

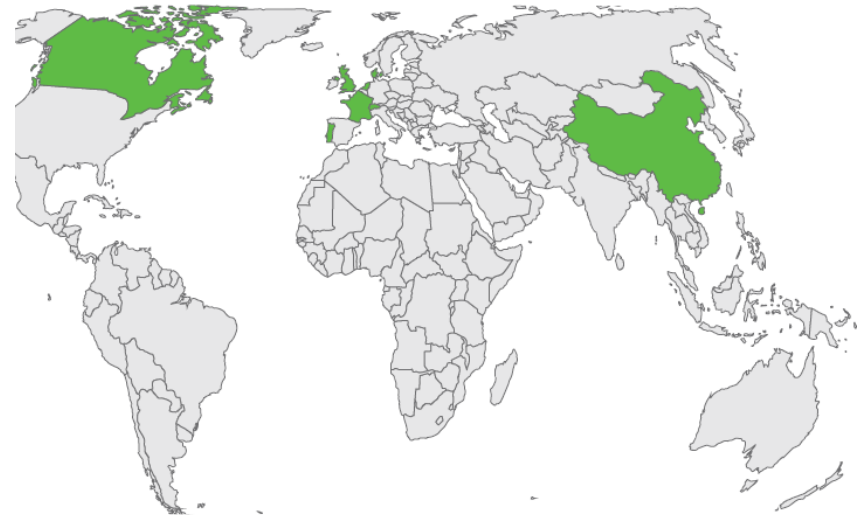
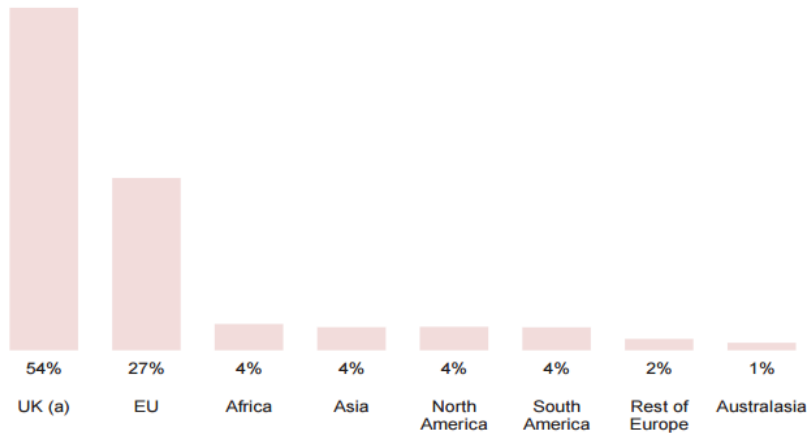
# A systematic review of AMR in food at the point of retail – launching the new FSA sponsored review

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**Food Retailers, Supply Chains and the Anti-microbial Resistance  
Challenge**  
**London, 25<sup>th</sup> November 2016**

# Background

- Antimicrobial resistance (AMR) in the food chain could pose a public health risk to British consumers
  - Emergence and global spread of resistant bacteria and resistance genes (**mcr-1**)
  - UK imports up to 46% of food



# Objectives

- Conduct a systematic review to
  - Assess prevalence of resistance in pork and poultry meats, dairy, seafood and fresh produce at retail level
    - Foodborne bacteria: *Salmonella* spp. (pork) and *Campylobacter* spp. (poultry)
    - Commensal bacteria: *Enterococcus faecium*, *E. faecalis* and *Escherichia coli*
  - Assess quality of evidence
  - Identify gaps in knowledge
  - Make recommendations

