PATH-SAFE webinar series September

AMR Surveillance Pilots: Dairy Cattle and Animal Feed Surveys

Animal & Plant Health Agency

PATH-SAFE:

WS2b.4: GB wide AMR in National Milk Lab Raw Milk

WS2b.5: AMR in Animal Feed Ingredients and finished feed

Project lead: Martina Velasova, Chloe Manning, Christopher Teale

Manal AbuOun

Animal & Plant Health Agency

WS2b.4: GB wide AMR in National Milk Labs Raw Milk

- Bovine Bulk Milk
  - Already collected and tested for various purposes, including some statutory purposes.
  - Bulk milk can be used to investigate occurrence of bacterial mastitis pathogens, zoonotic and other organisms.
  - Raw milk may be consumed in parts of UK.
  - Bathing milk.

  - Path-Safe Provided an Opportunity to:
    - Investigate aspects relating to AMR in bovine bulk milk samples from across GB in collaboration with NML.
    - Potential to integrate with other parallel Path-Safe studies.
    - Anonymised to region.

BULK MILK FROM DAIRY CATTLE.

Test	Purpose
Total viable count (TVC).	Hygienic milk production
Somatic cell count (SCC)	Indirect measure of mastitis
Physical properties	Milk Quality
Residues	Food Safety
Bacteriology	Cattle health, investigation of herd and environmental issues.
Serology	Exposure to various diseases.

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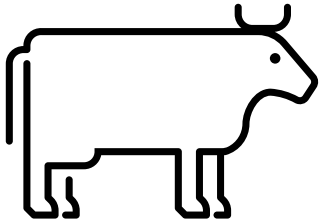
WS2b.4: GB wide AMR in National Milk Laboratories Raw Milk



AMU in Cattle.
Animal Movements
Exposure to AMR in environment, feed or water or other contacts, including human.

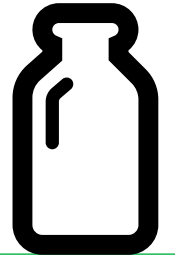
Cow environment/ cleanliness/ bedding/ loafing areas/ feed / pastures

Mastitis Pathogens

Milking plant and dairy hygiene

Refrigeration

Bacteria in Bulk Milk



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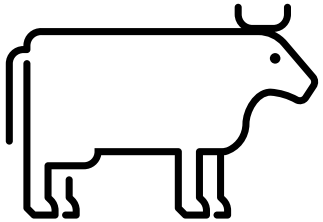
WS2b.4: GB wide AMR in National Milk Lab Raw Milk



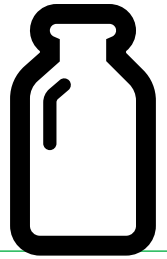
AMU in Cattle.

VARIABLE

Feed.

Cow environment/ cleanliness/ bedding/ loafing areas/ feed / pastures → Mastitis Pathogens → Milking plant and dairy hygiene → Refrigeration → Bacteria in Bulk Milk

CONTROL PROCESSES CAN SMOOTH VARIABILITY.



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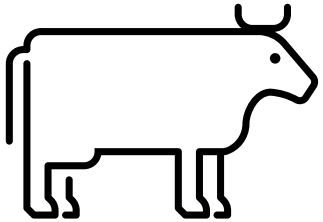
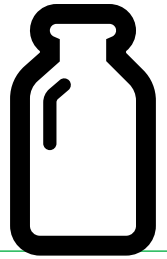
WS2b.4: GB wide AMR in National Milk Lab Raw Milk



Optimal G- and G+ indicator organisms *E. coli*, enterococci
Differing survival of different Enterobacterales?
Klebsiella pneumoniae

Cow environment/ cleanliness/ bedding/ loafing areas/ feed / pastures → Mastitis Pathogens → Milking plant and dairy hygiene → Refrigeration → Bacteria in Bulk Milk



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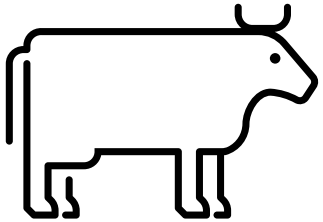
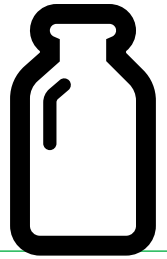


Optimal Indicator Organisms.
E. coli
Differing survival of different Enterobacterales?
Include *Klebsiella pneumoniae*, *Staphylococcus aureus*.

Cow environment/ cleanliness/ bedding/ loafing areas/ feed / pastures → Mastitis Pathogens → Milking plant and dairy hygiene → Refrigeration → Bacteria in Bulk Milk

General indicator of AMR in Enterobacterales/ other bacteria present in milk - qPCR for class 1 integrons.



