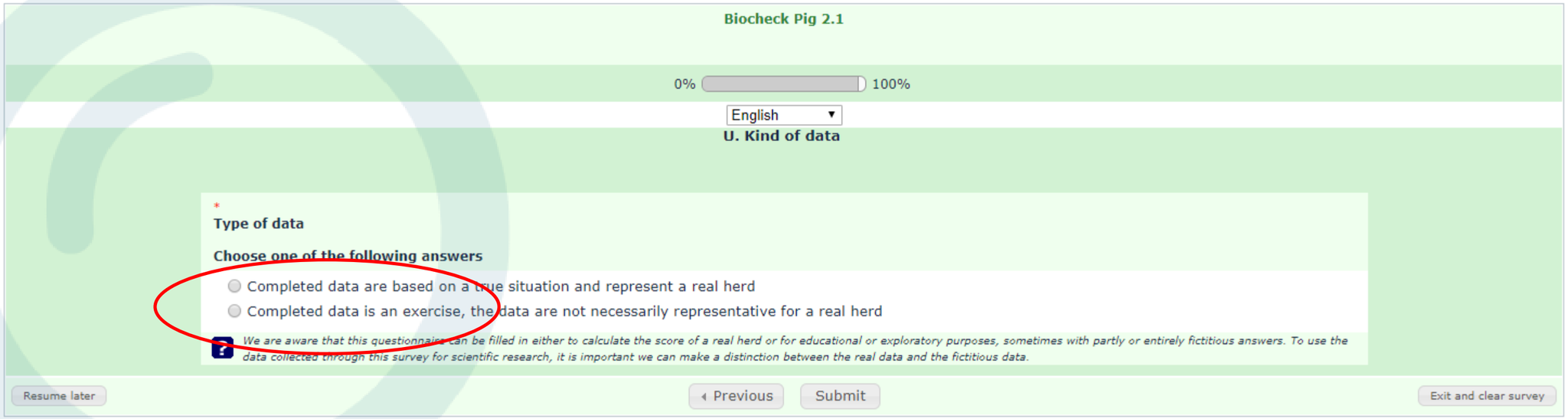


only “*” obligatory

GHENT UNIVERSITY

biocheck.ugent

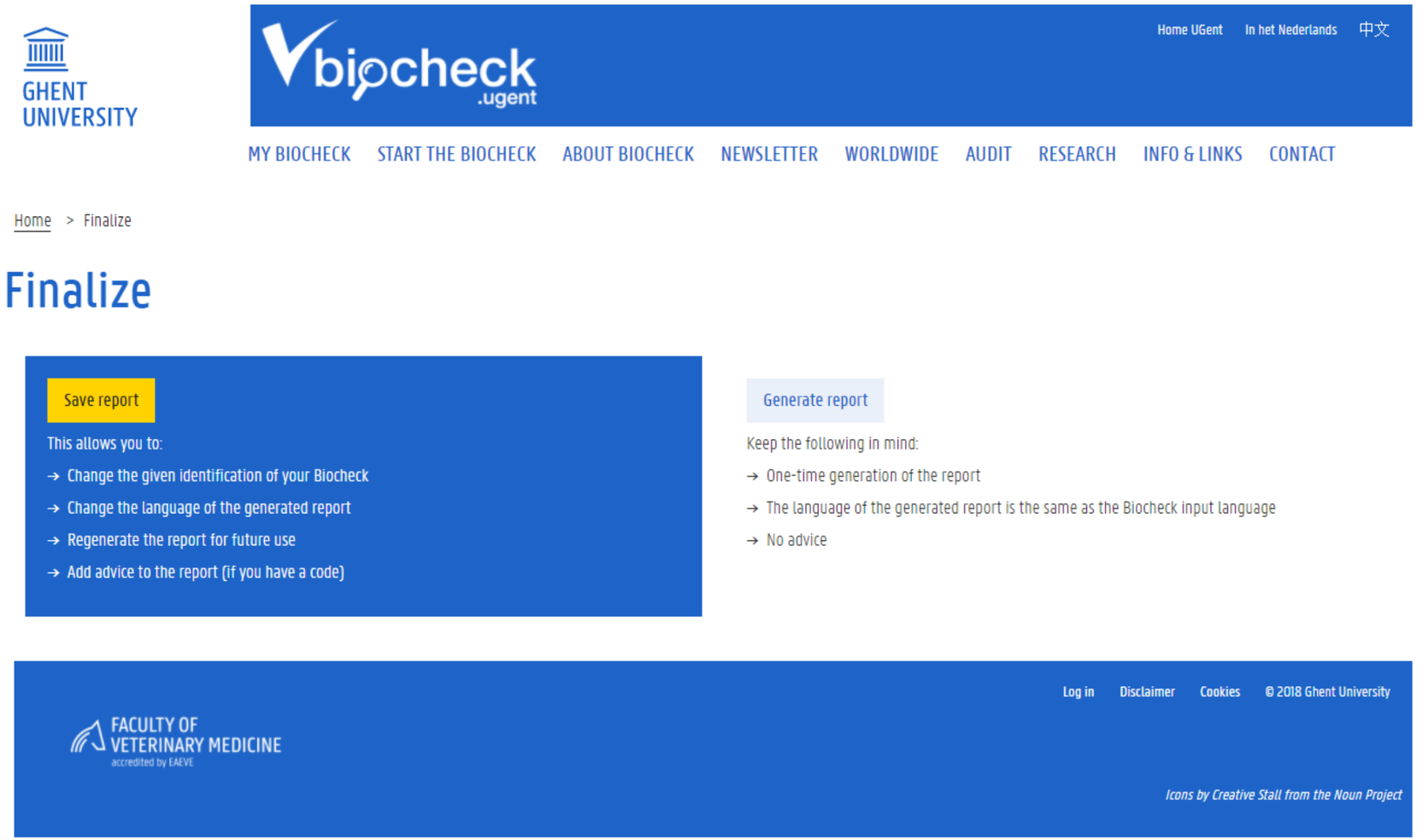
How to use Biocheck.Ugent



GHENT UNIVERSITY

biocheck .ugent

How to use Biocheck.Ugent



GHENT UNIVERSITY

biocheck .ugent

Check, Improve, Reduce

A SIMPLE AND EFFECTIVE APPROACH

GHENT UNIVERSITY

biocheck .ugent

Herd specific advice

GHENT UNIVERSITY

Substantial reduction antimicrobial usage without jeopardizing production by coaching?

Zoonoses AND PUBLIC HEALTH
Explore this journal >

Original Article

Reducing Antimicrobial Usage in Pig Production without Jeopardizing Production Parameters

M. Postma ✉, W. Vanderhaeghen, S. Sarrazin, D. Maes, J. Dewulf

GHENT UNIVERSITY

biocheck.ugent

Coaching

GHENT UNIVERSITY

biocheck.ugent

Biosecurity & Management

	% ADVISED	% FEASIBLE	% IMPLEMENTED
Registration symptoms & moment mortality for analysis	95	98	66
Hand hygiene, change coverall and clean boots	86	88	59
Change needles often	85	82	62
Hygiene lock per animal/age category	76	58	7
Use strict euthanasia policy	71	90	81
Wash sow before farrowing crate	68	45	20
Analysis drink water 1x/year well/pipes	68	98	80
Keep dog/cat out of the stable	49	34	21
AI / AO, do not return to younger age group	41	54	33
Use dirty road for transport of manure	20	100	75
Change wooden boards for plastic boards	10	67	83

GHENT UNIVERSITY

.ugent

Diagnostics & vaccination

	% ADVISED	% FEASIBLE	% IMPLEMENTED
Request slaughter findings for analysis	75	59	57
Additional vaccinations in general	51	94	81
Additional specific vaccinations: PCV2	16	100	62
Check serology titres in general	33	95	90
Adjustment of vaccination scheme: Atrofic rhinitis	8	100	80