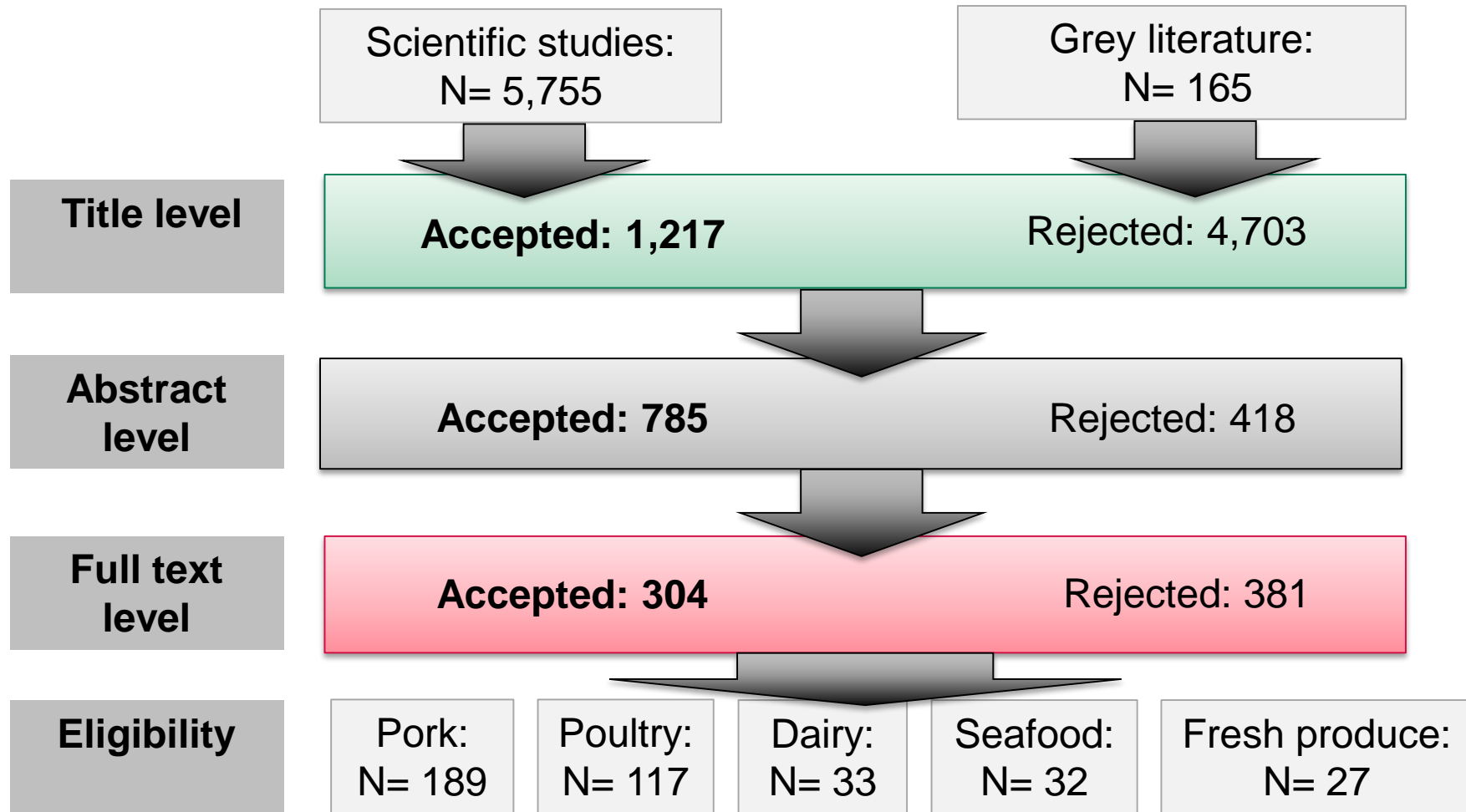
# Methods

## ➤ Systematic review

- Grey literature and scientific studies
- Between 1999 and end of May 2016
- Focus on critically important antimicrobials (CIAs) as defined by WHO
  - $\beta$ -lactams (including carbapenems)
  - Fluoroquinolones
  - Macrolides
  - Polymyxins (colistin)