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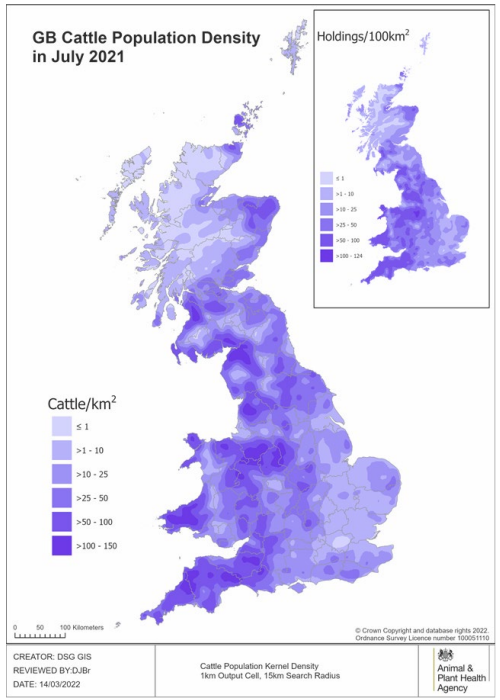

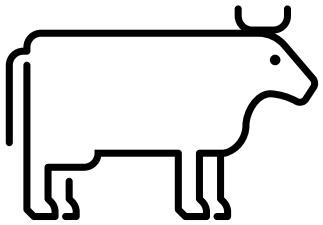

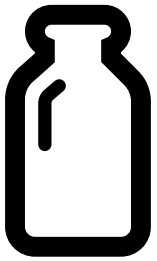

Scale of differences between herds reflected in bulk milk

Associations with size of herd

Regional AMR associations

Characterisation of isolates and AMR in mastitis bacteria, zoonotic, commensal and other bacteria occurring in bulk milk

Relation to bacteria occurring in humans

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WS2b.5: AMR in Imported Animal Feed Ingredients and finished feed

- Feed
- Few previous studies in other countries – limited detection of AMR, but potential to affect multiple herds/ flocks if present.
- Recent studies in Sweden and USA commented that possible role of feed in dissemination of AMR is not well defined.
- Collaboration with AIC
- Feed production processes – reduction in bacterial viability.
- Imported ingredients, domestically produced constituents and finished feed.
- MDR *Salmonella* affecting food-producing animals which are absent from the UK but prevalent elsewhere.

Animal & Plant Health Agency

WS2b.5: AMR in Imported Animal Feed Ingredients and finished feed

- Feed
- Indicator organisms appropriate for feed
- Recent Swedish study *Escherichia*, *Klebsiella, Enterobacter, Raoultella*.
- Recent USA study of feed and raw pet food, *Escherichia coli* and enterococci
- Occurrence of different bacteria and AMR in those bacteria in various types of feed materials.
- Non-selective and selective cultures.

NMR and PATH-SAFE

Eamon Watson MRCVS

Product Strategy Manager, National Milk Records Limited

eamonwa@nmrp.com

Decoding milk data, building robust insights.

National Milk Records Limited

- Working with producers, vets, processors, government agencies, university researchers and wider dairy sector.
- Milk recording for producers, ‘payment’ testing for processors, and health/disease testing for vets.
- Two laboratories (Wolverhampton and Glasgow) with UKAS accredited testing.
- Extensive range of tests - from bacteriology to ELISA to genomics and GenoCells.
- Other – animal identification ‘Nordic Star’ ear tags.
- *At the forefront of dairy industry innovation.*

Why AMR and why PATH-SAFE?

FarmAssist – working with processors to monitor antimicrobial use across their milk pool

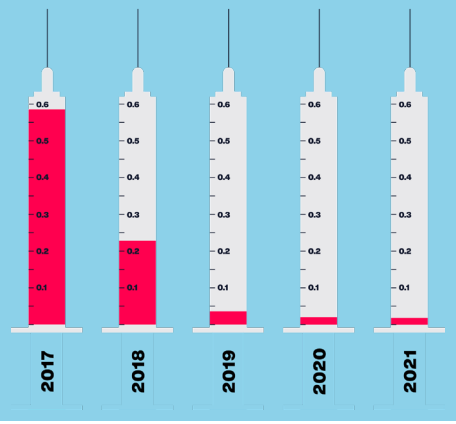
- ✓ Seven years of data (2017 to 2023)
- ✓ Multiple processors and retail groups
- ✓ 210 + vet practices
- ✓ 1,200 + herds
- ✓ 350,000 cows

FarmAssist From NMR

"What is a farm's 'resistance profile' and has it changed?"

Why NMR? It's interesting and relevant for the dairy sector, we have a fridge full of samples (every farm, every day) for opportunist epidemiology, and we all learn.

No commercially available testing for AMR.



Permission from supportive processor to access 100 randomly selected GB ex-farm raw milk samples per month.

Proportional sampling by NUTS1 region.

Brilliant lab team to collect 25 samples per week, two sub-samples – one refrigerated and sent weekly, and one frozen and sent in monthly batch of 100 samples.

Scheduled for 1,000 samples between Jan-23 and Oct-23 (40 weeks). Likely to total ~1,050 to include multi-vat farms.

