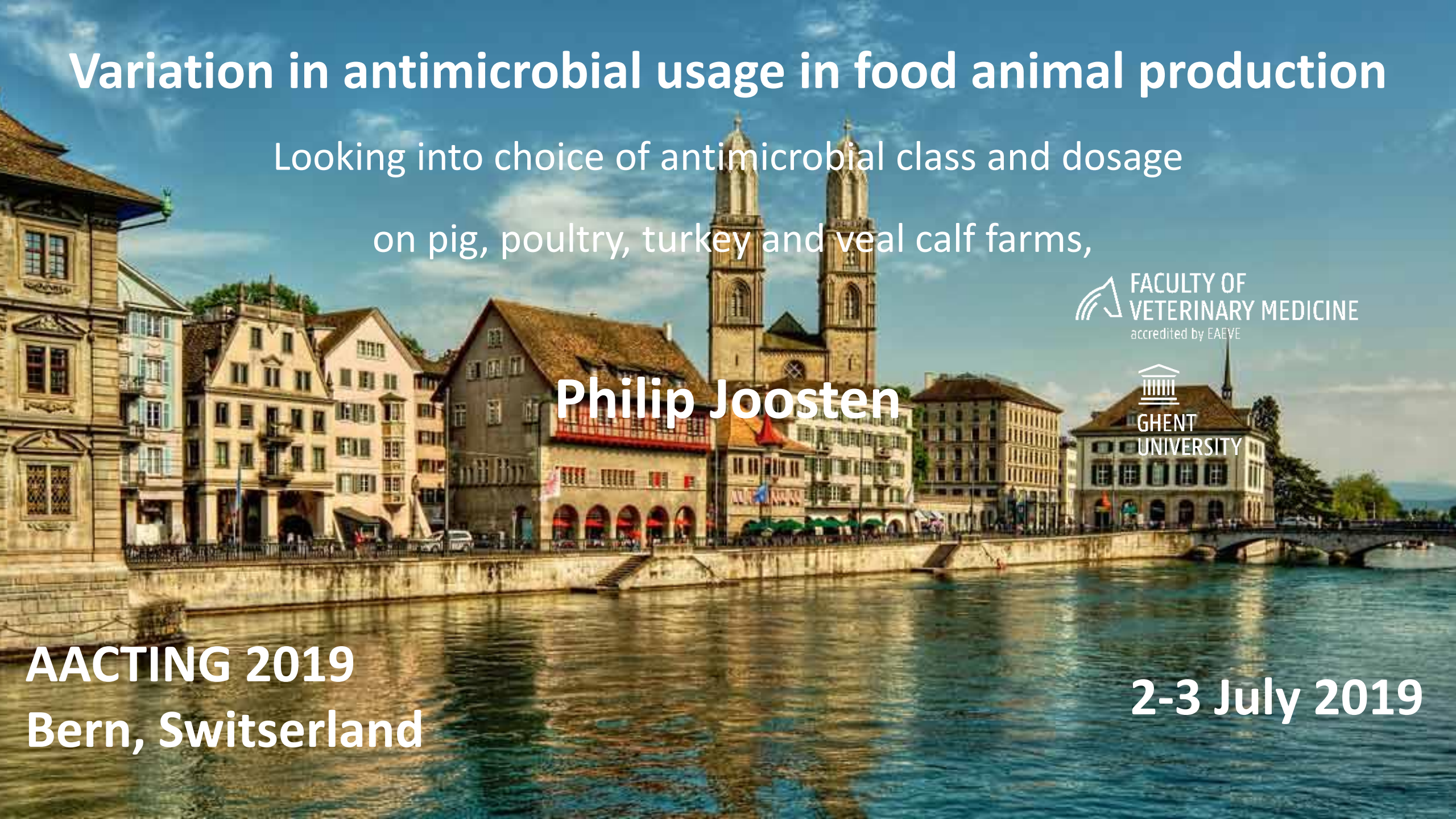
Variation in antimicrobial usage in food animal production

Looking into choice of antimicrobial class and dosage

on pig, poultry, turkey and veal calf farms,



Philip Joosten

FACULTY OF VETERINARY MEDICINE
accredited by EAEVE

GHENT UNIVERSITY

AACTING 2019
Bern, Switserland

2-3 July 2019

"If you use penicillin, use enough."

Medicine Laureate Alexander Fleming's Nobel Lecture in 1945

Nobelprize.org

The Official Web Site of the Nobel Prize

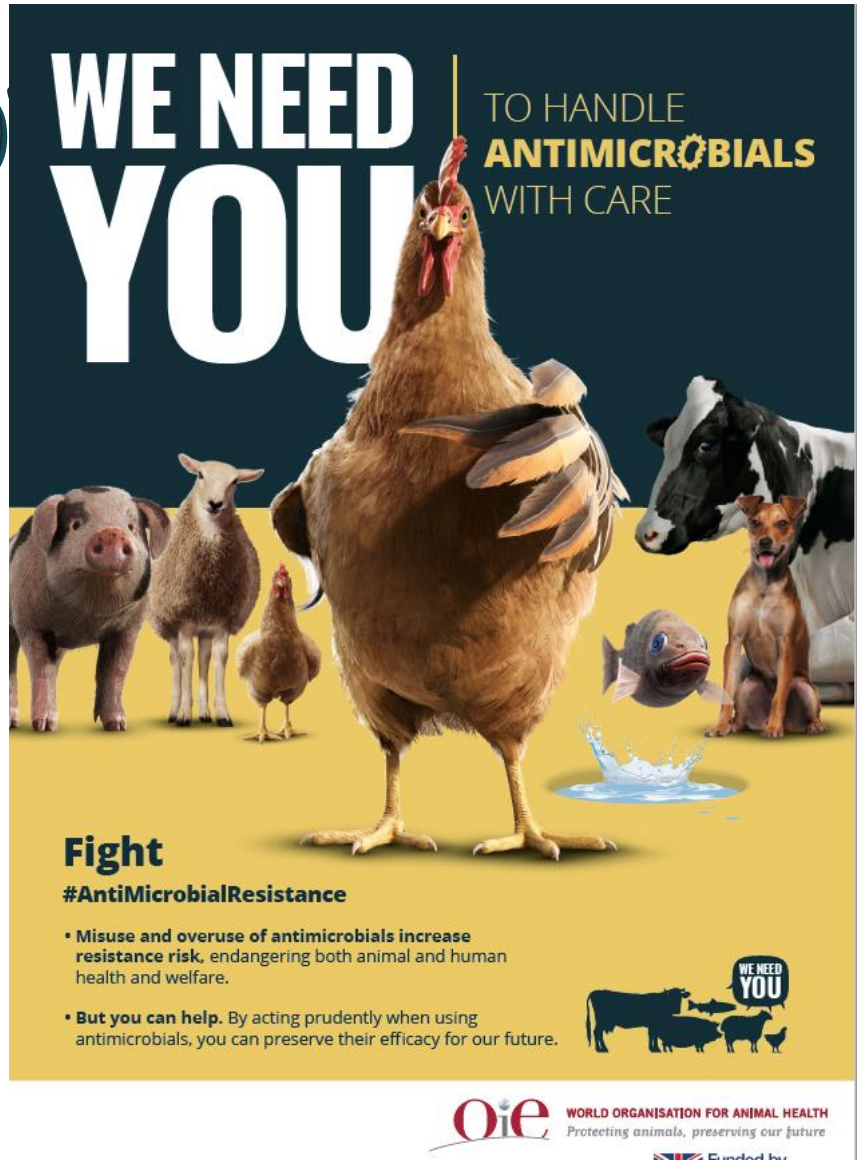
WORLD ORGANISATION FOR ANIMAL HEALTH

Protecting animals, preserving our future

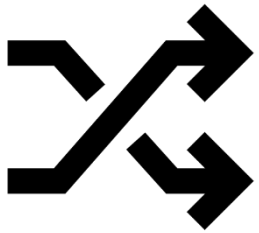
Funded by
UK Government

HO

Administration route



WHY



Indication for treatment

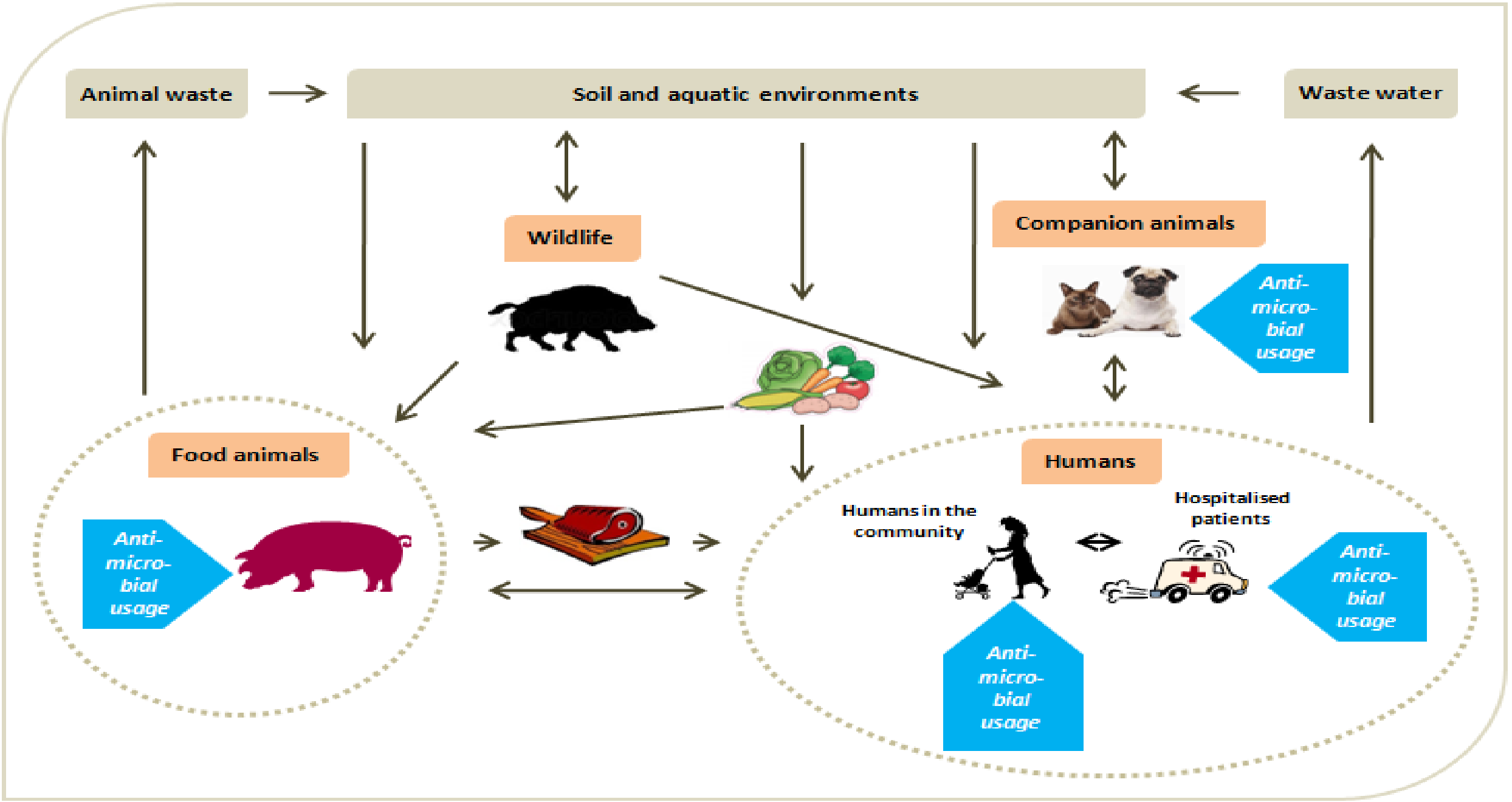
Ecology from Farm to Fork

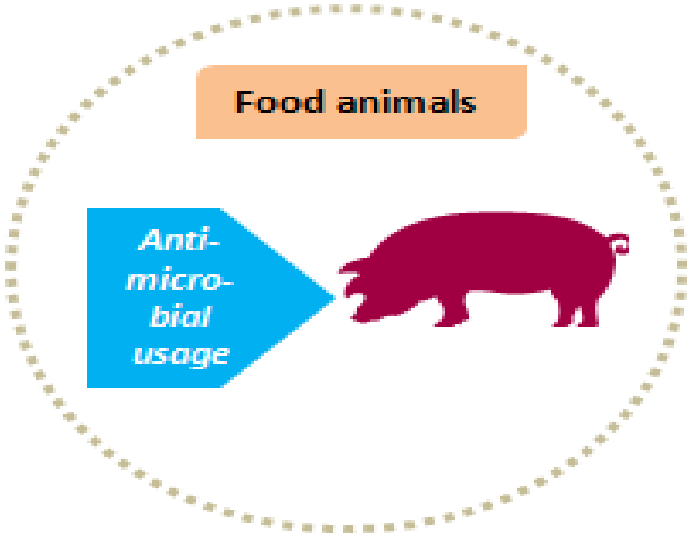
Of microbial drug Resistance and Transmission

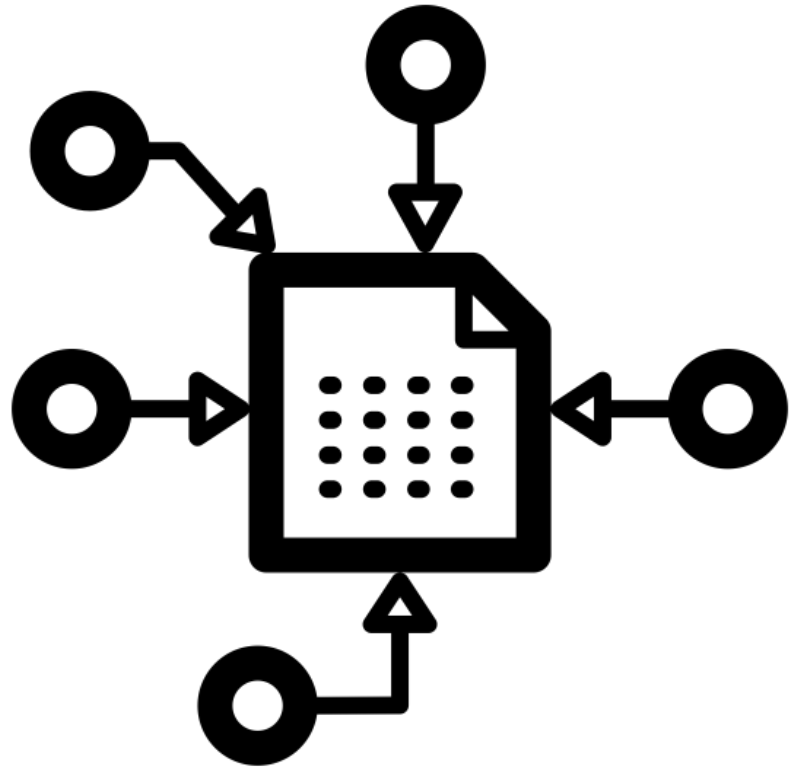
www.effort-against-amr.eu

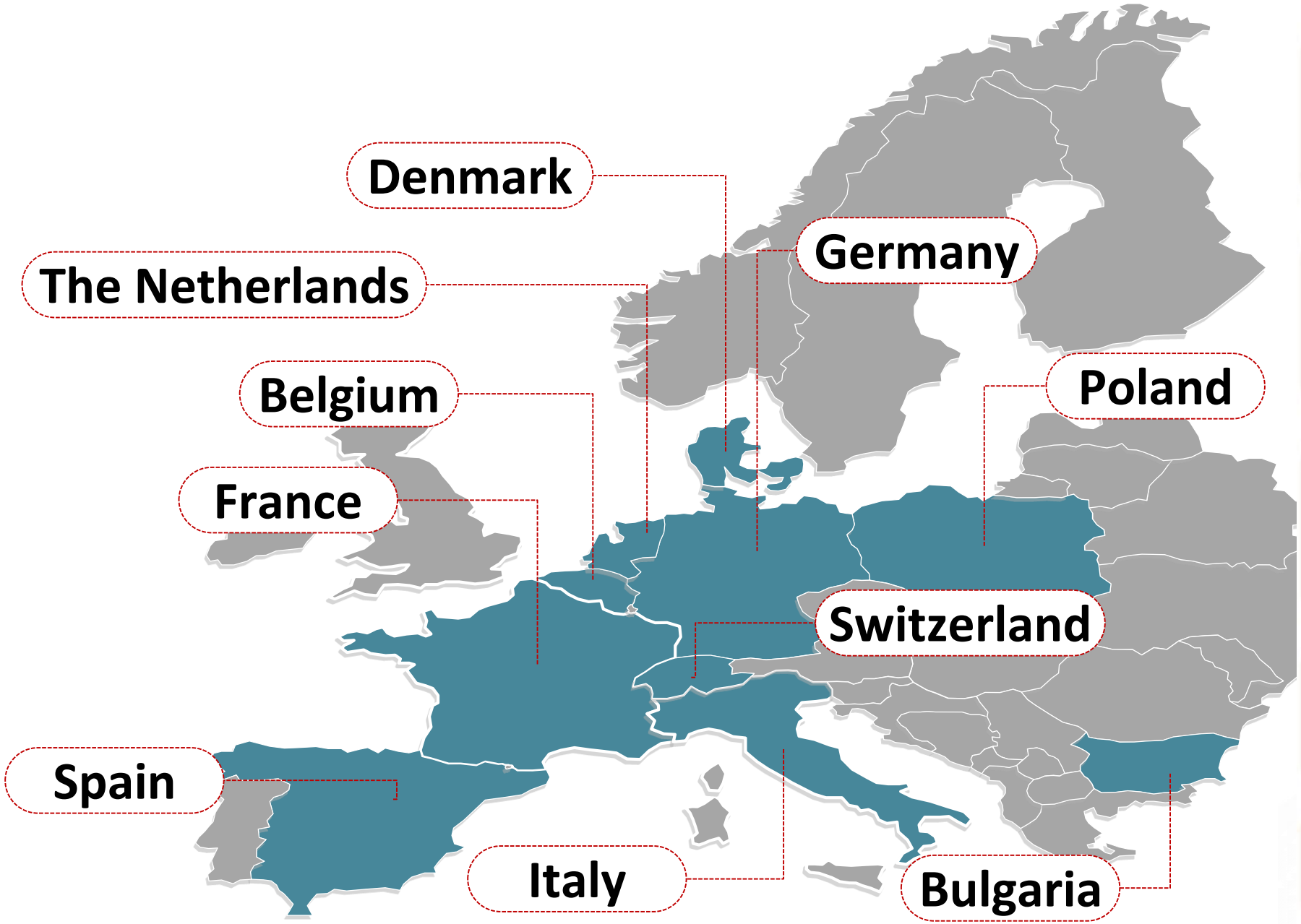
The research leading to these results has received funding from the European Community's Seventh Framework Programme [FP7/2007-2013] under grant agreement n°613754.