## ➤ Mapping of main exporting countries per food item (HMRC imports data 2015)

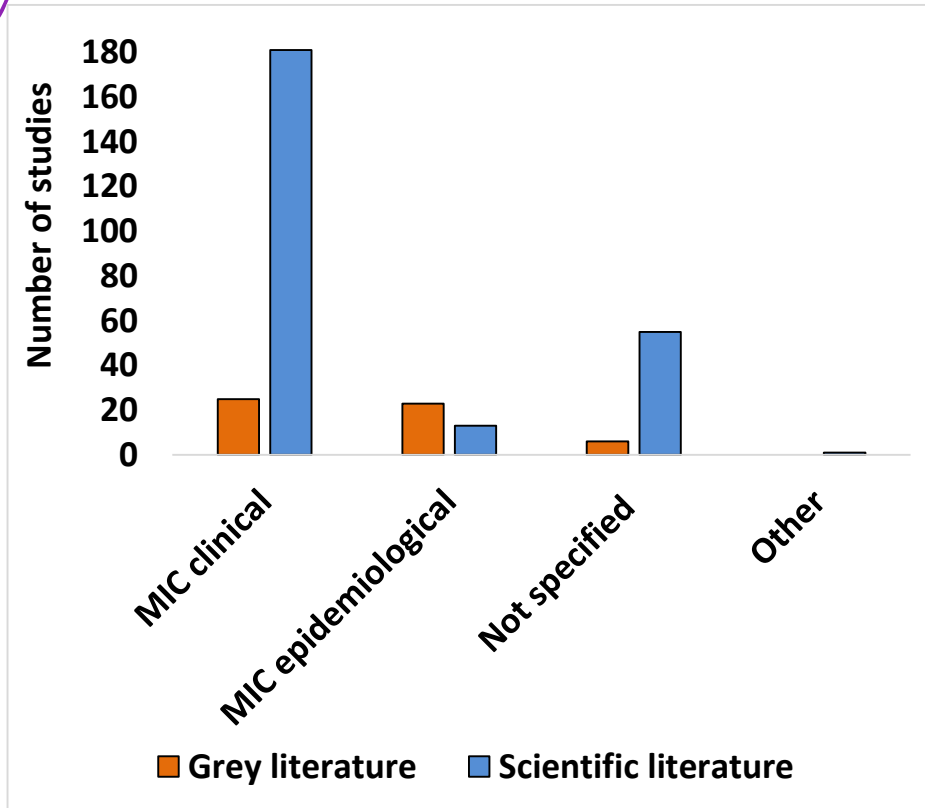
# Results- Eligible studies



# Study data

> 304 studies- 58 countries

- **UK:**
  - 15 studies (4.9%)
    - 8 original studies
    - 5 FSA surveys
    - 2 surveillance reports (EFSA)
  - Only 32 studies (10.5%) conducted random (probabilistic) sampling



## Word of caution!

Most eligible studies were deemed at a **high risk of bias** due to lack of representativeness of data

# Pork- *Salmonella* spp.

## > UK (*S. Typhimurium*)

- Ampicillin
  - 9/9 (2003-2005)
  - MDR 4/4 (2006-2007)
- Nalidixic acid (2003-2005): 3/9
- Colistin: ?

## > Denmark (*S. Typhimurium*)

- Ampicillin (2009-2013)
  - Imported pork: ↑ 20 to 73%
  - Danish pork: ↑ 0 to 4%
- Ciprofloxacin & nalidixic acid (2005)
  - Imported pork: 8 and 11%
  - Danish pork: 6 and 3%
- No colistin resistance!

## > Netherlands (*Salmonella* spp.)

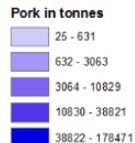
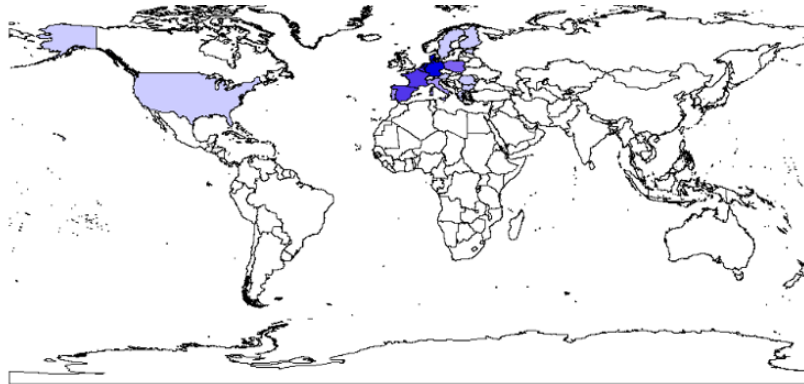
- Ampicillin (2006): 0%

## > Germany (*S. Derby*)

- Ampicillin: 8.3%
- No resistance to carbapenems or colistin!

## > USA (*Salmonella* spp.) (2001-2013)

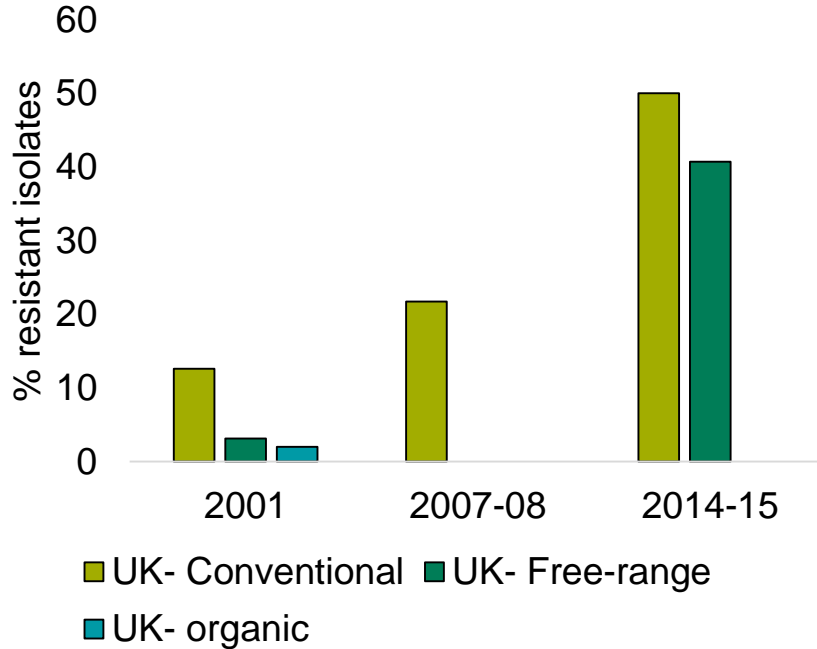
- Ampicillin: ↑ 0 to 13%
- Cefotaxime: ↓ 7 to 0%
- Ciprofloxacin & nalidixic acid: 0%