No issues aside from occasional courier delay.

FarmAssist Summary Report 2017-21

FarmAssist From NMR

NMR

FarmAssist Summary Report

Report 2 // 2017 to 2021

Reviewing five years of antibiotic use in GB dairy herds

FarmAssist // December 2022

Summary from FarmAssist // GB Dairy Herds 2017-2021

This is a summary from the FarmAssist dataset on antibiotic use in dairy herds in GB. The FarmAssist service is supported by milk processors and collects medicine records from vet practices for producers that have given consent for these records to be shared. Over 200 vet practices have helped in providing data for their clients, which means the number of herds we can report on has increased from 205 in 2017 to 1,051 in 2021, covering approximately 239,777 cows.

The FarmAssist service provides assurance for the milk supply chain through (1) quantified reports on antibiotic use for processor groups, and (2) farm reports to support vet-producer discussion on herd health and antibiotic use. The data in FarmAssist provide a benchmark to enable processors to assess antibiotic use across their milk pool, and to support vets with practical antibiotic reduction programs for their clients. Vets can access both practice level and individual farm reports through the FarmAssist web portal.

FarmAssist data are analysed and reported using standard RUMA metrics (table 1) and with standard VARSS classification (table 3) to allow direct comparison with previous industry estimates. FarmAssist data are collected quarterly and provide users with the most recent data on antibiotic use for dairy herds in GB. This summary to 2021 will be followed in 2023 with an update to include data from 2022.

The values used in this summary are the mean values from all recorded herds with a complete record for each 12-month recording period.

We are grateful to all the participating vets, their producer clients, and the supporting milk processors for their engagement with FarmAssist and their contribution to this summary report.

The FarmAssist service is provided by National Milk Records. For further information please contact: **farmassist@nmrp.com**.

Key Messages

- The total use, in mg/PCU, has reduced from 22.4 mg/PCU in 2017 to **19.6 mg/PCU** in 2021 (table 1).
- There is a notable reduction in use HPCIA since 2017. There has been a **97%** reduction in use of injectable HPCIA from 0.585 mg/PCU in 2017 to **0.018** mg/PCU in 2021, and a **98%** reduction in use of intramammary HPCIA from 0.132 DCD in 2017 to **0.002** DCD in 2021 (table 1).
- In 2021 the mean number of milking cow and dry cow treatments was **0.445** DCD and **0.403** DCD respectively (table 1) which if put onto a herd of 100 cows, this means that on average, **45** cows had a course of treatment for mastitis and **60** were dried off *without* antibiotic treatment.
- The proportion of herds below target has increased across all five measures (table 2). For HPCIA use, the proportion of herds below target has increased from 66.8% in 2017 to **99.0%** in 2021 for injectable HPCIAs, and from 80.0% in 2017 to **99.8%** in 2021 for intramammary HPCIAs. For intramammary tube use the proportion of herds below target has increased from 73% in 2017 to **84%** in 2021 for milking cow tubes. Overall, for dry cow tubes there has been an increase from 65% in 2017 to **71%** in 2021, but the proportion below target has reduced since 2019. In mg/PCU, the proportion of herds below target has increased from 61% in 2017 to **64%** in 2021 and has remained relatively stable since 2018 (table 2).
- In 2021 across all products (excl. topical) and in terms of total mg, betalactams (excl. 3rd & 4th gen. cephalosporins) are most used (**37%**), followed by aminoglycosides (**22%**) and tetracyclines (**14%**) (table 3).

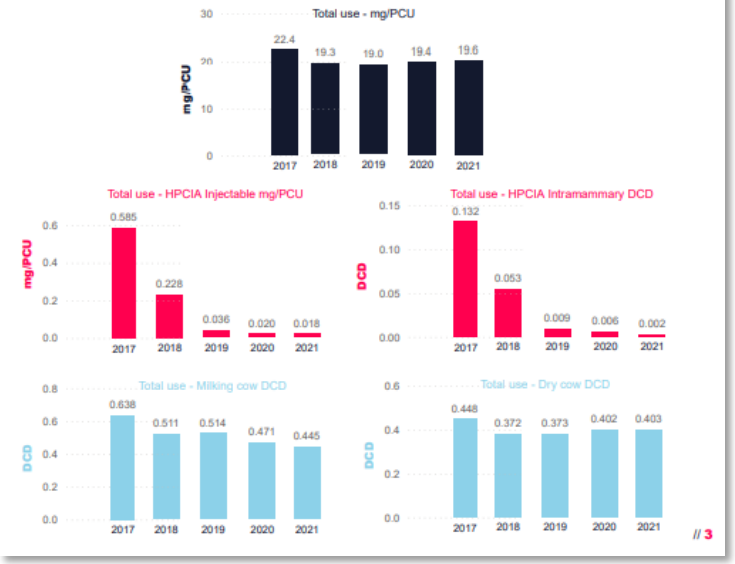
FarmAssist // 2

FarmAssist Summary // GB Dairy Herds 2017-2021

Table 1 / Mean total use from FarmAssist data 2017 to 2021 for the five RUMA measures.

