Foodborne Disease Policy Overview

FSA 24-03-06 - Report by Rebecca Sudworth.

1. Summary

1.1. This paper provides an overview of foodborne disease (FBD) in the UK and how the FSA and others throughout the food chain are mitigating the associated risks. The paper also identifies some of the challenges the FSA faces and the actions being taken to address them. While the Board receives quarterly updates on FBD prevalence through the Business Committee, a detailed progress report on our approach has not been discussed with the Board for some time.

The Board is asked to:

- **Note** the current profile of FBD.
- **Note** the next steps including the proposals on updated threshold levels.
- **Comment** on our overall approach for tackling FBD.

2. Introduction

2.1. The widespread presence of pathogens in our environment and their potential impact on our health means there are inherent risks in the food system – from production to consumption. As both the food system and external factors that may impact on FBD evolve, including the challenges presented by climate change and food insecurity, our mitigations need to evolve with them.

2.2. All players in the food system need to take steps to mitigate the risks of FBD, from action on farms, manufacturers, and retailers, to how we behave as consumers in our homes. The FSA has a statutory role in this process. Under our general powers the FSA monitors rates of FBD; develops policy and provides advice to Ministers on mitigation; and issues advice and guidance to local authorities on the control of FBD.

2.3. One of the challenges of FBD is understanding when and how to intervene and the causal effect of our interventions. All the work of a very careful supply chain can be undone by poor handling in the domestic kitchen; equally, incorrect management in the supply chain can lead to problems even though the consumer may have impeccable food hygiene practices. The FSA aims to ensure proportionality in its approach, finding the right balance between food safety risk and consumer choice.

2.4. Our approach to mitigating the risks is threefold:

- **Horizon scan**: Monitor data and intelligence from a wide range of sources to identify and address new threats, and opportunities to take further action.
- **Continuous improvement**: Maintain the wide range of controls and guidance in place across the FSA, reacting to situations when they arise, using the latest evidence to understand root causes and to update controls and advice to consumers and businesses, accordingly; and
- **Thresholds**: Monitor the rates of FBD against the agreed threshold levels and be ready to take further targeted action if needed.

2.5. It is estimated that annually there are 2.4 million cases of illness due to pathogens associated with FBD. Of these, an estimated 16,400 cases receive hospital treatment and 180 result in death, costing UK society an estimated £10.4 billion. The current FSA Infectious Intestinal Disease study 'IID3' is underway, and these estimates will be updated when this is completed (further detail on the IID studies is available in **Annex A**).

2.6. These figures are indicative of the societal impact, including tragic loss of life. However, pathogenic microorganisms are part of the natural environment and present an inherent risk in food. It is important to remember that not all cases of disease by these pathogens are acquired through food. For example, while norovirus is estimated to cause the greatest proportion of illness, the majority of these cases are due to transmission through person-person contact. Therefore, while elimination of pathogenic microorganisms leading to FBD is not realistic, we need to ensure that the activities that the FSA and others in the food system take are proportionate and effective at mitigating the risks and preventing illness.

2.7. The FBD estimates reflect illness prevalence even with the current mitigations and controls. The UK has an increasingly aging population, who are generally more susceptible to certain FBD and, if infected, are more likely to develop severe symptoms. However, we have not seen an increase in prevalence across any of the key pathogens. Refer to **Annex A** for how trends in the UK compare with other countries.

Our FBD approach

3. Horizon scan

3.1. The first of our mitigation approaches, as set out above, is horizon scanning to identify new threats and risk management opportunities. The FSA works with others such as the UK Health Security Agency (UKHSA) to monitor data and evidence from a wide range of sources to identify whether there are food safety problems that need our intervention to mitigate the risks of FBD to consumers and businesses. Our approach has evolved from big-scale action on individual pathogens, such as the Campylobacter Reduction Programme (**Annex B**), to include more intelligence-led and responsive action as threats and risks emerge, such as our response to high levels of Listeria monocytogenes detected in enoki mushrooms imported into the UK (further information on Listeria monocytogenes can be found in **Annex C**). Although there were no reported outbreaks linked to this source in the UK, there were cases including fatalities reported in other countries. The FSA issued advice to vulnerable consumers to thoroughly cook enoki mushrooms and follow good food hygiene practices to avoid the risk of listeriosis. Local authorities and industry were also informed.

3.2. One of the priorities for the FSA's science programme is identifying the impacts of foodborne pathogens and how we can reduce them to inform our FBD policy decisions and how we prioritise the focus of our work. One example is our response and actions to mitigate the risk of cold smoked fish to vulnerable consumers due to Listeria monocytogenes contamination.