(Adapted from: HMRC, *Imports data 2015*)

# Poultry meat- *Campylobacter jejuni*

## > UK



- Erythromycin: < 2% (2001-2014)
- MDR: ↑ 9.5 to 43.4% (2001 to 2014)

## > The Netherlands (2004- 2014)

- Ciprofloxacin: ↑ 39 to 63.4%
- Erythromycin: ↓ 6% to 0.7%

## > (Poland (2012)

- Ciprofloxacin: 100%
- Erythromycin: 11.4%
- MDR: 45%

## > USA

- Ciprofloxacin
  - NARMS: ↓ 17.2 to 11.2% (2002-2013)
  - Conventional: 69% (2007)
  - Organic: 41% (2007)
- Erythromycin: < 10% (2002- 2013)
- MDR: ↑ 0- 11.1% (2002-2009)

## > Brazil (2009)

- Ciprofloxacin: 100%
- Erythromycin: 68.8%



# Poultry meat- *Enterococcus faecalis*

## > UK (2002)

- Penicillin
  - Chicken: 90%
  - Turkey: 84%
- Erythromycin
  - Chicken: 33%
  - Turkey: 42%

## > The Netherlands

- Ampicillin (2013): 1.8%
- Erythromycin (2002-2013):  
↑ 32 to 51.8%

## > USA

- Penicillin (2013): 0%
- Erythromycin (2002-2013):  
↓ 45.5 to 35.1%
- MDR: 69.7% (2011)

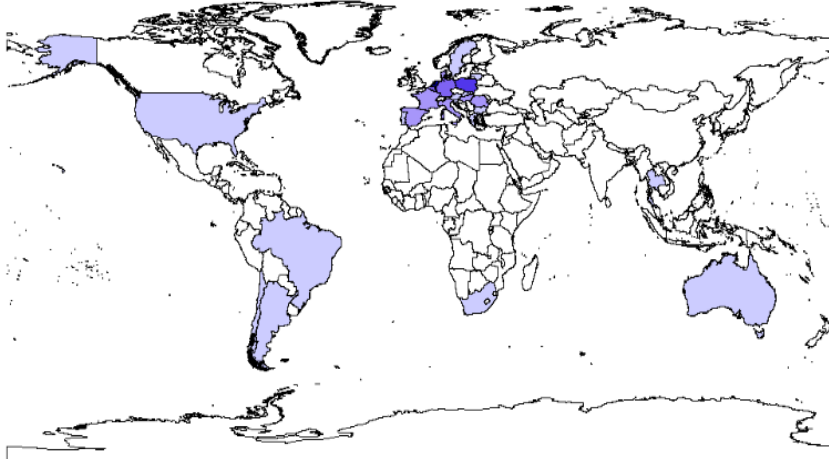
## > Brazil (2004)

- Erythromycin: 90.2%
- MDR: 43.9%

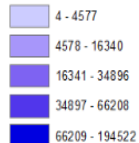
# Poultry- *Escherichia coli*

## > UK

- ESBL-producers (2006)
  - British: 1.6%
  - Imported: 17.5%



Poultry in tonnes



(Adapted from: HMRC, *Imports data 2015*)

## > The Netherlands

- Ampicillin (2008-2011):
  - Chicken: ↓ 68 to 40.7%
  - Turkey: ↓ 76.1 to 65.9%
- Cefotaxime (2011-2014):
  - Chicken: ↓ 22 to 1.9%
  - Turkey (2014): 2.3%
- Ciprofloxacin: 14%
- Colistin (2014)
  - Chicken: 4.5%
  - Turkey: 1.5%
  - ESBL-producers: up to 1.7%

## > USA

- Ampicillin (2010): 57.9%
- Amoxiclav: 76.9%
- Cefotaxime: 90.1%
- Ceftriaxone: 88.4%
- Ciprofloxacin & nalidixic acid (2012)
  - Conventional chicken: 97.5%
- Erythromycin: 0% (2011-2013)
- MDR: up to 26% (2002)

