Pathogen Surveillance in Agriculture, Food and Environment (PATH-SAFE) Programme

PATH-SAFE is a 4-year, UK wide and cross government programme, led by the FSA and utilising £24m funding from the HMT Shared Outcomes Fund (SOF) and match funding from a range of government and academic delivery partners. The programme is piloting the development of a national surveillance network, using the latest DNA-sequencing technology and environmental sampling, to improve the detection and tracking of foodborne human pathogens and associated AMR through the whole agri-food system from farm-to-fork.

Following the award of 24/25 continuation funding, the programme workstream structure is evolving to a thematic structure. The website will be updated to reflect the new thematic structure in due course.

PATH-SAFE programme background

Foodborne disease (FBD) is a major public health risk with 2.4 million individual illnesses and more than 16,000 hospitalisations per year. Most human disease is caused by a handful of bacteria which enter the food chain from farmed animals or the environment. In addition to FBD, the agri-food supply chain also poses a risk for the transmission of antimicrobial resistance (AMR) through food, animals, humans, and water.

Whilst the UK has made progress in reducing its use of antibiotics in humans and animals in the last five years, drug-resistant bloodstream infections in humans have increased by 32% from 2015 to 2019. The rise and spread of AMR is creating a new generation of ‘superbugs’ that cannot be treated with existing medicines.

For these reasons, government departments already undertake surveillance activities by analysing samples from food, livestock, and humans. Recent advances in technology and data management offer the opportunity to create a step change in surveillance, to protect public health. The PATH-SAFE programme will establish a new data platform that will allow for the analysis, storage and sharing of pathogen sequence and source data, collected from multiple locations across the UK by government departments and public organisations. This single system will enable rapid identification and tracking of FBD and AMR. This will improve public health and minimise the economic and environmental impact of outbreaks.

Aims of the programme

- to pilot a better national surveillance system for the monitoring and tracking of foodborne disease (FBD) and antimicrobial resistance (AMR) in the environment and agri-food system
- to bring together and build on existing initiatives across the UK and to understand what the end-user needs to improve how they work in this space
- to provide better data to identify the prevalence, source and pathways of FBD and AMR, helping to prevent spread by enhanced targeting of interventions

Benefits of the programme

- the information gathered through this pilot will help us to better identify the sources of FBD and AMR
- we expect this pilot will give users better access to relevant data so they can make more informed, evidence-based decisions
- this data can be used to prevent and predict the spread of FBD and AMR by improved, cost-effective targeting of interventions, providing economic savings both for government and industry
- PATH-SAFE will allow us to better identify and react more quickly to emergent diseases (or diseases of increasing concern) through improved surveillance
- this pilot could reduce the number and cost of FBDs and AMR, lower commercial losses, strengthen UK Science Excellence, and enhance the UK food sector's reputation

Programme structure

The FSA is the lead organisation for the programme, with several core and delivery partners. As the programme develops our partnerships and collaborations continue to grow.