Exchange of resistance genes and bacteria between different reservoirs




Food animals
Anti-
micro-
bial
usage





Academic partners:

UUVM (NL)
UGent (BE)
BEC (NL)
TIHO (DE)
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DTU (DK)

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ARTTIC (FR)
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PorQ (NL)
Vetworks (BE)

Research organisations:

CVI (NL)
NVRI (PL)
NDVRI (BG)

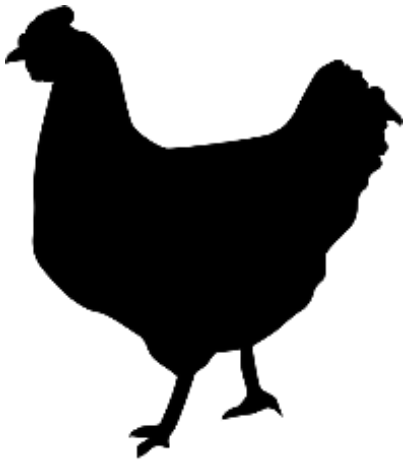
Public non-profit bodies:

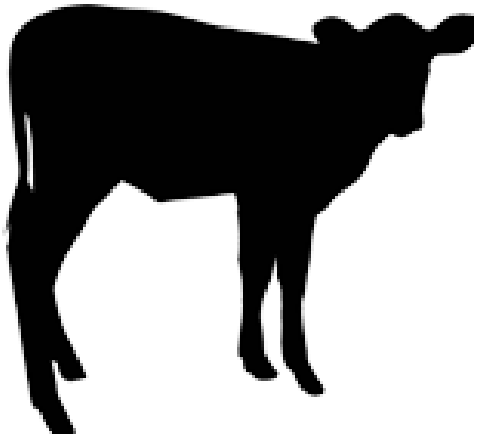
ANSES (FR)
BfR (DE)
ILSI Europe (BE)
IZSLT (IT)

Industrial:

VION FOOD (NL)