3.3. Prompted by an outbreak of listeriosis associated with smoked fish, FSA in collaboration with Food Standards Scotland (FSS) and UKHSA launched an investigation to identify the source of the outbreak. In the interim, FSA and FSS collaborated to review the existing consumer advice on this food commodity to identify where it needed to be improved. Gathering information and evidence from our science, social sciences and economics teams, external stakeholder feedback, and in consultation with other government departments, we published updated consumer advice on cold smoked fish. The revised advice better reflects the risk to vulnerable consumers and our commitment to provide proportionate, evidence-based information to consumers to enable them to make informed decisions about their food. Additional examples of recently completed projects are summarised in **Annex A** (Table 3).

3.4. As a result of recent Listeria monocytogenes outbreaks further work has been initiated to explore strain-specific differences which could affect foodborne transmissibility, dose-response relationship, and resistance. An Advisory Committee on the Microbiological Safety of Food (ACMSF) working group is currently being assembled to focus on L. monocytogenes strains. The working group will develop recommendations for how strain-specific information can best be incorporated into future risk assessments and technical advice to inform policy decisions and identify priorities for future research. Additional examples of current ongoing projects are summarised in **Annex A** (Table 2).

4. Continuous improvement

4.1. The second part of our risk mitigation strategy relates to the controls and guidance in place and their ongoing maintenance and improvement.

4.2. The food system is complex, and it is not always possible to disentangle the impact that each individual player has along the food chain. Often multiple levels of controls work together to manage FBD; the controls operate together to provide what could be considered the 'three lines of defence':

a) The actions of food business operators

b) The direct inspection by FSA operations teams and local authority officers

c) The FSA checking the overall health of the system.

4.3. At the end of a complex food chain, which includes several levels of checks and safeguards, is the consumer. Many of the precautions and activities undertaken to ensure that food arrives safely to the consumer can be undermined if consumers do not understand or participate in keeping food safe. For this reason, the FSA continually reviews and develops our consumer advice on food hygiene, food poisoning and food safety, which aims to reduce domestic cases of FBD.

4.4. As part of reviewing and improving existing practices, we are also exploring the interface between FBD controls and contributions to healthy food and sustainability policies. Examples of these policies include the impact on food waste reduction strategies and support for consumer choice when food insecurity is a factor in decision-making. For example, over the past year, we developed consumer guidance that ranges from how to maintain food safety during a power outage to how to safely forage for foods outdoors. This guidance was developed in response to consumer interest and practices that were detected by our monthly Consumer Insights Tracker survey.

4.5. Enhancement of existing controls is also reliant on advances in science and technology, for example: whole genome sequencing (WGS). WGS is being used to improve routine surveillance and outbreak investigations resulting in more cases of illness being linked and outbreaks being detected earlier than previously possible. WGS can also help identify the source of the contamination meaning that effective control measures can be put in place to prevent any further cases of illness. The PATH-SAFE programme, a consortium of 30+ partners led by the FSA uses the latest DNA-sequencing technology and environmental sampling to improve the detection and tracking of FBD and antimicrobial resistance.

4.6. Since the thresholds were set (see below), the application of WGS has significantly increased. Outbreak source attribution has improved significantly as a result, but it has increased the workload and need for higher numbers of detailed food chain analysis to be performed to enable the identification of the causal food sources. To complement WGS, UKHSA's development of descriptive epidemiological analysis has given rise to improved identification of the contaminated food sources and causes of the FBD. The FSA, along with UKHSA, are

considering how our organisations can make best use of these scientific developments to help develop triggers for response and prioritisation for operational response to the clusters of most concern, when detection rates are continuously increasing.

4.7. Refer to **Annex D** for further details of the controls.

5. Thresholds

5.1. The final element of our risk mitigation strategy is the monitoring of levels of FBD for the key pathogens and a system of thresholds to trigger action if disease levels rise significantly. The FSA monitors confirmed laboratory reports for Campylobacter, Salmonella, E. coli O157 and Listeria monocytogenes. Trends up to 2022 can be found in our latest Consolidated Annual Report of Accounts (2022-23 FSA Consolidated Annual Report and Accounts – see page 42 and 43).

5.2. These four key pathogens are monitored regularly as most cases of illness associated with these pathogens are food related (although not all) and are either responsible for a high number of cases of illness or are likely to cause more severe symptoms.

5.3. In June 2018, the FSA Business Committee agreed a set of thresholds for the four main foodborne pathogens.[3] These were set based on analysis of confirmed lab reports from 2001 to 2017. It was further agreed that due to the complexity of trends there was a need to be flexible in the scope of the policy action that may be taken so whilst the first step will always be investigating the reason behind the increase, the most appropriate response may vary in different scenarios. This balances the FSA's ambition to drive reduction in FBD whilst acknowledging the inherent volatilities in the data, and some factors being outside the FSA's direct control.