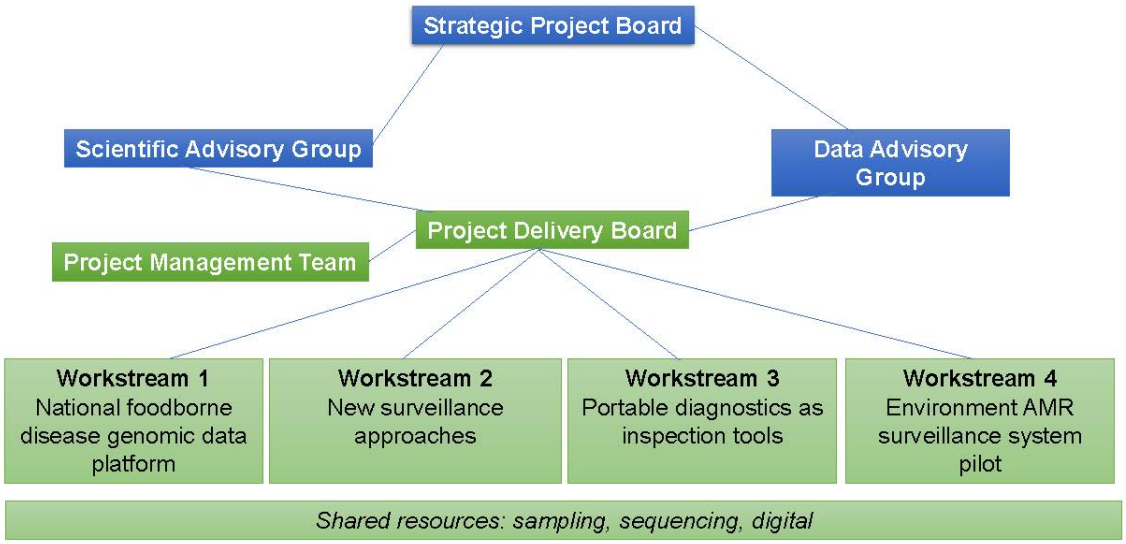
- Food Standards Scotland (FSS)
- Department of Environment, Food and Rural Affairs (Defra)
- Department of Health and Social Care (DHSC)
- UK Health Security Agency (UKHSA)
- Environment Agency (EA)
- Veterinary Medicines Directorate (VMD)
- Animal and Plant Health Agency (APHA)
- Centre for Environment, Fisheries and Aquaculture Science (Cefas)
- Welsh Government
- Scottish Environment Protection Agency (SEPA)
- Bangor University
- University of Oxford
- Queen's University Belfast
- Fera
- Public Health Wales
- Agri-Food & Biosciences Institute (afbi)
- Department of Agriculture, Environment and Rural Affairs (DAERA)
- National Milk Laboratories (NML)
- Capita
- Deloitte
- University of Worcester
- Quadram Institute
- University of Warwick
- Scotland's Rural College (SRUC)
- Moredun
- Aecom
- Cranfield University
- Scottish E.Coli Reference Laboratory
- Scottish Salmonella, Shigella and Clostridium difficile reference laboratory (SSSCDRL)
- Digital Epidemiology Services
- Ausvet

The Strategic Project Board sits at the top of the governance structure and provides strategic oversight to the programme.

Sitting outside this Board, as independent groups, are the Scientific Advisory Group and the Data Advisory Group.

The Project Delivery Board, supported by the FSA Project Management Team, has four different workstreams from which information is fed:

- workstream 1: National foodborne disease genomic data platform
- workstream 2: New surveillance approaches
- workstream 3: Rapid, in-field diagnostic technologies
- workstream 4: Environmental AMR surveillance system pilot



Funding source and timeline

PATH-SAFE is funded via the Shared Outcomes Fund (SOF). Spending Round 2019 announced £200 million for the Shared Outcomes Fund to fund pilot projects to test innovative ways of working across the public sector.

The first round of the SOF funded a wide range of projects to be run in 2020-21 and 2022-23 the Spending Review 2020 announced a further £200 million was to be made available for a second round of the Shared Outcomes Fund between 2021-22 and 2023-24.

The programme successfully secured £19.2m in phase 2 of the SOF, to run until March 2024.

In February 2024 PATH-SAFE successfully secured an additional £4.7m of funding to continue for an additional year (April 2024 to March 2025). HMT SOF are providing £2.2m of the continuation funding, leveraged by £2.5m of match funding from PATH-SAFE government department and academic delivery partners.

Workstream breakdown

All projects were presented at the PATH-SAFE Biosurveillance Conference on 28th and 29th February, in London. For those that were unable to attend the conference in person or online, recordings will be uploaded to the conference webpage.

Workstream 1: National foodborne disease genomic data platform

Part A: The UK is recognised global leader in genomic database systems. We will utilise this existing expertise, working with academic colleagues and major ‘big data’ stakeholders, to create a user-friendly platform for the rapid interrogation and contextualisation of genomic data. A key element of the data platform development will be allowing the integration of sample data with other existing data sources, for example, infection data, to create new knowledge.

