Food Standards Agency
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PATH-SAFE Overview

Dr Ed Haynes

PATH-SAFE Science Fellow

Pathogen **S**urveillance in **A**griculture, **F**ood and the **E**nvironment (PATH-SAFE)

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Food Standards Agency | Food Standards Scotland | Department for Environment Food & Rural Affairs | UK Health Security Agency | Veterinary Medicines Directorate | Department of Health & Social Care | Environment Agency

Pathogen **S**urveillance in **A**griculture, **F**ood and the **E**nvironment (PATH-SAFE)

Aim:

To pilot a **better national surveillance system** for the monitoring and tracking of foodborne pathogens (**FBP**) and antimicrobial resistance (**AMR**) in the **agri-food system**.

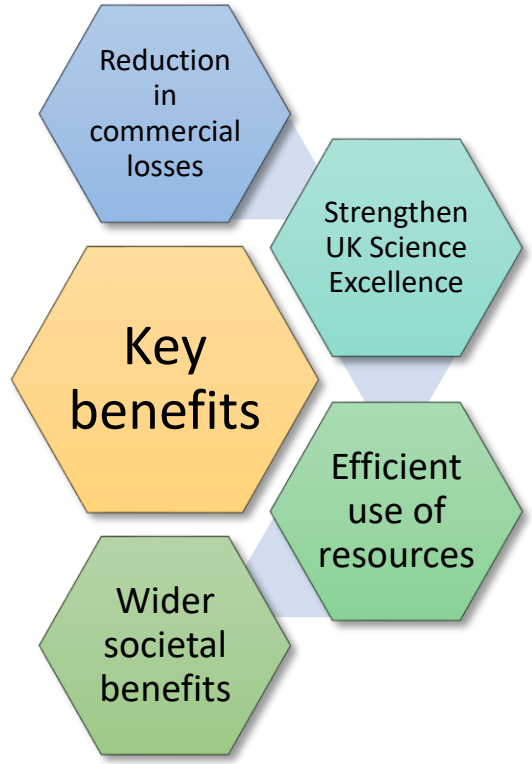
Shared Outcomes Fund
Cross departmental & Four Nations
£19.2m
2021-2024

WS1: Create national data system permitting analysis, storage and sharing of pathogen sequence and metadata

WS2: Pilot new surveillance approaches for monitoring major FBD pathogens and AMR, across a range of scenarios

WS3: Test remote genomic diagnostic methods 'in field'

WS4: Use catchment pilots to generate core data on transmission of AMR through the environment



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Department for Environment Food & Rural Affairs
Animal & Plant Health Agency
UK Health Security Agency
Centre for Environment Fisheries & Aquaculture Science
Veterinary Medicines Directorate
Department of Health & Social Care
Food Standards Scotland
SEPA
Scottish Environment Protection Agency
SRUC
Public Health Scotland
Food Standards Agency
Environment Agency
NIEA
Northern Ireland Environment Agency
www.daera-ni.gov.uk
NHS Lothian
Department of Health
Department of Agriculture, Environment and Rural Affairs
Department for Infrastructure
QUEEN'S UNIVERSITY BELFAST
UNIVERSITY OF LINCOLN
HSC Public Health Agency
northern ireland water
afbi AGRI-FOOD & BIOSCIENCES INSTITUTE
CARDIFF UNIVERSITY
PRIFYSGOL CAERDYDD
University of Exeter
Cranfield University
Llywodraeth Cymru Welsh Government
GIG CYMRU NHS WALES
Iechyd Cyhoeddus Cymru
Public Health Wales
Dŵr Cymru Welsh Water
resistomap
Quadram Institute
Science Health Food Innovation
Moredun Research Institute
EnteroBase
CLIMB BIG DATA
UNIVERSITY OF OXFORD
WARWICK
THE UNIVERSITY OF WARWICK
fera
AECOM
ARUP
Deloitte.
microbes NG
PRIFYSGOL BANGOR UNIVERSITY
University of Worcester
UK Centre for Ecology & Hydrology
CAPITA
NML
national milk laboratories


AIM
Pilot a national surveillance system that better monitors and tracks foodborne disease (FBD) and antimicrobial resistance (AMR) in the environment and agri-food system, taking a One Health approach
INPUTS
ACTIVITIES
OUTPUTS
OUTCOMES (2-5 years)
IMPACTS (5-10 years)
Staff and researcher time
Laboratories
Consumables and equipment
Sampling sites and samples
Contractors
WGS technology
Novel and user-friendly tools for analysis and visualisation of microbial genomes
Collaborations with key stakeholders and partners such as DEFRA, UKHSA devolved nations, and academics and access to their expertise and facilities
Funding
WS1
Establish a curated and national FBP (and their AMR) genomic data platform with Salmonella as exemplar pathogen
WS2
Pilot new FBP and AMR surveillance approaches based on regular, multi-location sampling in a range of settings, combined with novel technologies (e.g. whole genome sequencing)
WS3
Map and test new and repurposed technologies for rapid onsite FBP testing in collaboration with end users
WS4
Develop a pilot AMR surveillance system based on mechanisms of AMR spread in the environment
WS1
Functional and scalable data platform that houses sequences of exemplar pathogens and their AMR genes
Data platform is interoperable and can interact with other systems like Enterobase and provide an interrogatable user interface
WS2
AMR and FBP curated sample data captured from multiple sources, and tested using novel analysis techniques
Combined evidence from the piloted FBP and AMR surveillance and modelling approaches
WS3
TRL assessment of rapid onsite FBP testing tools with end users
Evidence on utilising COVID-19 testing technology (LAMP) for FBP detection in wastewater
WS4
AMR surveillance framework and suite of diagnostics monitoring of AMR across the environment within a catchment area
Key stakeholders can more easily share and access data across organisations for rapid identification and tracking of foodborne pathogens and AMR, bringing together multiple data sources
Predictive assessment of risk and threat is enabled when assessing a new isolate through access to a comparative repository of pathogen sequences and metadata
Improved understanding of source attribution and infection threat of FBP and AMR through various environments and international entry points
Additional knowledge of how to expand existing surveillance mechanisms to support a robust national surveillance infrastructure and improved monitoring
Guide the use of novel and existing/repurposed rapid onsite FBP testing technology with improved knowledge of where further development is needed
Informed consideration, based on evidence surfaced, on how proactive, rapid and efficient management can be used to reduce the risk of FBP and AMR introduction into the wider environment and food systems
Key stakeholders and decision makers are brought together to engage with evidence and take forward policy recommendations
Contributing to the One Health ambitions of reducing threats to public health and the ecosystem
Improved monitoring helps track spread of food borne pathogens and AMR across the agri-food system and wider environment
Knowledge and technology is added to the UK's capability to respond to and build resilience to AMR threats
Policy makers make informed, evidence-based decisions which improves efficient use of resources and strengthens cross-government collaboration in FBP and AMR surveillance and management
Detection of pathogen emergence and spread supports development of mitigation strategies to stop increased incidence of foodborne illness
Reduced incidence of foodborne illness
Innovations enable step change in approach to FBP/AMR surveillance and decision making promoting UK's food sector reputation internationally in FBP and AMR surveillance
Reduction of commercial losses from reduced food waste through prevention of FBP contamination
AMR: Antimicrobial resistance
FBP: Foodborne pathogen
TRL: Technology readiness level
WGS: whole genome sequencing

Inputs

- Staff and researcher time
- Laboratories
- Consumables and equipment
- Sampling sites and samples

- Contractors
- WGS technology

- Funding

- Novel and user-friendly tools for analysis and visualisation of microbial genomes
- Collaborations with key stakeholders and partners such as DEFRA, UKHSA devolved nations, and academics and access to their expertise and facilities

Outcomes (2-5 years)

WS1 WS2 WS3 WS4

- Key stakeholders can more easily share and access data across organisations for rapid identification and tracking of foodborne pathogens and AMR, bringing together multiple data sources
- Predictive assessment of risk and threat is enabled when assessing a new isolate through access to a comparative repository of pathogen sequences and metadata
- Improved understanding of source attribution and infection threat of FBP and AMR through various environments and international entry points
- Additional knowledge of how to expand existing surveillance mechanisms to support a robust national surveillance infrastructure and improved monitoring
- Guide the use of novel and existing/repurposed rapid onsite FBP testing technology with improved knowledge of where further development is needed
- Informed consideration, based on evidence surfaced, on how proactive, rapid and efficient management can be used to reduce the risk of FBP and AMR introduction into the wider environment and food systems
- Key stakeholders and decision makers are brought together to engage with evidence and take forward policy recommendations
- Contributing to the One Health ambitions of reducing threats to public health and the ecosystem

Continuation funding

- Data Sharing & Analysis theme
  - Additional pathogens and functionality
- Foodborne Disease theme
  - Further surveillance pilots and extension of models
- AMR theme
  - Novel surveillance methods and sources
- Onsite Diagnostics theme
  - Develop a framework for deployment of onsite diagnostics

Thank you for listening!

PATH-SAFE Programme

Email: PATHSAFE@food.gov.uk
Webpage: PATH-SAFE

Food Standards Agency
food.gov.uk

Session 1 Developing Biosurveillance Data Systems

Development of a National Foodborne Disease Genomic Data Platform - PATH-SAFE WS1a efforts

Centre for **Genomic Pathogen Surveillance**

Digital Epidemiology Services

Aim: to provide genomic interpretation linked to core minimal contextual data for decision makers within PATH-SAFE partner organisations - initially with a focus on Salmonella

Key Benefits

- Rapid cluster identification
- Standardised analysis
- Easier communication
- Multi-agency genomic surveillance
- Easy to use interface
- Trigger cross agency investigations

Project workstreams

WP1: **Project management & Administration**

WP2: **Platform development**

WP3: **Consortium partners** (CLIMB-BIG-DATA, PubMLST, EnteroBase)

WP4: **Community Input Advisory Groups**: Technical, AMR, FBD Data Standards, International Interaction

2022

- Discovery 1: General overview of foodborne infrastructure in the UK
- Discovery 2: Salmonella specific investigation

January 2023-March 2024

- Consortium efforts
- Platform development

CLIMB BIG DATA

https://www.climb.ac.uk/

- Established 2014, multi-site cloud infrastructure dedicated to microbial bioinformatics, established sustainability model through user and institutional contributions

- Multiple rounds of investment in hardware specific for microbial big data analysis, upgraded and refreshed in 2020-2022 in Birmingham and Cardiff. Each site:
  - Very large storage capacity, fast (>1PB SSD) and slow (>10PB spinning disk)
  - GPU server farm for machine learning applications (>40 Nvidia A100s)
  - Very large memory machines for genome assembly (1-3Tb)
- Scalable cloud hosting and containerised analytic pipelines

jupyterhub

nextflow

UKRI UK Research and Innovation

https://enterobase.warwick.ac.uk/

- Years of experience hosting and providing research interface for multiple pathogens (Salmonella, Escherichia/Shigella etc.)
- Conducted assembly pipeline comparisons to inform decision making and sign-off by PATH-SAFE governance.
- Worked with the development team to ensure API utility to deliver analytics and where possible pull data into the data platform

https://pubmlst.org/

- Providing gold-standard typing (MLST/cgMLST) for the research and public health communities for multiple pathogens
- Ensured maximal utility of APIs to deliver typing and where possible enhanced usage of data for the data platform
- Additional retrospective sequencing and analysis of Campylobacter is being undertaken across the UK in order to gather baseline data

Exemplar End User Group

Aim: understand user needs and organisation requirements as well as discussions on policy, data and analytics

- Questionnaires
- Metadata requirements
- Risk factors (analytics)
- User personas
- Platform use cases

Animal & Plant Health Agency

UK Health Security Agency

Food Standards Agency

Food Standards Scotland

Public Health Scotland

Community Input Advisory Groups

1. **Technical Advisory Group**: Best practice analytics and QC – assembly recommendations, typing, clustering, additional (eg serotyping)

1. **AMR Advisory Group**: Define markers of risk (e.g. genes, SNPs, mechanisms) to be reported for genotypic resistance and tools used

1. **FBD Data Standards Group**: Adherence to, and extension of data standards ti improve interoperability and QC

1. **International Interaction Advisory Group:** Liaise with international stakeholders regarding best practice standards, challenges and learnings