5.4. Advances in sampling approaches means that the monitoring and the thresholds need to evolve accordingly. For example, for Campylobacter and Salmonella, the FSA had previously only been able to include faecal samples in the confirmed laboratory reports. However, since 2022 we have access to other sample results e.g. blood and urine through UKHSA. While including these makes relatively little difference for Campylobacter, for Salmonella it has led to a notable increase in the number of cases identified and rates in the last couple of years have exceeded the threshold previously set. The thresholds are currently being reassessed. This will include analysis using data from the four UK surveillance bodies – UKHSA, Public Health Wales (PHW), Public Health Agency for Northern Ireland (PHANI) and Public Health Scotland (PHS) – to help us understand the trends and impact of changes in the ways of reporting. We will return to the Board to present the recommended changes to the thresholds later this year.

5.5. Our focus and priorities are driven by evidence and data from our partners at UKHSA, PHW, PHANI and PHS. When intelligence is received, or thresholds are breached, we will take the steps outlined above to develop interventions tailored to the specific situation. We will evaluate and analyse the information available and recommend the appropriate actions to be taken.

5.6. A trigger levels toolkit (**Annex E**) is established and sets out the process for investigating and/or developing a risk reduction action plan at pace in the event of a significant increase in human case figures or a breach of the thresholds.

6. Conclusions and next steps

6.1. The three mitigation elements:

- **Horizon scan**: Our FBD priorities have evolved from large-scale strategies on individual pathogens to a more intelligence-led and responsive approach. We will continue to monitor

data and intelligence from a wide range of sources to identify and address new threats, and opportunities to take further action.
- **Continuous improvement**: Multiple levels of controls and guidance work together to manage FBD; the controls operate together to provide the 'three lines of defence'. We will continue to maintain and update the controls and guidance based on latest evidence, reacting to situations when they arise. In parallel, working with UKHSA and other government departments, the FSA will continue to develop national capabilities in surveillance and WGS.
- **Thresholds**: Continue to monitor the rates of FBD. Due to changes in reporting the thresholds are being reassessed and we will come back to the Board prior to implementing any changes that might be needed.

6.2. The Board is asked to:

- **Note** the current profile of FBD.
- **Note** the next steps including the proposals on updated threshold levels.
- **Comment** on our overall approach for tackling FBD.

Annex A – Science, Evidence and Research

1. How much foodborne disease is there in the UK, and how do we measure it?

The FSA produces estimates of foodborne disease (FBD) cases, GP presentations, hospital admissions and deaths for 13 pathogens (based on those included in the IID1 and IID2 studies) plus an overall total which includes estimates for unknown pathogens (the latter make up around 60% of all cases (footnote 1)). We estimate that annually there are 2.4 million cases (footnote 2) (footnote 3), 222,000 GP presentations, 16,400 (footnote 4). Norovirus is responsible for the largest number of cases per year (383,000), followed by *Campylobacter* (299,000). Estimates for all 13 pathogens can be found in Foodborne Disease Estimates for UK.

These figures are estimates to account for under-reporting and under-diagnosis. For this reason, the UK, like many countries, uses mathematical models to produce estimates of foodborne disease based on large scale research studies. In the UK these are the Study of Infectious Intestinal Disease in England (IID1 study) (footnote 5), the second study of infectious intestinal disease in the community (IID2 study) (footnote 6) and the associated costed extensions to the IID2 study (IID2 extension) (footnote 7)). These studies occur approximately every 10 years. The third study of infectious intestinal disease in the community is currently underway and due to report in 2027. Once that dataset is available, we will be able to update both overall estimates and estimates for individual pathogens. In the interim, we are using and updating data from 2012.

2. How much does FBD cost society?

We estimate the total cost of foodborne illness (footnote 8) at a £10.4bn per year (2022 prices); with £6.9bn associated with cases where the pathogen was unknown. For those cases where the pathogen was known, Norovirus imposes the greatest societal burden at an estimated annual cost of £1.9bn, followed by *Campylobacter* (£817.8m) and *Salmonella* (£244.5m); while *E. coli* O157 (footnote 9) (£4.7m) and *Cryptosporidium* (£2.5m) impose the lowest societal cost.