Partners include: Digital Epidemiology Services, University of Oxford, University of Warwick, University of Birmingham

Current status: The data platform came online in March. It is now live and ready for use by relevant government organisations. Accompanying training materials have also been provided to support system use. Preparations for development of the platform to incorporate analytics for E.Coli and a second pathogen during the continuation year are underway. A public-facing training environment is currently being considered.

Part B: The aim of the PATH-SAFE Scottish pilot is to use whole genome sequencing (WGS) to understand source attribution, infection threat, and the level of AMR of E. coli. Samples will be taken from a range of different reservoirs in Scotland. This includes animal hosts, bathing water, wastewater, soil/plants, food, and humans.

Partners include: FSS, Cefas, SEPA, Moredun, Scotland's Rural College (SRUC), MicrobesNG, Public Health Scotland, Scottish E. coli Reference Laboratory, Scottish Salmonella, Shigella and Clostridium Difficile reference laboratory (SSSCDRL).

Current status: Final sequencing has completed as planned. Analysis continues with the interim analysis report (covering work to date) and associated publications currently are in preparation.

Workstream 2: New surveillance approaches

Part A: Focusing on Foodborne disease (FBD) in the agri-food environment:

- appraise current surveillance systems by identifying existing environmental data and sampling infrastructure for the detection of FBD pathogens.
- explore whether novel analysis technologies (for example WGS of pathogens from wastewater and shellfish) can improve the accuracy, speed and efficiency of outbreak detection and associated risks.
- use high resolution pilot studies (including wastewater and shellfish sampling) at the river catchment scale to determine the feasibility of scaling up to an improved national surveillance infrastructure.
- some of this work will build on existing networks and infrastructure, such as that already in place for water sampling, including recent UK-wide COVID-19 testing initiatives, as well as new approaches.

Partners include: Cefas, Bangor University, Defra, Arup, Welsh Water, Public Health Wales

Current status: Following two very successful Taw/Torridge sampling periods (Jan-Mar 2023 and Jun-Aug 2023), more than 2800 isolates were recovered and over 1200 isolates selected and sequenced. ‘Norovirus quantification in UKHSA COVID-19 archived wastewater samples’ analysis completed and journal article submitted to Water Research. ‘Salmonella in Scottish wastewater’ sequences uploaded to NCBI and processed through Scottish Salmonella Reference Lab bioinformatic pipelines. Welsh pilot sample collection complete, manuscripts being drafted and metagenome sequences to be submitted to ENA. Northern Ireland historical Listeria isolates successfully sequencing. Final reports and publications developed and submitted. Preparations underway to transition the work within the project into 24/25 continuation.

Part B: Focusing on antimicrobial resistance (AMR) surveillance in the agri-food environment, a number of projects will support this work:

- Characterisation of AMR E. Coli from raw meat to identify resistance genes and circulating plasmids.
- AMR surveillance sheep abattoir survey, including abattoir environment and wastewater AMR surveillance pilot.
- AMR surveillance in cattle abattoir survey.
- AMR targets in bulk milk samples from dairy herds across Great Britain (GB).
- AMR in imported animal feed.
- AMR in imported raw pet food discovery work (scoping).

Partners include: VMD, APHA, Cefas, National Milk Records (NMR), FSA, Welsh Government, AFBI, Scotland's Rural College (SRUC).

Current status: Sampling successfully concluded, sample analysis is complete and final analyses and report writing progressing well. Results communication and publication plans developed and reviewed, ahead of implementation over the coming months. Preparations underway to transition these six projects into three 24/25 continuation projects.

The September PATH-SAFE webinar focused on the bulk milk and animal feed projects, including the perspectives of the industry partners whose involvement has made this work possible. The recording of the webinar can be found in the 'past webinars and resources' section on this website.

Part C: Utilise the infrastructure developed for NI SARS-CoV-2 wastewater surveillance programme and undertake building level wastewater monitoring to investigate prevalence of a foodborne disease, norovirus, and antimicrobial resistance within the NI care home setting.