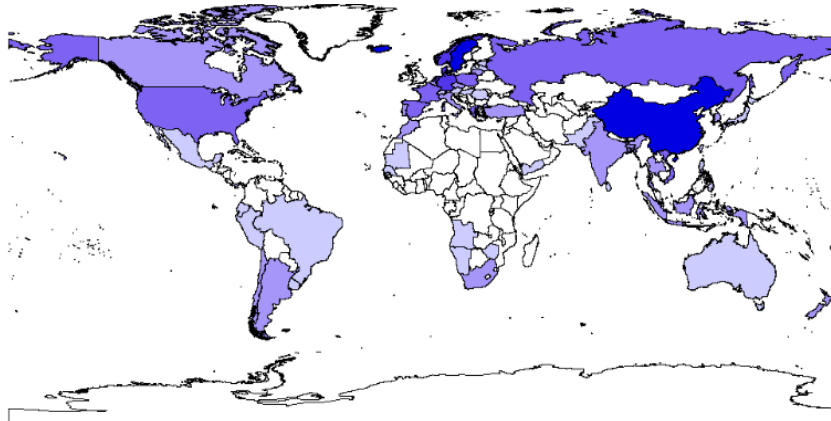
# Seafood- *Escherichia coli*

## > UK

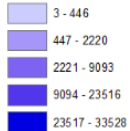
- No data!

## > European & American countries

- No data!



Seafood in tonnes



(Adapted from: HMRC, *Imports data 2015*)

## Vietnam

- Ampicillin (2004): 30%
- Penicillin: 30%
- Ciprofloxacin & enrofloxacin: 10%
- Nalidixic acid: 25%
- MDR: 35%
- ESBL- producers (2013): 18.3%

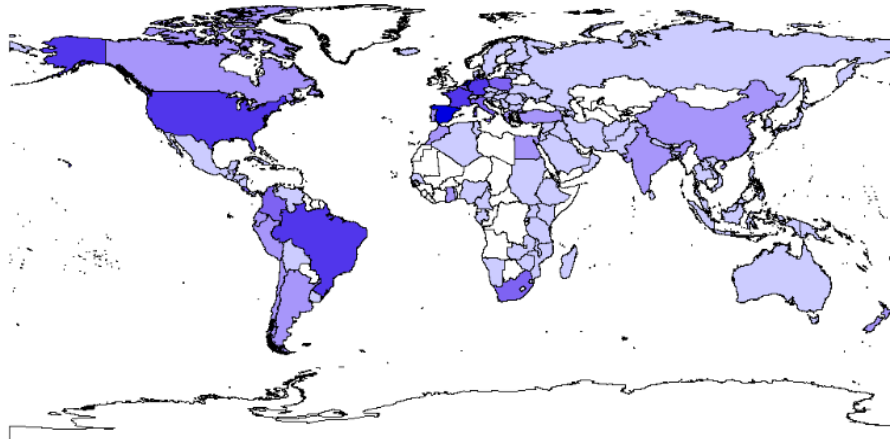
## > China

- Ampicillin (2008): 78.9%
- Cefotaxime: 2.3%
- Ceftiofur: 0%
- Ciprofloxacin (2010): 4.1%
- Nalidixic acid: 16%
- ESBL-producers (2012): 1.3%

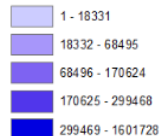
# Fresh produce- *Escherichia coli*

## > UK

- No data!



Vegetables and fruits in tonnes



(Adapted from: HMRC, *Imports data 2015*)

## > The Netherlands (2012)

- Ampicillin: 2.3%
- Cefotaxime: 0%
- Ciprofloxacin: 2%
- Nalidixic acid: 1.5%
- Colistin: 0%
- ESBL-producers (imported):
  - Thailand: 6/6
  - Spain: 1/1

## > Germany

- MDR: 3/3

## > South Africa

- Ampicillin (2012): 3/5
- Cefotaxime: 0/5
- Amoxiclav: 0/5
- ESBL & AmpC-producers (2011): 9/10

# Conclusions

- There are limited data for British food at retail level
  - Exception: *Campylobacter jejuni* in poultry
  - No evidence for
    - Milk and dairy
    - Seafood
    - Fresh produce
- For imported food
  - Good evidence for Nordic countries & the Netherlands
  - Limited evidence for overseas exporting countries
    - South America
    - Asia

# Recommendations I

- To follow epidemiological cut-off values (ECOFFs) as these have lower MIC values than clinical breakpoints
- To promote random sampling and adequate study design for studies and surveillance systems of AMR in the food chain as indicated in the EFSA guidelines
- To develop common definitions acceptable for MDR criteria to allow easier and quicker comparison of data between scientists as well across countries
- Additional systematic reviews should be conducted to assess prevalence levels and trends of AMR and MDR in beef and eggs
- Surveillance priorities to use a risk-based approach taking into account the importance of AMs for human and animal health and AMR mechanisms in bacteria of interest