DATA COLLECTION

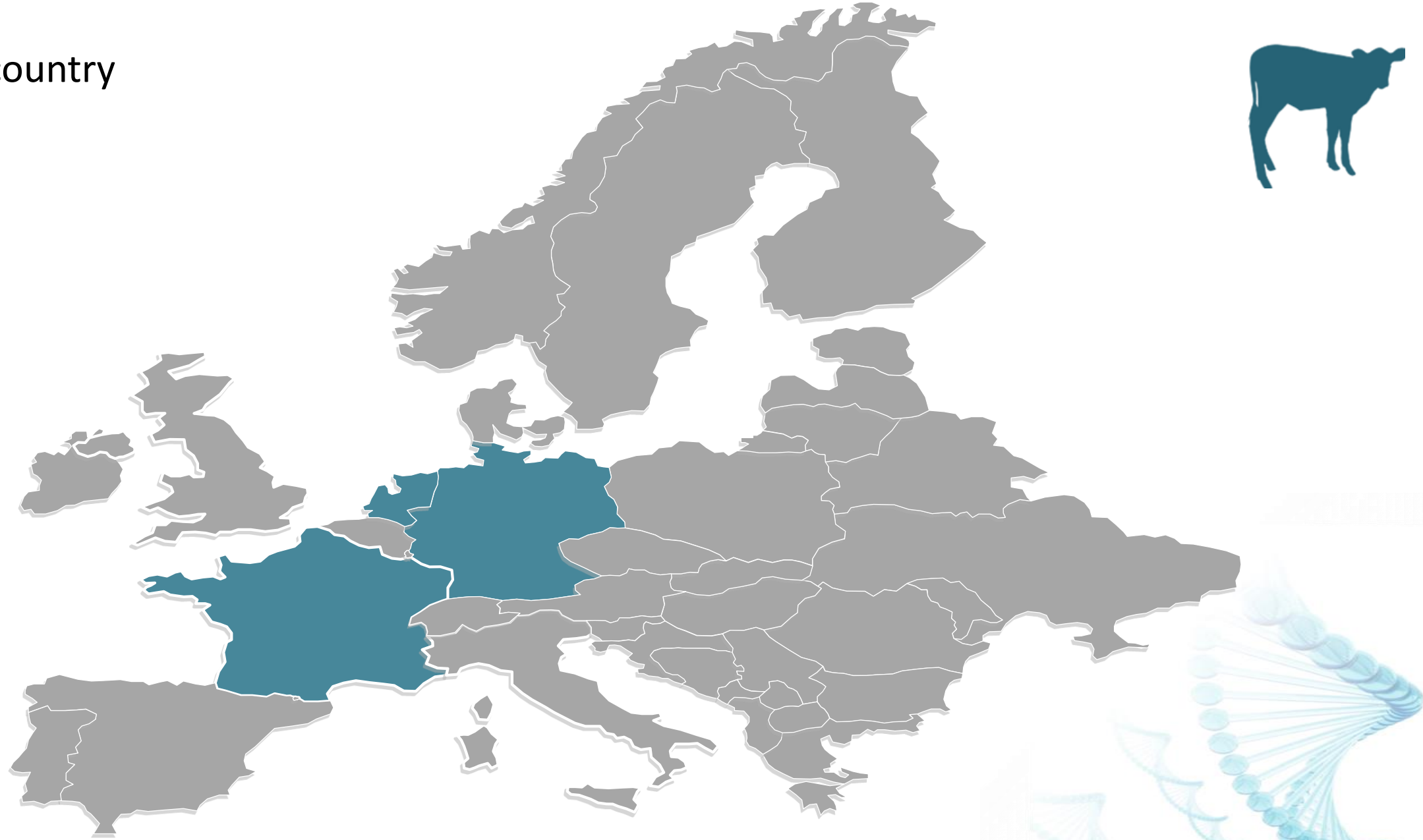




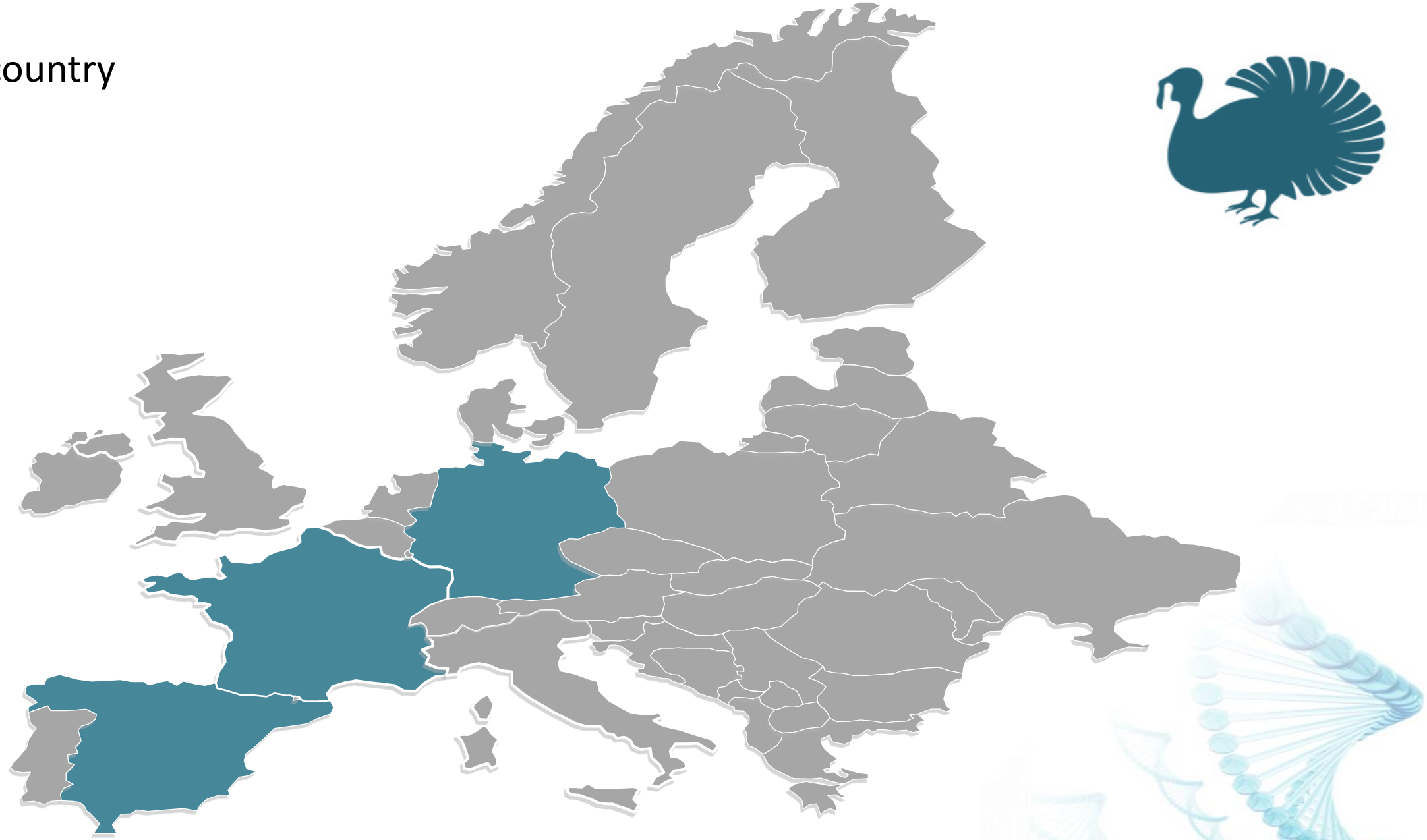
EFFORT
AGAINST ANTIMICROBIAL RESISTANCE

20 farms/country

20 farms/country



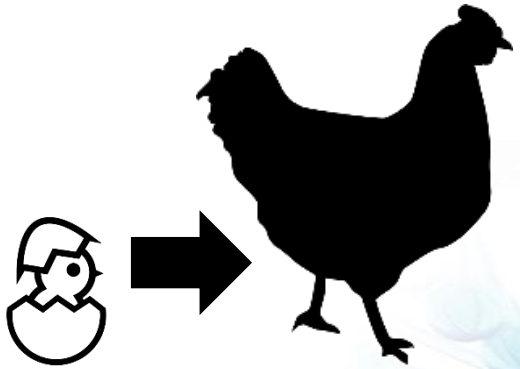
20 farms/country



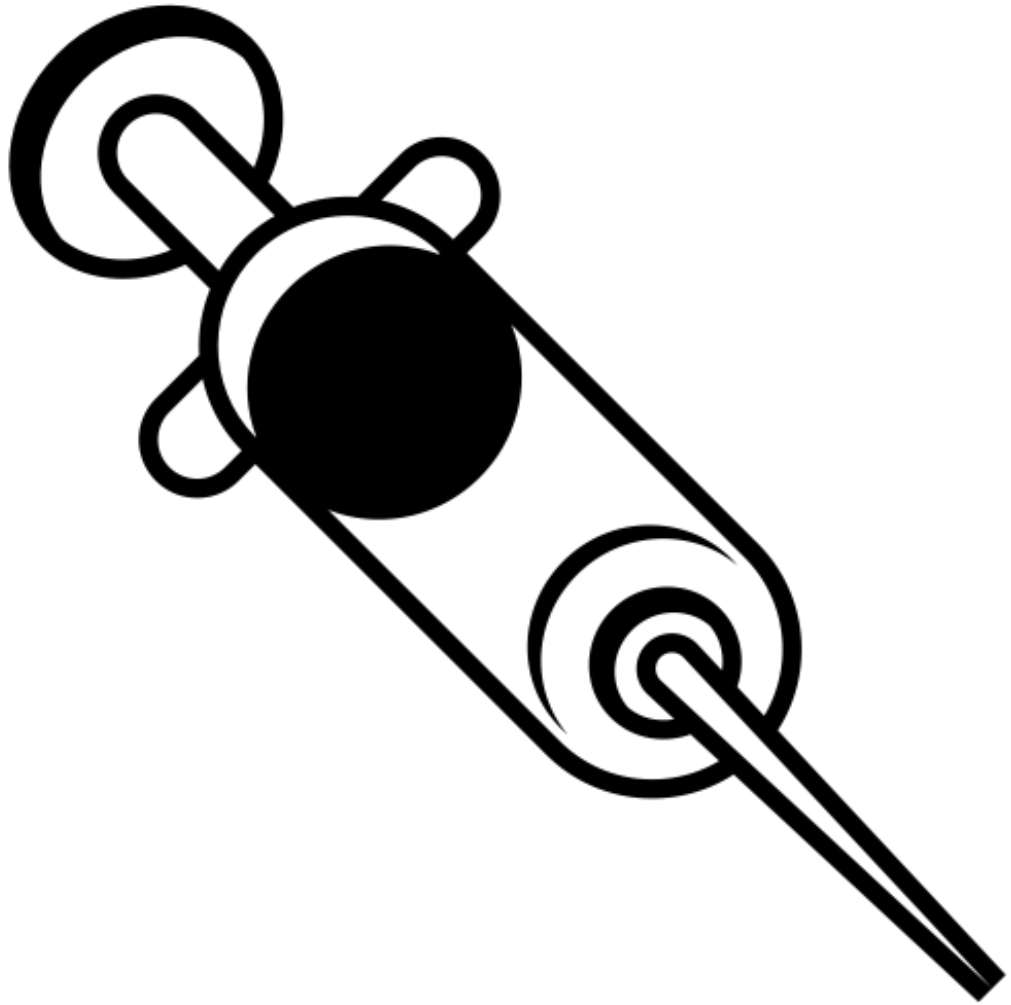
DATA COLLECTION
group treatments

Questionnaire

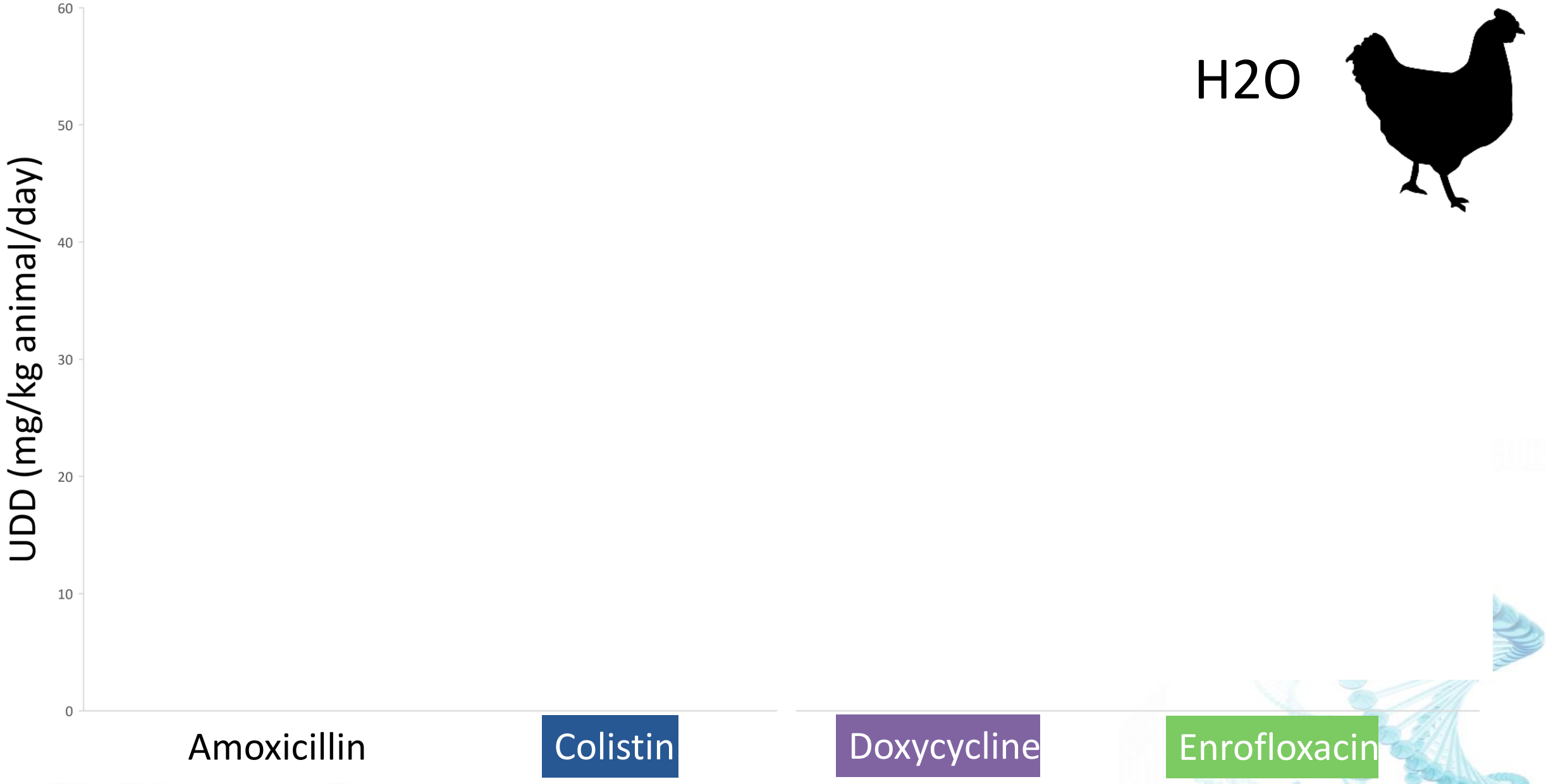
1 house
=flock level

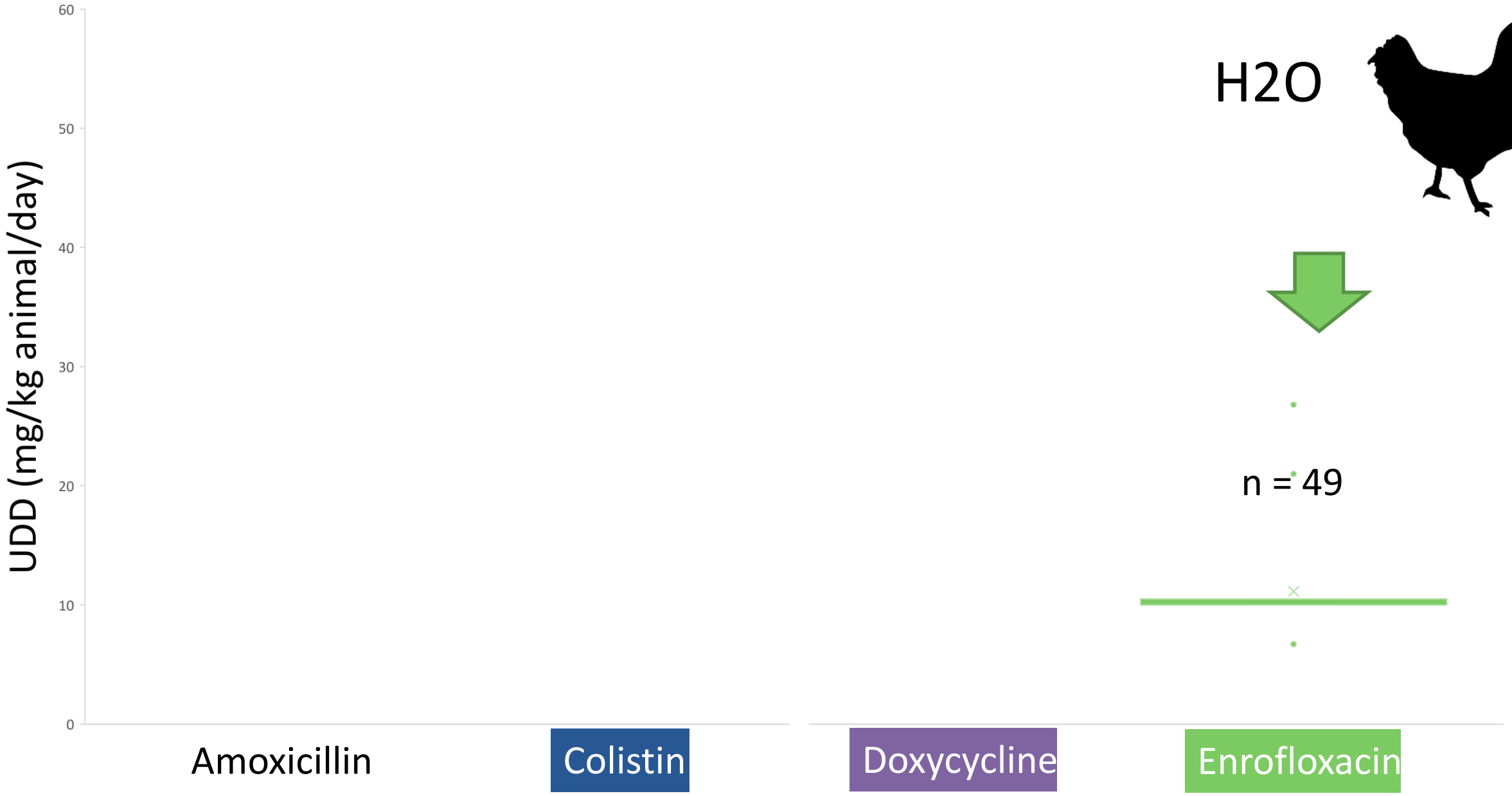


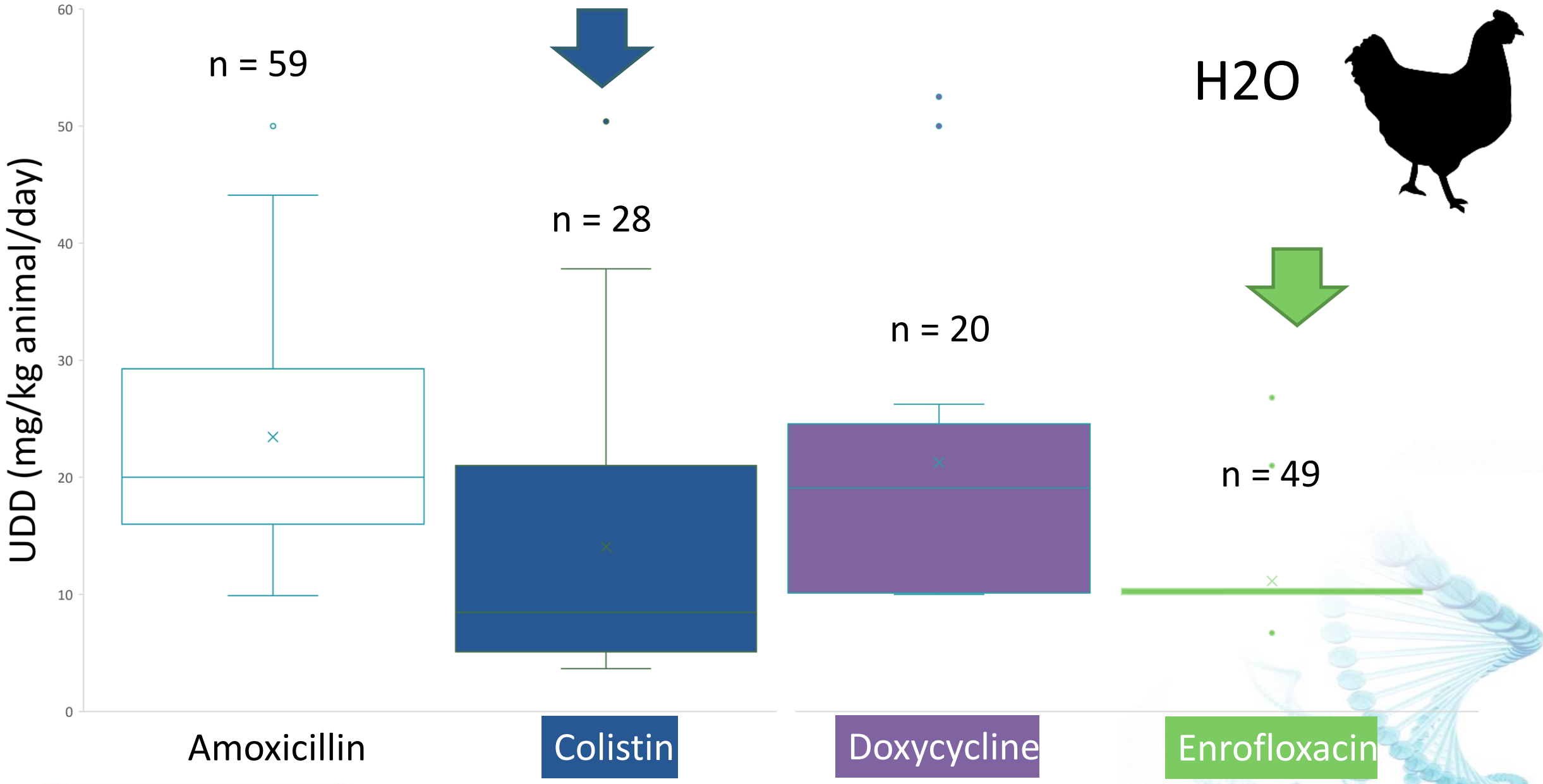
Birth to slaughter



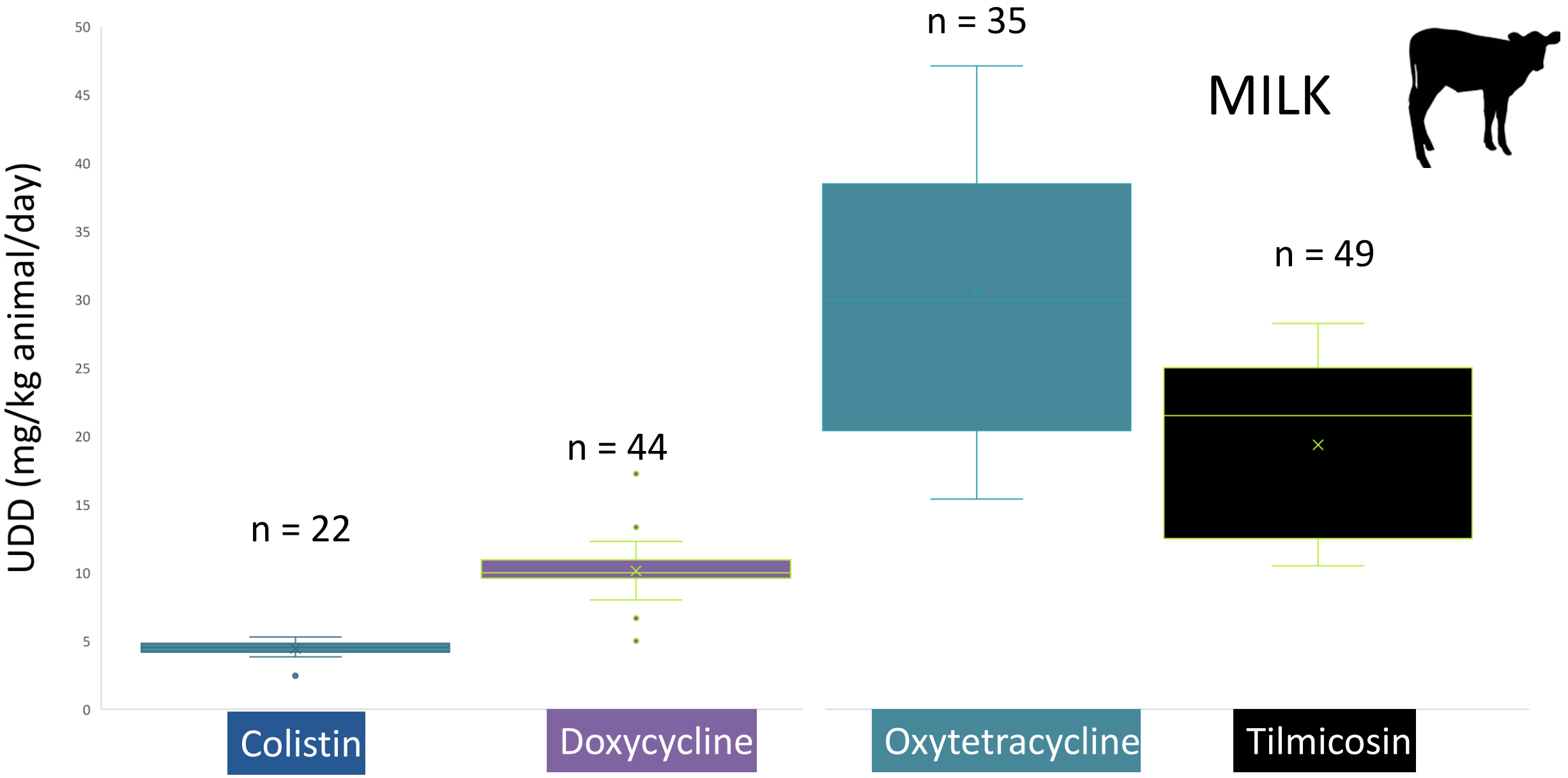
EFFORT
AGAINST ANTIMICROBIAL RESISTANCE


60
50
40
30
20
10
0
UDD (mg/kg animal/day)
H2O
Amoxicillin
Colistin
Doxycycline
Enrofloxacin

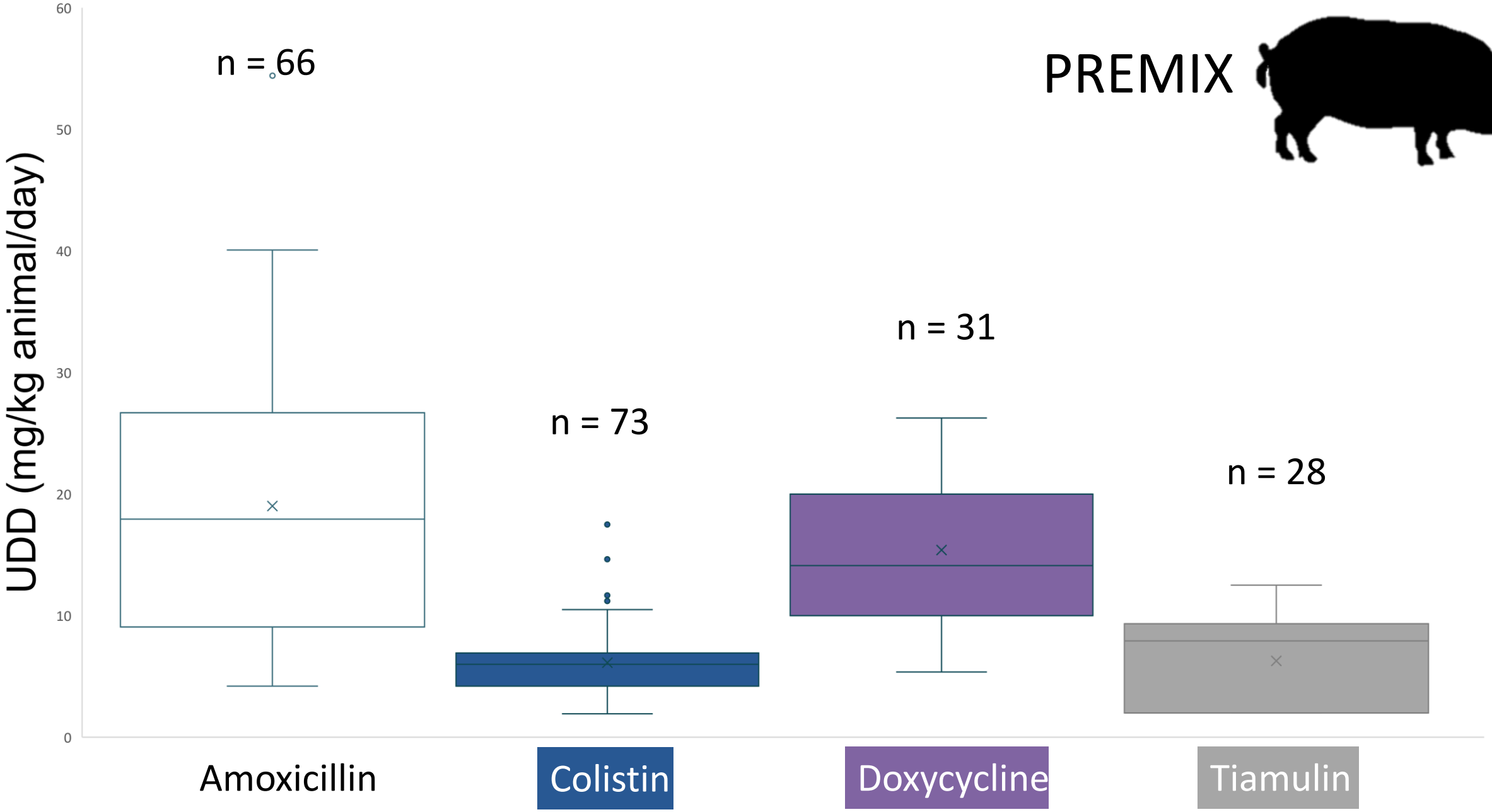

60
50
40
30
20
10
0
UDD (mg/kg animal/day)
H2O
n = 49
Amoxicillin
Colistin
Doxycycline
Enrofloxacin

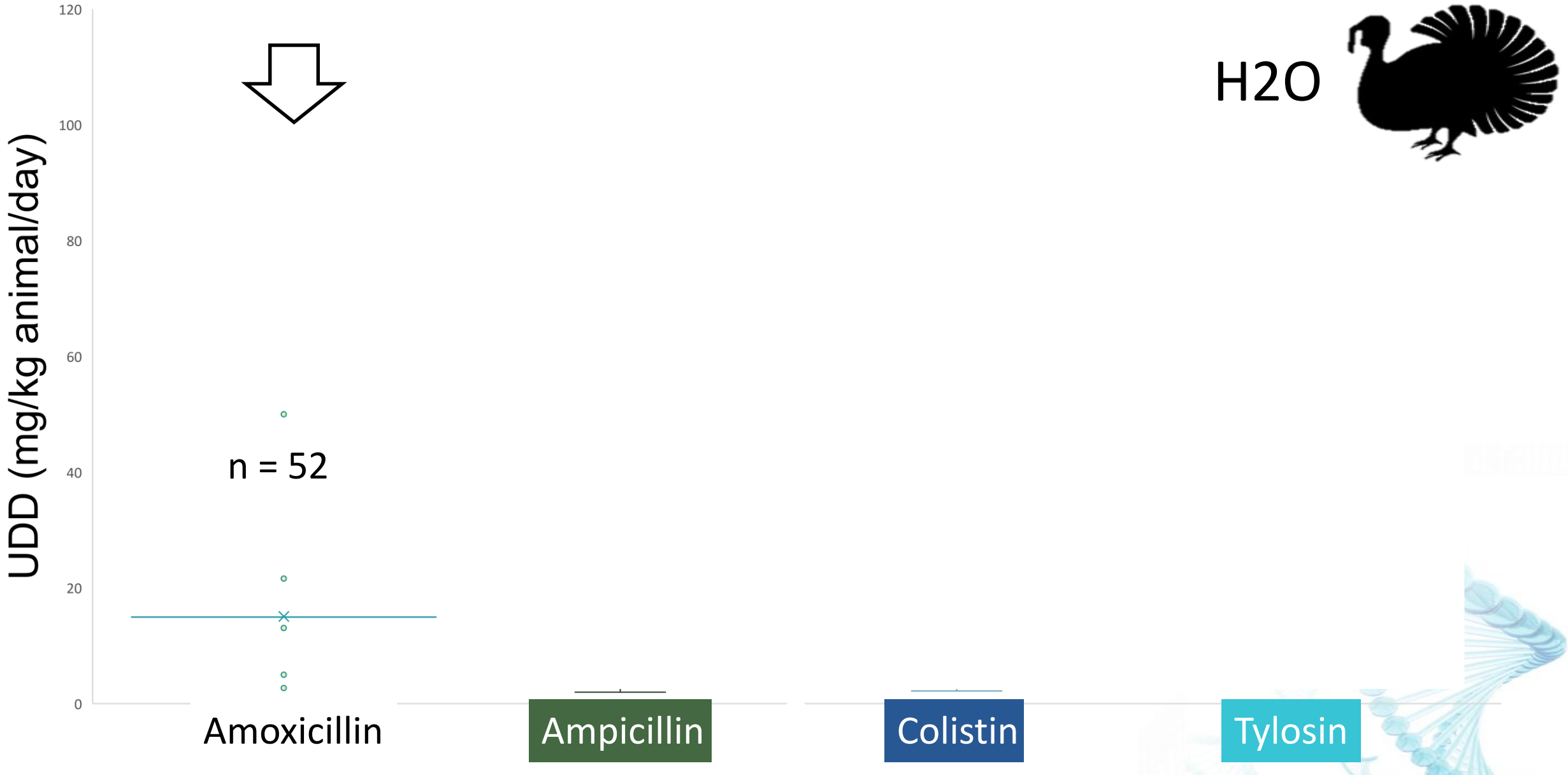


EFFORT
AGAINST ANTIMICROBIAL RESISTANCE


MILK
UDD (mg/kg animal/day)
50
45
40
35
30
25
20
15
10
5
0
n = 22
n = 44
n = 35
n = 49
Colistin
Doxycycline
Oxytetracycline
Tilmicosin

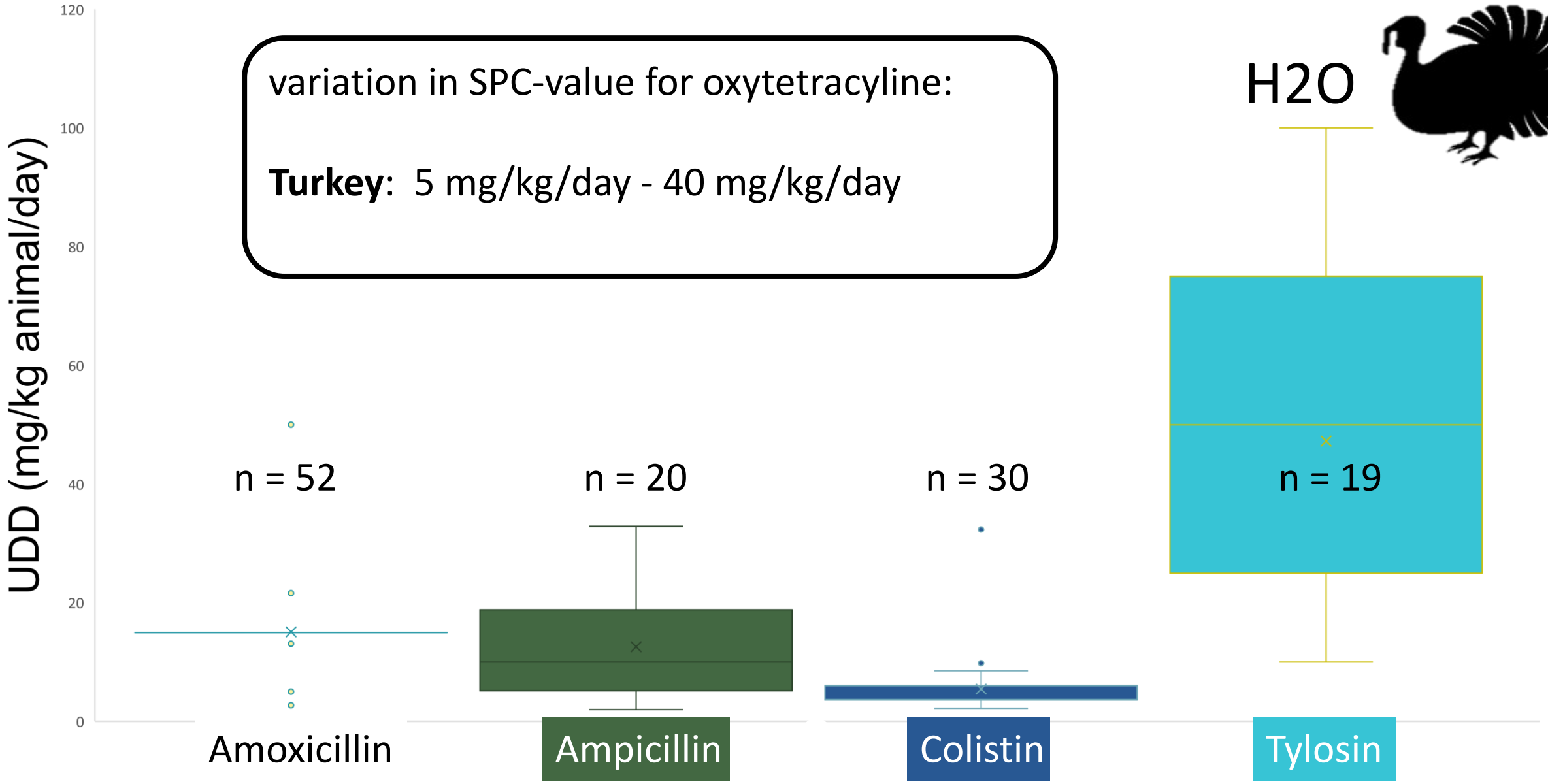
PREMIX


UDD (mg/kg animal/day)
60
50
40
30
20
10
0
n = 66
n = 73
n = 31
n = 28
Amoxicillin
Colistin
Doxycycline
Tiamulin


H2O
UDD (mg/kg animal/day)
120
100
80
60
40
20
0
n = 52
Amoxicillin
Ampicillin
Colistin
Tylosin

variation in SPC-value for oxytetracyline:

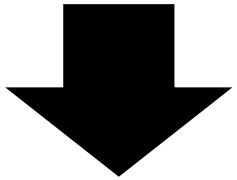
Turkey: 5 mg/kg/day - 40 mg/kg/day



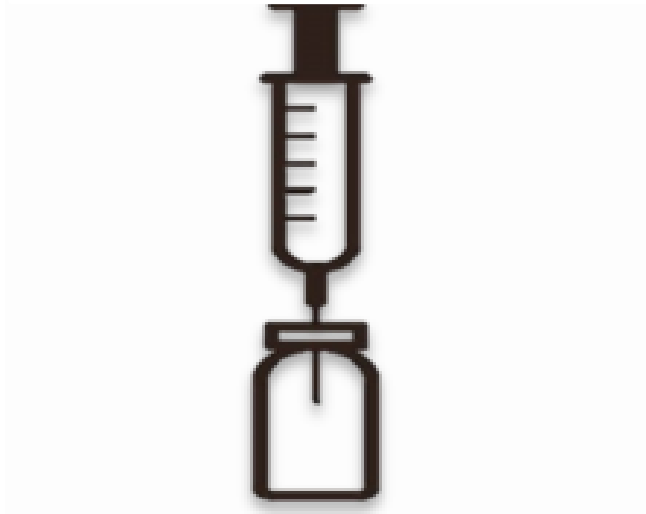
SPC-values

Farmer

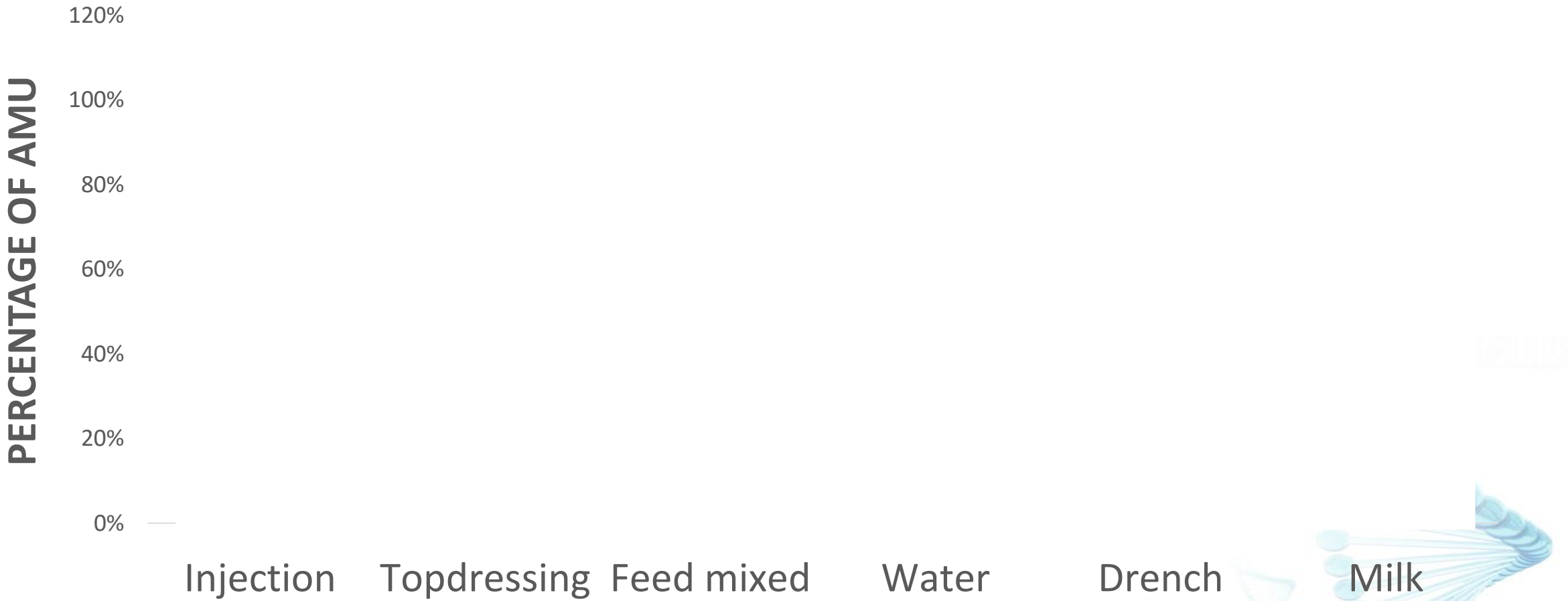
Veterinarian



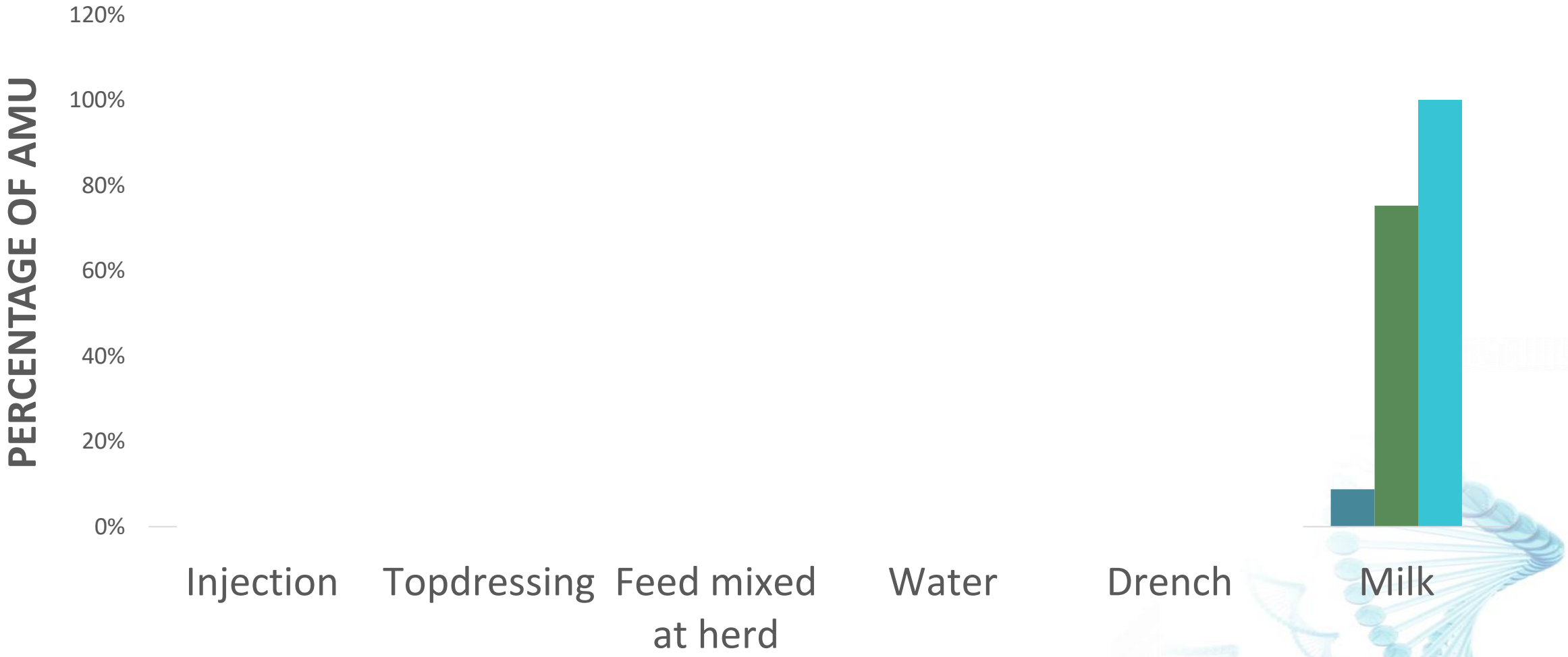
Dosage guidelines
Dosage optimalisation



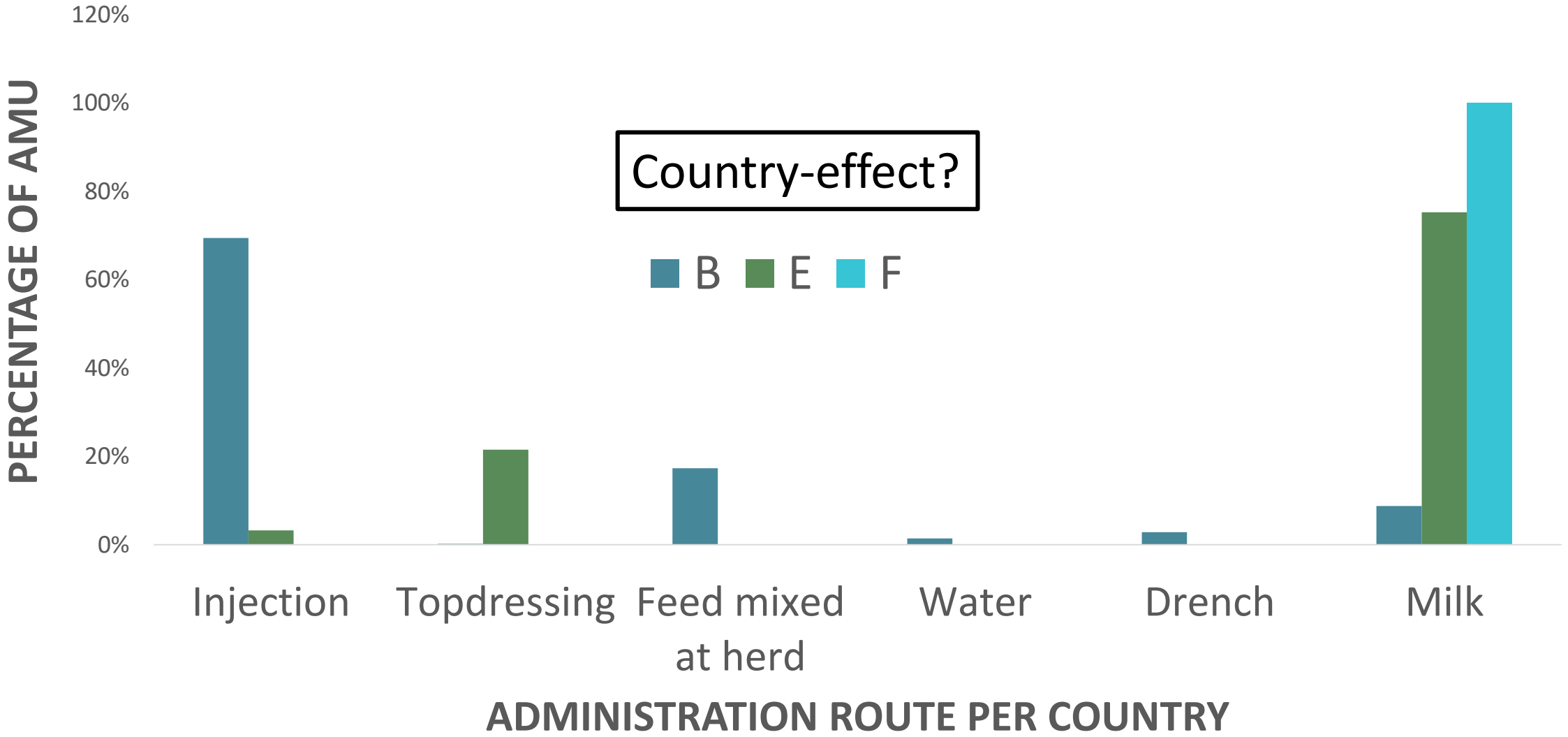
Variation in administration route between countries

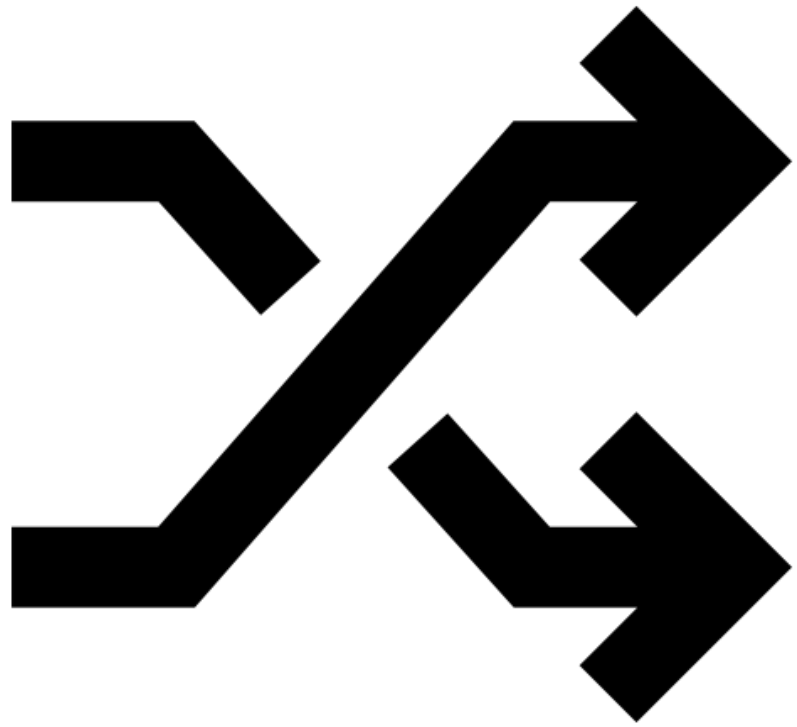


Variation in administration route between countries

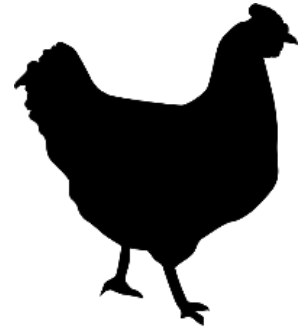


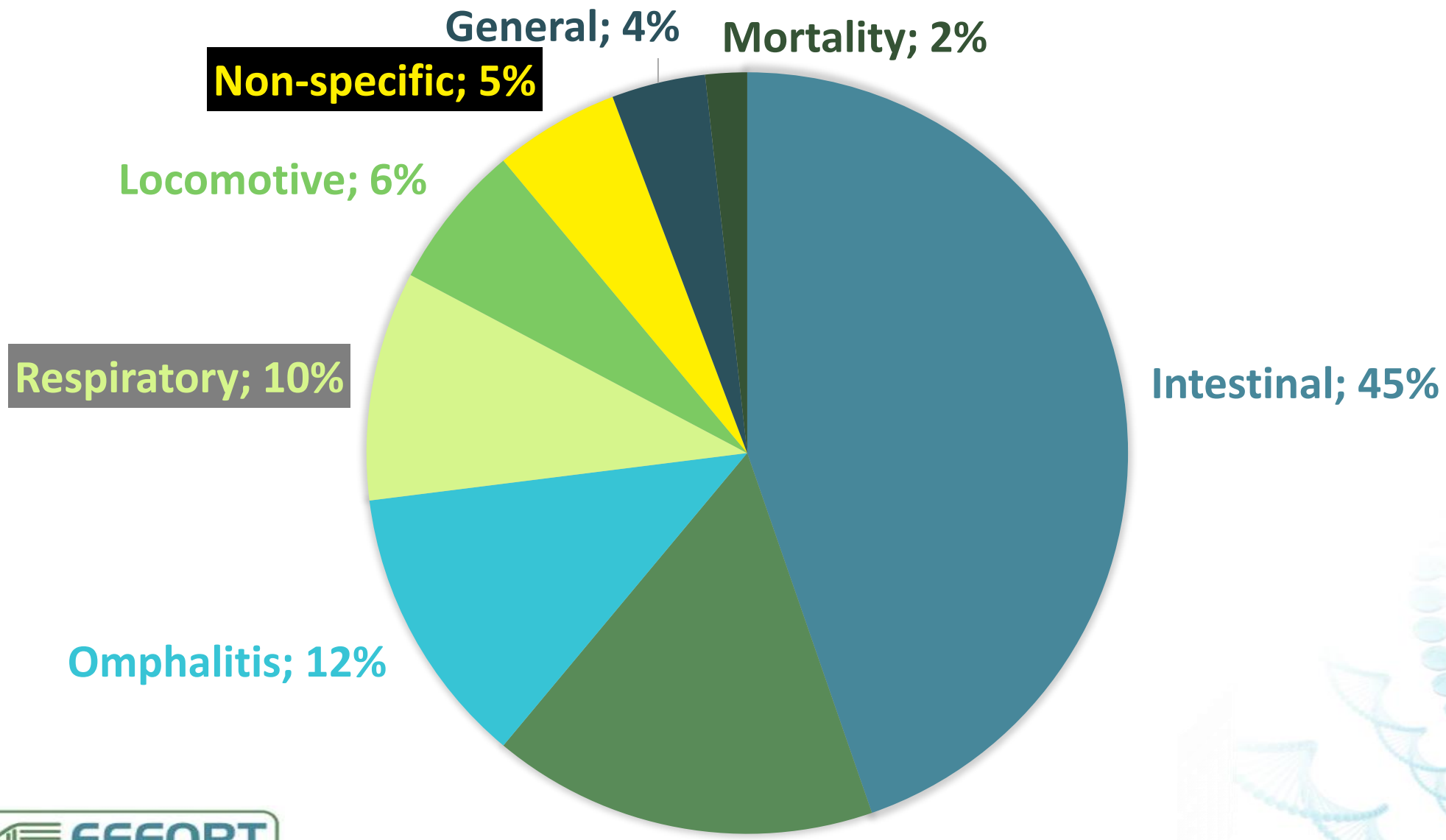
Variation in administration route between countries



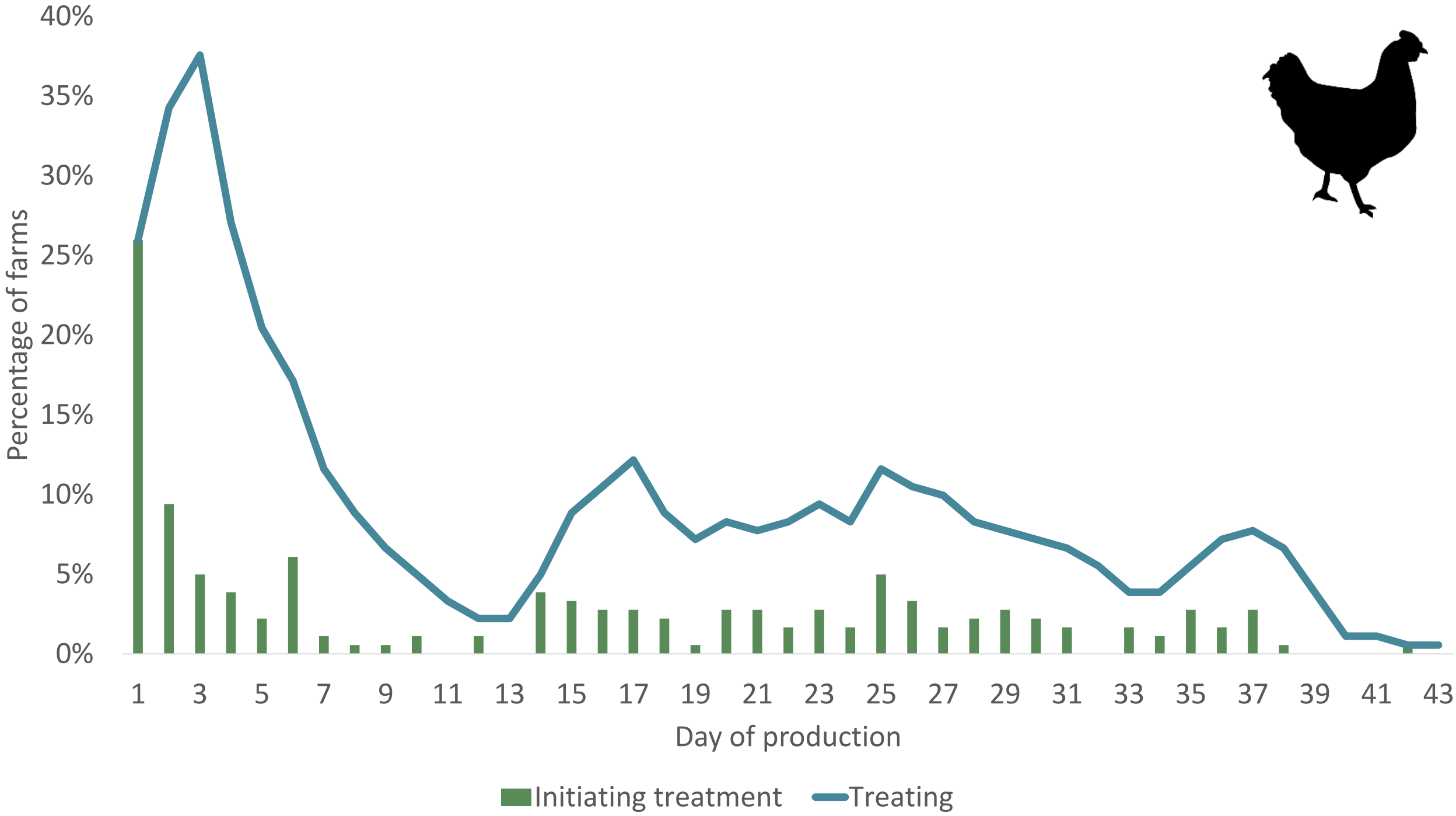


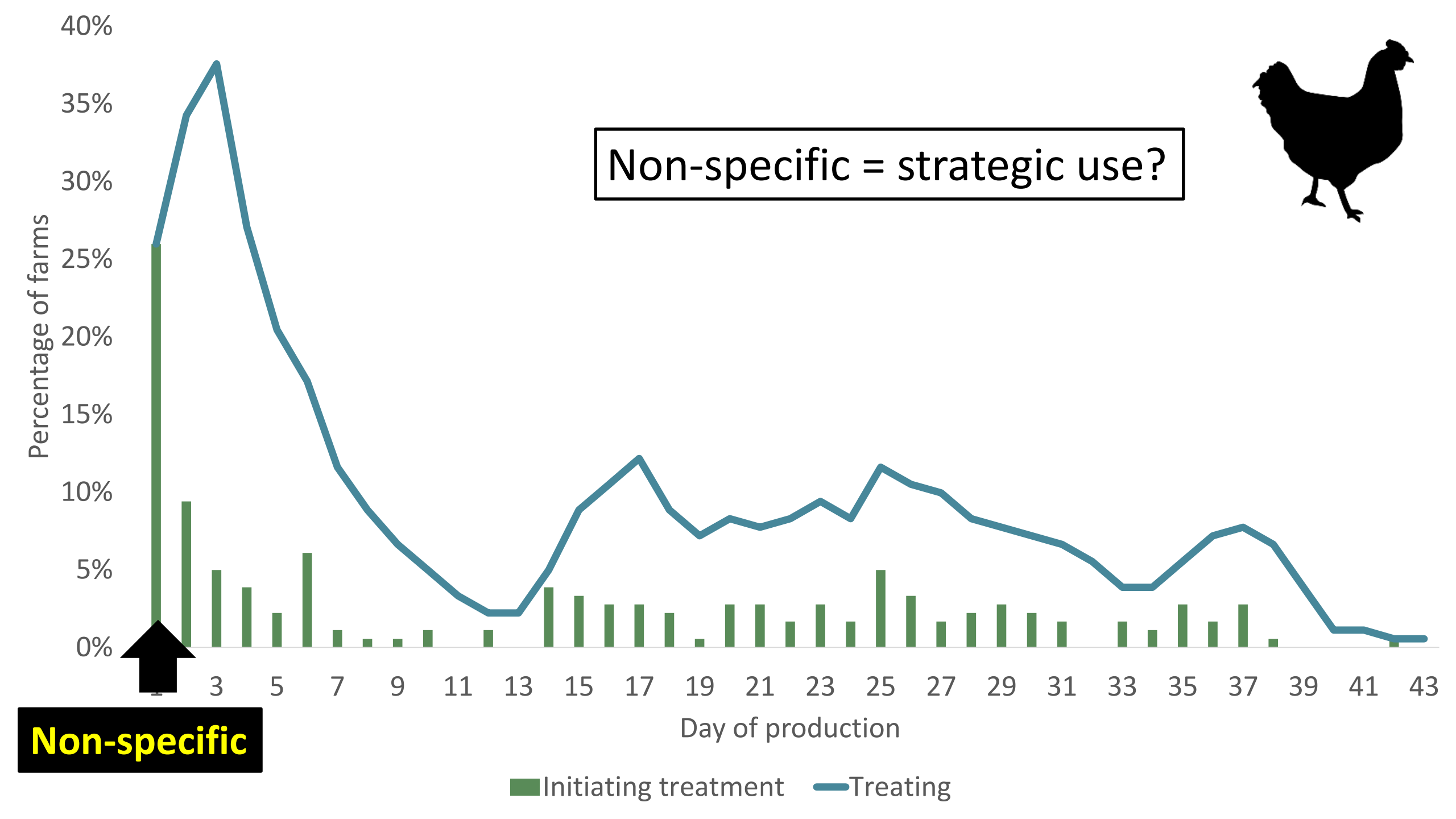
Indications for treatment





EFFORT
AGAINST ANTIMICROBIAL RESISTANCE


40%
35%
30%
25%
20%
15%
10%
5%
0%
Percentage of farms
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
Day of production
Initiating treatment
Treating


40%
35%
30%
25%
20%
15%
10%
5%
0%
Percentage of farms
Non-specific = strategic use?
1
3
5
7
9
11
13
15
17
19
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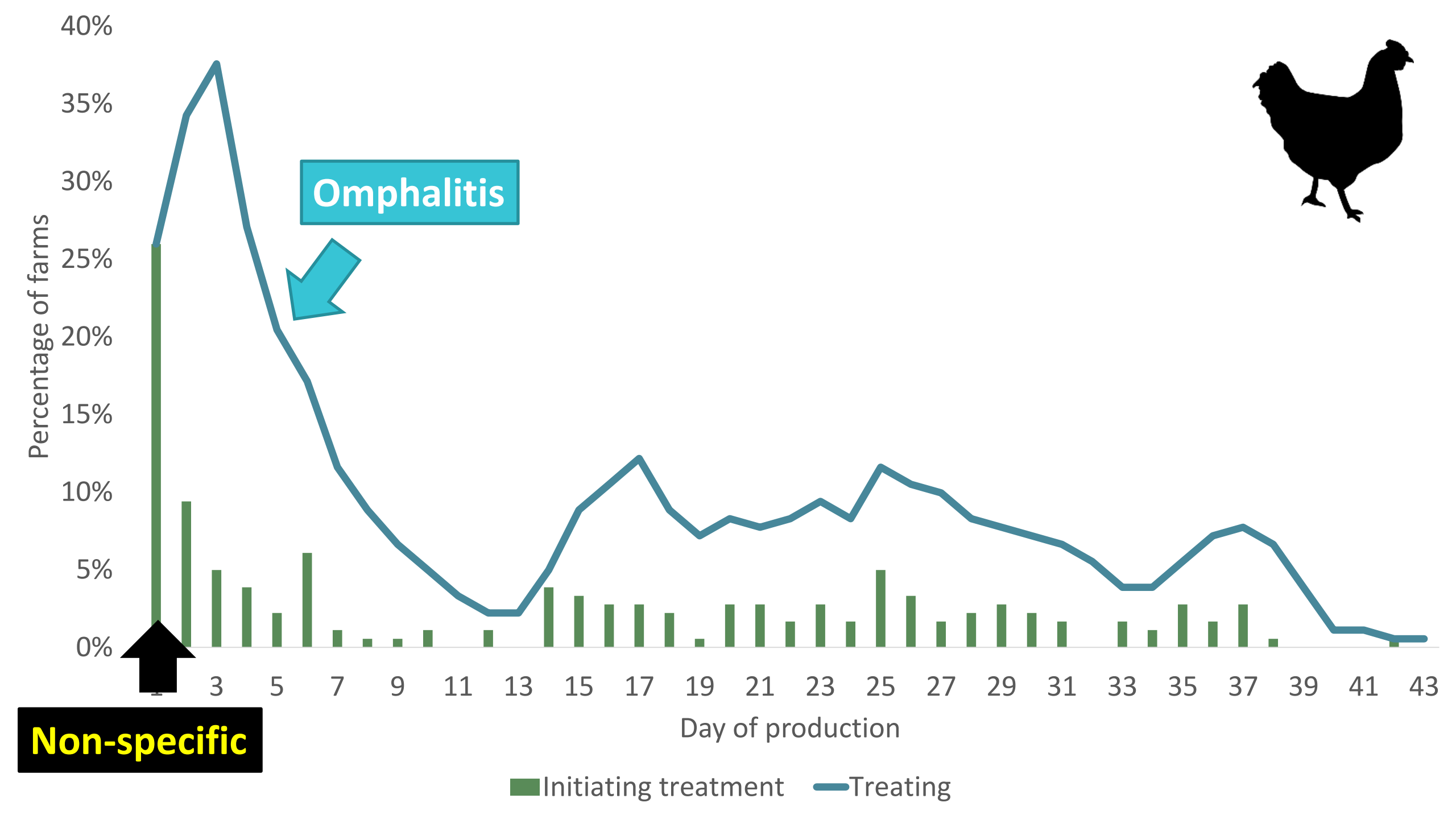
41
43
Day of production
Non-specific
Initiating treatment
Treating