GHENT UNIVERSITY

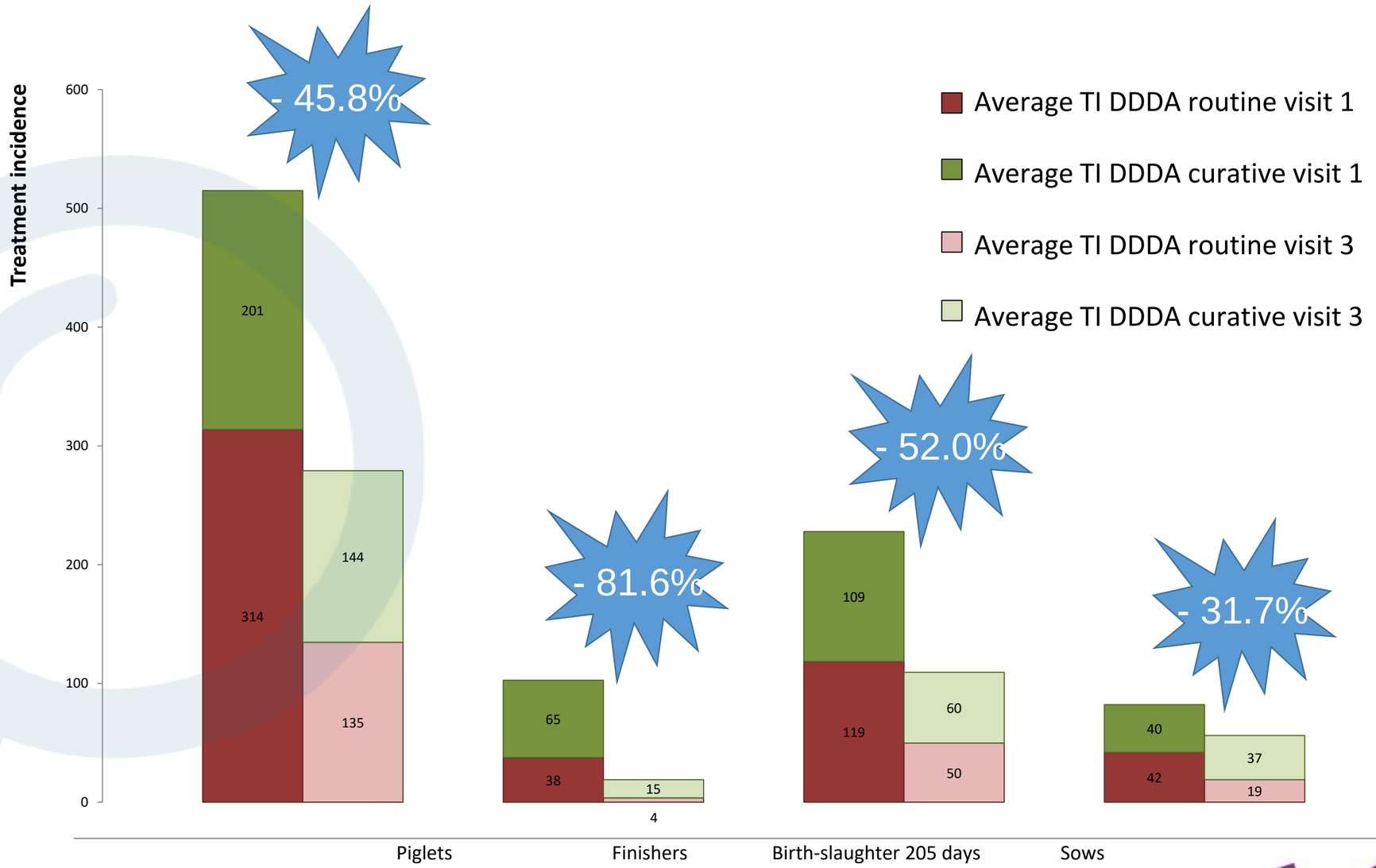
bipcheck .ugent

Prudent antimicrobial usage

	% ADVISED	% FEASIBLE	% IMPLEMENTED
Restrictive use of potent AM	92	72	45
Stop (routine) prophylactic treatment birth until slaughter	88	69	59
Stop prophylactic treatment in sows	24	90	83
Ask for resistance profile/sensitivity testing	7	79	0