Table 1. Total cost by pathogen

Pathogen	Total Cost by pathogen £(m)*

Bacteria	
Campylobacter	£817.8
Salmonella	£244.5
Clostridium perfringens	£116.2
Listeria monocytogenes	£42.8
Shigella	£14.0
E.coli O157	£4.7
Parasites	
Giardia	£85.2
Cryptosporidium	£2.5
Virus	
Norovirus	£1,908.0
Sapovirus (SRSV)	£193.4
Adenovirus	£55.7
Astrovirus	£11.4
Rotavirus	£9.8
Total FBD (pathogen attributed)	£3,506.1
Total unattributed foodborne illness (UFI)	£6,888.1

Total FBD including UFI	£10,394.3

*Median, 2022 prices

3. How do trends in the UK's rate of foodborne disease compare to other countries?

All countries have different surveillance systems, data availability, and modelling approaches which makes cross-comparisons difficult. However, it is possible to look at recent trends based on published surveillance data. Here we have chosen to benchmark against Ireland, France, Germany, the Netherlands and Canada but we have data for estimated cases per 100,000 of the population for more than thirty countries (footnote 10). As shown below trends in UK, are fairly typical (footnote 11). Similar to the UK, estimated cases in most countries decreased over the COVID-19 pandemic period. Further work will investigate whether the largest decreases or increases seen in other countries are actual or artefacts of changes in surveillance and/or testing, and whether the UK can learn lessons from these countries.

4. What pathogens do we monitor?

We have ranked the major pathogens that we monitor using Multi Criteria Decision Analysis. This work identified the following six criteria as the most important to consider by an expert panel:

- Estimated Number of Annual Cases
- Quality Adjusted Life Years per Case of the Pathogen
- Public Concern
- Total Cost to Society per Annum
- Estimated Number of Annual Fatalities
- Scientist Confidence

From the list of priority pathogens, we have then applied two additional criteria, namely: a) what proportion of disease was attributable to food and b) whether reliable data is available – i.e. whether they are tested for during routine surveillance. This allowed us to prioritise four key pathogens: *Campylobacter*, *Salmonella*, *E. coli* O157 and *Listeria monocytogenes*, which are reported on annually in addition to being reported through the major IID studies, based on confirmed laboratory reports. However, due to factors such as access to health care, evolving laboratory testing methods, and various source attributions (e.g. person-person), these trends should be interpreted with caution. For example, norovirus, despite being the pathogen which is estimated to cause the largest number of foodborne cases, is not reported on, as the majority of cases are not foodborne and hence trends in confirmed laboratory reports are not necessarily indicative of the foodborne contribution to case numbers.

5. How should we set acceptable thresholds?

Given that these pathogens occur naturally in the environment and not all resulting disease is attributable to food, the elimination of these diseases is unrealistic. In June 2018, the FSA Business Committee agreed a set of thresholds that if exceeded would require investigation and potentially responses by the FSA in collaboration with the four UK public health surveillance agencies. The charts which follow set out estimated levels of FBD against the agreed threshold.

These thresholds are currently being reviewed. For *Campylobacter* and *Salmonella*, at the time the thresholds were set the FSA had been including only faecal samples in the confirmed

laboratory reports. However, we now have access to other samples e.g. blood and urine. While including these has made relatively little difference for *Campylobacter*, for *Salmonella* it has made a notable increase to the number of cases reported and has had the unintended consequence of rates exceeding the threshold which had been based on previous methods of measuring FBD. We are working with UKHSA to reconsider threshold levels; note that, this work depends on access to data from the four UK surveillance bodies.

6. What trends are we seeing in these four pathogens?

Campylobacter

Confirmed laboratory reports for Campylobacter have decreased since the peak years of 2011/2 but have increased since 2016 other than the first COVID-19 year of 2020. This drop occurred mainly in the first two first quarters of the pandemic so may be due to underreporting issues given restricted access to medical care over this period. As the numbers went back to pre-pandemic levels while COVID-19 restrictions were still in place this may indicate the decrease was less likely to be due to behavioural changes occurring over the pandemic than some other pathogens. It remains under the threshold agreed by the FSA Business Committee in 2018. SERD is currently reviewing information on Campylobacter interventions along the broiler food chain and producing a report for spring 2025. This report will recommend interventions predicted to be most effective at reducing Campylobacteriosis cases, together with the cost of these.

Salmonella

Trends in confirmed laboratory reports for *Salmonella* have stabilised since large scale reductions during the first decade of the century largely due to vaccination programme in poultry. As with all pathogens there was a decrease over the COVID-19 period; this was more sustained than for *Campylobacter*. This may suggest that as well as increased underreporting other behavioural and societal changes during COVID-19 may also have played a part; for example, reduced foreign travel. In recent years we have adjusted our sampling to get a more accurate picture. Levels appear to be approaching the ‘old’ threshold, and we are keen to review this as soon as the UKHSA data becomes available.

E. coli O157

From a peak in confirmed laboratory reports in 2011 there has been a general downward trend. Again, as with all pathogens there was a decrease in confirmed cases during the COVID-19 period which lasted for both 2020 and 2021. The increase seen in 2022 is greater than might have been expected from the easing of Covid restrictions and is largely attributable to a single national outbreak which was investigated in the summer of 2022 (as reported to the Board here).