	2017	2018	2019	2020	2021	RUMA Target
Number of herds	205	274	536	1171	1051	-
Total mg/PCU	22.4	19.3	19.0	19.4	19.6	< 21.0
HPCIA injectable mg/PCU	0.585	0.228	0.036	0.020	0.018	< 0.461
HPCIA intramammary DCD	0.132	0.053	0.009	0.006	0.002	< 0.166
Milking cow DCD	0.638	0.511	0.514	0.471	0.445	< 0.727
Dry cow DCD	0.448	0.372	0.373	0.402	0.403	<0. 586

Figures 1a-e / Mean total use from FarmAssist data 2017 to 2021 for the five RUMA measures.



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aic 20 YEAR ANNIVERSARY

PATH-SAFE Webinar 25 September 2023

Our coverage

AIC group overview

WATCH ANIMATION

AIC Group

AIC

AIC Services

UKFFPA

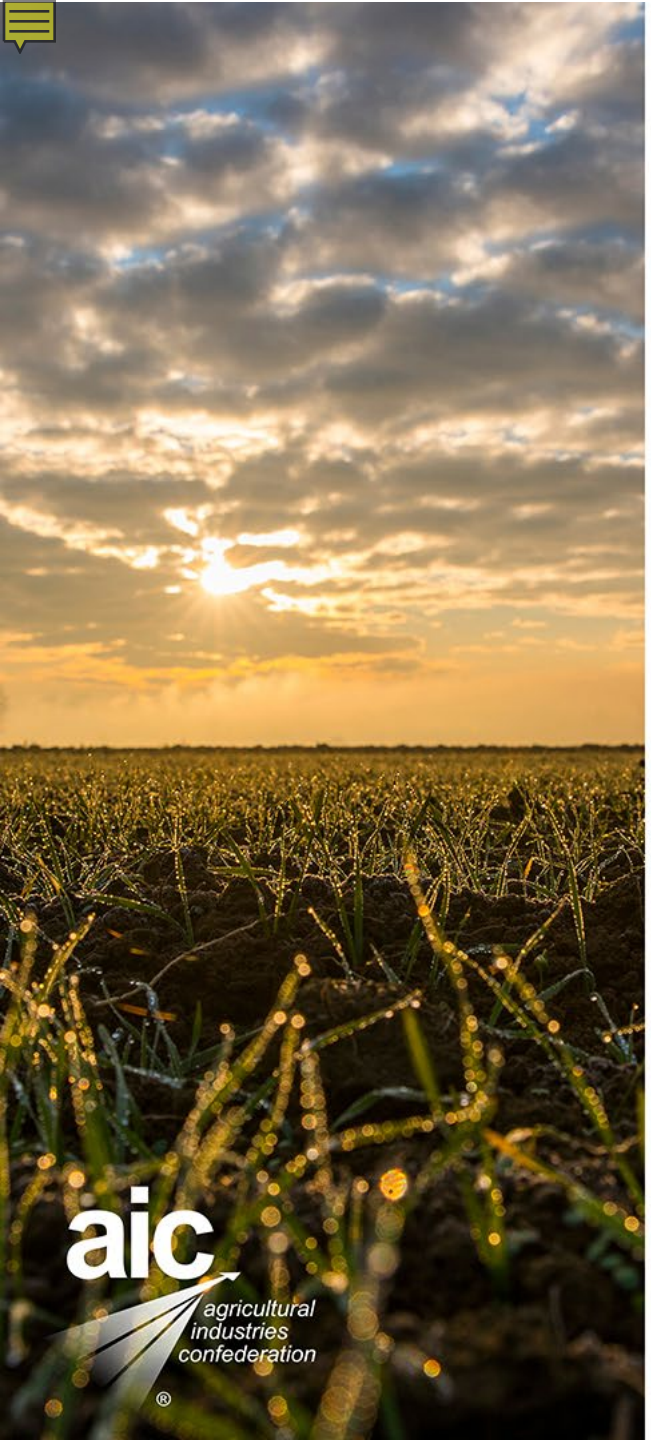
UK Former Foodstuffs Processors Association

Robert Sheasby
Chief Executive, AIC

John Kelley
Chief Operating Officer, AIC
Managing Director, AIC Services

aic agricultural industries confederation

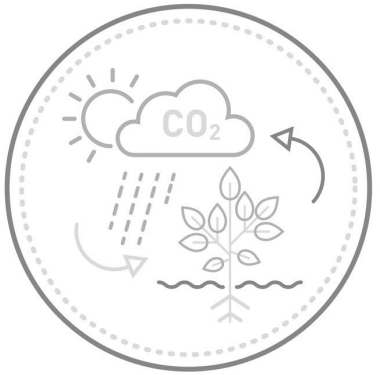
Working in support of modern, sustainable, commercial agriculture