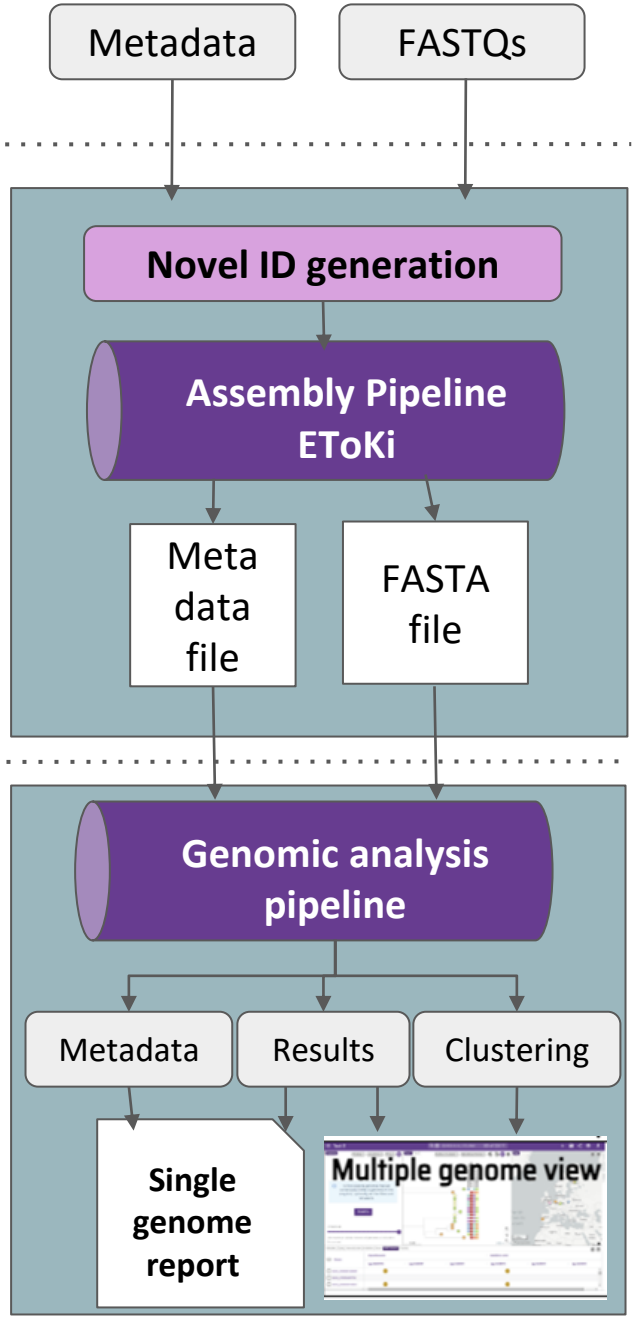
Sequencing lab

CLIMB-BIG-DATA

- Secure Login + user authentication
- Sequence assembly
- Metadata validation
- Secure data storage

Pathogenwatch

- Interactive investigation
- Cluster identification
- Data governance
- Data sharing of analysis results



Important to consider:

- De-centralised sequencing capacity
- Standardised analytical pipeline needed to be able to compare genomes
- Value provided to genomic information by providing context to publicly available genomes
- Linkage to minimal associated data (time, place, organism, sample type)

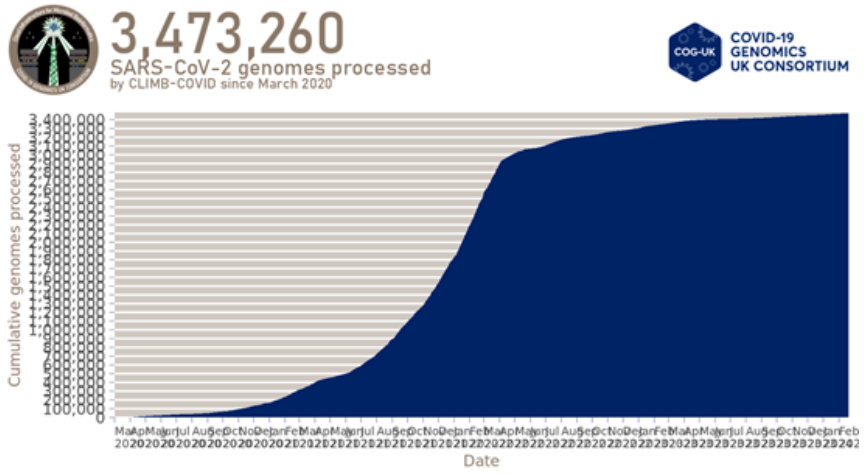
CLIMB BIG DATA

https://climb-tre.github.io

Swansea University Prifysgol Abertawe · University of Bath · Warwick, The University of Warwick · Quadram Institute · Cardiff University / Prifysgol Caerdydd · University of Leicester · University of Birmingham · MRC Unit The Gambia · London School of Hygiene & Tropical Medicine

CLIMB-TRE: Trusted Research Environment

- Specialised TRE for pathogen genomic surveillance
- Base platform utilised for COG-UK & UK COVID-19 genomics response, ~3.5m genomes processed
- Decentralised sequencing – centralised real-time analytics - decentralised delivery to public health agencies and academics
- Web upload/authentication and ID generation



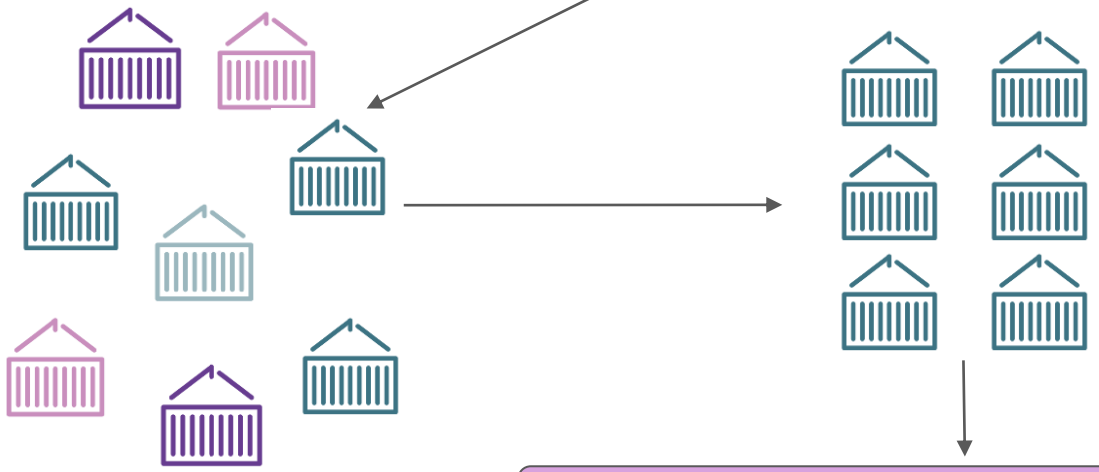
UK Research and Innovation

Pathogenwatch

Sequence(s) and data in

Analytics / Containers

Speciation



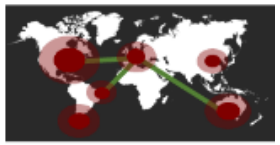
Species specific reporting and interaction

User focused and friendly

Single genome report

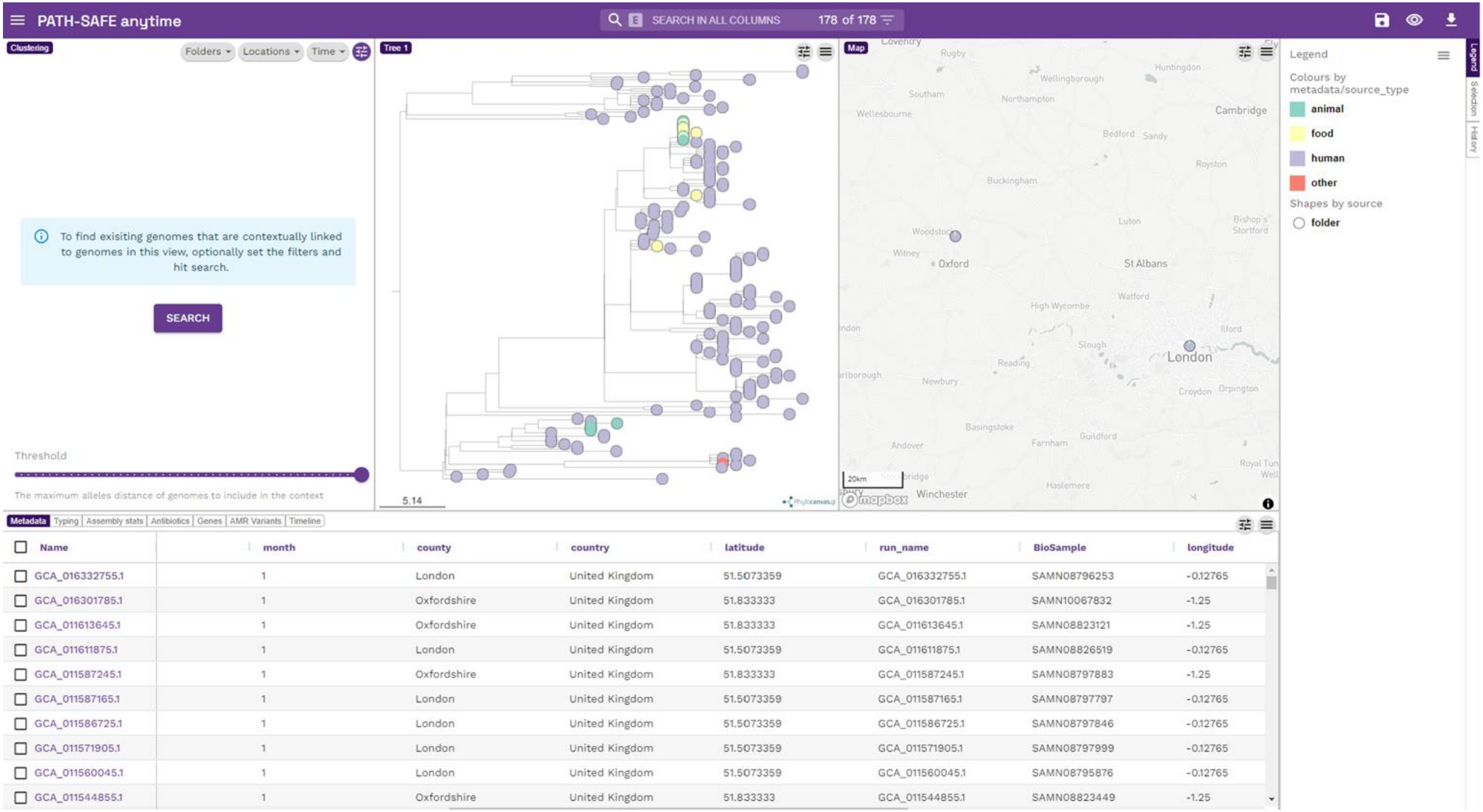
Collections of genomes

Population monitoring



List of analytics

- Serotyping
- MLST
- cgMLST
- Clustering
- AMR
- Tree building


PATH-SAFE anytime
SEARCH IN ALL COLUMNS
178 of 178
Clustering
Folders
Locations
Time
To find exisiting genomes that are contextually linked to genomes in this view, optionally set the filters and hit search.
SEARCH
Threshold
The maximum alleles distance of genomes to include in the context
Tree 1
5.14
Map
Legend
Colours by metadata/source_type
animal
food
human
other
Shapes by source
folder
Metadata
Typing
Assembly stats
Antibiotics
Genes
AMR Variants
Timeline
Name
month
county
country
latitude
run_name
BioSample
longitude
GCA_016332755.1 1 London United Kingdom 51.5073359 GCA_016332755.1 SAMN08796253 -0.12765
GCA_016301785.1 1 Oxfordshire United Kingdom 51.833333 GCA_016301785.1 SAMN10067832 -1.25
GCA_011613645.1 1 Oxfordshire United Kingdom 51.833333 GCA_011613645.1 SAMN08823121 -1.25
GCA_011611875.1 1 London United Kingdom 51.5073359 GCA_011611875.1 SAMN08826519 -0.12765
GCA_011587245.1 1 Oxfordshire United Kingdom 51.833333 GCA_011587245.1 SAMN08797883 -1.25
GCA_011587165.1 1 London United Kingdom 51.5073359 GCA_011587165.1 SAMN08797797 -0.12765
GCA_011586725.1 1 London United Kingdom 51.5073359 GCA_011586725.1 SAMN08797846 -0.12765
GCA_011571905.1 1 London United Kingdom 51.5073359 GCA_011571905.1 SAMN08797999 -0.12765
GCA_011560045.1 1 London United Kingdom 51.5073359 GCA_011560045.1 SAMN08795876 -0.12765
GCA_011544855.1 1 Oxfordshire United Kingdom 51.833333 GCA_011544855.1 SAMN08823449 -1.25

Single genome report

GCA_016332755.1

Salmonella

Pathogenwatch

Metadata

day	Host	NAME
22	Homo sapiens	GCA_016332755.1
file	**year**	**month**
GCA_016332755.1.fna	2024	1
county	**country**	**latitude**
London	United Kingdom	51.5073359
run_name	**BioSample**	**longitude**
GCA_016332755.1	SAMN08796253	-0.12765
data_owner	**submit_org**	**source_type**
UKHSA	UKHSA	human
Isolation type	**sample_accession**	
clinical	SAMN08796253	

Typing

MLST - Multilocus sequence typing

http://mlst.warwick.ac.uk/mlst/dbs/Senterica

Sequence type 11

aroC	dnaN	hemD	hisD	purE	sucA	thrA
5	2	3	7	6	6	11

Serotype

Salmonella In Silico Typing Resource (SISTR)