Listeria monocytogenes

Due to the small number of cases trends for *Listeria monocytogenes* these figures should be treated with caution and are particularly susceptible to the effects of large outbreaks. If there was a decrease due to COVID-19, this only appears to have had an impact in 2020.

Table 2. Current Research Projects Supporting FBD Policy

Project Title	Research question	Timeline
Infectious Intestinal Diseases 3	**What is the current level of foodborne disease in the UK?** Using cohort studies for those experiencing vomiting and diarrhoea (a general population cohort and one for those seeking medical attention), the IID3 project will provide a current estimate for overall IID in the UK and the underreporting associated with it. This data will be used to update our foodborne disease estimates and cost of illness modelling.	Data collection began in September 2023 and will run for two years. The third study of infectious intestinal disease in the UK (IID3)

Project Title	Research question	Timeline
PATH-SAFE	**How can we improve the detection and tracking of foodborne human pathogens and AMR through the whole agri-food system from farm-to-fork?** The Pathogen Surveillance in Agriculture, Food and Environment (PATH-SAFE) programme is a £19.2m Shared Outcomes Fund (SOF) research programme, which aims to develop a national surveillance network, using the latest genome sequencing technology and environmental sampling.	Originally due to finish March 2024 (with reporting by June); has recently received a one-year extension. PATH-SAFE
Kitchen Life 2	**What risky behaviours happen in kitchens?** Kitchen Life 2 (KL2) used motion-sensitive cameras to explore food safety behaviours in 70 households and 31 food business operator (FBO) kitchens. It also captured data using surveys, interviews, and fridge and freezer thermometers. KL2 was commissioned in February 2021 and completed in June 2023. This research project won the Analysis in Government 'Innovative Methods' award in 2022.	First reports published November 2023 Based on this, FSA will be updating consumer guidance webpages in relation to using and washing chopping boards and storing foods correctly. Updates to guidance will be supported by social media and communication activity. Risk assessments will include high-risk behaviours in kitchens. Workshops are taking place with key teams in policy and operations to ensure that this new dataset informs decisions. Beyond the FSA, KL2 data is also being used to inform wider research on food safety by several research institutions.

Project Title	Research question	Timeline
Thresholds review	**What is an appropriate acceptable threshold for the four key pathogens in the UK?** The FSA has action thresholds for the four key pathogens. If the number confirmed laboratory reports for any of these pathogens exceeds the relevant threshold, then the FSA together with colleagues from the UK surveillance agencies, will investigate the reasons behind the increase and then determine the most appropriate response following such a review. These thresholds are based on analysis of trends between 2001 and 2016 and were agreed by the business committee in June 2018. These thresholds are based on faecal isolates only. We would now like to include non-faecal isolates in our reporting going forward as a) there is evidence these too can be associated with food sources and b) to be consistent with reporting elsewhere. For Salmonella non-faecal samples account for around 15% of the total in recent years. This means the thresholds need adjusting to take account of these additional numbers, otherwise thresholds will be breached most years.	This is dependent on access to surveillance data.

Project Title	Research question	Timeline
Survey of the microbiological contamination of cull ewes and prime lamb at slaughter in England and Wales	**What pathogens are found on sheep at slaughter?** There has been no recent monitoring of microorganisms on sheep at slaughter in England and Wales, with the last survey being 20 years ago. To address this evidence gap, the FSA has commissioned a survey to gather data on the prevalence and levels of pathogenic (*Salmonella* and *Campylobacter*) and commensal microorganisms contaminating lamb and sheep carcases.	February 2023-May 2024. Further information on the Survey of the microbiological contamination of cull ewes and prime lamb at slaughter .
A microbiological survey of AMR bacteria in raw dog and cat food on retail sale in the UK	**What is the risk presented by raw pet food?** Raw pet food is a growing sector in the UK. Raw pet food does not undergo any heat treatments meaning that the final product can be microbiological contaminated. There is currently no data on the presence of AMR bacteria in raw pet foods as this could present a risk to consumers during the handling and storage of these products within the home. This survey aims to gather data on AMR bacteria found in raw dog and cat food on retail sale in the UK.	March 2023-July 2024. Further information on the microbiological survey of AMR bacteria in raw dog and cat food.