# Recommendations II

- Further research and surveillance is needed to establish and quantify the risk of transmission of resistance from foods of animal and non-animal origin to humans (Codex Alimentarius)
- To include commensal *E. faecium*, *E. faecalis* and *E. coli* as indicator bacteria in AMR surveillance programmes
- Research and surveillance should be developed to monitor AMR and MDR levels in foodborne pathogens and commensal bacteria from imported and domestically-produced pork meat in the UK
- Need to continue to monitor AMR and MDR in *Campylobacter* spp. but also to include commensal bacteria from poultry meat in the UK
- There is a particular lack of surveillance data of AMR occurrence in dairy, seafood and fresh produce in the UK that should be addressed through research and surveillance efforts

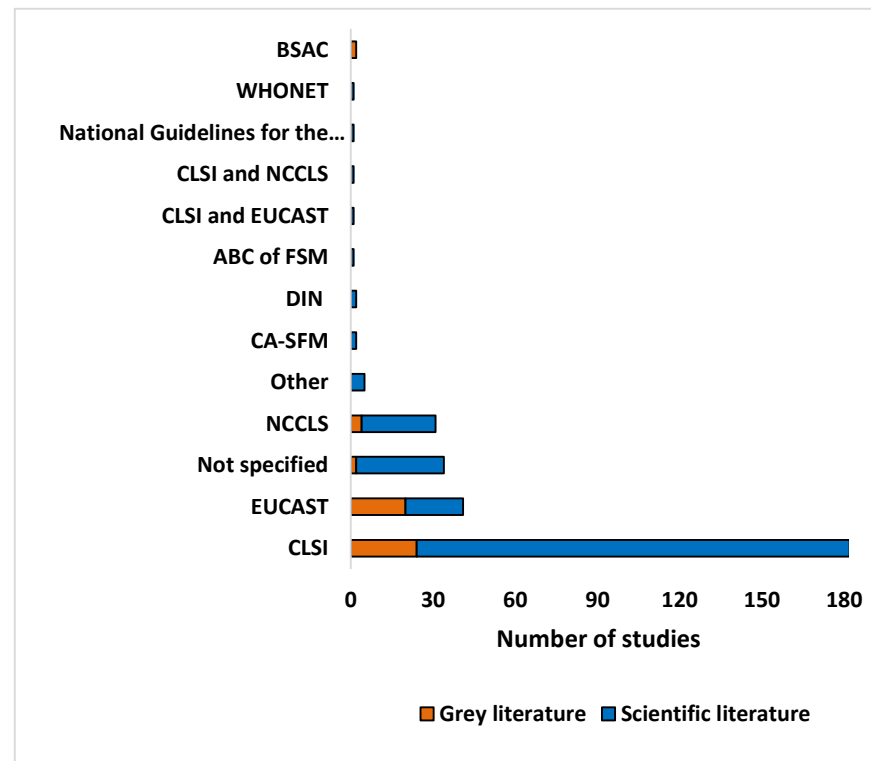
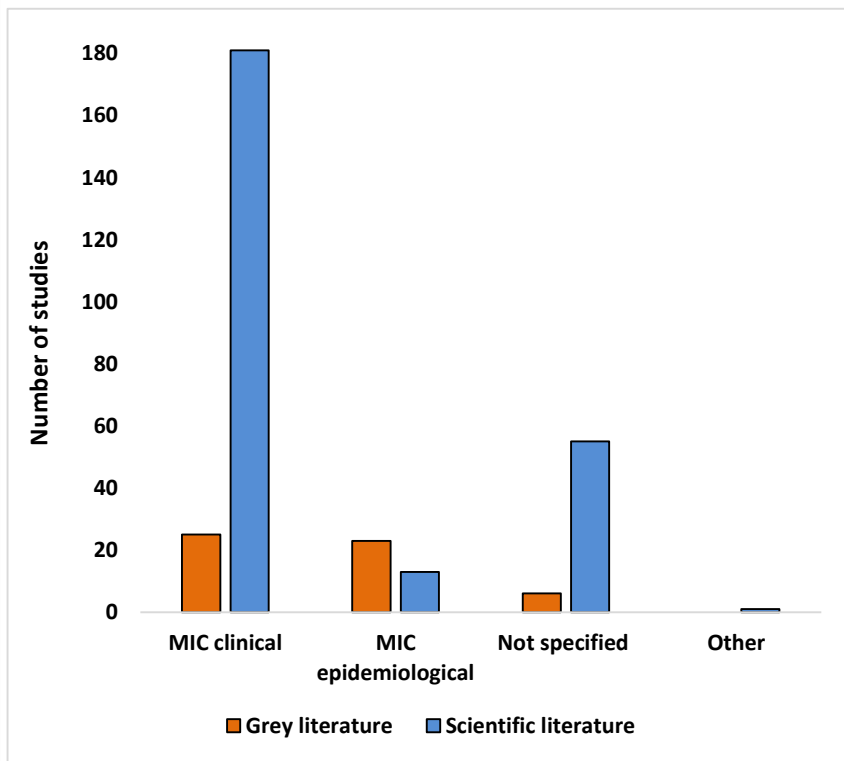