Subspecies	Serovar
enterica	Enteritidis

AMR - Anti-microbial resistance

ResfinderPlus AMR

Agent	Inferred resistance	Known determinants
Imipenem	None	-
Piperacillin+Tazobactam	None	-
Azithromycin	None	-
Ciprofloxacin	**Resistant**	**gyrA_S83Y**
Trimethoprim	None	-

Plasmid Inc Types

https://cge.food.dtu.dk/services/PlasmidFinder/

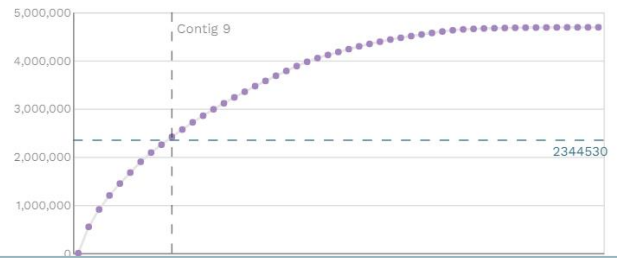
No matches reported

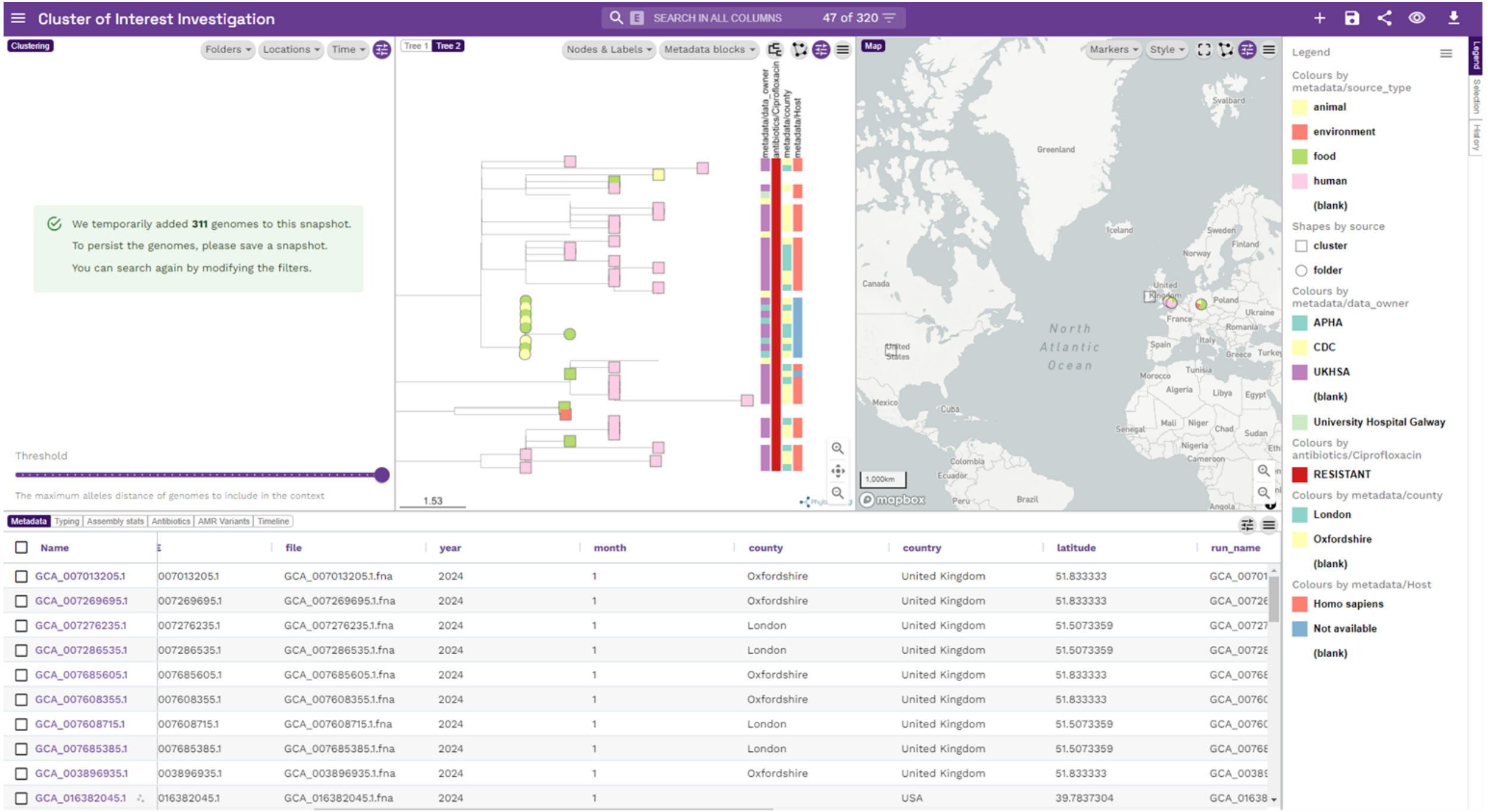
Core Stats

Core matches	Core families	Non-core
2830	99.8%	32.6%
Complete alleles	**Families matched**	**Pathogenwatch reference**
2722	2830	GCF_020714645.1_ASM2071464v1_genomic

Assembly Stats

Genome length	No. contigs	Smallest contig
4689060	50	446
Largest contig	**Average contig length**	**N50**
546173	93781	162472
Non-ATCG	**GC content**	
0	52.1%	





Name	file	year	month	county	country	latitude	run_name
GCA_007013205.1	007013205.1	GCA_007013205.1.fna	2024	1	Oxfordshire	United Kingdom	51.833333	GCA_00701
GCA_007269695.1	007269695.1	GCA_007269695.1.fna	2024	1	Oxfordshire	United Kingdom	51.833333	GCA_00726
GCA_007276235.1	007276235.1	GCA_007276235.1.fna	2024	1	London	United Kingdom	51.5073359	GCA_00727
GCA_007286535.1	007286535.1	GCA_007286535.1.fna	2024	1	London	United Kingdom	51.5073359	GCA_00728
GCA_007685605.1	007685605.1	GCA_007685605.1.fna	2024	1	Oxfordshire	United Kingdom	51.833333	GCA_00768
GCA_007608355.1	007608355.1	GCA_007608355.1.fna	2024	1	Oxfordshire	United Kingdom	51.833333	GCA_00760
GCA_007608715.1	007608715.1	GCA_007608715.1.fna	2024	1	London	United Kingdom	51.5073359	GCA_00760
GCA_007685385.1	007685385.1	GCA_007685385.1.fna	2024	1	London	United Kingdom	51.5073359	GCA_00768
GCA_003896935.1	003896935.1	GCA_003896935.1.fna	2024	1	Oxfordshire	United Kingdom	51.833333	GCA_00389
GCA_016382045.1	016382045.1	GCA_016382045.1.fna	2024	1		USA	39.7837304	GCA_01638

Challenges

- Data release
- Standardisation
- Policy and Governance going forward
- Measuring impact and value provided

What's next?

- Build trust in the platform
- Increase level of data uploaded to the platform
- Measure impact and value
- Continuation bid
- Scale up to additional pathogen(s)

Acknowledgements

Special thanks to all members of our end user group, advisory groups, international collaborators, and everyone that has contributed and helped develop this data platform.

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Dr Kathryn Callaghan
Dr Anthony Wilson
Dr Sarah Evans
Dr Liljana Petrovska
Dr Janine Thoulass

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Prof Sascha Ott
Prof Martin Maiden

CIAG Chairs:
Prof Kat Holt
Prof Tom Connor
Dr Tim Dallman
Dr Matthew Gilmour

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Dr Shona O'Rourke
Dr Rick Mumford
Prof Robin May

The team at DES and CGPS

Centre for Genomic Pathogen Surveillance

Digital Epidemiology Services

UK Health Security Agency

Developing an exemplar One Health Data System for a pilot Environmental AMR surveillance

Olisaeloka Nsonwu - Project manager

Principal Scientist / Project Manager

HCAI, Fungal, AMR, AMU & Sepsis Division

UK Health Security Agency

Objectives

One Health Surveillance System (OHSS)

Objective

- ✓ to complete discovery for target vision & feasibility of creating a UK wide One Health AMR Surveillance System

Environmental Surveillance System (ESS)

Objective

- ✓ to design and develop a shared data environment for environmental AMR

Epics development

1. For each source, what resistance is present and in what organisms?
2. What is the level of resistance?
3. What is the context of resistance?
4. How is resistance distributed?
5. What is the risk?
6. Has the resistance been investigated and acted upon?

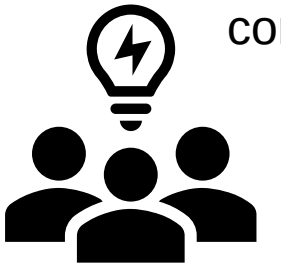
User Groups

Data providers

Clinicians | Environmental scientists | Public health specialists | Veterinarians | Water suppliers | Sewage/wastewater treatment plants | Government agencies* | Academia‡ | Agricultural management | Fisheries | Food manufacturers | Devolved Administrations (except Northern Ireland)

Data processers

Lab scientists | Data scientists | Business analysts

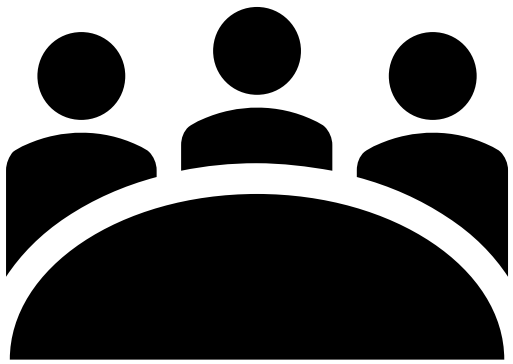


Data consumer

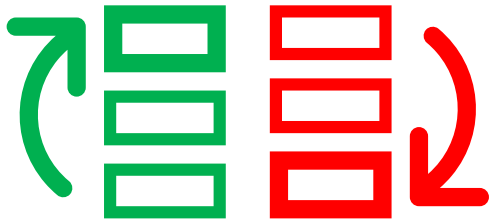
Government agencies* - Policy makers, Operational managers and Board members/executives

User Story Building Exercise

User Story:
What do I want to need or want from an OHSS?



User groups then ranked these user stories - high, medium or low priority.



Exercise 1

13:35 – 14:15

AMR One Health Surveillance System Exercise

The OHSS exercise requires you to place yourself in the shoes of the allocated users, think about what objectives this person would have for OHSS and the reasons for these objectives.

1. Attendees have been **divided into groups** according to whether they **provide** data, **process** data or **receive** data. **Names of group members** are included in each frame.

2. Each group will be asked to **define user stories** for the users within their section, using the **templates** in the sticky notes.

Note: user groups on there that aren't represented in the attendees, so we are asking you to think of what those users may require and we will engage them at a later date.

3. Groups will then be asked to **prioritise the user stories**, by pasting the user stories into the **relevant category: low, medium** or **high** priority

11 OFFICIAL Link

Exercise 2

14:30 – 14:55

AMR Environmental Surveillance System Exercise

The ESS exercise is similar to the OHSS exercise just completed but requires you to place yourself in the shoes of the allocated users specifically concerned with the ESS.

1. Attendees will be asked to **define user stories** for a variety of users using the **templates** in the sticky notes.

2. Attendees will then be asked to **prioritise the user stories**, by pasting the user stories into the **relevant category: low, medium** or **high** priority

Note: user groups on there that aren't represented in the attendees, so we are asking you to think of what those users may require and we will engage them at a later date.

13 OFFICIAL Link

Number of user stories identified

User Group	OHSS	ESS
Public Health Outbreak Specialists	17	12
Sewage/ Wastewater Treatment Plants	11	7
Policy Maker	11	8
Data Scientist	10	4
Lab Scientist	7	5
Clinicians	7	4
Academia	5	3
Board Members / Executives	4	3
Food Manufacturers	3	1
Fisheries	3	2
Pharmaceutical Companies	2	1
Frontline Workers	2	-
Environmental Scientist	2	5
Data / Business Analyst	2	-
Agricultural Management	2	2
Lab Scientist	1	5
Operational Managers	-	1
Total	**89**	**63**

User Story Prioritisation

	For each source, what resistance is present and in what organisms?	What is the level of resistance?	What is the context of resistance?	How is resistance distributed?	What is the risk?	Has the resistance been investigated and acted upon?	System set up, integrity and governance
OHSS	3	6	0	7	8	10	19
	3	4	0	4	2	3	7
	1	2	0	0	0	2	10
ESS	0	2	0	2	1	3	8
	0	0	0	1	0	1	2
	0	0	0	0	0	0	2

NB: No user stories were aligned to Epic 3, “what is the context of resistance?”. A new category, “system set up, integrity, and governance” was created for user stories that described process requirements and governance features.