40%
35%
30%
25%
20%
15%
10%
5%
0%
Percentage of farms
Omphalitis
Non-specific
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
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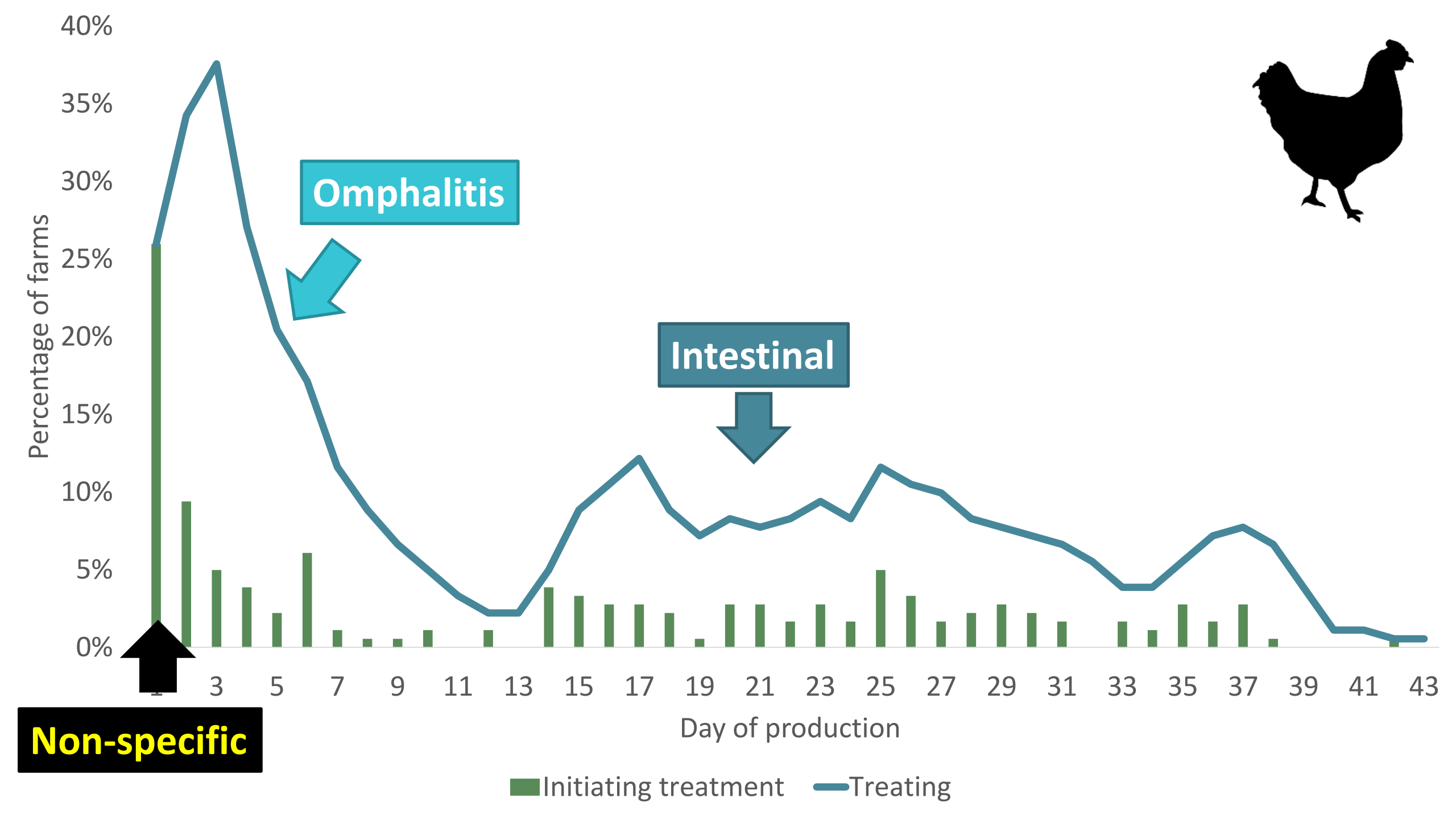
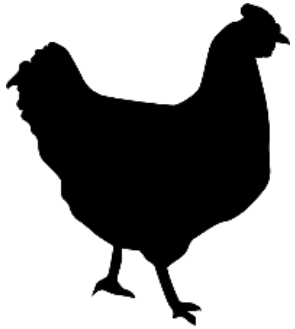
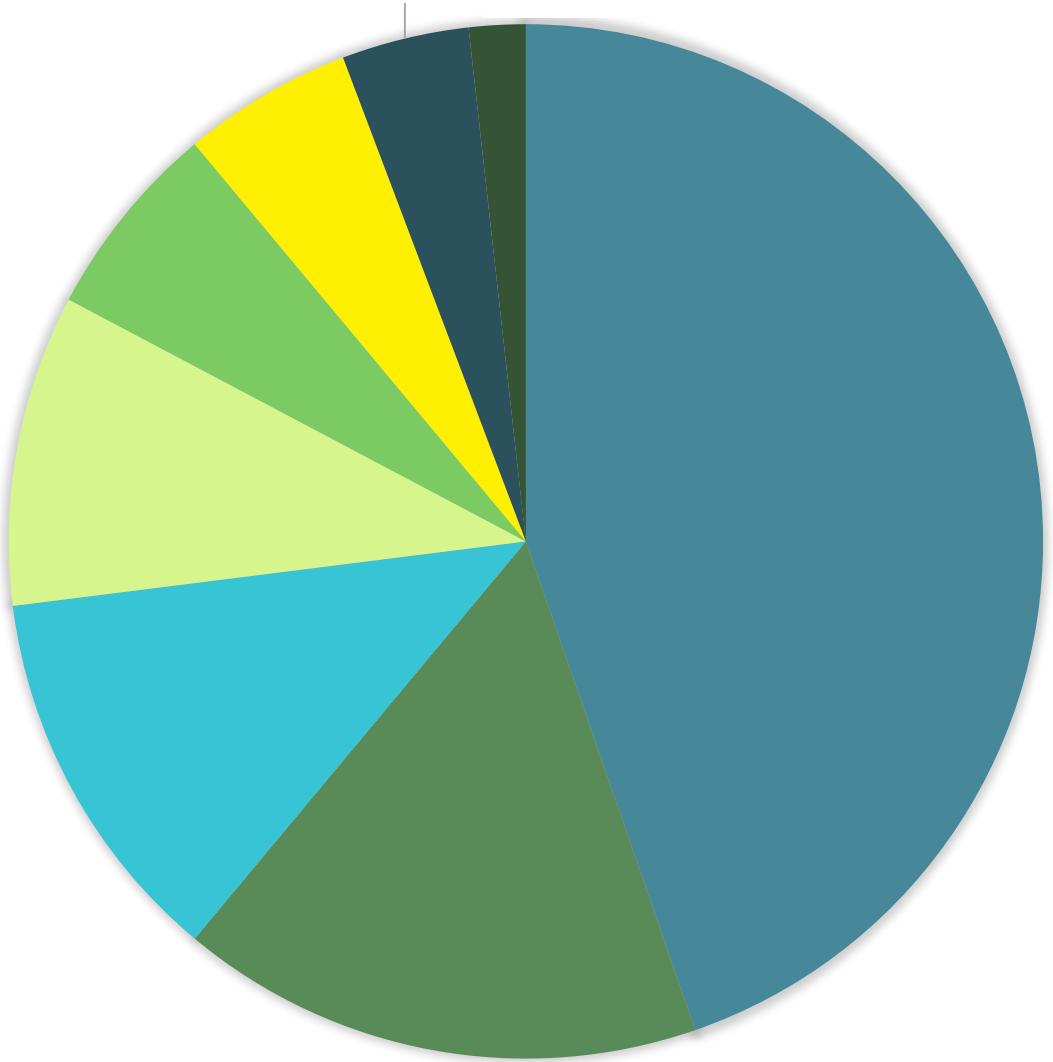
33
35
37
39
41
43
Day of production
Initiating treatment
Treating


40%
35%
30%
25%
20%
15%
10%
5%
0%
Percentage of farms
Omphalitis
Intestinal
Non-specific
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
Day of production
Initiating treatment
Treating

Indications for treatment





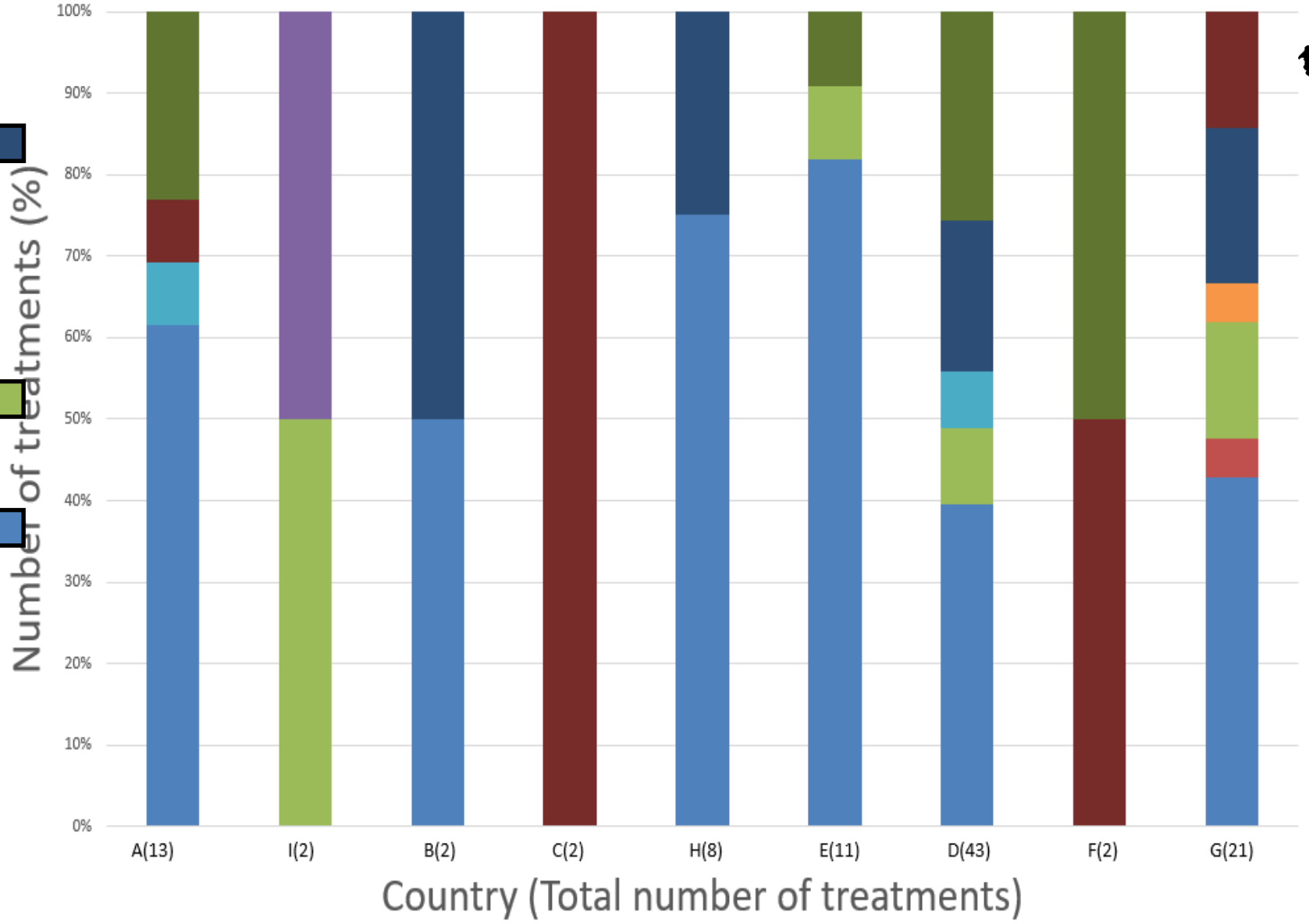
Intestinal; 45%

EFFORT
AGAINST ANTIMICROBIAL RESISTANCE

Variation in choice of active substance

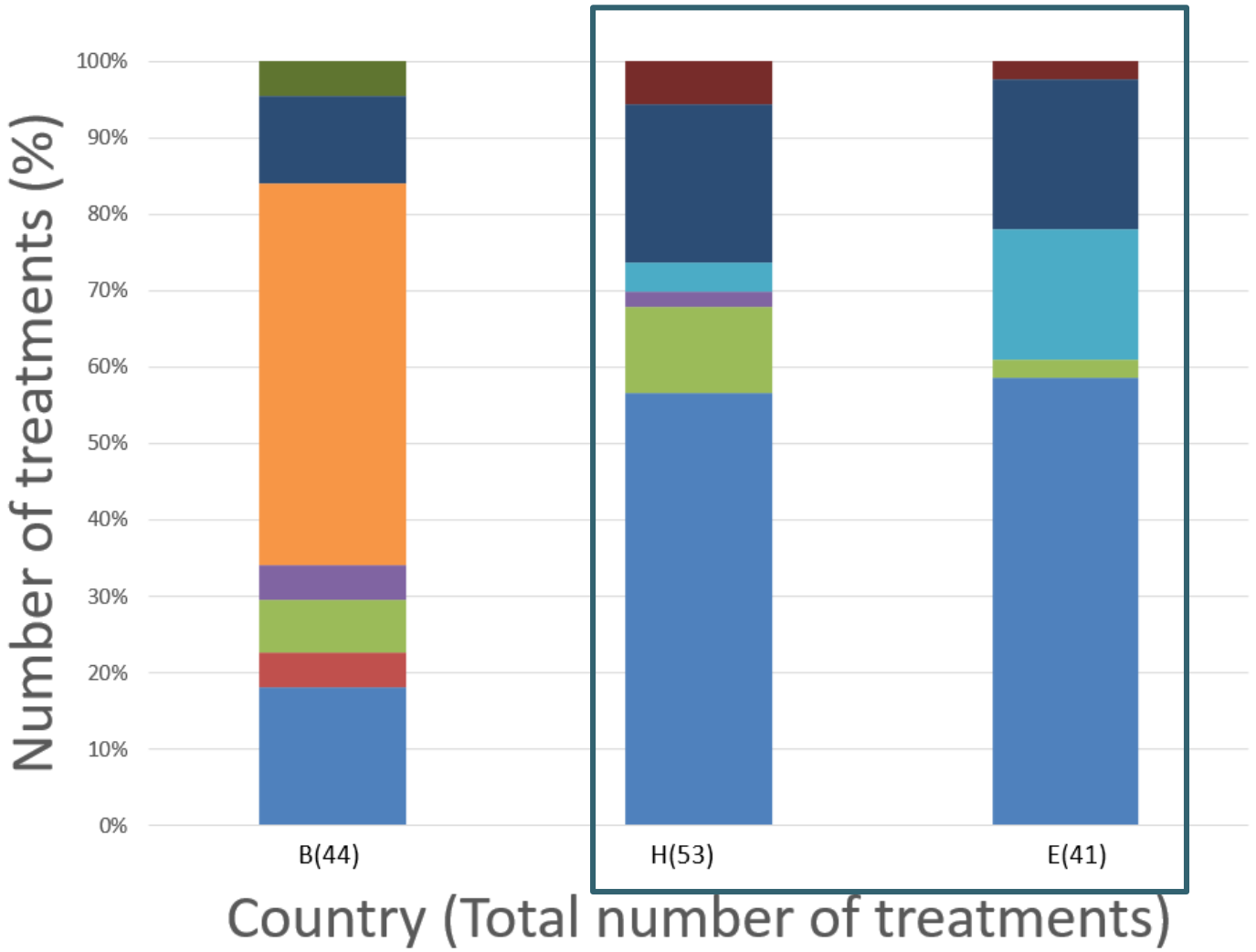
Intestinal

- Trim/Sulfa
- Tetracyclines
- Polymyxins
- B-lact sens Penicillins
- Macrolides
- Lincosamides
- Fluoroquinolones
- Amphenicols
- ES Penicillins
- Pleuromutilins
- Other Quinolones
- Linco/Spec
- Cephalosporins
- Aminoglycosides
- Sulfonamides



Variation in choice of active substance

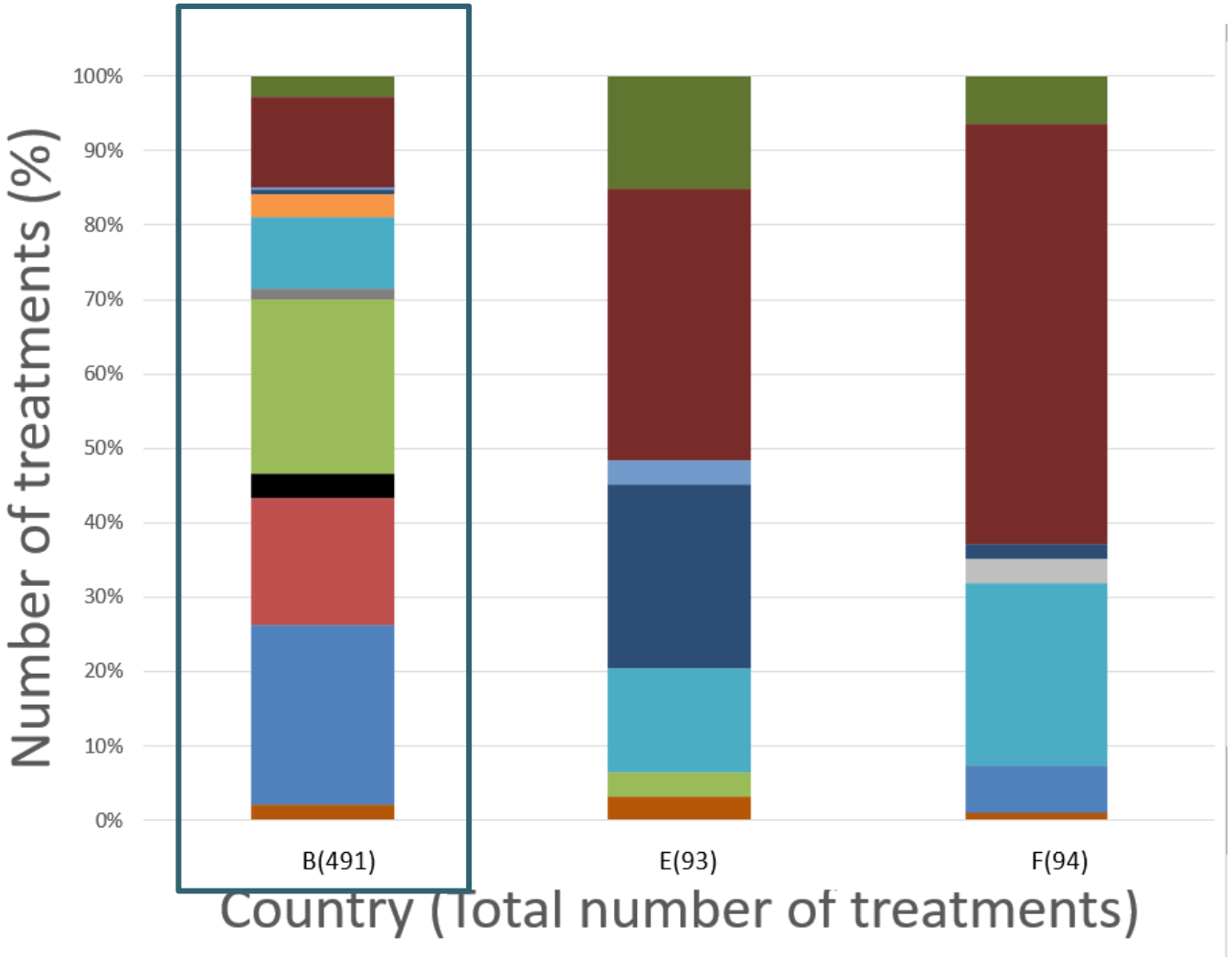
- Trim/Sulfa
- Tetracyclines
- Polymyxins
- B-lact sens Penicillins
- Macrolides
- Lincosamides
- Fluoroquinolones
- Amphenicols
- ES Penicillins
- Pleuromutilins
- Other Quinolones
- Linco/Spec
- Cephalosporins
- Aminoglycosides
- Sulfonamides



Intestinal

Variation in choice of active substance

- Trim/Sulfa
- Tetracyclines
- Polymyxins
- B-lact sens Penicillins
- Macrolides
- Lincosamides
- Fluoroquinolones
- Amphenicols
- ES Penicillins
- Pleuromutilins
- Other Quinolones
- Linco/Spec
- Cephalosporins
- Aminoglycosides
- Sulfonamides