**Many thanks for your  
kind attention!**



Extra slides

# Criteria used for assessment resistance to antimicrobials



**Note:** Lack of harmonisation of methods used to assess susceptibility to antimicrobials affected comparison of results across studies

# Pork- *Enterococcus faecalis*

## > UK

- Ampicillin?
- Penicillin?
- Erythromycin: 8.1% (2001-2002)
- No vancomycin-resistant enterococci (VRE) (2001-2002)

## > Denmark

- No resistance to penicillin or ampicillin (1999-2013)
- Erythromycin: 0-12% (1999-2013)
- No MDR (1999-2013)

## > Netherlands

- Ampicillin: 0.1% (2003-2014)
- Erythromycin: ↑ 2 to 15% (2012-2015)
- No MDR

## > Germany

- No ampicillin resistance
- Erythromycin ?

## > USA

- Penicillin: ↑ 0-4% (2002-2013)

# Pork- *Enterococcus faecium*

## > UK

- Ampicillin?
- Penicillin?
- Erythromycin: 9.6% (2001-2002)
- MDR ?

## > Denmark

- Ampicillin & penicillin:
  - Imported pork: 9% (2009)
  - Danish pork: ↑ 0 to 6.3% (2008-2014)
- Erythromycin:
  - Imported pork: 3% (2013)
  - Danish pork: 14.8% (2013)
- MDR ?

## > The Netherlands

- Ampicillin:
  - 9% (2009)
  - 2% (2011)
- Erythromycin: 41.4% (2014)
- MDR ?

## > USA

- Penicillin: 8% (2002-2013)
- Erythromycin ?
- MDR: 54.6%

# Pork- *Escherichia coli*

## > UK

- No data available!

## > Denmark

- Amoxiclav: 1% (2004)
- Ampicillin: ↑ 8 to 33 (1999-2012)
- Cefotaxime: 1.4% (1999-2013)

## > The Netherlands

- Ampicillin: ↓ 34 to 12.7% (2006-2014)
- Meropenem: 0% (2014)

## > Germany (2004)

- Amoxiclav: 13.2%
- Cefotaxime: 0%
- Ceftiofur: 0%
- Imipenem: 0.5%

## > USA

- Amoxiclav: ↓ 6.8 to 0.9% (2009-2014)
- Ceftriaxone: < 1.5% (2002-2013)
- Ceftiofur: 1.5% (2002-2013)

# Poultry- *Enterococcus faecium*

## > UK

- Penicillin: 98% (2002)
- Erythromycin
  - Chicken: 20%
  - Turkey: 53%
- MDR ?

## > The Netherlands

- Ampicillin
  - Chicken: ↓ 16 to 6% (2003-2009)
  - Turkey: ↓ 50.6 to 39.6% (2002-2013)
- Erythromycin
  - Poultry: ↑ 19 to 57% (2003-2013)
  - Turkey: 43.1% (2013)

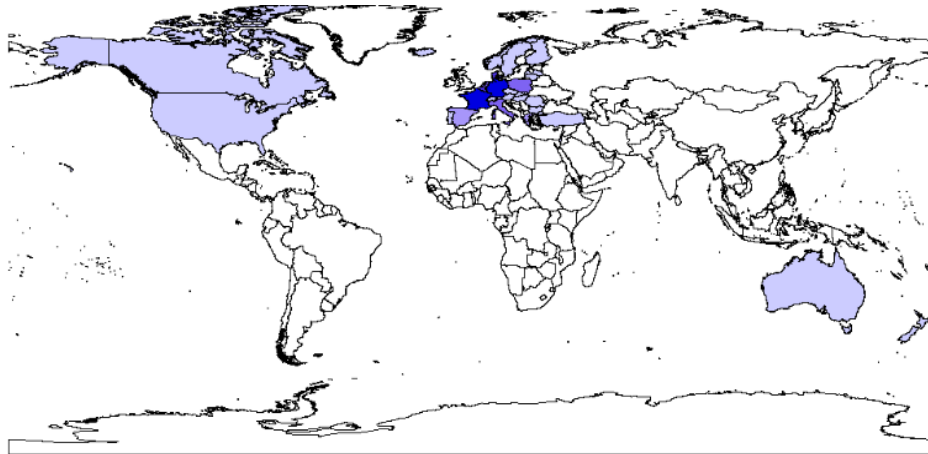
## > USA

- Penicillin: ↓ 44.2 to 9.9% (2002-2013)
- Erythromycin
  - Chicken: ↑ 9.5 to 29.6% (2006-2013)
  - Turkey: ↓ 50.6 to 39.6% (2002-2013)
- MDR
  - Chicken: 79.4% (2003)
  - Turkey: 93.5% (2006)
- VRE: 0% (2007)