Partners include: DAERA, Queen’s University Belfast, Department of Health (Northern Ireland), Public Health Agency (Northern Ireland), Northern Ireland Environment Agency, Department for Infrastructure (Northern Ireland), Northern Ireland Water.

Current status: Air and wastewater sampling have progressed well at nursing home and control site, with high throughput culturing of both sample types undertaken and minimum inhibitory concentration determined for 16 antibiotics. Sample collection winding down to ensure end of March milestones met. Solubilities of the individual antibiotics and antifungals were determined, and mass spectrometry controls and standards prepared. Qualitative questionnaire aspect of the project, reaching final stages. Analysis of shotgun metagenomic data from wastewater and air samples being finalised and whole genome sequencing of pure culture isolates showing antibiotic resistance underway.

The six aspects of this project completed successfully:

- Product 1. Screening for the presence of Norovirus at six wastewater treatment sites across Northern Ireland
- Product 2. Foodborne and respiratory pathogens in the Nursing Home setting
- Product 3. AMR in Care Homes
- Product 4. AMR genotype versus phenotype

- Product 5. Qualitative assessment of stakeholder views and knowledge on AMR and antibiotic prescribing

- Product 6. Modelling of pathogen spread within care home.

The final report has been written, and associated publications are being prepared. Work already underway to expand and build upon this work, as part the 24/25 continuation.

Part D: This project will utilise existing sample sets and data to investigate source and transmission dynamics of food borne disease (FBD) caused by Campylobacter, including investigation of the spread of antimicrobial resistance (AMR) through Agri-Food systems.

Partners include: University of Oxford, Quadrum Institute

Current status: The interim analysis report (covering work to date) and associated publications are currently in preparation. Some analyses have been delayed due to technical issues with whole genome sequencing of final isolates. Analyses on isolates sequenced so far will be completed as soon as the data is available. Data continues to be made available on PubMLST as it is reviewed and analysis continues.

Part E: Whole Genome Sequencing of historical Salmonella isolates, to generate background data on the genomic diversity of foodborne pathogens in the UK.

Partners include: AFBI

Current status: Phase 1 (WS2e): Sequencing Project Complete 31/03/2023 – during February and March 2023 AFBI successfully processed 100 historical salmonella isolates (culture, extraction and sequencing), and uploaded the sequences to Enterobase.? PATH-SAFE has been noted in comment field on uploaded sequences in Enterobase to allow identification.

Phase 2: (WS2e.1): Bioinformatic analysis of sequences, including data visualisation and report writing, completed March 2024.

(WS2e.2): Sequencing Project Complete 07/12/2023 - A further 200 historical isolates, 152 salmonella and 48 listeria, have been processed (culture, extraction and sequencing); Salmonella sequences uploaded to Enterobase (with PATH-SAFE_23_24 noted in the comment field) and Listeria sequencing uploaded to SRA (Study noted as PATH-SADE 2023/24, BioProject PRJNA1049374).

Workstream 3: Rapid, in-field diagnostic technologies

Part A: Investigate the technology readiness levels (TRLs) of in-field FBD and AMR diagnostic technologies. This includes horizon scanning, stage of development and end-user needs. The results of these investigations will inform options for the next stages of in-field testing. The co-design of applications with end-users will be critical to ensure real-world applicability.

Partners include: Fera, University of Lincoln

Current status: Onsite testing by end users successfully conducted and concluded (Port Health Authority tested multiple sesame seed shipments for Salmonella and both an agronomist and a farmer tested irrigation water for E. coli). Analysis of test results and end user feedback completed, and final report submitted. Preparations underway to further build on his work, as part of the 24/25 continuation.

Part B: The key aim of this activity is to repurpose rapid, in-field wastewater diagnostic technology that was developed in response to the COVID-19 pandemic for detection of FBD. This workstream will aim to demonstrate its viability, economic value, and versatility in one or more agri-food settings.