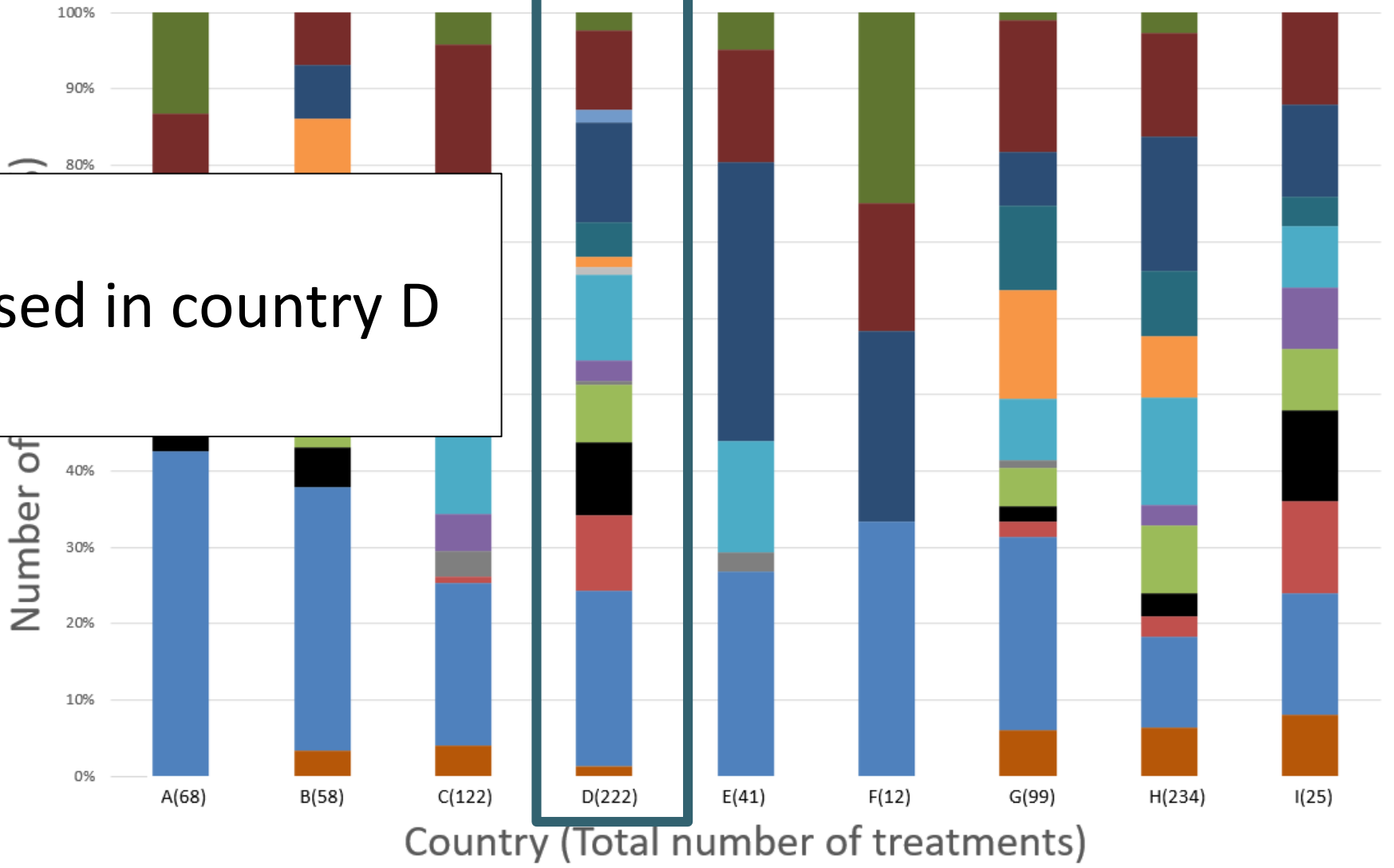
Intestinal

Variation in choice of active substance

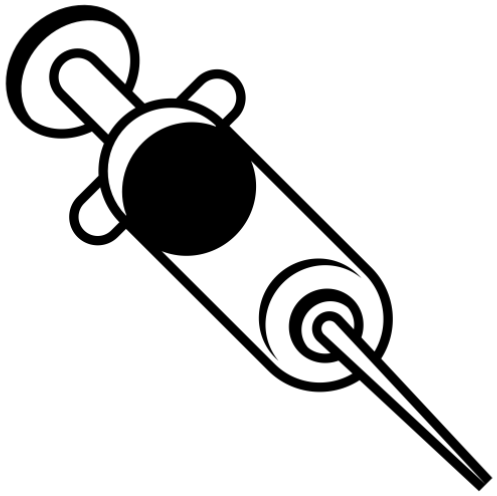
Intestinal

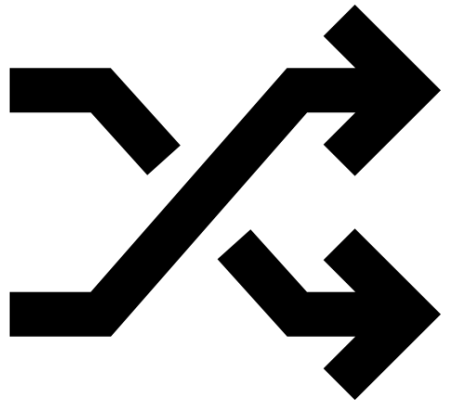
Trim/Sulfa
Tetracyclines
Polymyxins
B-lact sens Penicillins
M
Lin
Flu
Amphenicols
ES Penicillins
Pleuromutilins
Other Quinolones
Linco/Spec
Cephalosporins
Aminoglycosides
Sulfonamides

14 classes used in country D



Big variation in AMU





TARGETS TOWARDS A MORE RESPONSIBLE AND PRUDENT AMU?

EFFORT
AGAINST ANTIMICROBIAL RESISTANCE

"If you use penicillin, use enough."

Medicine Laureate Alexander Fleming's Nobel Lecture in 1945

Nobelprize.org

The Official Web Site of the Nobel Prize

The research leading to these results has received funding from the European Community's Seventh Framework Programme [FP7/2007-2013] under grant agreement n°613754.

EFFORT
AGAINST ANTIMICROBIAL RESISTANCE

Thank you for your attention!

Universiteit Utrecht
WAGENINGEN UNIVERSITY WAGENINGEN UR
DTU
SAFOSO
intomics from data to biology
anses French agency for food, environmental and occupational health & safety
PorQ
BfR Bundesinstitut für Risikobewertung
FACULTY OF VETERINARY MEDICINE accredited by EAEVE
VION
STIFTUNG TIERÄRZTLICHE HOCHSCHULE HANNOVER
IZS Istituto Zooprofilattico Sperimentale delle Regioni Lazio e Toscana
PIWet
vetworks
ARTTIC INTERNATIONAL MANAGEMENT SERVICES
ILSI Europe International Life Sciences Institute
BFSA
AGAINST ANTIMICRO

FACULTY OF VETERINARY MEDICINE
accredited by EAEVE

GHENT UNIVERSITY

Philip Joosten

PhD-Candidate

VETERINARY EPIDEMIOLOGY UNIT

DEPARTMENT OF REPRODUCTION,OBSTETRICS AND HERD HEALTH

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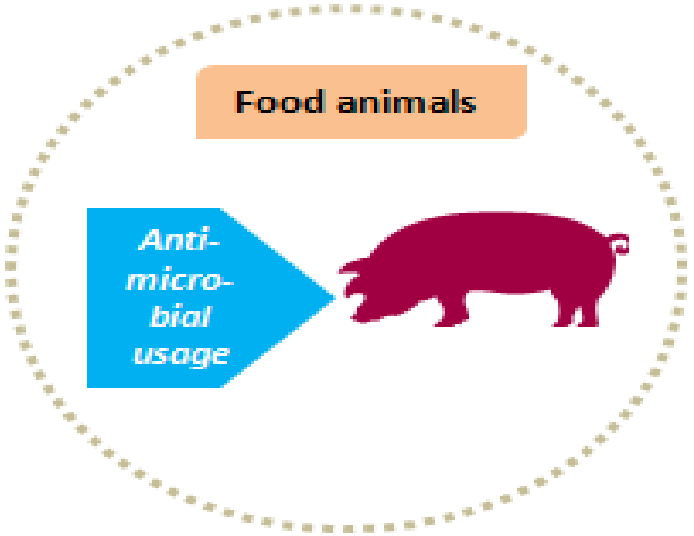
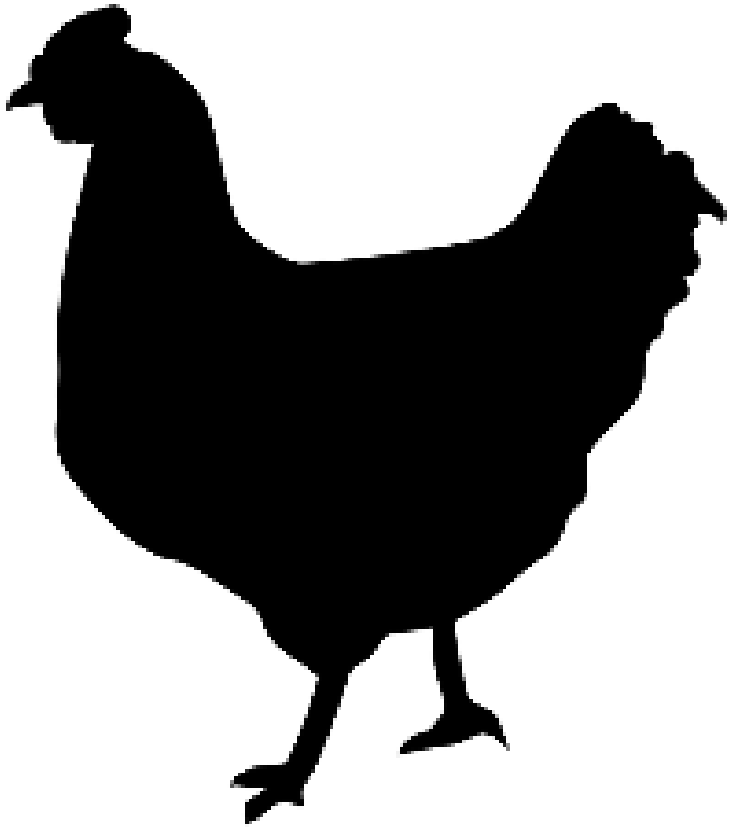
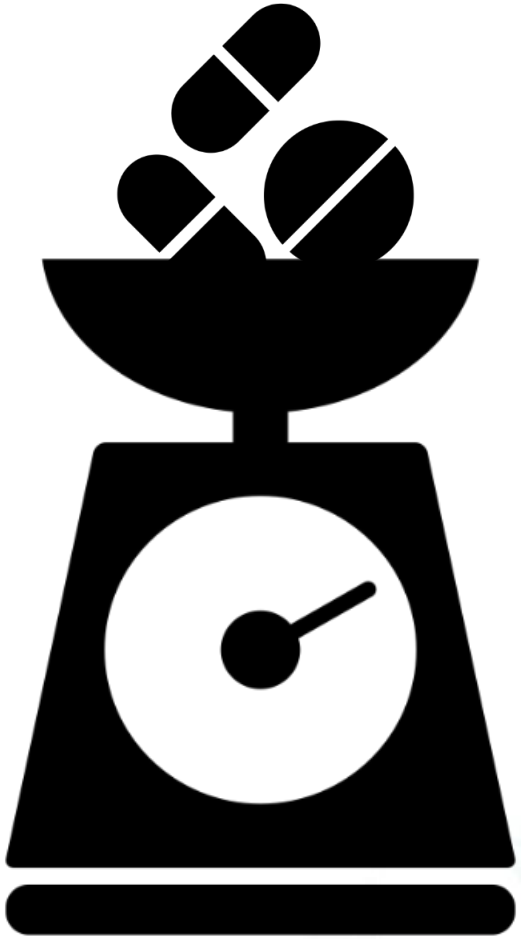
EFFORT
AGAINST ANTIMICROBIAL RESISTANCE


Food animals
Anti-
micro-
bial
usage

AMU on broiler farms

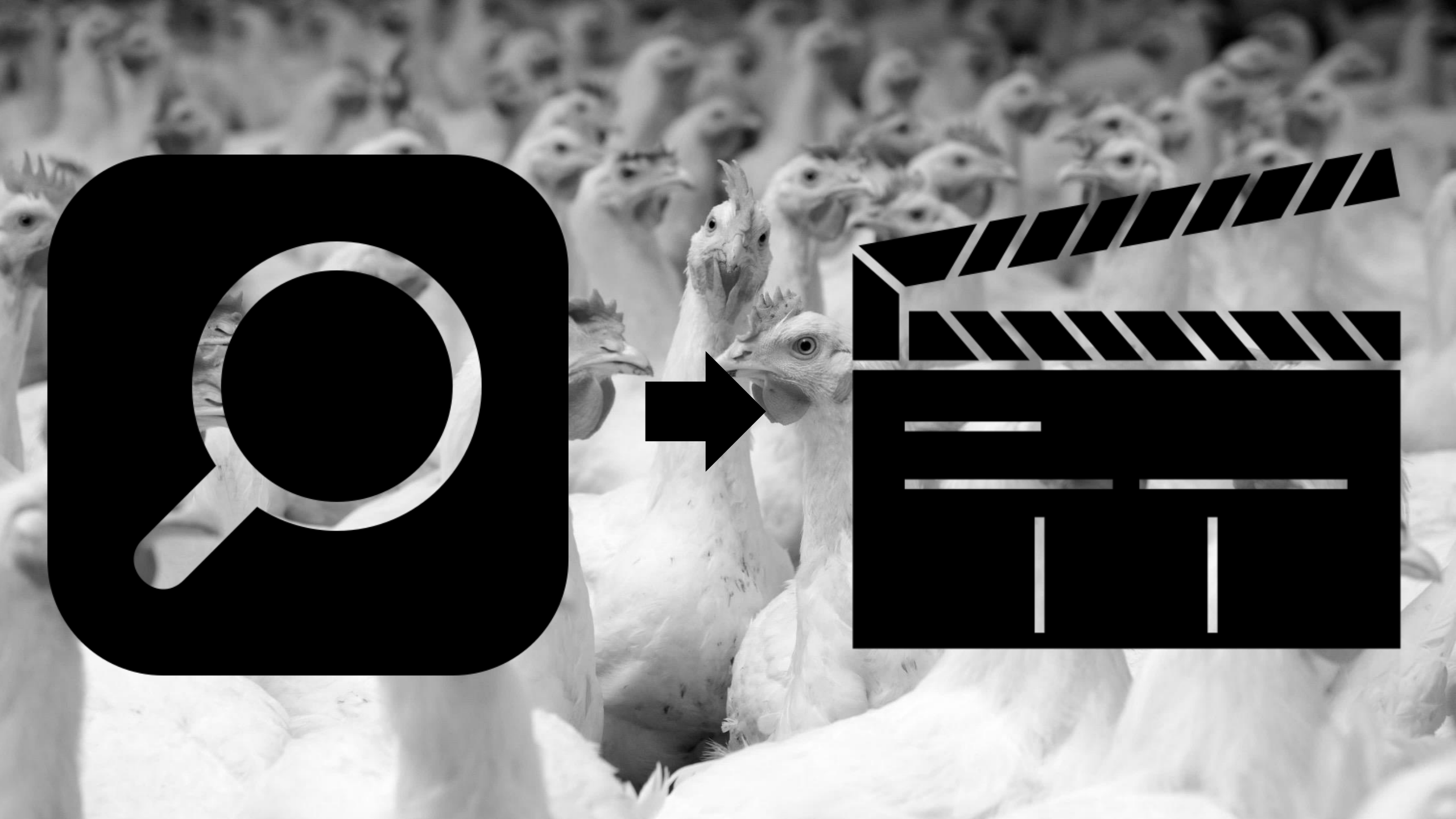


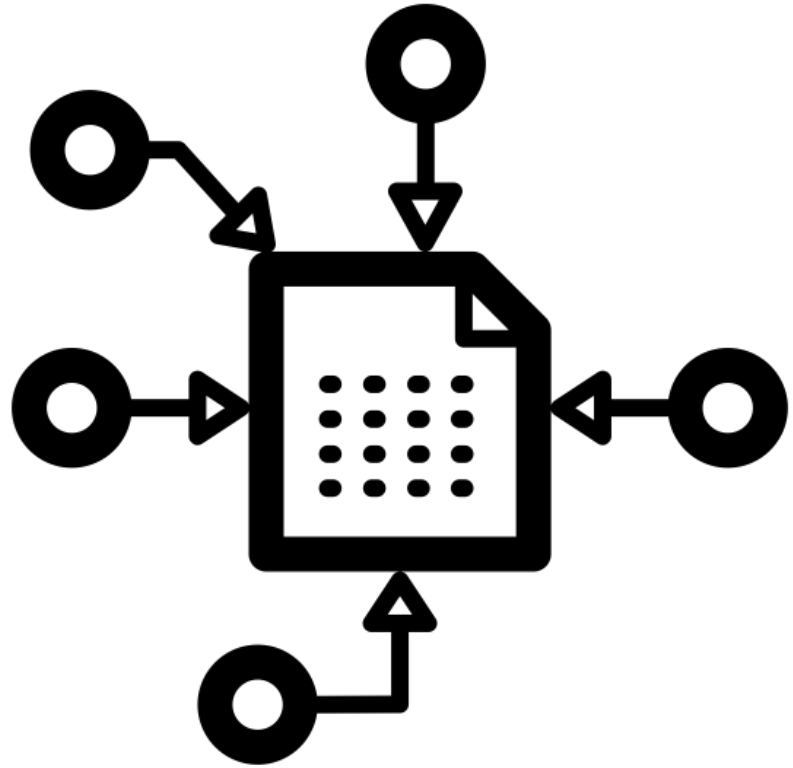


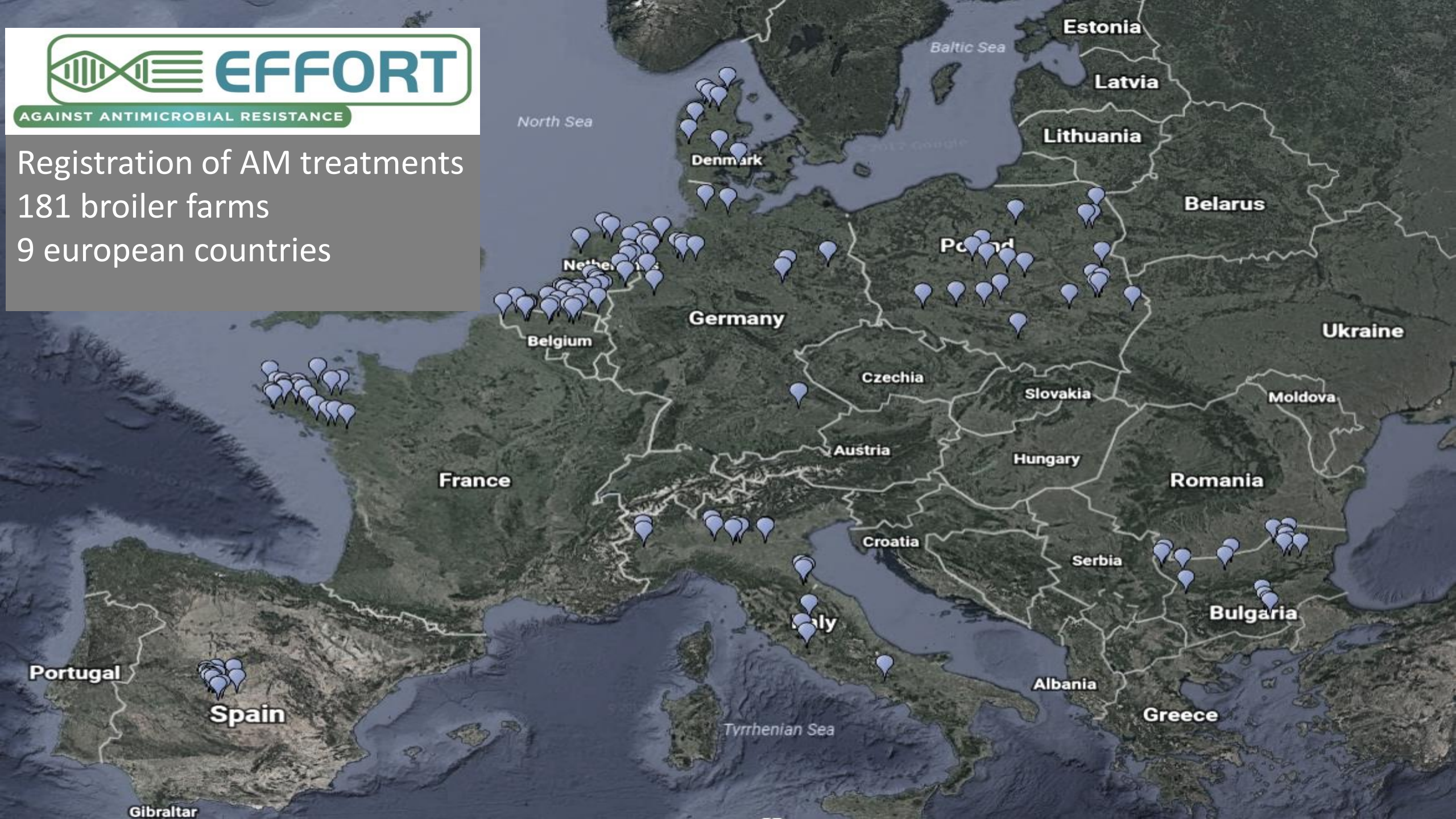
Size

Housing system

Mass medication



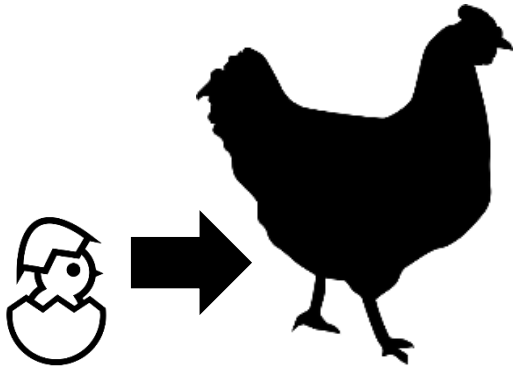



EFFORT
AGAINST ANTIMICROBIAL RESISTANCE
Registration of AM treatments
181 broiler farms
9 european countries
Estonia
Baltic Sea
Latvia
North Sea
Lithuania
Denmark
Belarus
Germany
Belgium
Ukraine
Czechia
Slovakia
Moldova
Austria
Hungary
France
Romania
Croatia
Serbia
Bulgaria
Portugal
Spain
Albania
Greece
Tyrrhenian Sea
Gibraltar

DATA COLLECTION
group treatments

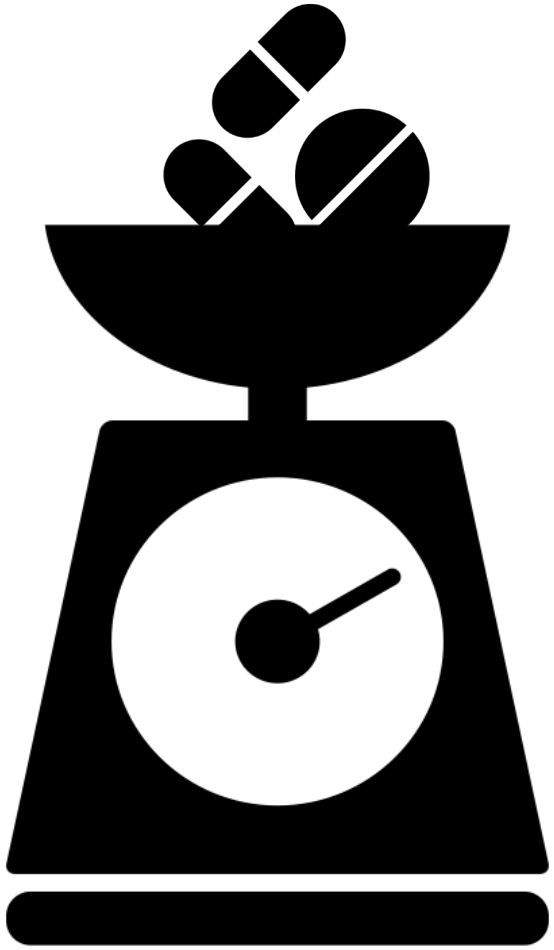
Questionnaire

1 house
=flock level



Birth to slaughter

Methodology



Treatment incidence (TI)

$$\frac{\text{Total amount of antimicrobial drug used}}{\text{Dose} \times \text{Number of days at risk} \times \text{Kg animal at risk}}$$

(Timmerman et al., 2006)

Total amount of antimicrobial drug used

$$\frac{\text{Dose} \times \text{Number of days at risk} \times \text{Kg animal at risk}}{}$$

$$\frac{\text{Total amount of antimicrobial drug used or purchased}}{\textbf{Dose} \times \text{Number of days at risk} \times \text{Kg animal at risk}}$$

Defined Daily Dose → DDDvet → ESVAC

Total amount of antimicrobial drug used or purchased

Dose × Number of days at risk × Kg animal at risk

Broilers (poultry) – DDDvet

Abbreviations used: DCDvet - defined course dose for animals; DDDvet - defined daily dose for animals; EU/EEA - European Union/European Economic Area; mg/kg - milligram active substance per kilogram body weight; VMP - veterinary medicinal product.