Our Guiding Pillars

Competitiveness

Productivity



Environment

Working in support of modern, sustainable, commercial agriculture

Our role is to:

1. Lobby and represent Members
2. Shape policy at the highest level
3. Deliver information to Members
4. Provide Trade Assurance Schemes
5. Offer training and technical support

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Working in support of modern, sustainable, commercial agriculture

Key facts

230 Full & Associate Member companies

Over **95%** market coverage

Agri-supply input value approx. **£9** billion

Over **43,000** direct and indirect employees

Part of the **£120** billion food & drink supply chain, employing over **4** million people

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Animal Feed – priorities

Supplying UK livestock farms

- New feeds and alternative proteins
- Feed additives
- Medicated feed authorisation

Sustainability

- Metrics and GFLI
- Responsible sourcing of soy and palm oil
- Feed in the circular economy

Feed safety

- Regulation
- Equivalent assurances schemes abroad
- Animal health and welfare

James McCulloch
Head of Animal Feed

Sue Whittington
Technical Manager (FAR)

David Moss
Technical Manager (UKFFPA)

Simon Williams
Technical Manager (UFAS/FEMAS)

WATCH ANIMATION

Working in support of modern, sustainable, commercial agriculture

AIC and PATH-SAFE

Contacted via VMD

- Ongoing contact on veterinary medicines in feed

Initial discussion

- Scope of project
- Feed mill visit to discuss practicalities

Decision on involvement

Feed industry takes responsibility on AMR seriously

- But sometimes feels like a scapegoat
- Same could also apply for Salmonella controls

If feed is introducing exotic AMR onto farms it is better to know

- If not, it is all good news

Possible risk to reputation if there is a significant problem

- Some confidence that general Salmonella risk is low

Project format

Samples taken

- Incoming feed materials
- Finished feeds

At a single site

- Consistent sampling

Feed materials chosen based on usage and Salmonella risk

Finished mixture of heat-treated/ non-treated

Thank you

Agricultural Industries Confederation Ltd

Tel: 01733 385230

Email: enquiries@agindustries.org.uk

Animal & Plant Health Agency

PATH-SAFE Logistics:

WS2b.4: GB wide AMR in National Milk Lab Raw Milk

WS2b.5: AMR in Animal Feed Ingredients and finished feed

Project lead: Martina Velasova, Chloe Manning, Christopher Teale

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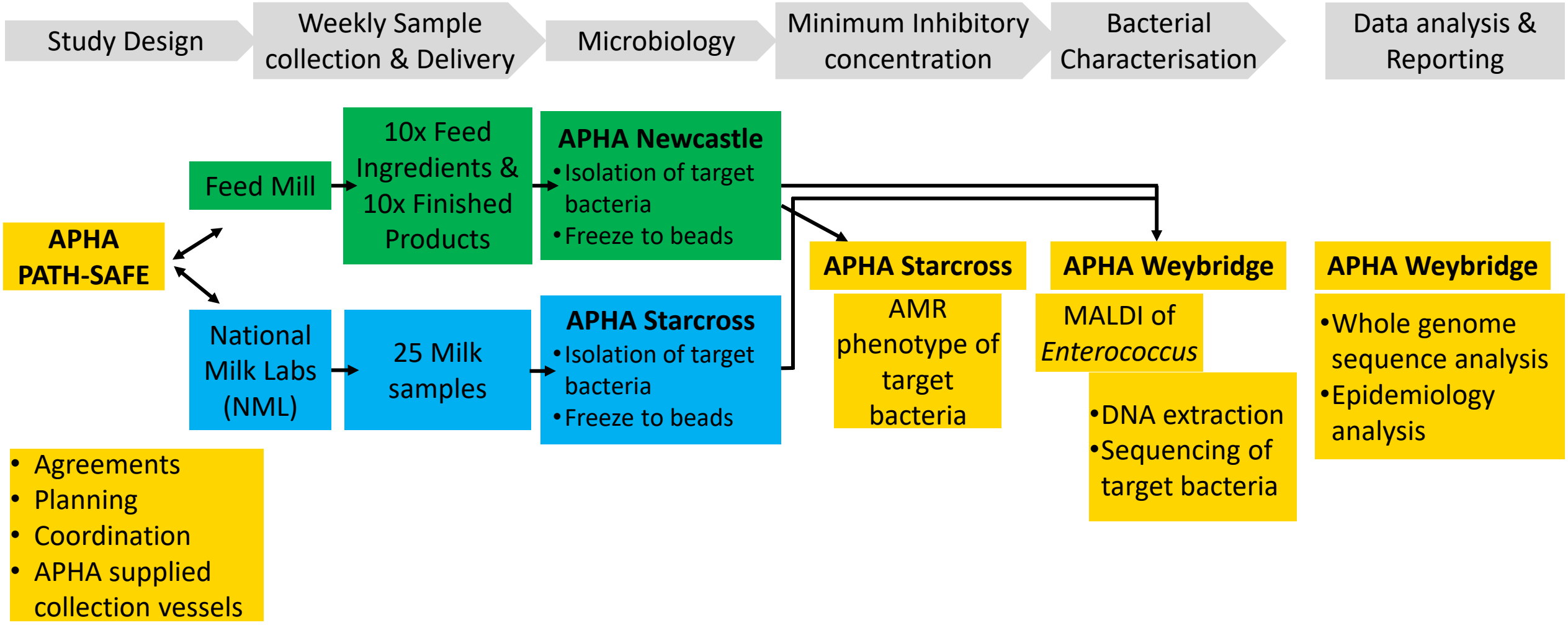
Overview of PATH-SAFE projects