GHENT UNIVERSITY

biocheck .ugent



GHENT UNIVERSITY

biocheck.ugent

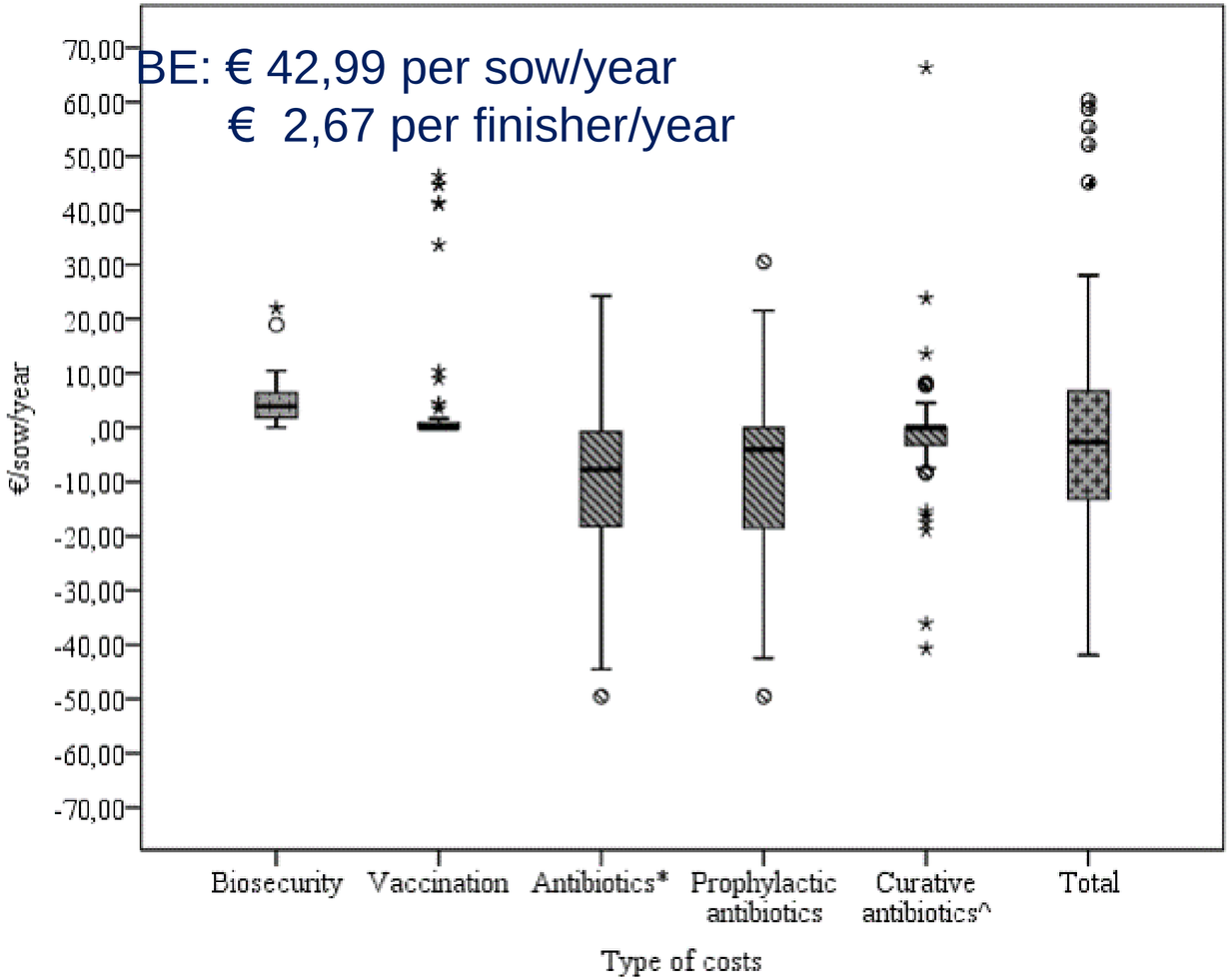
Production parameters

	VISIT	MEAN	DIFFERENCE	P-VALUE
Number of weaned piglets per sow per year	Initial	26.4	+1,1	<0.01
	Follow up	27.5		
Daily weight gain (g/day) finishers	Initial	667.5	+7,7	0.01
	Follow up	675.2		
Mortality in finisher period (%)	Initial	3.2	-0,6	0.04
	Follow up	2.6		