Key:

- High priority
- Medium priority
- Low priority

Data Maturity Assessment

- User stories broken down and assessed against the following pillars: completeness, accuracy, accessibility
- The initial rank of the user stories was an output from the workshop and is an assessment of the relative value the story has to One Health AMR surveillance.
  - *Note that this ranking may have been subject to change based on further stakeholder input and evaluation throughout discovery.*

Completeness	Accuracy	Accessibility	Automation*
Are there existing and suitable system? Are new systems required 	Is data capture subject to error due to human involvement and complexity level? 	How easy is it to access and manipulate data? 	How feasible is it to have data captured automatically e.g. through API calls to LIMS system? 

*Note: Automation may be populated at a later date as deemed appropriate during wider OHSS development.

Summary of Engagements: User Needs and Requirements

- ✓Monitoring Trends, thresholds/ Benchmarks
- ✓Source and flow of AMR through the Ecosystem
  - ✓Sequencing Data
  - ✓Metadata and Provenance
  - ✓Increase in Testing
- ✓Governance, data access and sharing
  - ✓Communication
  - ✓Incomplete/ Inconsistent Data
  - ✓Timeliness of Data
- ✓Policy Not Practice
  - ✓Pragmatic Approach
- ✓System capacity
  - ✓Technology Agnosticism
  - ✓Future Proofing
  - ✓Front-end & Flexibility of Information
  - ✓Linkage to Authoritative Databases/ Infrastructure
  - ✓Method Alignment
  - ✓Data dictionary
- ✓Sample Matrices and Analysis Pipelines

Summary of Engagements: Considerations from Devolved Administrations

- ✓Interoperability
  - ✓Different testing methods for susceptibility
  - ✓Unstandardized LIMS systems
  - ✓Different sampling regimes and lab processing techniques
  - ✓Agile processes
- ✓Data quality and presentation
  - ✓Lack of comparative dashboards/ functions
  - ✓Data quality and representativeness
  - ✓Exploration of data
  - ✓Lack of constant metadata collected
  - ✓Lack of coherence between sources of AMR
- ✓Inferential frameworks and understanding of causation
- ✓Identification of shared commitments
- ✓Governance and commercially sensitive considerations
- ✓Loss of control over data
  - ✓Misinterpretation of data
  - ✓Accessibility and practicality of insights

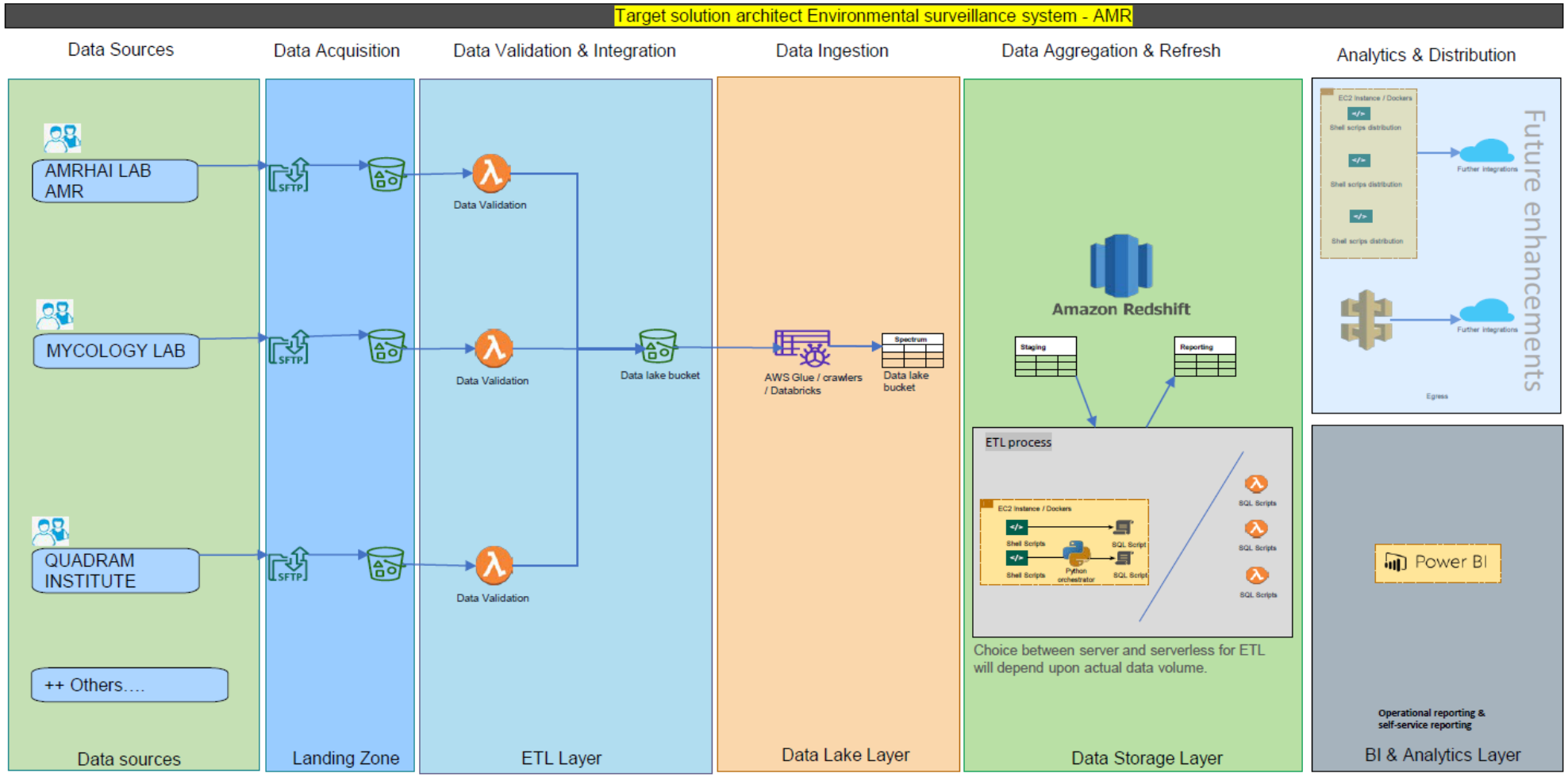
Summary of Engagements: Challenges

- ✓Linkage of differing AMR questions & interpretations
- ✓Operationalisation of surveillance
- ✓Communication
- ✓Availability and management of data
  - ✓Multiple large data systems
  - ✓Limited data sharing systems
  - ✓Variations in data collected
  - ✓Frequency of data collection
  - ✓Lack of robust data systems
  - ✓Manual data system

UK Health Security Agency

Exemplar Environmental Surveillance System

ESS – High Level Design Architecture



ESS Goals

- Exemplar for a UK wide One Health AMR surveillance data system (OHSS)
- Proof of concept for OHSS solution proposed at discovery

ESS – Low Level Design Architecture

ESS Goals

- Exemplar for a UK wide One Health AMR surveillance data system (OHSS)
- Proof of concept for OHSS solution proposed at discovery

User personas

JAMIE

ENVIRONMENTAL LAB SCIENTIST

JOB CONTEXT

- Works in the FWE Lab
- Currently runs tests on two species of bacteria from river water samples
- Inserts test results into an Excel spreadsheet
- Currently regularly uses LIMS platform to monitor data and to produce regular reports
- Currently shares Excel data sheet and initial reports with other AMR stakeholders via email

ATTITUDE TOWARD TECHNOLOGY

SUSAN

DATA SCIENTIST

JOB CONTEXT

- Performs analysis on AMR data from FWE Lab
- Currently assists with test result recording in Excel spreadsheet
- Currently performs data analysis in Excel, R, SQL, and STATA
- Currently performs limited visualisations in RStudio
- Currently shares visualisations via PowerPoint with other AMR stakeholders via email

ATTITUDE TOWARD TECHNOLOGY

SAM

SUPPORT ENGINEER

JOB CONTEXT

- Provides operational and maintenance support, particularly around multiple data feeds and data processing once steady state of platform is achieved
- Owns platform following offboarding of development team
- Liaises with SMEs and data scientist/ platform engineer(s) in the case of any issues with the system/ solution

ATTITUDE TOWARD TECHNOLOGY

NOLAN

PUBLIC HEALTH SPECIALIST

JOB CONTEXT

- Supports in sample collection from the field
- Currently supports test result data entry into Excel
- Currently supports data analysis in Excel and RStudio
- Currently performs basic visualisations in RStudio and presents via PowerPoint
- Currently presents basic AMR data visualisations from PowerPoint at stakeholder meetings

ATTITUDE TOWARD TECHNOLOGY

BROOKE

CLINICIAN

JOB CONTEXT

- Inputs AMR related test results into NHS Labs system which automatically syncs with SGSS (UKHSA clinical data platform)
- Currently uses basic AMR data visualisations from PowerPoint to inform policy decisions
- Patient results are currently sent to UKHSA and analysis is not shared with clinicians

ATTITUDE TOWARD TECHNOLOGY

TRUDY

POLICY MAKER

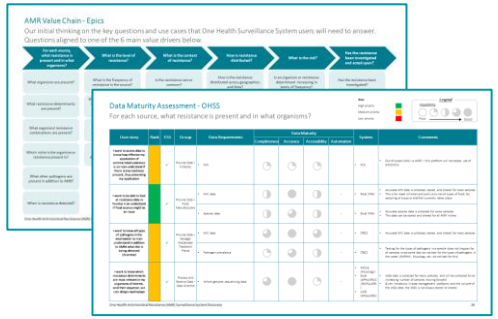
JOB CONTEXT

- Currently presents basic AMR data visualisations that were shared by colleagues via PowerPoint at stakeholder meetings
- Currently uses basic AMR data visualisations that were shared with them to inform policy decisions

ATTITUDE TOWARD TECHNOLOGY

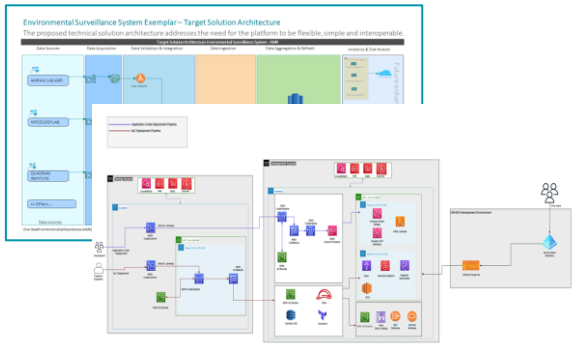
ESS: Development activities

Discovery



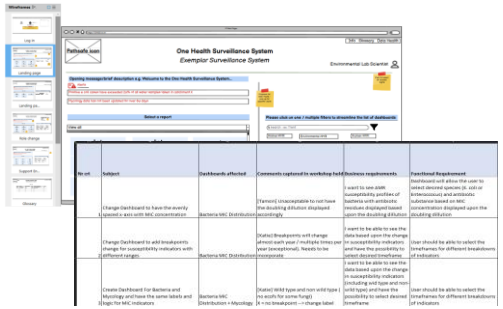
- Develop research plan
- Conduct stakeholder interviews to develop use cases and user personas

Alpha



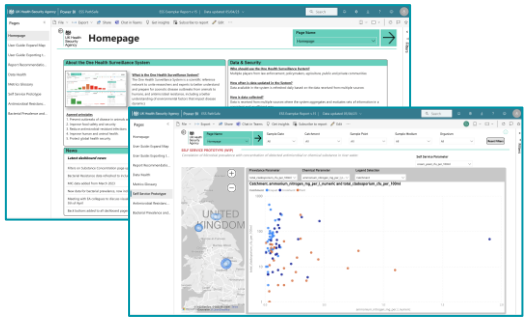
- Finalise user personas
- Build a basic cloud base data platform
- Develop wireframes and basic dashboard designs
- Develop low level design architecture