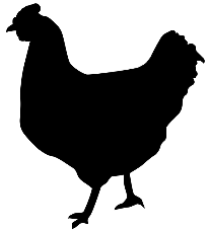
An underscore (_) in the substance indicates that the assigned DDDvet and DCDvet are subject to an exception which is explained in the comment.

Note: ta were originally collected for broilers, but values can be used as roxy for er poultry species.

Substance	Antimicrobial class	Route	DDDvet	DCDvet	Unit	Comment
Amoxicillin	Penicillins with extended spectrum	Oral	16	74	mg/kg	
Ampicillin	Penicillins with extended spectrum	Oral	108	453	mg/kg	
Apramycin	Aminoglycosides	Oral	81	388	mg/kg	

$$\frac{\text{Total amount of antimicrobial drug used or purchased}}{\text{Dose} \times \textbf{Number of days at risk} \times \text{Kg animal at risk}}$$

$$\frac{\text{Total amount of antimicrobial drug used or purchased}}{\text{Dose} \times \textbf{Number of days at risk} \times \text{Kg animal at risk}}$$

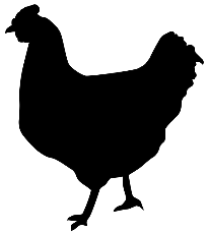


Broilers
42 days
[35; 49]

$$\frac{\text{Total amount of antimicrobial drug used or purchased}}{\text{Dose} \times \text{Number of days at risk} \times \textbf{Kg animal at risk}}$$

$$\frac{\text{Total amount of antimicrobial drug used or purchased}}{\text{Dose} \times \text{Number of days at risk} \times \textbf{Kg animal at risk}}$$

number of animals at risk x standard weight



1 kg

Treatment incidence (TI)

$$\frac{\text{Total amount of antimicrobial drug used}}{\text{Dose} \times \text{Number of days at risk} \times \text{Kg animal at risk}}$$

(Timmerman et al., 2006)

Treatment incidence (TI)

On flock level

Treatment 1 → TI = x_1

Treatment 2 → TI = x_2

Treatment 3 → TI = x_3

…

Treatment *n* → TI = x_n

Treatment incidence (TI)

On flock level

Treatment 1 → TI = x_1

Treatment 2 → TI = x_2

Treatment 3 → TI = x_3

…

Treatment *n* → TI = x_n

$\sum$

Treatment incidence (TI)

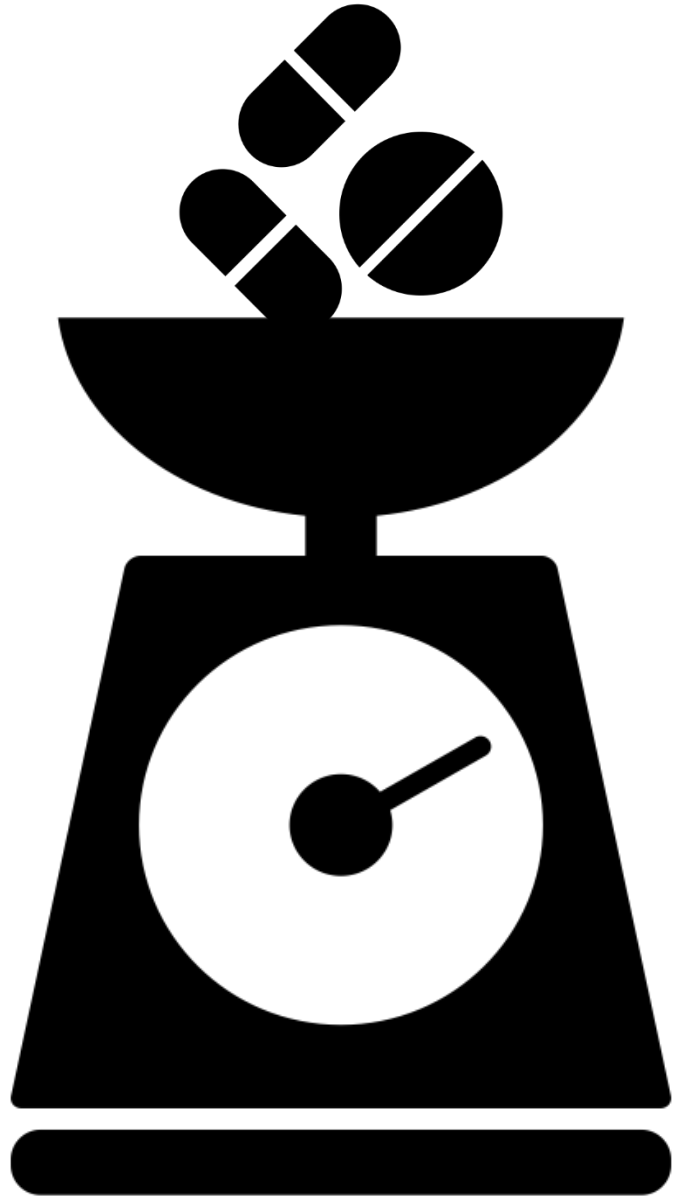
Number of animals per 100 animals at risk

That received a daily dosage antimicrobials

during which % of time an animal

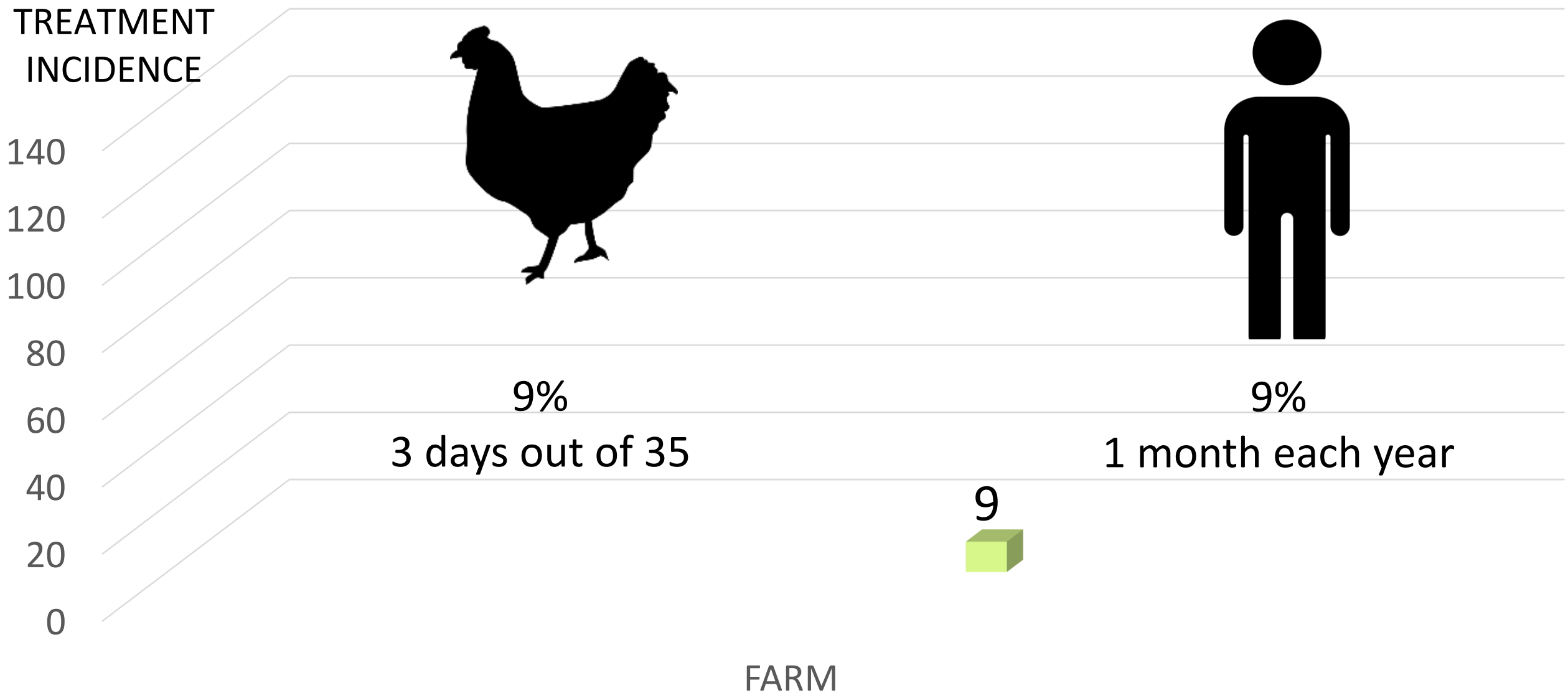
is treated with antimicrobials

(Timmerman et al., 2006)