GHENT UNIVERSITY

biocheck .ugent

Benefits - Economics



Preventive Veterinary Medicine 144 (2017) 167–178

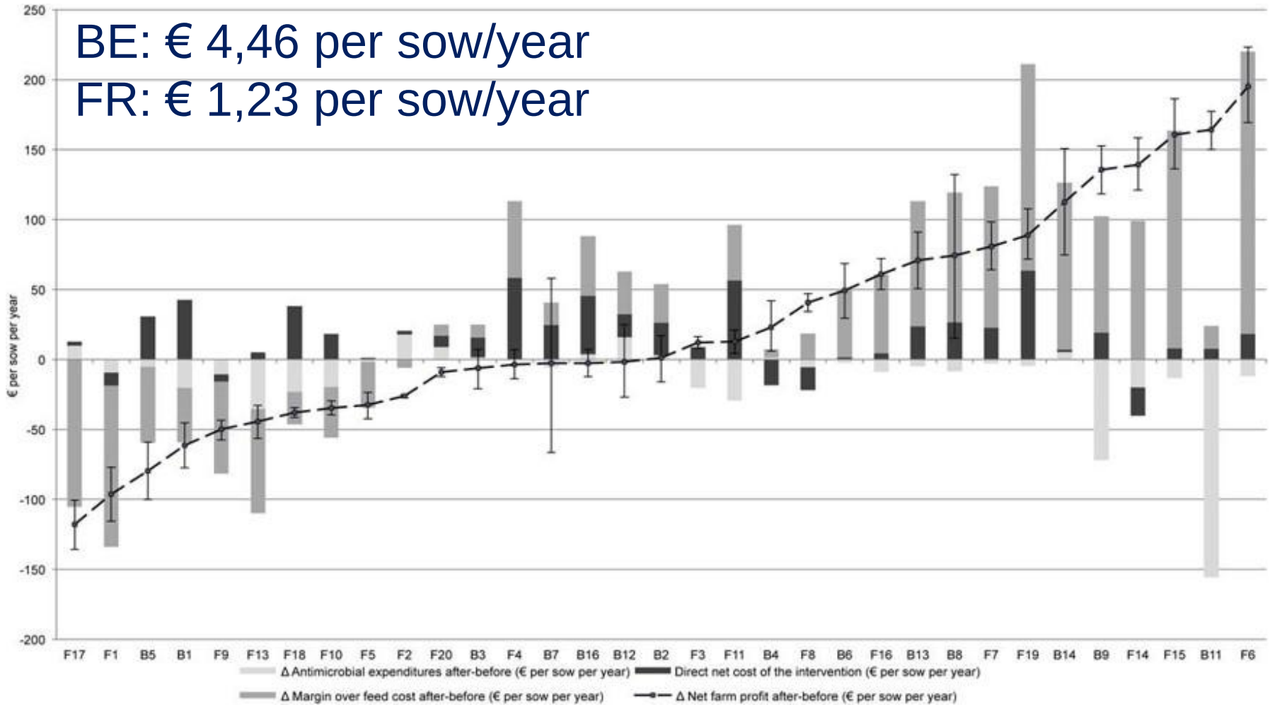
Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

Herd-specific interventions to reduce antimicrobial usage in pig production without jeopardising technical and economic performance