Beta



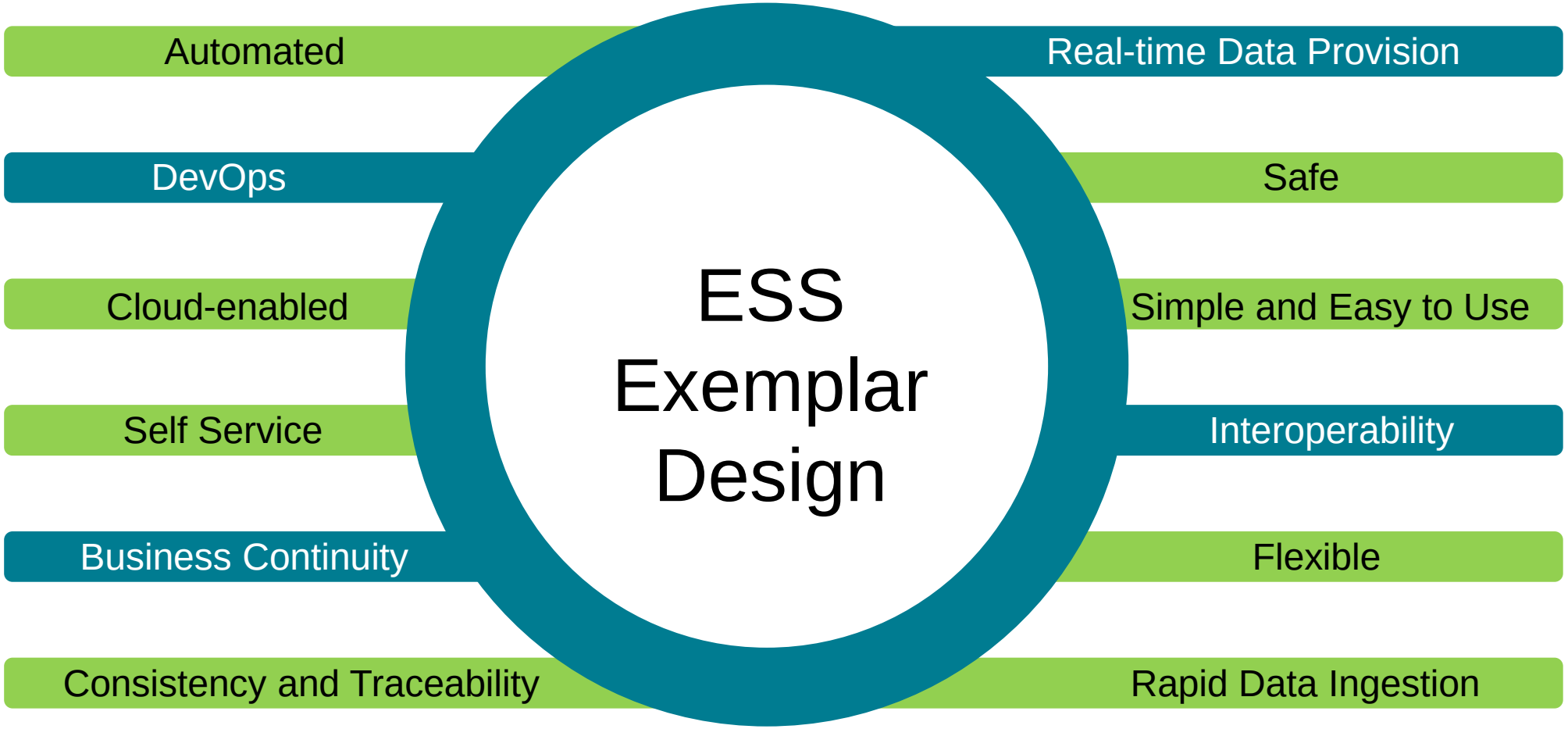
- Build dashboards using Power BI
- Conduct user testing of automated ingestion and validation of data source

Live



- Support and iterate the dashboards according to the user acceptance testing
- Knowledge transfer between Deloitte and UKHSA
- Prepare to decommission the system

Developed solution



ESS: Home page

UK Health Security Agency

Page Name: Homepage

HOMEPAGE

About the ESS

What is the ESS?

The Environmental Surveillance System (ESS) is an exemplar IT platform for a one health surveillance system to report, analyse and visualise pathogen sequence and environmental antimicrobial resistance data.

Partners

1. Food Standards Agency (FSA)
2. Food Standards Scotland (FSS)
3. The Department of Environment
4. Food and Rural Affairs (Defra)
5. The Department of Health and Social Care (DHSC)
6. UK Health Security Agency (UKHSA)
7. The Environment Agency (EA)

Data & Security

Who should use the Environmental Surveillance System?

A wide range of stakeholders and policy makers across but not limited to public health, agricultural and environmental surveillance communities.

How often is data updated in the System?

Data available in the system is refreshed daily based on the data received from multiple sources

How is data collected?

Data is collected from multiple across different organisations.

- Environmental sampling data - Sampling River catchments (Environmental Agency)
- Pathogen data - Bacteriology (AMRHAI reference unit) and Mycology (Mycology reference lab)
- Pathogen meta-genomic (QUADRUM Institute)

Security

Role Level Security security is implemented in Power BI and will allow the possibility to create a single set or a set of reports that targets a set of reports accessible to specified users

News

Latest dashboard news:

- Filters on Substance Concentration page updated
- Bacterial Resistance data refreshed to include columns containing fungal data
- MIC data added from March 2023
- New data for bacterial prevelance, now including VRE and ESBL percentages
- Meeting with EA collegues to discuss visualisation changes scheduled for 10am 5th of April
- Back buttons added to all dashboard pages

User Guides

To **display** an **interactive user guide**, please **click** the **icon** shown **below**, found in the **top right corner** of data pages:

Click anywhere on the page to exit.

For **detailed user guide** documents, **click** the following **button**, found in the **top right corner** of data pages:

Using the expand map | Exporting the dataset

Useful Links

To view some report recommendations, data health page or the metrics glossary, please select one of the buttons below:

Report Recommendations | Data Health | Metrics Glossary

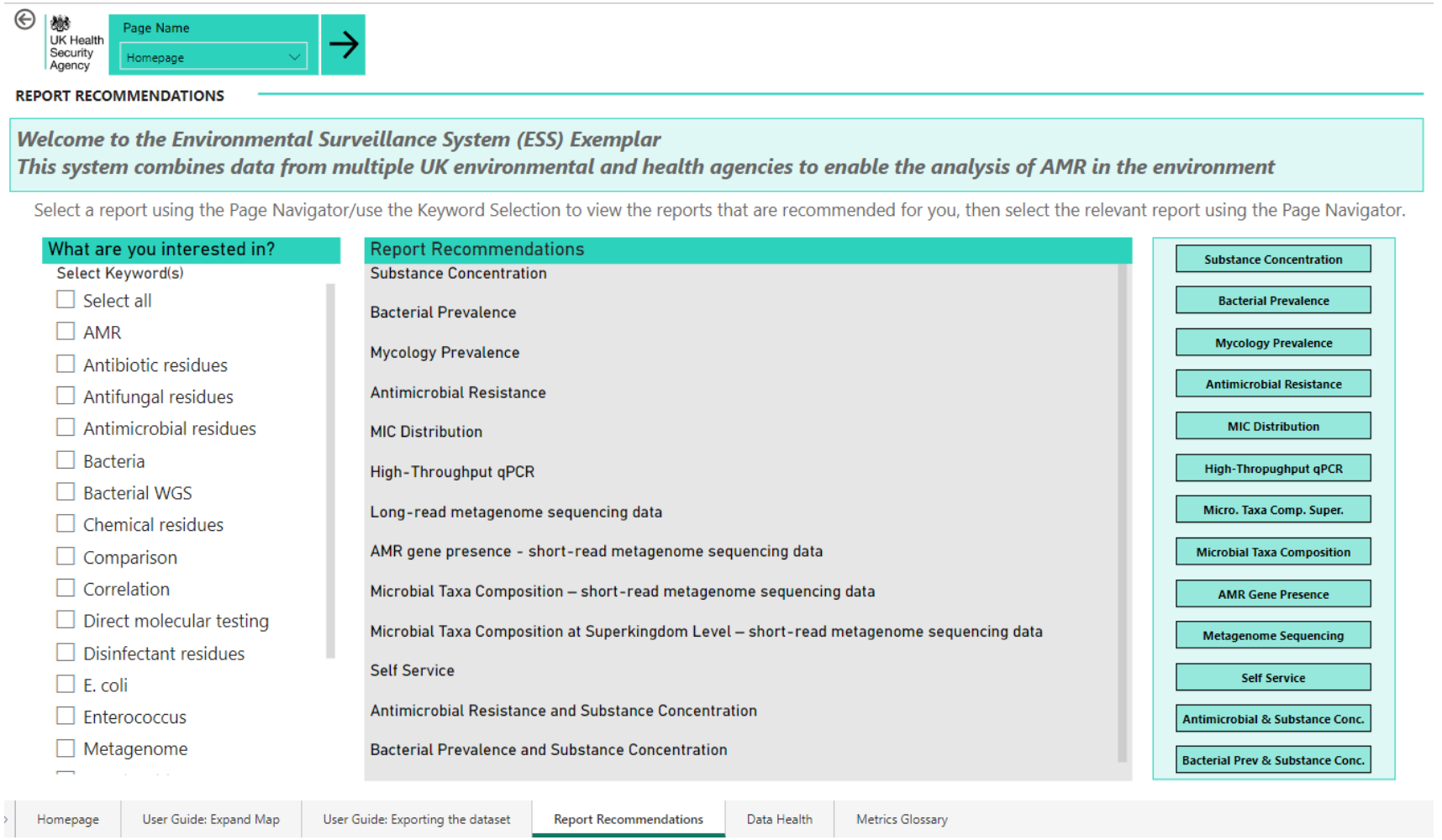
Help & Support

For queries and enquiries, you can contact us at:

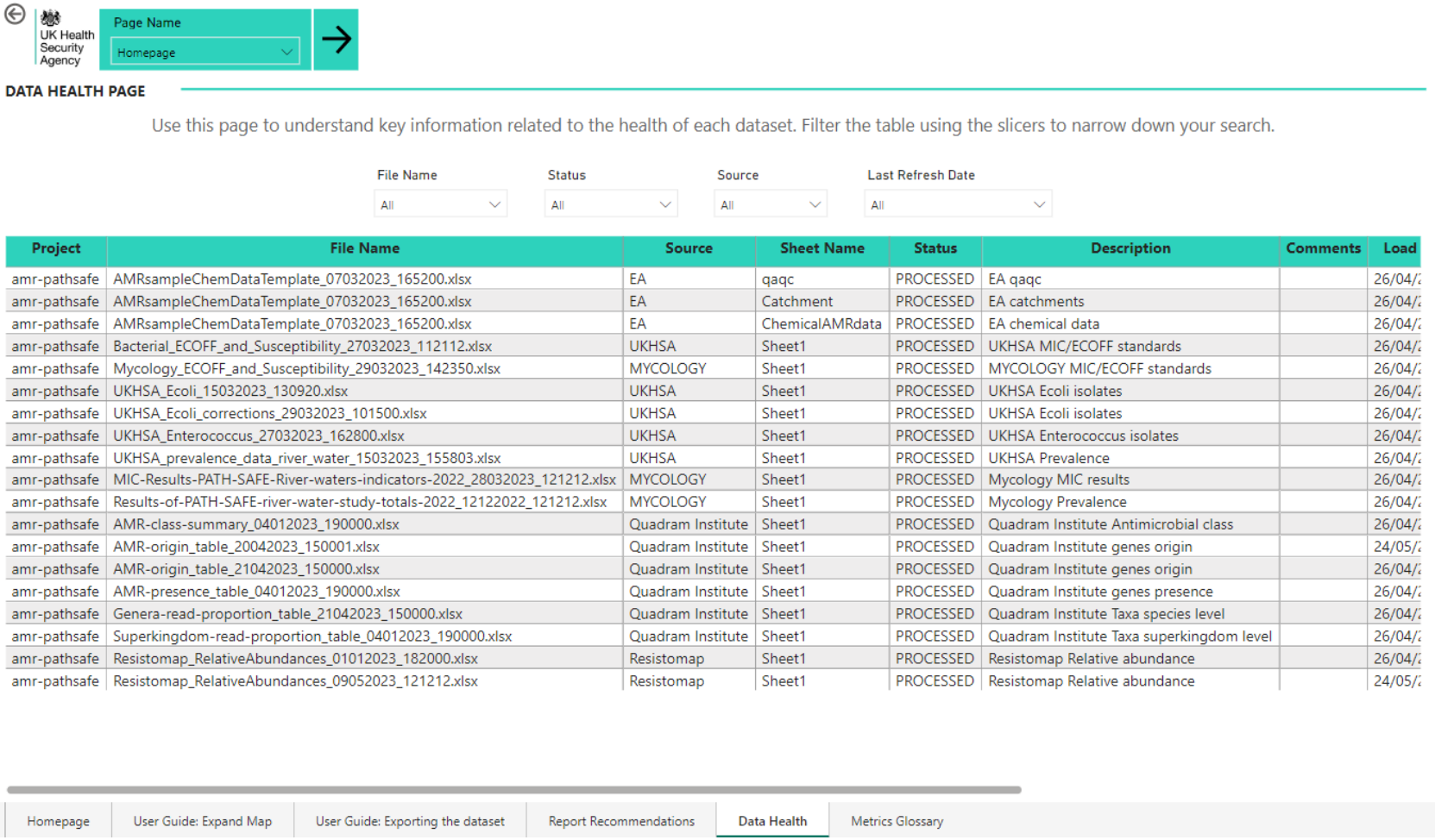
UKHSA queries: enquiries@ukhsa.gov.uk
EA queries: enquiries@environment-agency.gov.uk
Quadram Institute queries: info@quadram.ac.uk

Homepage | User Guide: Expand Map | User Guide: Exporting the dataset | Report Recommendations | Data Health | Metrics Glossary