Animal & Plant Health Agency

AMR in Animal Feed: Collection

- Feed Mill
  - APHA trained mill staff to collect samples, including ways to avoid cross contamination between different sample types
  - Mill staff collect and send 25g of each selected sample type
  - Each week, 10 raw ingredients + 10 finished feed products (total of each 300)
  - Sample information sent to lab in advance of samples
  - Samples are couriered and typically arrive on Wednesdays
    - Between January and September 2023

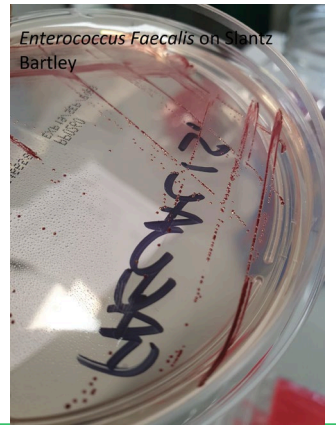
Raw Ingredients	Finished Products
Barley	Cold line poultry pellets
Wheat	Poultry meal
Maize	Heat treated poultry pellets
High Protein Soya	Pig Pellets
Rape Meal Extract	Pig cakes
Sunflower	

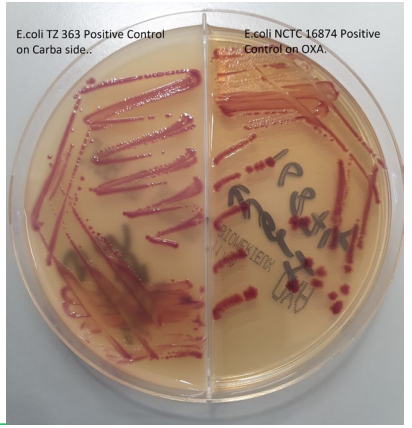
Animal & Plant Health Agency

AMR in Animal Feed: Microbiology

- APHA Newcastle
  - 25g of each product are enriched
    - Brain heart infusion broth to enrich
      - *Enterococcus spp*., *E. coli*, *Klebsiella spp*., Extended Spectrum Cephalosporins and Carbapenemase producing resistant Enterobacteriaceae.
    - Buffered peptone water (BPW)
      - *Salmonella enterica*
  - After enrichment, broths are plated on selective agars
  - Following selection a target colony from each plate is purified twice on blood agar prior to archiving on -80°C beads.
  - The microbiology process takes approx. 1 week
  - Frozen beads are sent to APHA Starcross and APHA Weybridge for MIC, MALDI & WGS

Target Bacteria	Isolation Agar
E.coli	MacConkey
Klebsiella spp	MacConkey
Enterococcus faecalis *Enterococcus faecium*	Slanetz-Bartley
Extended Spectrum Cephalosporins (ESC)	MacConkey +1mg/L CTX
Carbapenemases producing Enterobacterales	ChromidCARBA
Salmonella enterica	MRSV > MKTT broth > XLD and Brilliant green



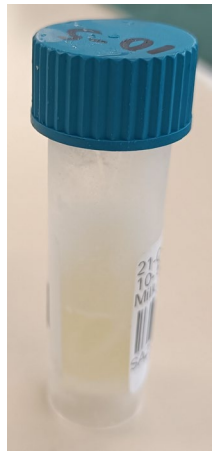


Examples

Animal & Plant Health Agency

AMR in Bulk Milk: Collection

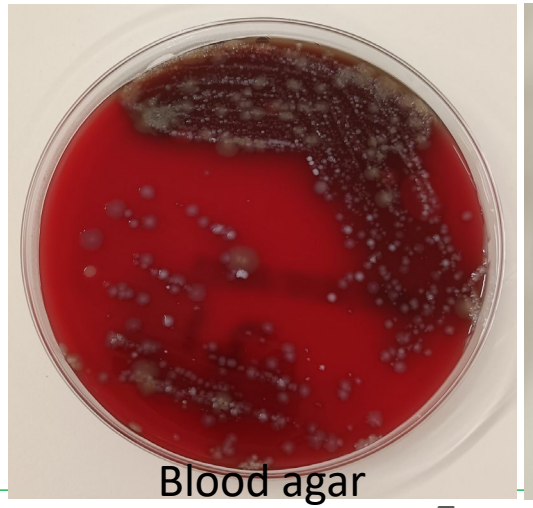
- National Milk Labs (NML)
  - Obtained agreement from farmers
  - Co-ordinated farm selection
  - Collected
    - 5ml of each milk sample for microbiology
      - ~25 x fresh samples sent to APHA Starcross weekly
    - 1ml of milk for Integron PCR
      - Frozen samples sent monthly to APHA Weybridge
    - Sample ID and region sent to labs in advance of samples
  - Samples arrive weekly on Friday > refrigerated over weekend prior to testing
    - Between January and October 2023