L. Collineau[a,b,*], C. Rojo-Gimeno[c,d], A. Léger[a], A. Backhans[e], S. Loesken[f], E.Okholm Nielsen[g], M. Postma[d], U. Emanuelson[e], E.grosse Beilage[f], M. Sjölund[e,h], E. Wauters[c], K.D.C Stärk[a], J. Dewulf[d], C. Belloc[b], S. Krebs[b]



Preventive Veterinary Medicine 129 (2016) 76–87

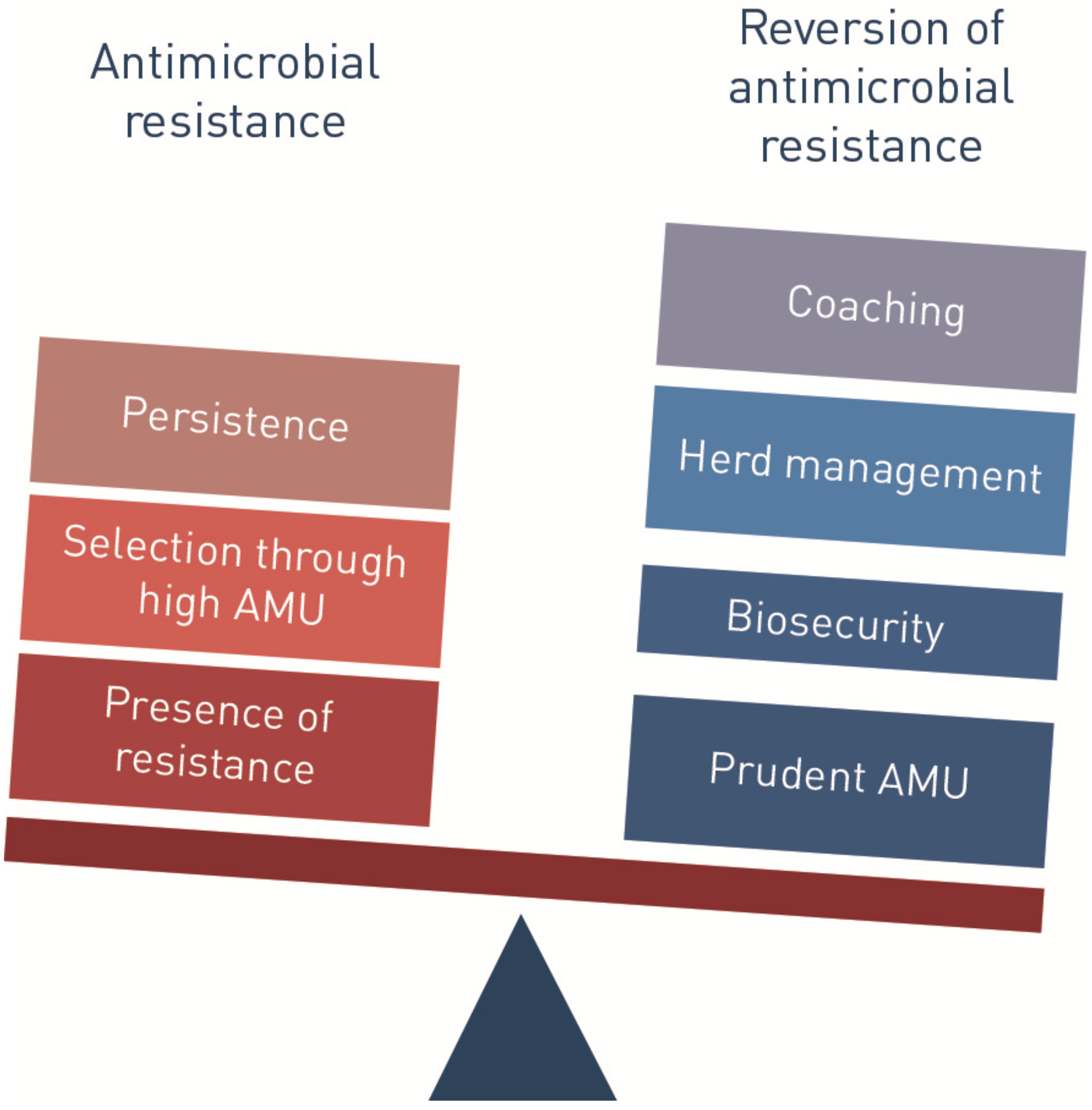
Contents lists available at ScienceDirect