ESS: Report recommendation



ESS: Data health



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amr-pathsafe	AMRsampleChemDataTemplate_07032023_165200.xlsx	EA	Catchment	PROCESSED	EA catchments		26/04/2
amr-pathsafe	AMRsampleChemDataTemplate_07032023_165200.xlsx	EA	ChemicalAMRdata	PROCESSED	EA chemical data		26/04/2
amr-pathsafe	Bacterial_ECOFF_and_Susceptibility_27032023_112112.xlsx	UKHSA	Sheet1	PROCESSED	UKHSA MIC/ECOFF standards		26/04/2
amr-pathsafe	Mycology_ECOFF_and_Susceptibility_29032023_142350.xlsx	MYCOLOGY	Sheet1	PROCESSED	MYCOLOGY MIC/ECOFF standards		26/04/2
amr-pathsafe	UKHSA_Ecoli_15032023_130920.xlsx	UKHSA	Sheet1	PROCESSED	UKHSA Ecoli isolates		26/04/2
amr-pathsafe	UKHSA_Ecoli_corrections_29032023_101500.xlsx	UKHSA	Sheet1	PROCESSED	UKHSA Ecoli isolates		26/04/2
amr-pathsafe	UKHSA_Enterococcus_27032023_162800.xlsx	UKHSA	Sheet1	PROCESSED	UKHSA Enterococcus isolates		26/04/2
amr-pathsafe	UKHSA_prevalence_data_river_water_15032023_155803.xlsx	UKHSA	Sheet1	PROCESSED	UKHSA Prevalence		26/04/2
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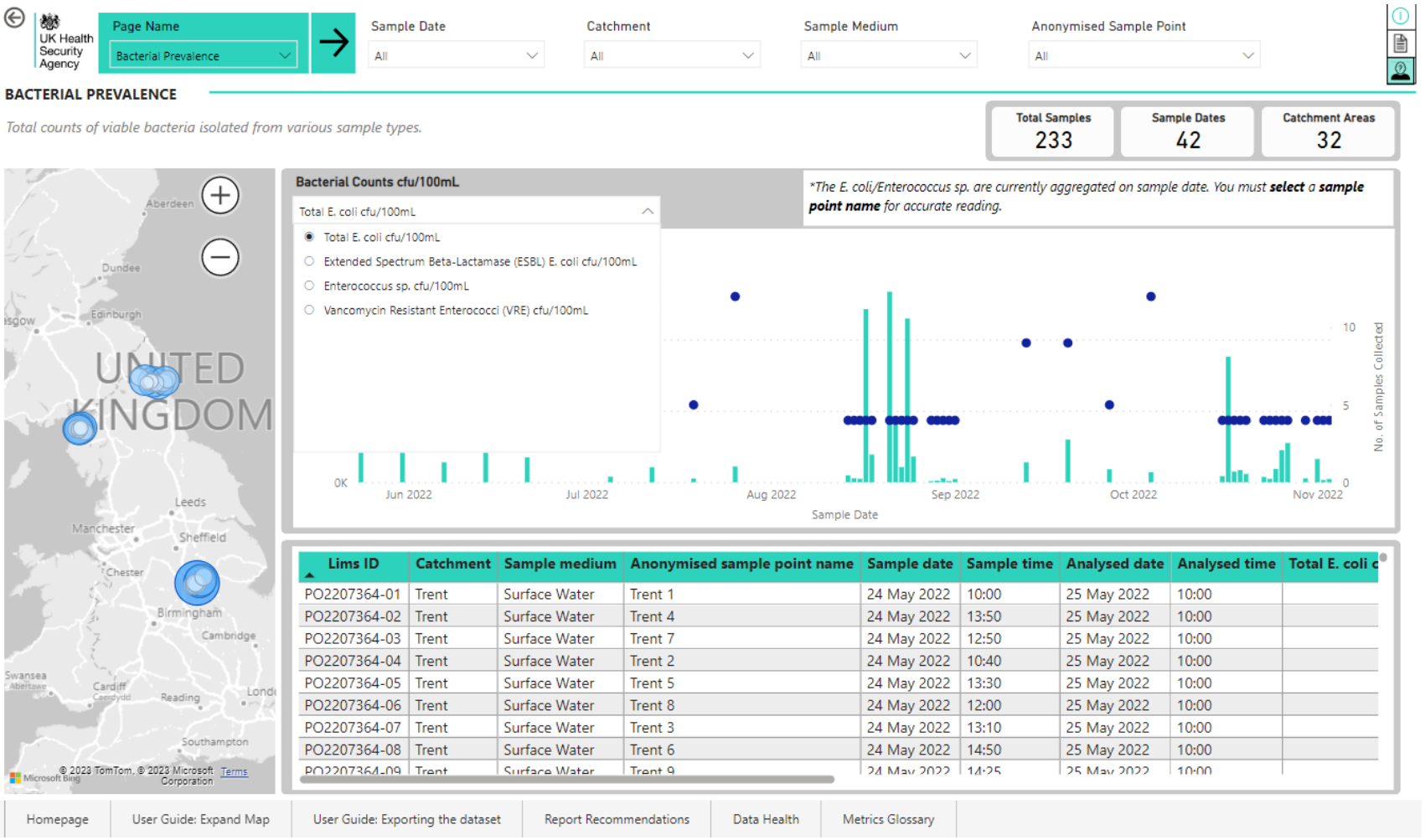
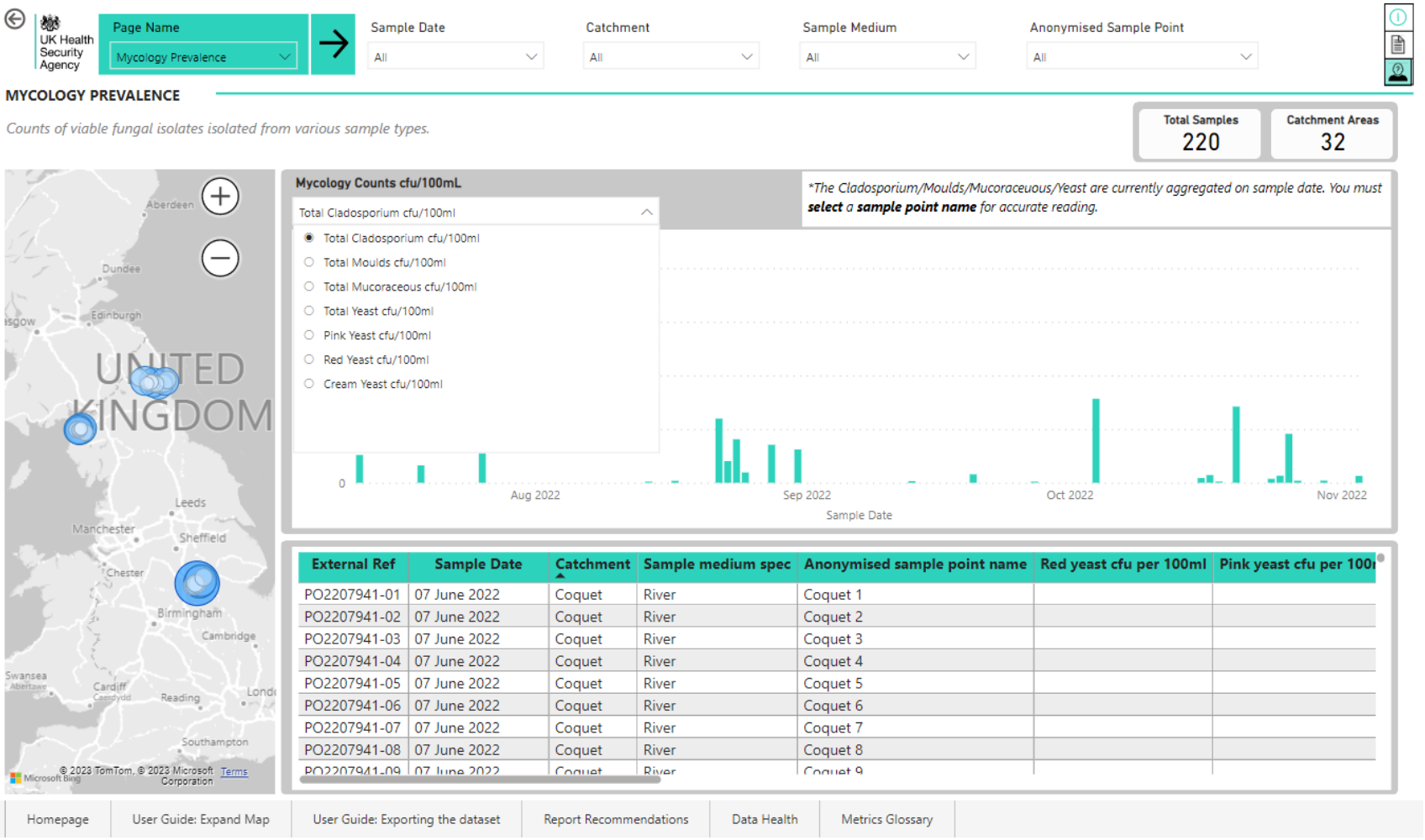
amr-pathsafe	Superkingdom-read-proportion_table_04012023_190000.xlsx	Quadram Institute	Sheet1	PROCESSED	Quadram Institute Taxa superkingdom level		26/04/2
amr-pathsafe	Resistomap_RelativeAbundances_01012023_182000.xlsx	Resistomap	Sheet1	PROCESSED	Resistomap Relative abundance		26/04/2
amr-pathsafe	Resistomap_RelativeAbundances_09052023_121212.xlsx	Resistomap	Sheet1	PROCESSED	Resistomap Relative abundance		24/05/2