Project Title	Research question	Timeline
Survey of *Campylobacter* in chicken from small poultry processing plants	**Can we reduce the amount of testing in small poultry plants?** Smaller slaughterhouses find current sampling requirements overly burdensome and costly. This project will find out if the testing whether the same level of food safety can be delivered with less burdensome surveillance. In addition, the FSA Board has indicated that a proportionate approach should be taken when implementing the requirement as the costs of full compliance on small producers is disproportionate. The data gathered will not be published but will be used to inform a strategic risk assessment which will be used by policy to come to a decision on the amount of testing required in small slaughterhouses.	Ongoing

Project Title	Research question	Timeline
ACMSF Working Group on Listeria strains	**To what extent do strain-level differences in *Listeria monocytogenes* affect foodborne transmissibility, dose-response relationship/severity of infection and resistance (particularly of biofilms) to typical cleaning processes in food preparation environments?** It will develop specific recommendations for how strain-specific information can best be incorporated into future risk assessments and technical advice produced by FSA Science & Evidence teams for use to inform policy decisions and identify priorities for future research that will support or enable the incorporation of strain-specific *Listeria monocytogenes* information into future risk assessments.	A chair has been invited and accepted, and the terms of reference are being drafted. The intention is that once group members have been invited and accepted, the first meeting of the subgroup will occur between March and May 2024, and after 1-2 meetings to identify data requirements the meetings will pause for around 9 months while data are gathered, at which point the assessment and report writing will begin.

Project Title	Research question	Timeline
Food and You 2	**How do consumer food safety behaviours change over time and vary by group?** This survey monitors consumers' food safety knowledge and behaviour. It is conducted on a bi-annual basis and a sample of 4,000 households across England, Wales and Northern Ireland take part in each wave. Core questions on food safety are asked annually with a more in-depth module of questions asked every 2 years. Data captured includes consumers self-reported behaviour in relation to handwashing, cooking, reheating and chilling food, washing raw meat and understanding of use-by dates. The findings are used to inform risk assessment exposure modelling, risk management intervention and to target risk communication.	Ongoing - Latest report published in July 2023 Food and You 2 - Wave 6
The Consumer Insights Tracker	**What are consumers concerned about now when it comes to food?** The Consumer Insights Tracker is the FSA's monthly tracking survey, monitoring consumer behaviour and attitudes on topical food-related issues. A nationally representative sample of 2,000 adults (aged 16+) in England, Wales and Northern Ireland participate in the survey each month. Results are published each month on the FSA website and give up to date information on consumer concerns, including monitoring consumer confidence, supporting crisis communications, and understanding changes in behaviour due to system disruptions.	Ongoing – latest report published January 2024 Consumer Insights Tracker

Project Title	Research question	Timeline
Consumer awareness of AMR	**How aware are consumers of antimicrobial resistance and its causes?** In order to meet the FSA's commitment under the AMR national action plan to *'Assess and track the perceptions and understanding of food handlers and consumers about AMR bacteria in food and what can be done to protect people through food hygiene at home*', the Agency's Analytics Unit have been tracking consumer awareness of AMR since 2016. Since 2023, consumer awareness of AMR has been measured through Food and You 2.	Ongoing – latest report published in Wave 5 of Food and You 2 (published March 2023). Consumer awareness will next be asked in Wave 8 (publishing Summer 2024). -
Review of *Campylobacter* reduction interventions during chicken production, preparation and retail in the UK	**How effective are our efforts to reduce *Campylobacter*?** This research will comprise of an appraisal of the effectiveness of *Campylobacter* reduction interventions, applied across conventional broiler chicken production (and organic broiler production, if possible) from farm to fork, and the potential at reducing human campylobacteriosis in the UK. The outcomes will contribute to FSA objectives for protecting public health and helping businesses do the right thing.	Currently going through approval process

Table 3. Recently completed FBD research projects – findings and implementation

Project Title	Details	Publication Date

Survival of SARS-CoV-2 on food surfaces and food packaging materials	A risk assessment published by the FSA in 2020 concluded that is very unlikely you could catch SARS-CoV-2 from food but a key uncertainty in this risk assessment was how long infectious virus can remain on food. Following this, a laboratory-based study was commissioned to address this key uncertainty. Results showed that virus survival varied depending on the foods/packaging type examined but for most foods, and all packaging types tested there was a significant drop in virus contamination over the first 24 hours. These results were used by Policy in response to queries about Covid-19 and the risk from foods. It was also used by Communications to reassure the general public.	2020 Risk Assessment 2022 Lab based study
Thermal inactivation model for hepatitis E virus (HEV)	The purpose of this project was to produce a mathematical model to predict the thermal stringency, in terms of time and temperature combinations, needed to inactivate hepatitis E virus (HEV) typically found in different matrices. Policy will use this to inform future research. The findings were shared with other government organisations with an interest in HEV.	January 2022; Thermal inactivation model for hepatitis E virus (HEV)
Survey of AMR bacteria in lamb and turkey meat on retail sale in the UK	The survey was carried out to gather data on the prevalence of AMR in lamb and turkey meat on retail sale from October 2020 to January 2021. Policy worked with Comms to ensure that our messaging to consumers, highlighting that thorough cooking will destroy any microorganisms present including those that are AMR. This highlighted good hygiene practices to minimise the risk from and spread of AMR bacteria when handling raw meat.	February 2022; Survey of AMR bacteria in lamb and turkey meat on retail sale in the UK