Preventive Veterinary Medicine

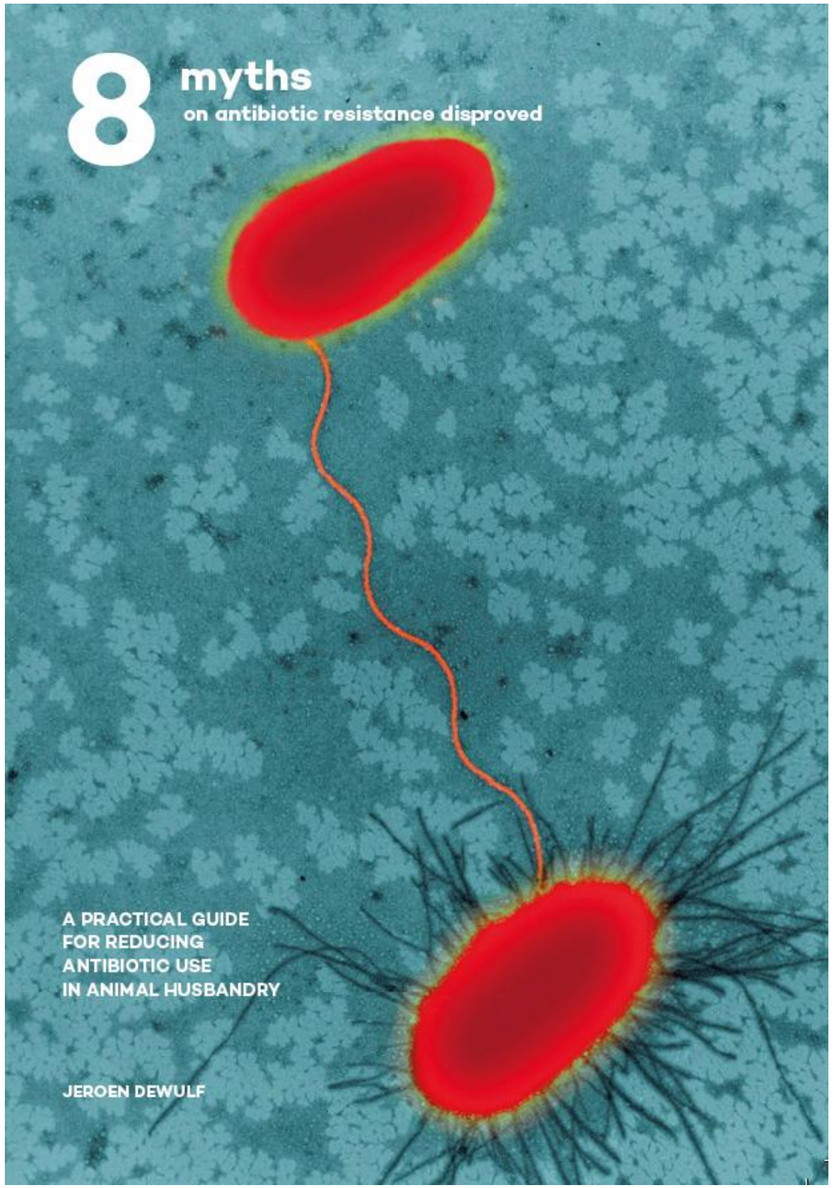
journal homepage: www.elsevier.com/locate/prevetmed