Partners include: UKHSA

Current status: Project Complete 31/03/2023 - 20/30 Labs completed the proof of concept and optimisation work on utilising?LAMP on 7 target pathogen - Salmonella spp, Listeria monocytogenes, Norovirus, adenovirus, astrovirus, rotavirus and sapovirus.? The final report is undergoing the last stages of review and will be made available in due course.

Workstream 4: Environment AMR surveillance system pilot

The overall aim of this workstream is to create a scientific and evidence-based understanding of the nature and extent of AMR in the environment and the drivers that influence this. This pilot will deliver an agreed and tested methodology for environmental AMR surveillance. This will include an environmental IT platform that will enable a scaled-up surveillance programme to be undertaken. This IT platform will be designed and developed so that it will have the capability to integrate AMR surveillance data collected from humans and animals. The overall ambition is to establish a UK One Health surveillance system for AMR.

Partners include: EA, VMD, Defra, UKHSA, Deloitte, Quadram Institute, Aecom, Cranfield University, University of Exeter, UK Centre for Ecology and Hydrology, Ausvet.

Current status: This workstream is complete. Final reports from the projects continue to come in. See the Outputs section of the website for reports published to date.??

Evaluation

Synthesis and write up is underway for the draft final evaluation report, which will include the final process and outcome evaluation. This will shortly be followed by the addition of the impact feasibility assessment, with a complete final report expected in June 2024.

PATH-SAFE Biosurveillance Conference

On Wednesday 28 and Thursday 29 February 2024, a two-day PATH-SAFE Biosurveillance Conference was held in London. The aim of the conference was to facilitate knowledge exchange within the biosurveillance community, by showcase the biosurveillance work that has been undertaken within the PATH-SAFE programme initiatives, whilst and also creating an opportunity for people to connect and expand their professional networks.

You can access further information, including the presentation recordings on the PATH-SAFE Biosurveillance Conference page.

PATH-SAFE webinar series

PATH-SAFE has started a series of webinar events which will be continuing now until the end of the programme (March 2024). The webinars will showcase results from the programme, as well as invited speakers to discuss topics relevant to programme partners. If you have not already received an invite but would like to attend, please contact pathsafe@food.gov.uk.

Please see below for details of past and upcoming events and links to recordings and presentations we are able to share.

Calendar of webinar events

Please see below for details of upcoming webinars:

Information on future webinars will be added in due course.

Past webinars and resources

15 March 2023 - "Understanding source attribution, infection threat and level of AMR of E. coli in Scotland using whole genome sequencing". Dr Adriana Vallejo-Trujillo (Research Fellow, Food Standards Scotland).

Please note the following resources are not accessible. If you require an accessible alternative please contact fsa.communications@food.gov.uk.

Slides from the 15 March 2023 meeting

PDF
View PATH-SAFE FSS Scottish Pilot - ws1b slides as PDF(Open in a new window) (3.53 MB)

Recording of the 15 March 2023 meeting

27 April 2023 - Genomic epidemiology of foodborne pathogens and antimicrobial resistance - A talk from Professor Alison Mather

Unfortunately, due to the sensitivity of content, we are unable to share a recording or slides.

18 May 2023 - PATH-SAFE and The Food Safety Research Network Showcase

Please note the following resources are not accessible. If you require an accessible alternative, please contact fsa.communications@food.gov.uk.

Slides from the 18 May 2023 meeting

PDF
View PATH-SAFE and The Food Safety Research Network Showcase as PDF(Open in a new window) (12.19 MB)

Recording of the 18 May 2023 meeting

Please note due to a technical issue it was not possible to record this webinar.

15 June 2023 - Rapid diagnostic technologies for Foodborne Pathogens

Please note the following resources are not accessible. If you require an accessible alternative, please contact fsa.communications@food.gov.uk.

Slides from the 15 June 2023 meeting

PDF
View Rapid diagnostic technologies for Foodborne Pathogens as PDF(Open in a new window) (873.37 KB)

Recording of the 15 June 2023 meeting

13 July 2023 - 'First steps towards an environmental surveillance system for Antimicrobial Resistance (AMR) in England'

Unfortunately, due to the sensitivity of content, we are unable to share a recording or slides.