A survey of *Salmonella*, *E. coli* and antimicrobial resistance (AMR) in frozen, part-cooked, breaded or battered poultry products on retail sale in the UK.	In response to an incident, this survey was carried out to gather data on the prevalence and levels of *Salmonella*, *E. coli*, and AMR detected in selected frozen part-cooked poultry products (e.g., chicken nuggets, goujons, etc.) on retail sale in the UK. The findings from the survey were used by Policy and Communications to highlight advice to consumers to thoroughly cook breaded poultry products before eating. This message has become incorporated into core messaging and is periodically highlighted on social media.	May 2022; A survey of Salmonella, E. coli and antimicrobial resistance (AMR) in frozen, part-cooked, breaded or battered poultry products on retail sale in the UK.
Assessment of the risk to consumers as a result of disruption to the cold chain during direct supply of Qurbani meat and offal	This risk assessment was commissioned to assess the annual risk to consumers of practicing Qurbani, where typically they wish to collect Qurbani meat and red offal within a short time after slaughter, which means these products cannot complete normal chilling processes before leaving the slaughterhouse. The findings from the risk assessment are being used to develop Policy that underpins the industry-led mitigations (in lieu of the full legislative chilling requirements). This will ensure that consumer safety is paramount when they collect their Qurbani meat and offal.	June 2022; Assessment of the risk to consumers as a result of disruption to the cold chain during direct supply of Qurbani meat and offal | Food Standards Agency
Social Science, Consumer handwashing tracker survey.	This survey was commissioned at the start of the COVID-19 pandemic (April 2020), and ran every quarter, until January 2022. The survey monitored self-reported data in relation to consumer handwashing practices. Findings are used by Policy and Comms in their Business-as-Usual messaging to emphasise the importance of good hygiene in food preparation.	August 2022; Consumer Handwashing Tracker

Feasibility study for *in vitro* analysis of infectious foodborne hepatitis E virus (HEV).	This feasibility study was carried out to identify cells lines that are suitable for development of an infectivity assay for HEV. Currently, there is no suitable test for infectivity, but this study has provided us with some knowledge if specific food items would be detrimental to cells when assessing the presence of infectious virus in vitro. Policy will use this research to inform future research.	September 2022; Feasibility study for in vitro analysis of infectious foodborne hepatitis E virus (HEV).
Social Science; food behaviours in the UK student population	Social science commissioned a study which explored the knowledge, attitudes and behaviors of university students relating to food safety, food security, diet, and other food-related topics. This research has been used by both Policy and Comms to develop student focused food safety messaging which is used annually to help students prepare food safely.	January 2023; Food behaviours in the UK student population: executive summary
Risk assessment for increasing the threshold for designation of low-capacity slaughterhouses	This risk assessment was commissioned to estimate the risk of campylobacteriosis from poultry produced at low-throughput abattoirs, compared with high-throughput abattoirs. The findings are being used by Policy to determine the levels of Campylobacter sampling that low-throughput abattoirs need to carry out.	Completed in June 2023. Trade concerns - not being published.
Risk assessment of acquiring Avian Influenza (AI) from Poultry Products	The last FSA assessment on the risk of exposure to AI from the food chain was in 2015. Given the increased prevalence of AI in UK birds, the risk assessment was updated to make sure advice related to consumption of poultry products remains appropriate. The risk assessment was used to update the consumer pages on cooking and advises cooking all game birds to reduce the risk of AI.	July 2023: Risk assessment of acquiring Avian Influenza from Poultry Products Policy advice on Avian Influenza

Risk of campylobacteriosis from low-throughput poultry slaughterhouses	The risk assessment considered the whole pathway of the chicken from farm to fork. Campylobacter levels from chicken processed by low and high throughput slaughterhouses were the main data used for our comparison. The findings are being used by Policy to determine the levels of Campylobacter sampling that low-throughput abattoirs need to carry out.	July 2023: Risk of campylobacteriosis from low-throughput poultry slaughterhouses
Salmonella risk profile of UK-produced hen shell eggs	In 2016 an ACMSF risk assessment assessed the risk from *Salmonella* in UK-produced eggs produced under a recognised farm assurance scheme (Lion Code or equivalent). This risk assessment led the FSA and FSS to update their consumer advice on the consumption of eggs in 2017, stating that vulnerable groups could consume raw or runny eggs produced within an assurance scheme. This risk profile examined the current situation of Salmonella in UK-produced table eggs. The risk profile found that the total number of outbreaks and cases linked to consumption of eggs and egg products per year has not changed significantly since the 2016 ACMSF risk assessment. Consumer advice has remained unchanged.	July 2023: Salmonella risk profile of UK-produced hen shell eggs