AMR in Bulk Milk: Microbiology

- APHA Starcross
  - 1ml of milk sample
    - Direct plating
      - *Klebsiella spp*, *E. coli*, *Streptococcus spp, S. aureus*
    - Enriched in
      - Buffered peptone water (BPW)
        - *E. coli*, Extended Spectrum Cephalosporins and Carbapenem resistant Enterobacteriaceae
      - Brain heart infusion broth (BHI) + 6.5% NaCl
        - *Enterococcus spp*
      - MHB+6.5% NaCl
        - MRSA
  - After enrichment, broths are plated on selective agars
  - Following selection a target colony from each plate is purified twice on blood agar prior to archiving on -80°C beads.
  - The microbiology process takes approx. 1 week
  - Frozen beads are sent to APHA Weybridge for characterisation

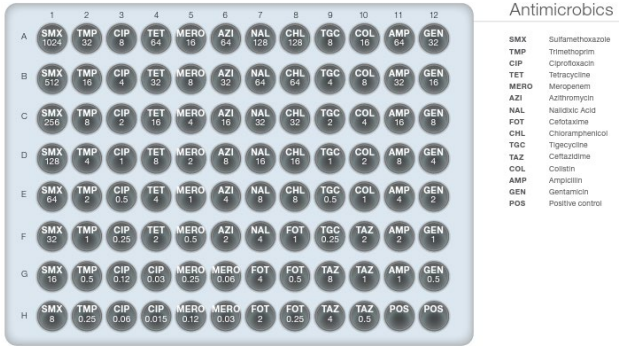
Bacterial species	plates	Isolation Agar
Streptococcus spp	Direct	Blood Edwards MacConkey
Klebsiella spp	Direct	
E. coli	Direct/Enrich	
Staphylococcus aureus	Direct	
Enterococcus faecalis *Enterococcus faecium*	Enrich	Slanetz-Bartley
MRSA	Enrich	Brilliance MRSA
Extended Spectrum Cephalosporins (ESC)	Enrich	MacConkey +1mg/L CTX
CARBA/OXA	Enrich	ChromidCARBA


Blood agar


MacConkey

Examples

AMR in Animal Feed and Bulk Milk: Characterisation (A)



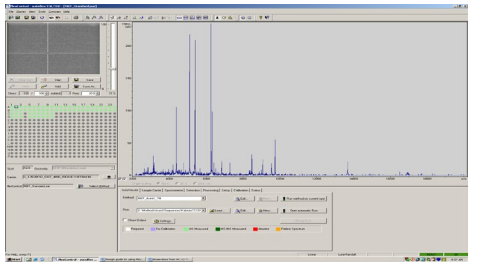
- APHA Starcross
  - Minimal Inhibitory Concentration (MIC) testing is performed on all target organisms using the Sensititre system using predefined plates
    - MIC is the lowest concentration required of the specific antibiotic to inhibit visible *in vitro* growth

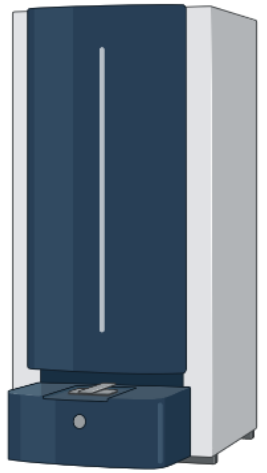
Bacterial species	MIC plates	No. of antibiotics
Streptococcus spp	GBPAPHA3	15
Klebsiella spp	EUVSEC3	15
E. coli		
Enterococcus faecalis / faecium	EUVENC	12
Staphylococcus aureus	EUST2	19
Methicillin resistance *Staph aureus* (MRSA)		
ESC *E. coli*	EUVSEC2/3	14
Carbapenemase producing Enterobacteriaceae		15

- Epidemiological cut-off value (ECOFF) used to determine if bacteria is susceptible or non-susceptible to an antibiotic