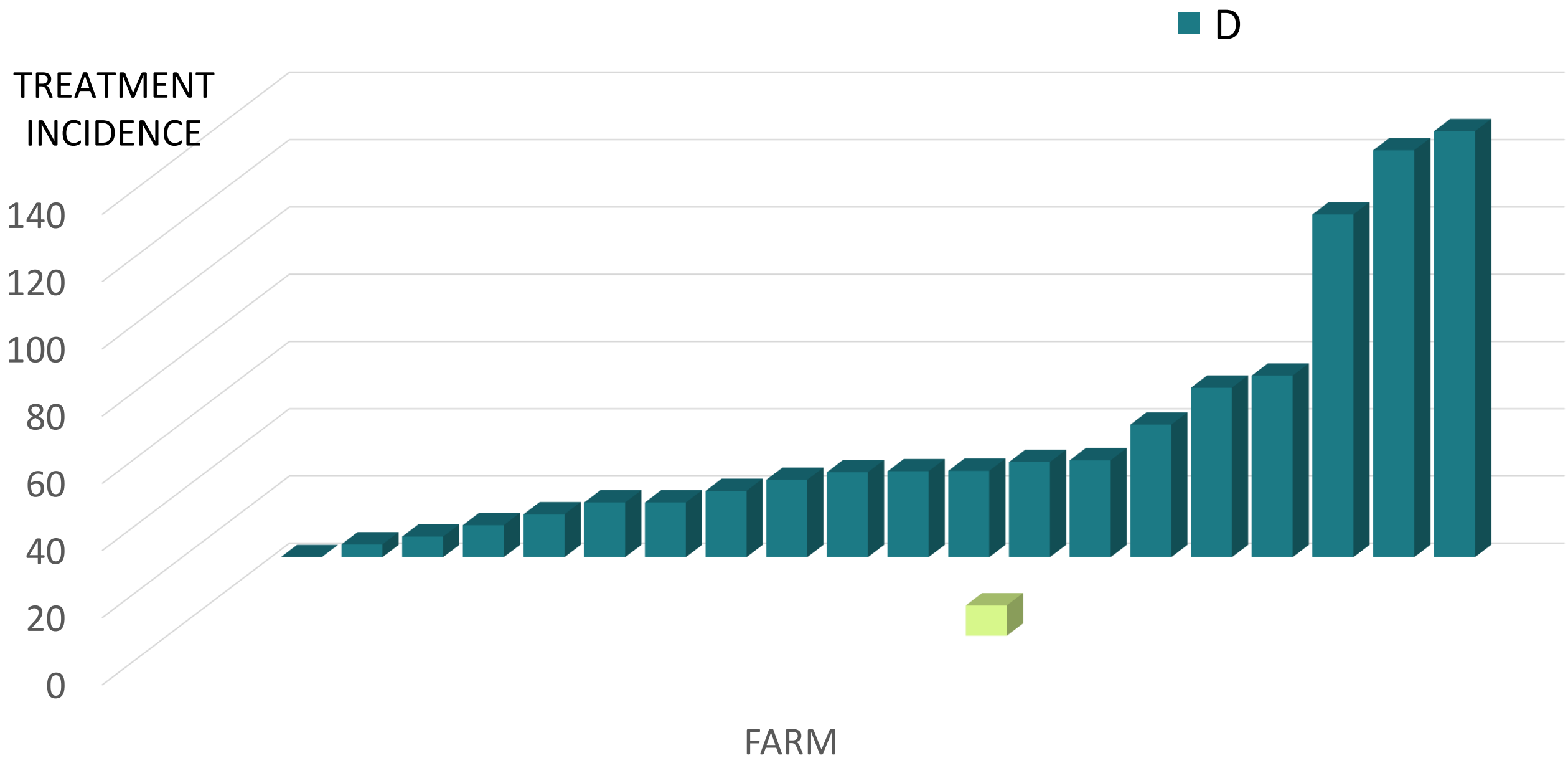


EFFORT
AGAINST ANTIMICROBIAL RESISTANCE

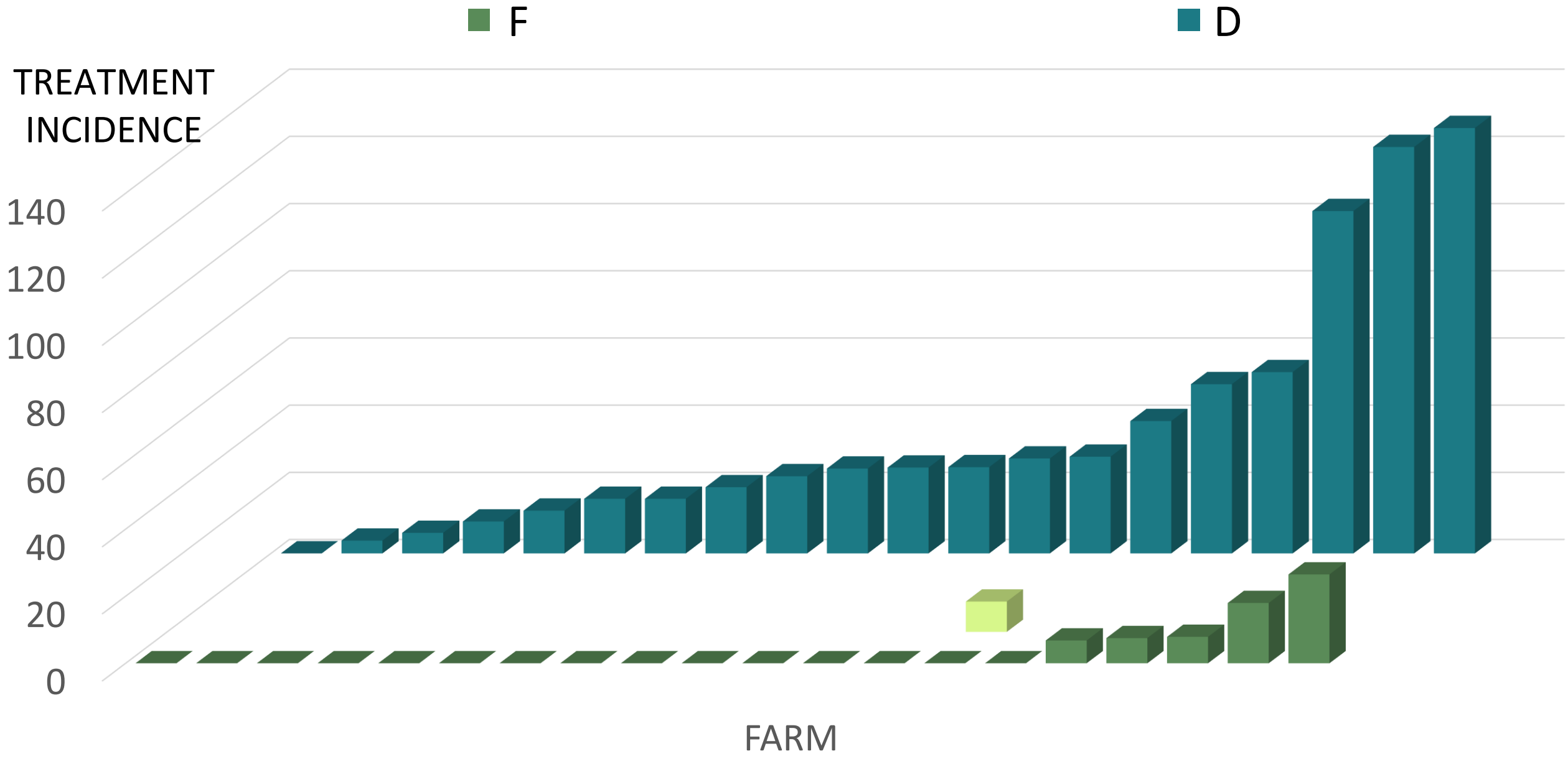
Usage on the median farm

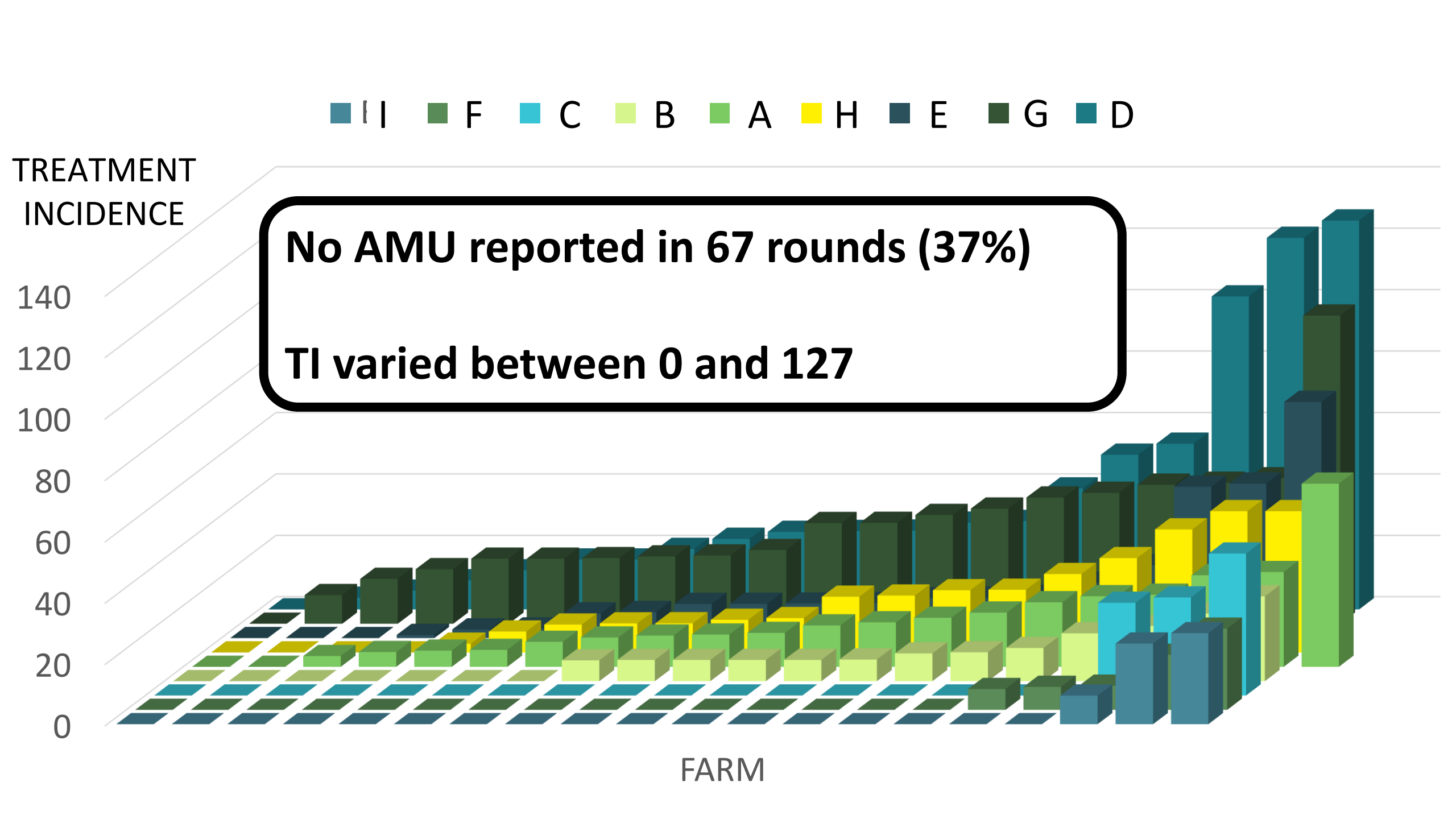


Variation in usage within a country

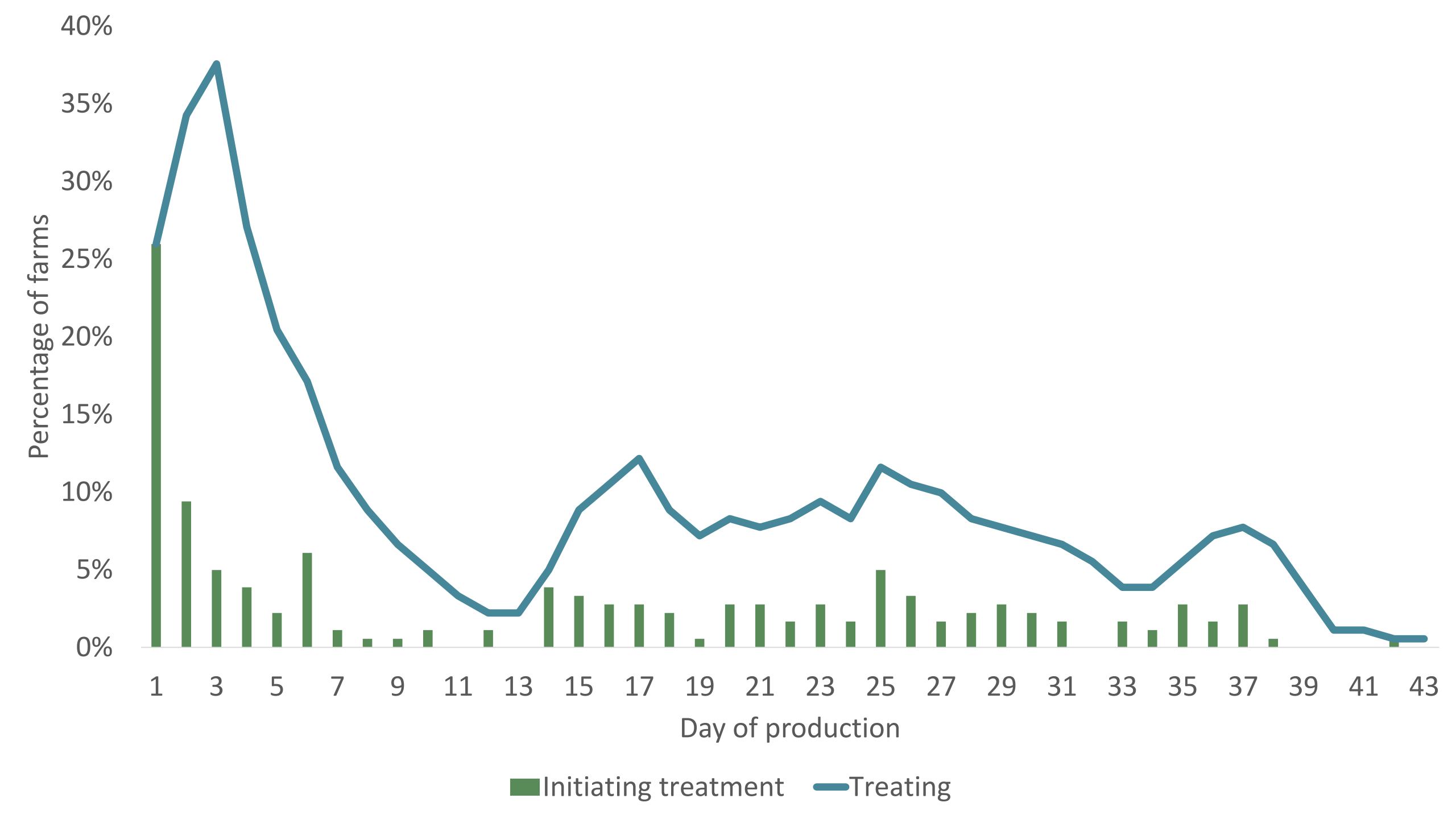


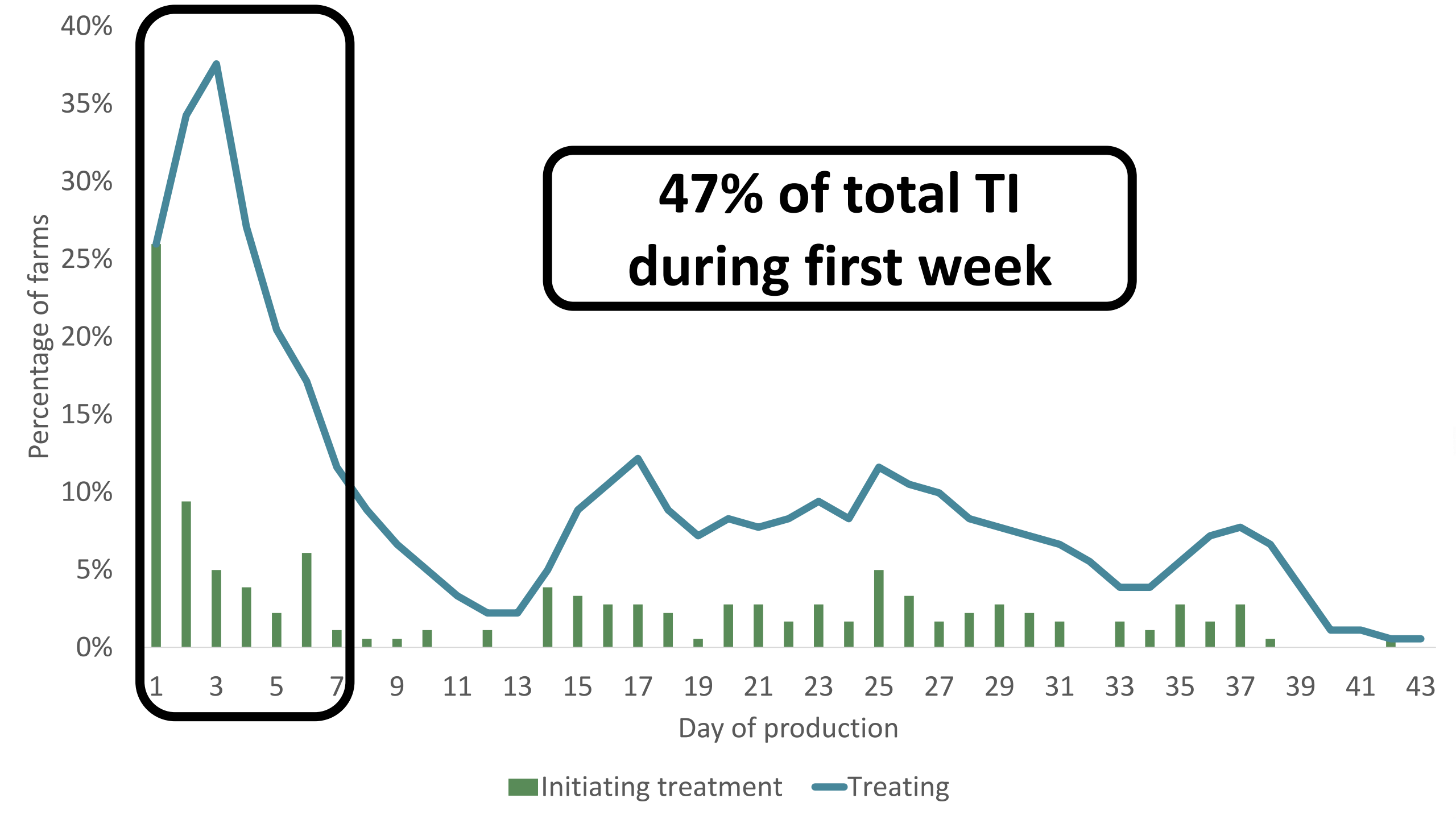
Variation in usage between countries

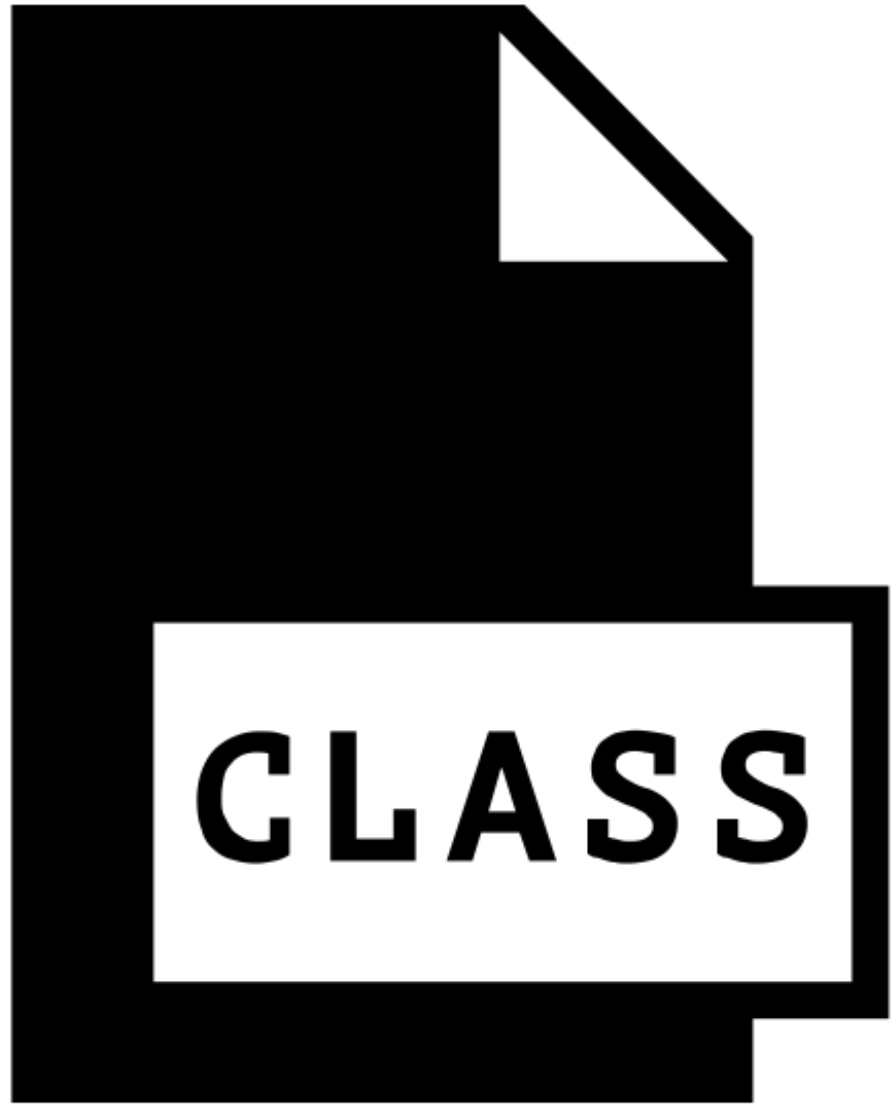



I F C B A H E G D
TREATMENT INCIDENCE
140
120
100
80
60
40
20
0
No AMU reported in 67 rounds (37%)
TI varied between 0 and 127
FARM

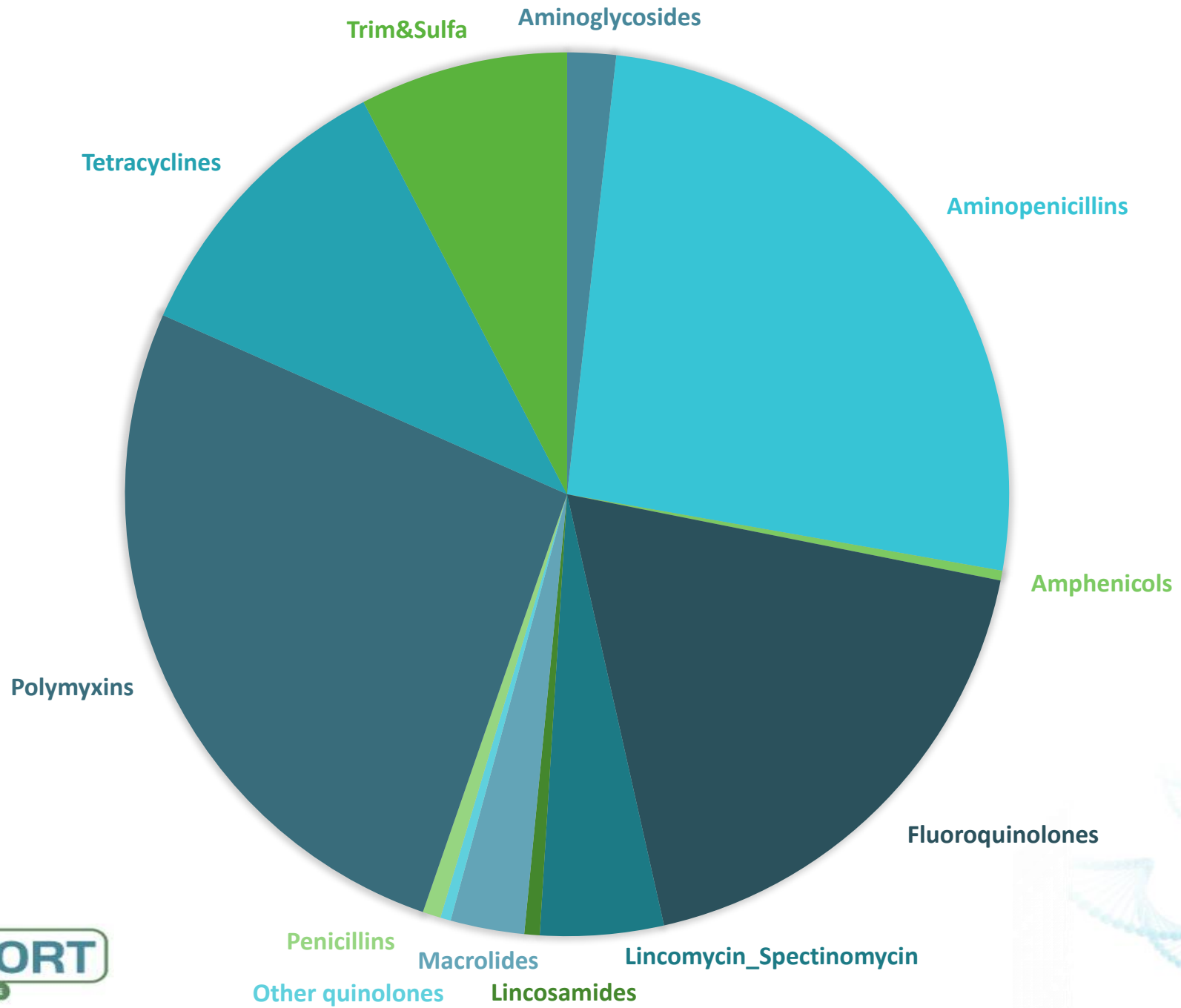
EFFORT
AGAINST ANTIMICROBIAL RESISTANCE


40%
35%
30%
25%
20%
15%
10%
5%
0%
Percentage of farms
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
Day of production
Initiating treatment
Treating

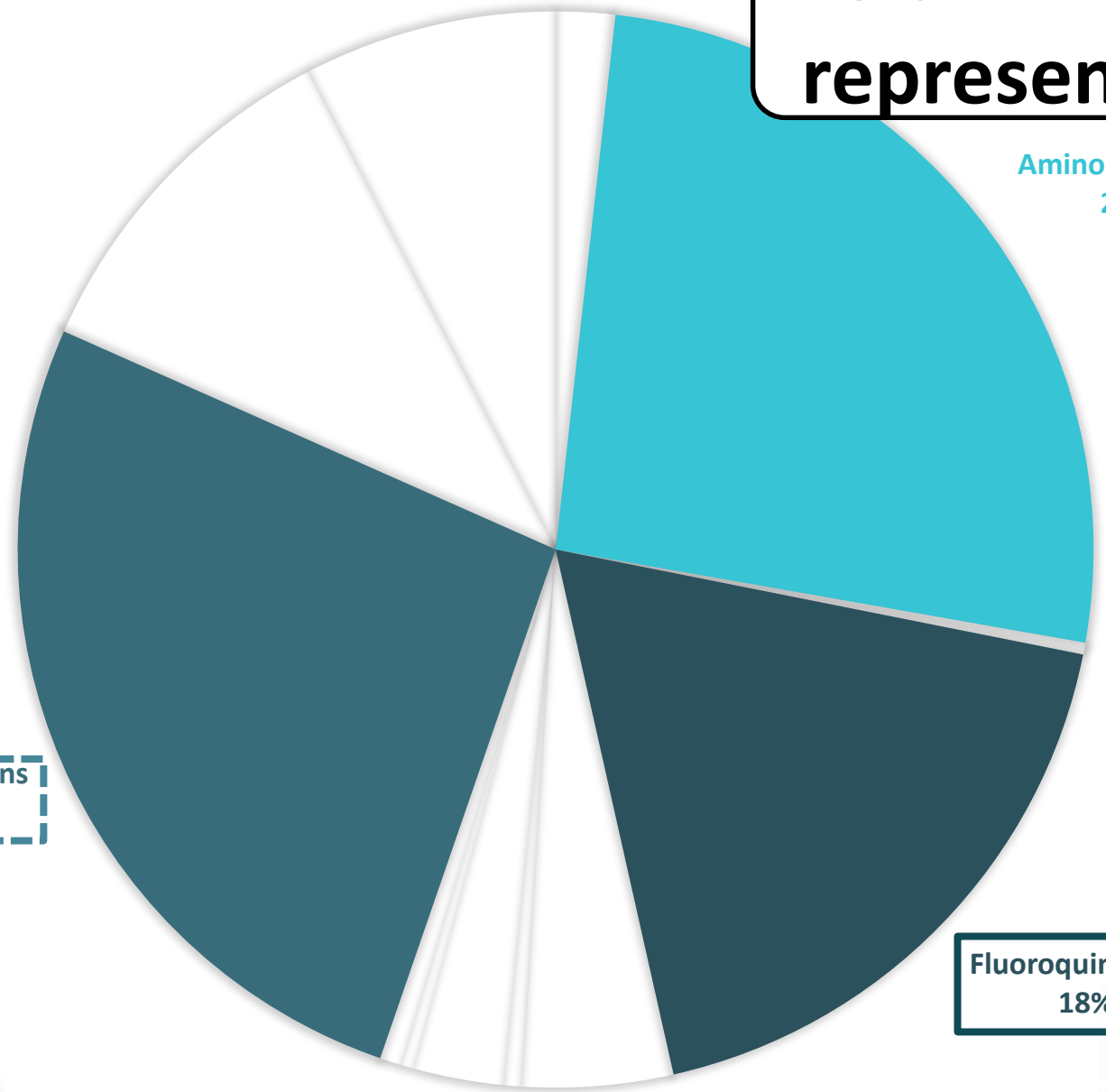

47% of total TI during first week
Percentage of farms
40%
35%
30%
25%
20%
15%
10%
5%
0%
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
Day of production
Initiating treatment
Treating



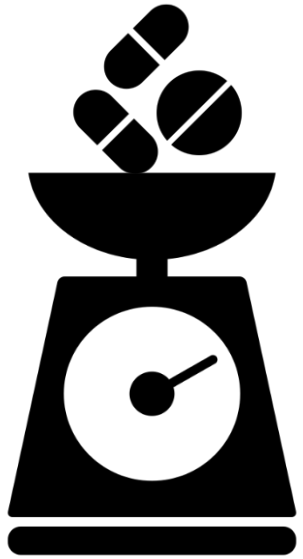
EFFORT
AGAINST ANTIMICROBIAL RESISTANCE

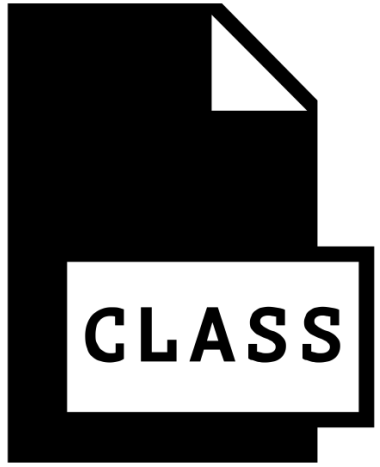

Trim&Sulfa
Aminoglycosides
Tetracyclines
Aminopenicillins
Amphenicols
Polymyxins
Fluoroquinolones
Penicillins
Macrolides
Lincomycin_Spectinomycin
Other quinolones
Lincosamides

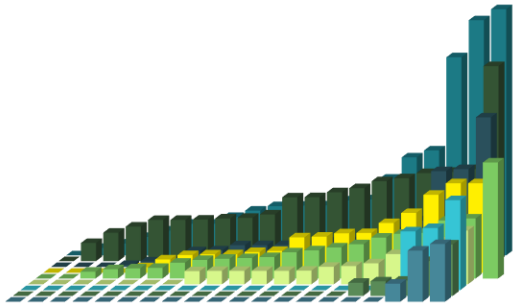
3 antimicrobial classes represent 70% of total TI

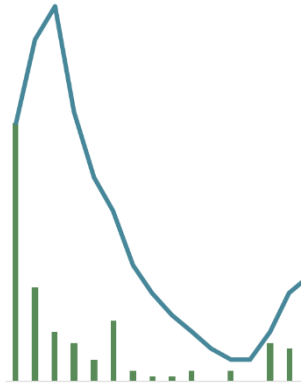


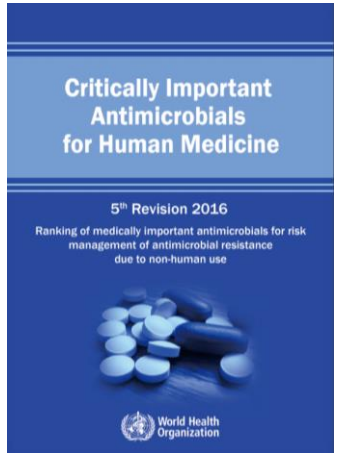
Key messages











HANDLE
ANTIBIOTICS
WITH CARE

Do you want to know more about the outcome of the EFFORT project?

Please save the dates!

More information:
http://www.effort-against-amr.eu/page/final-conference.php