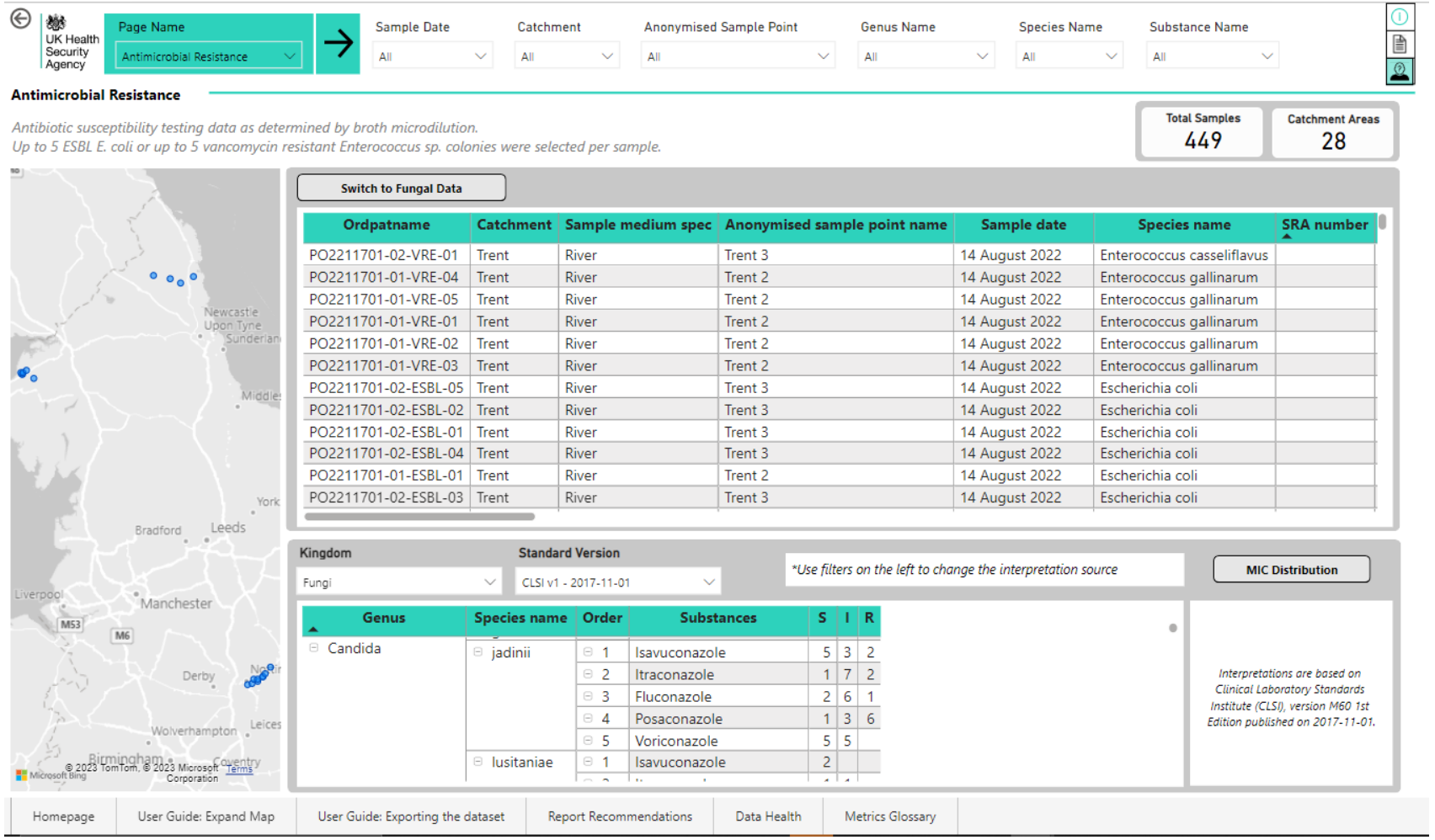
ESS: Bacterial prevalence



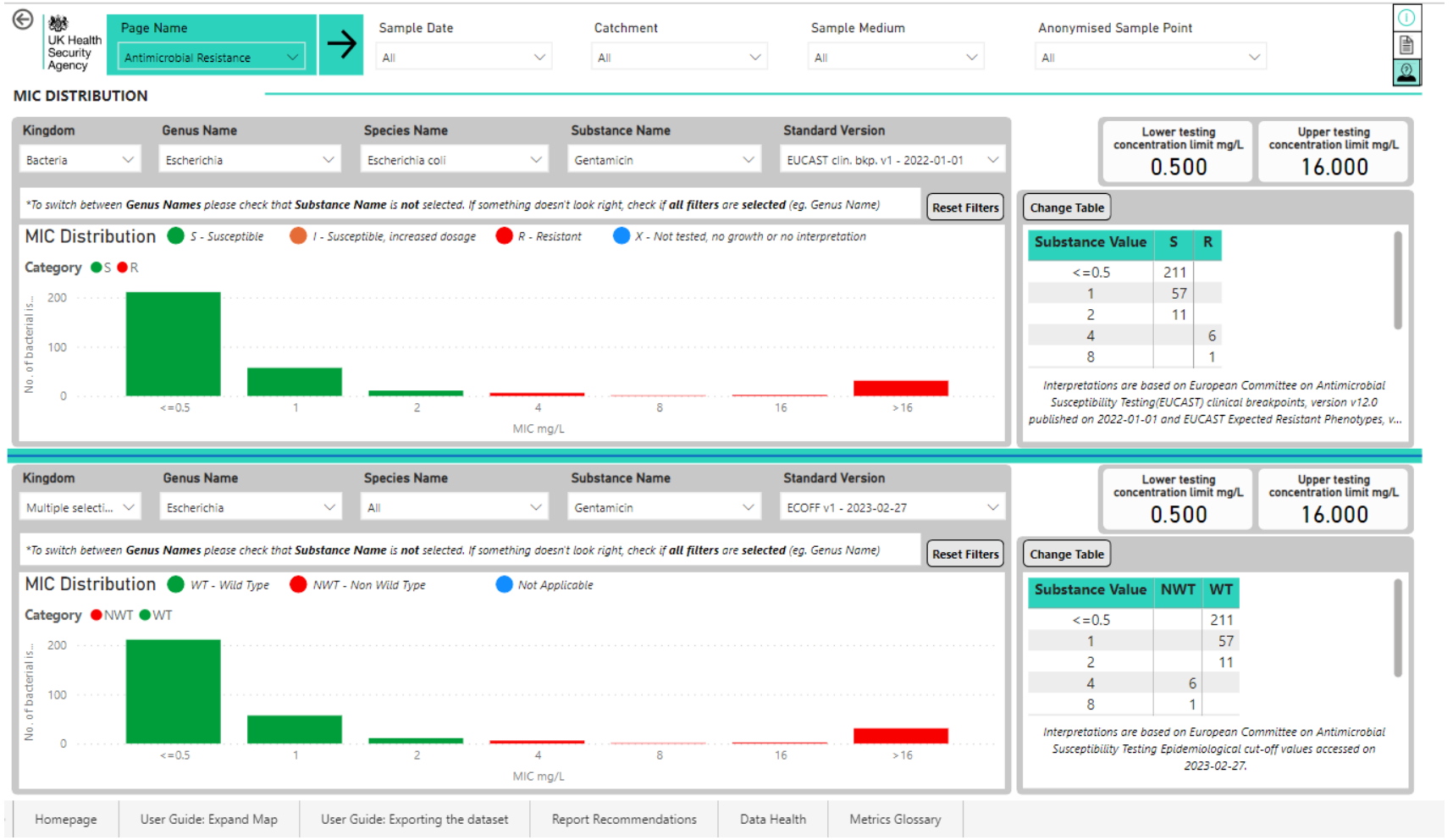
ESS: Mycology prevalence



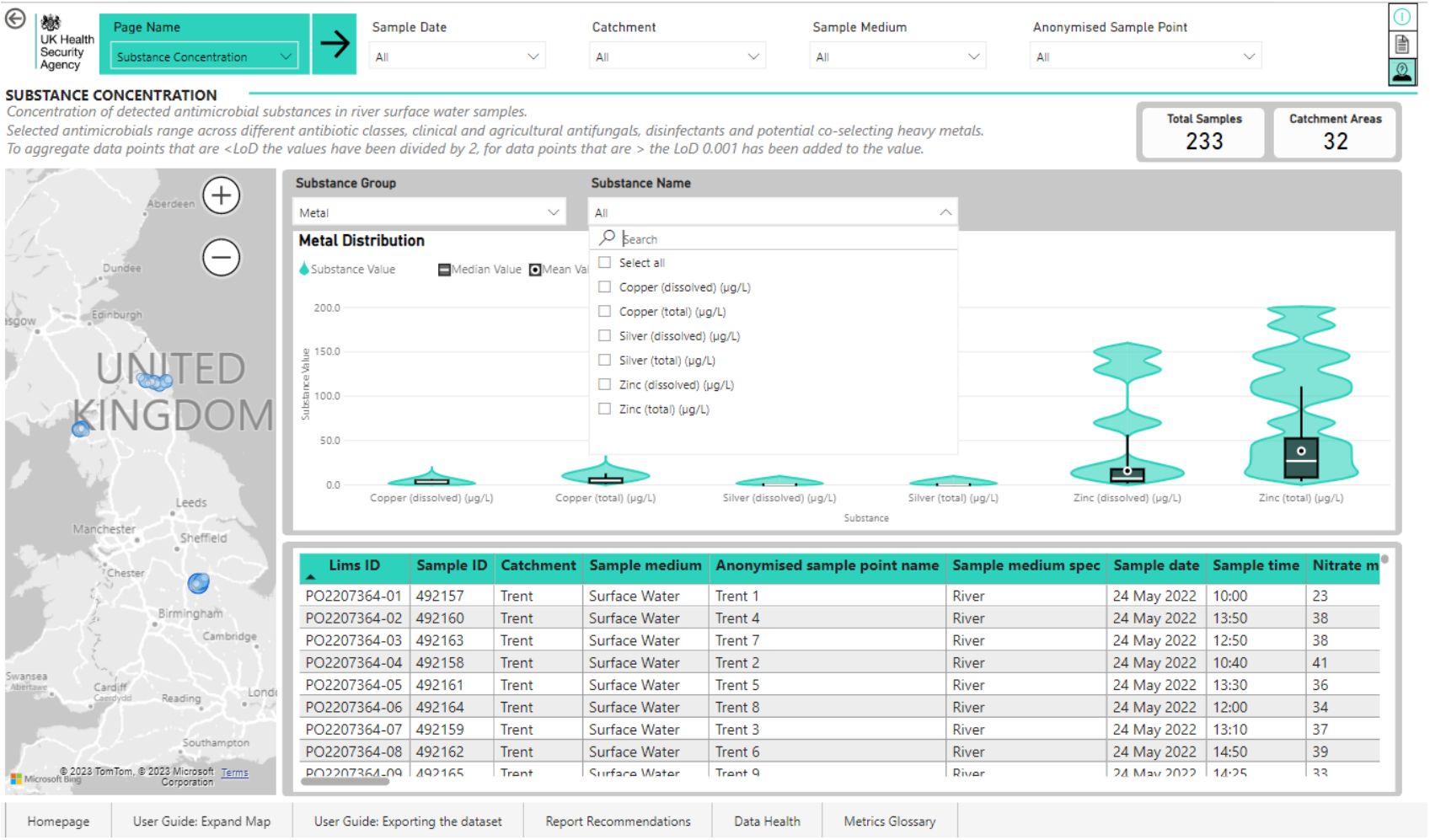
ESS: Antimicrobial resistance



ESS: MIC distribution

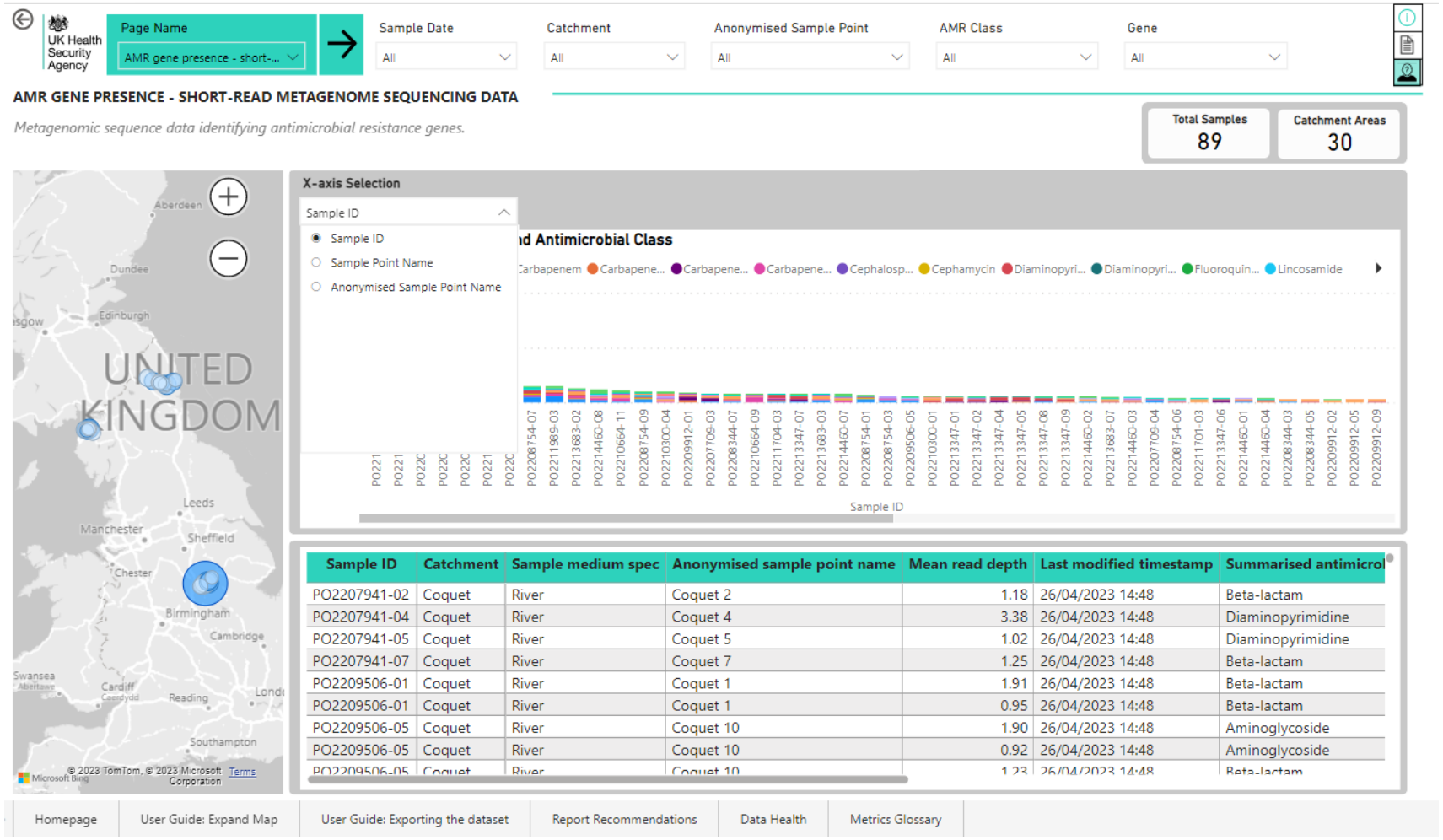


ESS: Substance concentration

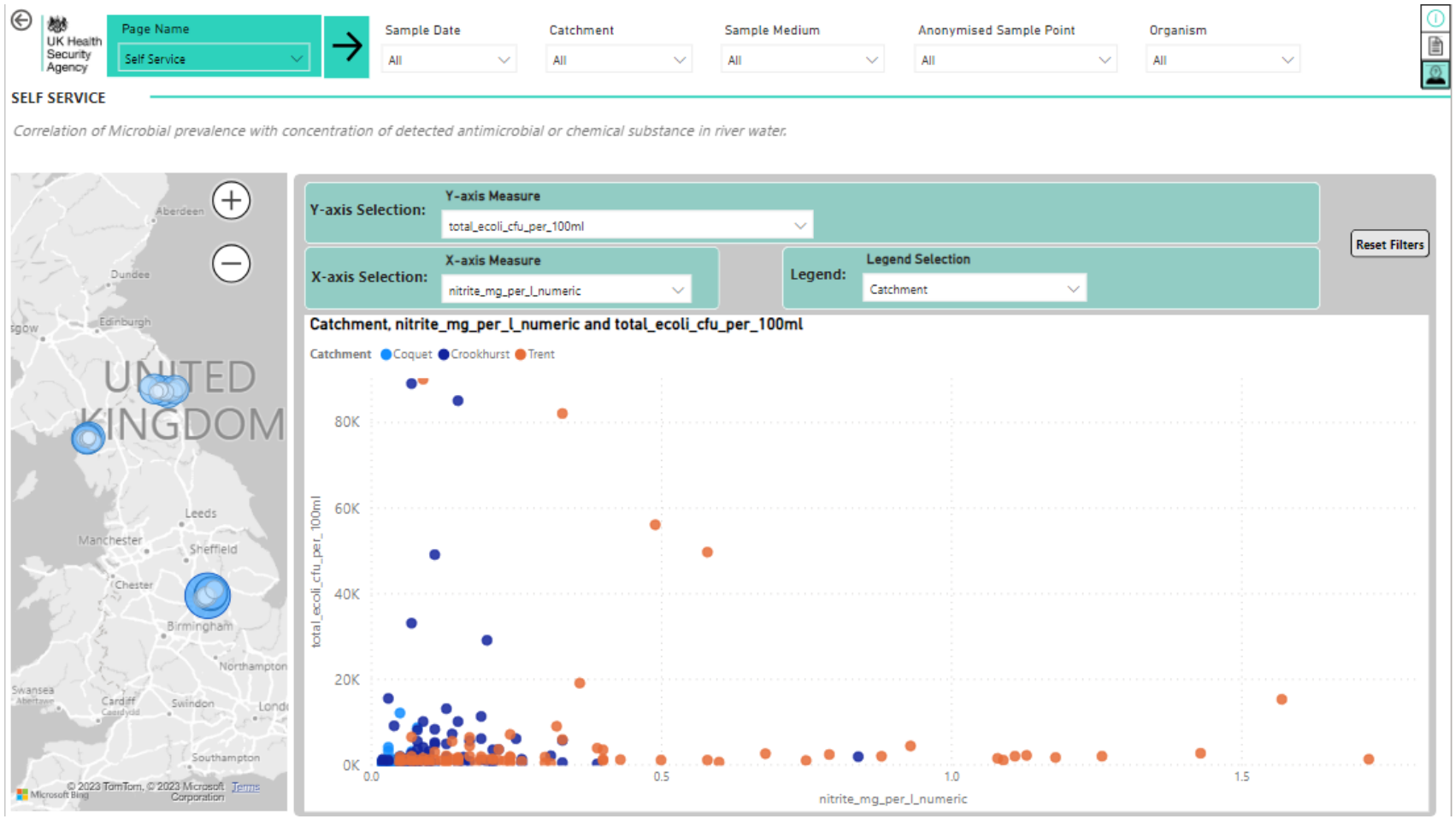


Lims ID	Sample ID	Catchment	Sample medium	Anonymised sample point name	Sample medium spec	Sample date	Sample time	Nitrate m
PO2207364-01	492157	Trent	Surface Water	Trent 1	River	24 May 2022	10:00	23
PO2207364-02	492160	Trent	Surface Water	Trent 4	River	24 May 2022	13:50	38
PO2207364-03	492163	Trent	Surface Water	Trent 7	River	24 May 2022	12:50	38
PO2207364-04	492158	Trent	Surface Water	Trent 2	River	24 May 2022	10:40	41
PO2207364-05	492161	Trent	Surface Water	Trent 5	River	24 May 2022	13:30	36
PO2207364-06	492164	Trent	Surface Water	Trent 8	River	24 May 2022	12:00	34
PO2207364-07	492159	Trent	Surface Water	Trent 3	River	24 May 2022	13:10	37
PO2207364-08	492162	Trent	Surface Water	Trent 6	River	24 May 2022	14:50	39
PO2207364-09	492165	Trent	Surface Water	Trent 9	River	24 May 2022	14:25	33

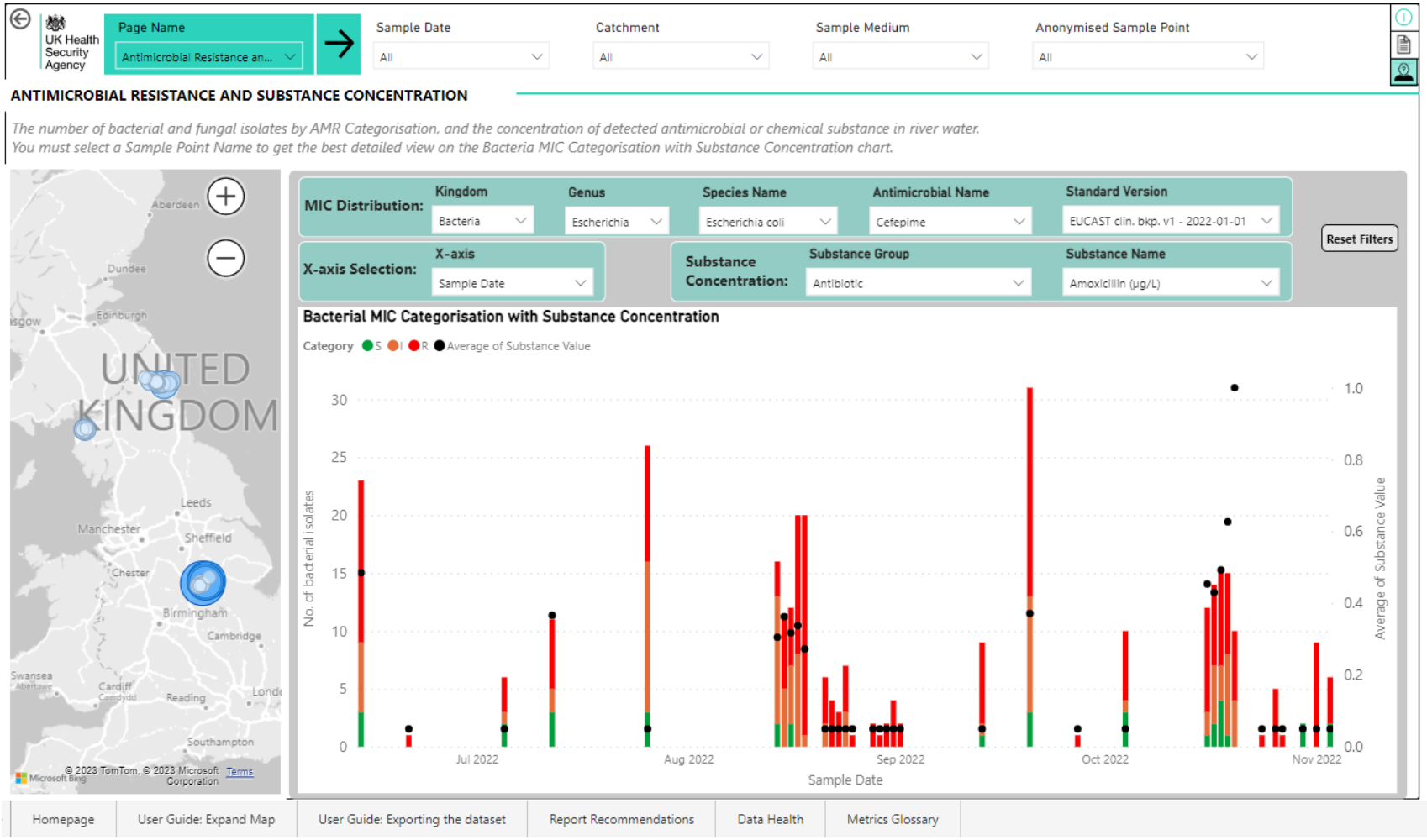
ESS: AMR gene presence



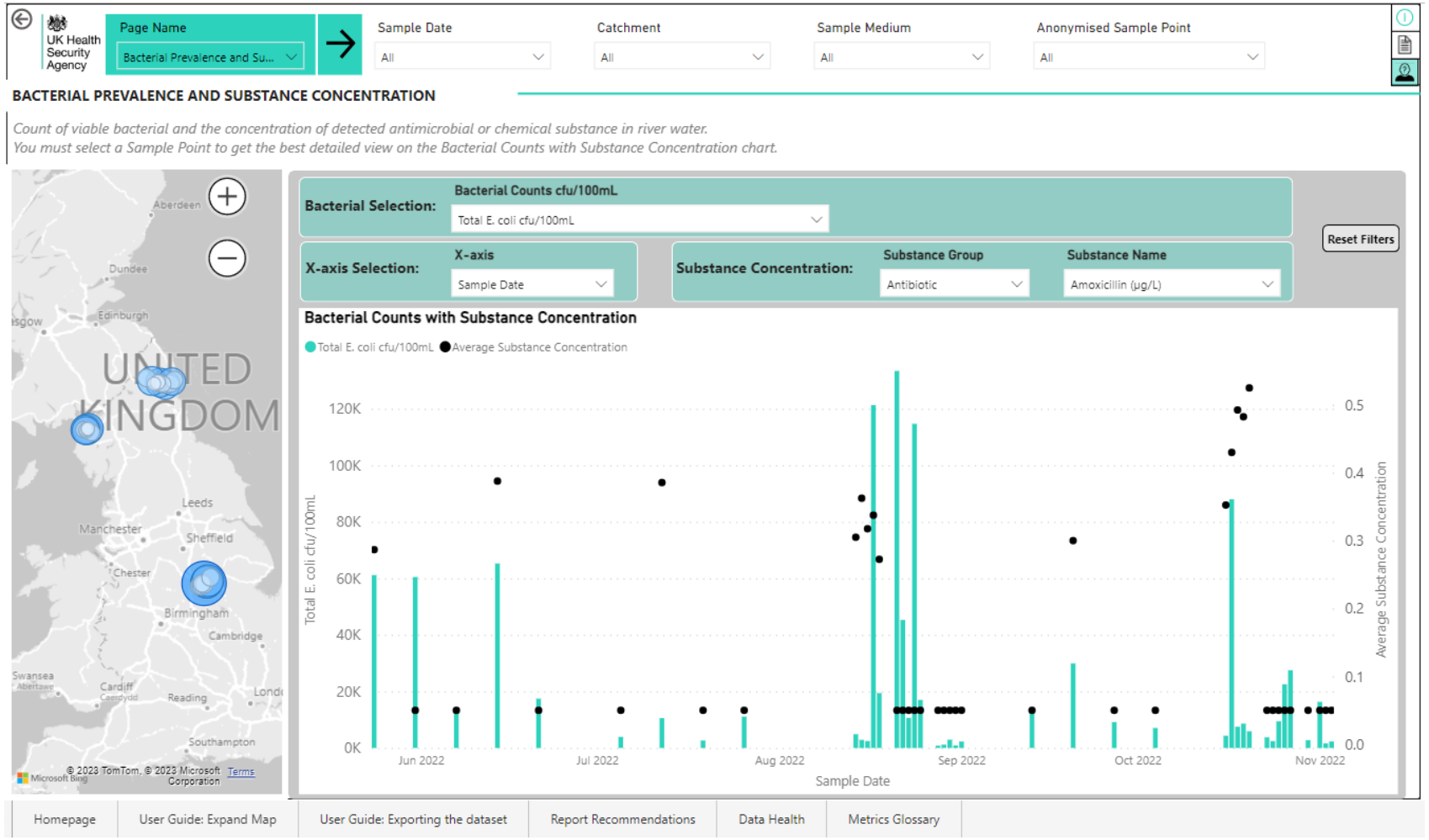
ESS: Self service



ESS: AMR and substance concentration