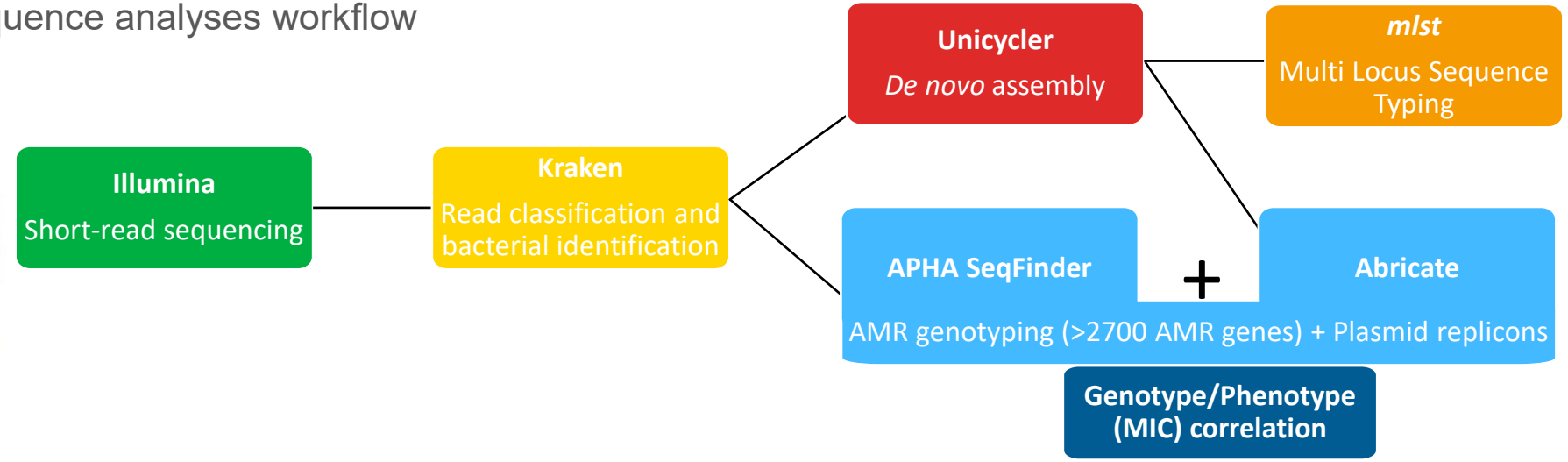
AMR in Animal Feed and Bulk Milk: Characterisation (B)

- APHA Weybridge
  - Where identification of species can not be achieved by culture, MALDI analysis is performed – mainly *Enterococcus* spp.





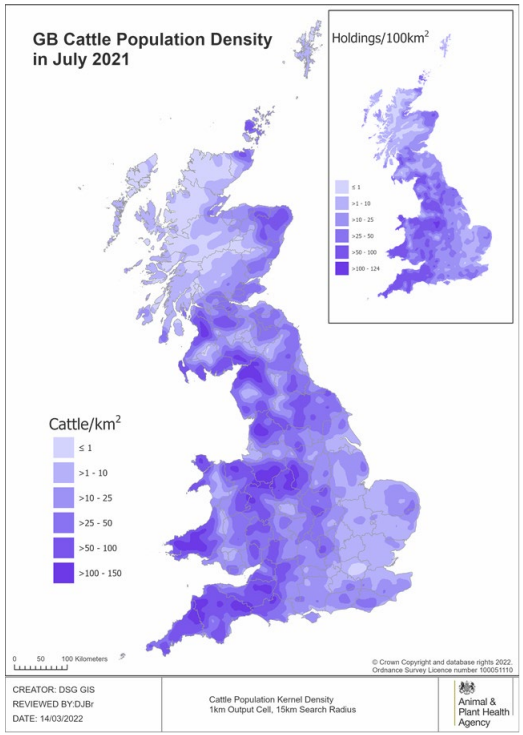
  - WGS of target bacteria
    - DNA extracted using Kingfisher
    - DNA sequenced using NextSeq platform
    - Sequence analyses workflow



Time permitting and where appropriate whole genome comparison to assess epidemiology

Epidemiology Data analysis

- **Animal Feed**
  - Feed mill selected within the Agricultural Industries Confederation (AIC).
  - Sample size of raw feed ingredients (n=300) & finished feed products (n=300) was based on volume used (raw ingredients) and produced (finished feed products) by the feed mill.
    - 99% confidence that AMR occurring at a prevalence of 5% will be detected in at least one sample, and 95% confidence of detecting 1% prevalence of resistance.
  - *Analytical Objectives*:
    - Determine the proportion of AMR within ingredient & finished feed samples.
    - Estimate the prevalence of pathogens within ingredient & finished feed samples.
- **Bulk Milk**
  - Farms were stratified by region within GB (10 regions incl. Scotland & Wales). From each region, a representative sample was taken proportional to the size of its dairy cattle population.
  - *Analytical Objectives*:
    - Estimate the prevalence of AMR pathogens (*E. coli*, ESBL-producing *E. coli*, *Enterococcus*, and *S. aureus*) and AMR genes in the GB dairy cattle population using bulk milk samples.
    - Compare regional variation in the prevalence of AMR resistant pathogens/genes descriptively.



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Q&A session