25 September 2023 - AMR Surveillance Pilots: Dairy Cattle and Animal Feed Surveys webinar slides

Slides from the 25 September 2023 meeting

PDF
View AMR Surveillance Pilots: Dairy Cattle and Animal Feed Surveys webinar slides as PDF(Open in a new window) (3.84 MB)

Recording of the 25 September 2023 meeting

17 October 2023 - PATH-SAFE Process Evaluation

Please note the following resources are not accessible. If you require an accessible alternative, please contactfsa.communications@food.gov.uk.

Slides from the 17 October 2023 meeting

PDF
View PATH-SAFE Process Evaluation webinar slides as PDF(Open in a new window) (634.98 KB)

Recording of the 17 October 2023 meeting

9 November 2023 - Genomics of Animal and Plant Health Disease Centre II (GAP-DC2)

Unfortunately, due to the sensitivity of content, we are unable to share a recording or slides.

17 January 2024 - Genomics of antimicrobial resistant Campylobacter transmission through UK Agri-Food systems

Please note the following resources are not accessible. If you require an accessible alternative, please contact fsa.communications@food.gov.uk.

Slides from the 17 January 2024 meeting

PDF
View PATH-SAFE - Genomics of antimicrobial resistant Campylobacter transmission through UK Agri-Food systems - slides as PDF(Open in a new window) (2.03 MB)

Recording of the 17 January 2024 meeting

Outputs and publications

Below are links to outputs and publications following programme activities. This section will be regularly updated as new publications become available.

WS4 - Scoping review into environmental selection for antifungal resistance and testing methodology. Published on 22 July 2022. This reviews the current understanding of the mechanism for selection for antifungal resistance in fungal species following exposure to antifungals.

WS4 - Antimicrobial resistance surveillance pilot site selection and database extension. Published on 22 July 2022. This project developed selection criteria to identify suitable river catchments for piloting a surveillance programme for environmental antimicrobial resistance.

WS4 - Sampling strategy and assessment options for environmental antimicrobial resistance in airborne microorganisms. Published on 22 July 2022. Reviews the available sampling options for antimicrobial resistant microorganisms, including their antimicrobial resistance genes, from the atmosphere.

WS4 - Antifungal medicines in the terrestrial environment: Levels in biosolids from England and Wales. Published 02 February 2023. Clinical antifungals found in biosolids at treatment centres in England and Wales. Over-the-counter items including ketoconazole and miconazole were most prevalent. Substances introduced at levels that may induce selection pressure for resistance.

WS4 - Environmental surveillance of AMR, perspectives. Published 30 March 2023. A perspective paper on AMR environmental surveillance.

PATH-SAFE Evaluation Framework report. Published 31 July 2023. This report sets out the evaluation framework that will be used to guide the evaluation of the Pathogen Surveillance in Agriculture, Food and Environment (PATH-SAFE) programme.

Five reports on environmental AMR surveillance, all funded by PATH-SAFE workstream 4 were published on October 26, 2023.

Environmental antimicrobial resistance: A review of biological methods

Antimicrobial resistance surveillance strategies within wild flora and fauna of England

Shellfish as bioindicator for coastal antimicrobial resistance

A review of approaches to monitoring and surveillance of antimicrobial resistance in bathing waters

Antimicrobial resistance in bioaerosols: towards a national surveillance strategy

More information

For more information and updates on the PATH-SAFE programme, read the latest PATH-SAFE newsletter.

PATH-SAFE newsletter March 2024

PATH-SAFE newsletter December 2023

PATH-safe newsletter September 2023

PATH-safe newsletter June 2023

PATH safe newsletter March 2023

PDF
View PATH-SAFE newsletter, January 2023 as PDF(Open in a new window) (273.2 KB)

Get in touch

If you would like to get in touch with the PATH-safe team, you can email them at pathsafe@food.gov.uk