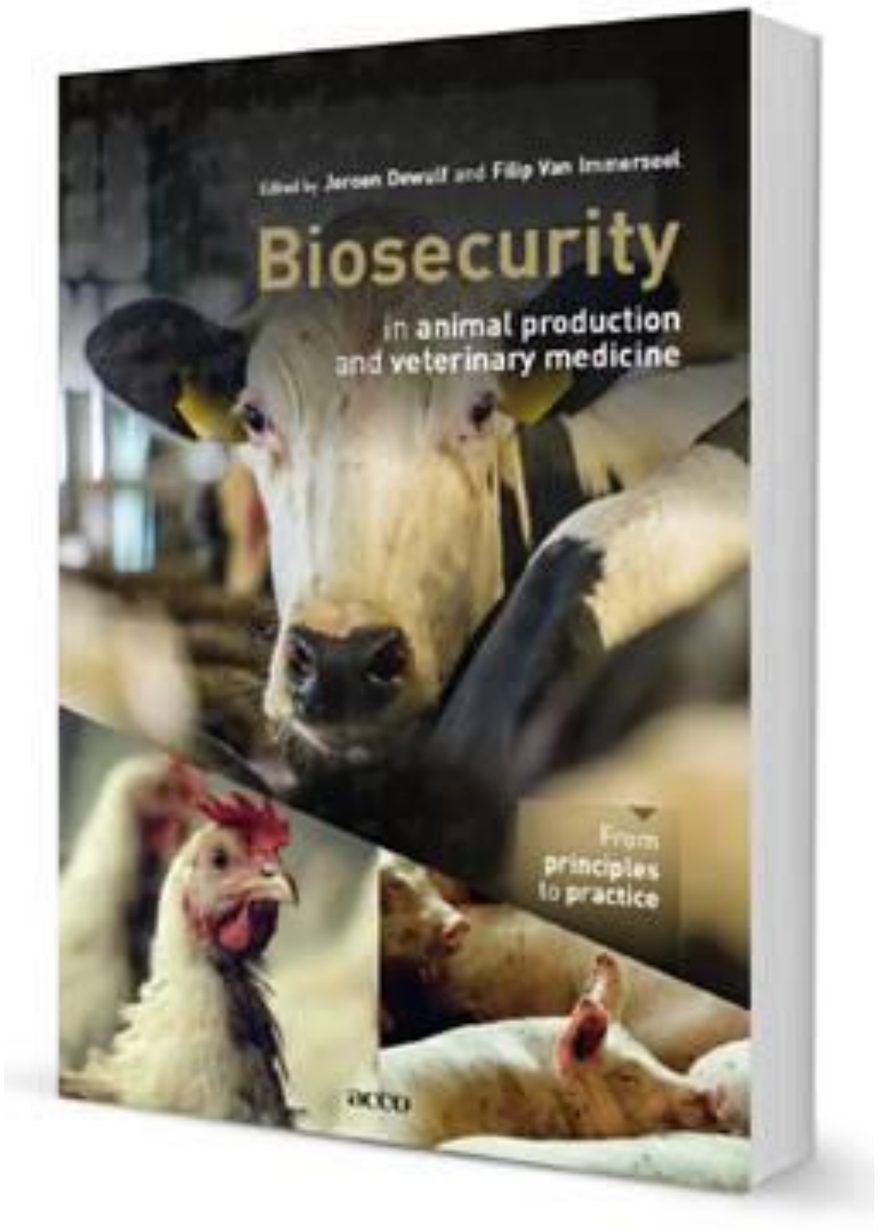
Farm-economic analysis of reducing antimicrobial use whilst adopting improved management strategies on farrow-to-finish pig farms

Cristina Rojo-Gimeno[a,b,c,1], Merel Postma[b,1], Jeroen Dewulf[b], Henk Hogeveen[c], Ludwig Lauwers[a,d], Erwin Wauters[a,e]



GHENT UNIVERSITY





GHENT
UNIVERSITY

“An ounce of prevention, is worth a pound of cure”

- Benjamin Franklin -

GHENT UNIVERSITY

FACULTY OF VETERINARY MEDICINE
accredited by EAEVE

Jeroen Dewulf

VETERINARY EPIDEMIOLOGY

E Jeroen.dewulf@ugent.be
T +32 9 264 75 43
M +32 476 49 70 40

www.ugent.be

Ghent University
@jkdewulf
jkdewulf

GHENT UNIVERSITY