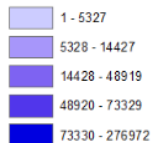
# Dairy- *Enterococcus faecalis*

## > UK

- No data!



Dairy imports in tonnes



(Adapted from: HMRC, *Imports data 2015*)

## > France (2005)

- Erythromycin
  - Cow cheese: 67.1%
- MDR: 60.7%

## > Turkey

- Ampicillin
  - Milk: 36.5% (2000)
  - Cheese: 30.6% (2000)
- Erythromycin
  - Milk: 91.7%
  - Cheese: 90.3%
- MDR ?

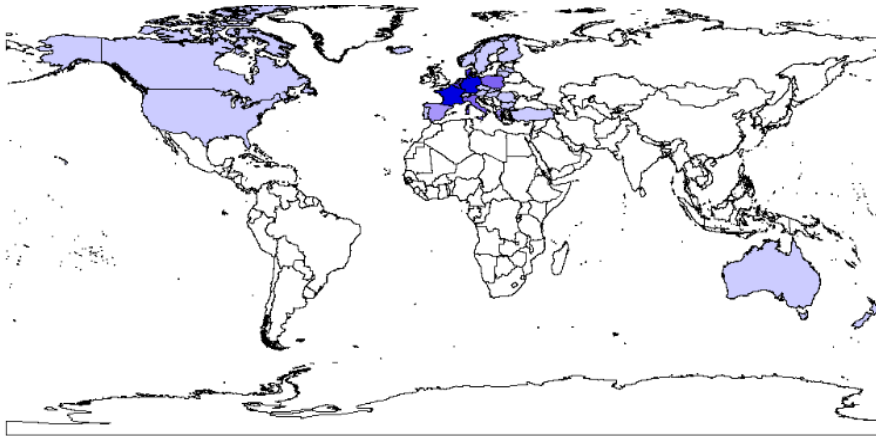
# Dairy- *Enterococcus faecium*

## > UK

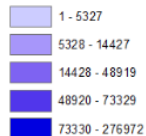
- No data

## > Turkey (2000)

- Ampicillin
  - Milk: 47.1%
  - Cheese: 32%
- Erythromycin
  - Milk: 92.3%
  - Cheese: 96%
- VRE
  - Milk: 48%
  - Cheese: 76.3%



Dairy imports in tonnes



(Adapted from: HMRC, *Imports data 2015*)



# Dairy- *Escherichia coli*

## > UK

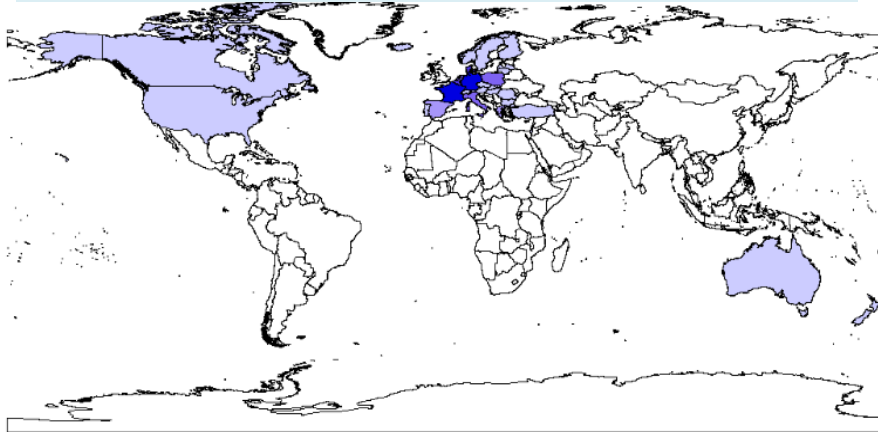
- No data!

## > France

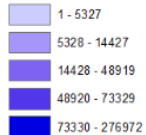
- MDR: 2/2 (both resistant to colistin!)

## > USA

- Ampicillin: 80%
- Ceftriaxone: 30%
- MDR: 32%



Dairy imports in tonnes



(Adapted from: HMRC, *Imports data 2015*)