ESS: Bacterial prevalence and substance concentration



Summary

- We developed recommendations and strategic case for the development of a UK-wide one health surveillance system (OHSS)
- We developed an exemplar for this OHSS based on a proposed solution developed through discovery albeit, with limited scope
- Some learnings from this process are;
  - The choice of visualisation tool can limit desired functionalities
  - Timely availability of data
  - Uncertainty and time for approval process
- A key stakeholder feedback is one health being much more than generating and processing AMR data.
- Future work should focus on what we do with signals identified from the
  - More work and research is needed on how to decide appropriate action

Acknowledgement

- Nicola Rupawala and Russell Hope - UKHSA project team
- Ranjit Puri, Arun Singh, Nicole Advani and Nicholas Dellasanta - Deloitte
- Collet Allen, Katie Hopkins - AMRHAI reference unit
- Elizabeth Johnson - Mycology reference lab
- Caroline Willis - Food, Water and Environmental Laboratory Network
- Wiebke Schmidt, Jono Warren and Alwyn Hart - Environment Agency
- Greg Haden, Stephen Povey, Joana Blankson-Wilson – DEFRA
- Alison Mather and Samuel Bloomfield - Quadram Institute

UK Health Security Agency

Quadram Institute

Department for Environment Food & Rural Affairs

Deloitte.

Environment Agency