Listeria in smoked fish	This was a complex piece of work which spanned over a year and was in response to a fatal outbreak related to the consumption of ready to eat smoked fish. The response was multidisciplinary and co-ordinated across all four nations. Individual pieces of work which lay in this stream were: • A Risk Assessment on the risk of listeriosis to vulnerable consumers from smoked fish • Social Science commissioned a consumer survey which sought to understand consumer understanding of smoked fish, caused by the bacteria Listeria when eating RTE smoked fish products. • Economics considered Other Legitimate Factors which could influence our advice to consumers (unpublished report) FSA/FSS has since updated its advice to emphasise avoiding consumption rather than cooking until steaming hot.	July 2023 Policy advice on smoked fish Risk Assessment: Risk from Listeria monocytogenes in ready to eat smoked fish Consumer survey: Survey on knowledge and behaviours towards smoked fish Updated advice: smoked fish updated advice
Optimising extraction and detection of Hepatitis E virus (HEV) from pork meat and products	The aim of this project was to address the lack of standardised methods for the detection of HEV in pork and pork products. This work will be used to inform future Policy needs and research on HEV.	July 2023; Optimising extraction and detection of Hepatitis E virus (HEV) .

Risk assessment to support guidance for norovirus outbreaks in oysters.	This assessment was commissioned in response to recurring outbreaks of norovirus linked to the consumption of raw oysters. Each outbreak required food safety and health protection resource to manage, as well as having a direct and indirect impact on consumers and on businesses involved, and further guidance had been requested to deal with norovirus outbreaks. A policy response to the risk assessment was developed on a 4-nation basis, and guidance for food business operators on our response to norovirus outbreaks was published on the FSA website.	October 2023; Risk Assessment to support guidance for norovirus outbreaks in oysters Policy response Industry guidance
Listeria Hospital Guidance review	As part of our response to the 2019 outbreak of listeriosis in hospital patients the FSA commissioned a survey to assess how well the guidance is being implemented in hospitals, health and social care settings and how we can improve uptake of the advice. The report concluded that it remains fit for purpose, but work is required to increase awareness and accessibility.	October 2023; Implementation of the FSA Listeriosis Guidance

Infant formula preparation machines	An FSA/UKRI-funded Citizen Science study on the preparation of infant formula in the home found that the majority of infant formula preparation machines were dispensing water at a temperature less than 70°C. NHS guidance on infant formula preparation stipulates that the water should be 70°C to ensure any pathogenic bacteria in the powdered infant formula is eliminated. FSA Policy, SERD and Comms worked with other relevant government departments on developing consumer advice on preparation machine and a coordinated response for potential inquiries. DHSC updated their Better Health Start for Life webpage with the new consumer advice, and we continue to work with health departments and our NHS partners to update advice pages across the three nations.	October 2023; Exploring the safety of at home powdered formula preparation - Article published in the Maternal and Child Nutrition journal
Listeria in blue cheese	The FSA/FSS published a risk assessment on blue cheese to vulnerable consumers. It supports the existing FSA and FSS advice to vulnerable consumers on the consumption of blue cheese. NHS partners in England, Wales and NI removed stilton from the list of safe foods to eat for pregnant women aligning the advice across the 4-nations. Comms messaging has targeted relevant stakeholders so that the messaging reaches pregnant women.	November 2023;
Social Science research; knowledge of AMR amongst food handlers	This research explored awareness of AMR amongst food handlers (those who handle food or touch surfaces likely to be in contact with food) employed by FBOs. The results are highlighted by Comms in our Business-as-Usual messaging.	November 2023 Knowledge of AMR amongst food handlers

Foraging advice	Within the fourth quarter of 2022, FSA Communications detected increased public interest in foraging for foods in the wild, which may have been related to the current cost-of-living crisis and/or increased interest in sustainable living practices. The FSA had archived advice on foraging and Policy determined this should be updated and made available to the public. Alongside potential risks of foraging from foodborne illness due to pathogens, there are also potential risks due to environmental chemical contaminants on plants, and endogenous toxins in poisonous plants. We consulted with relevant teams across the FSA for expertise in these areas, including microbiological risk assessment and chemical contaminants.	January 2023 Guidance for safe foraging

Annex B – Campylobacter

1. Campylobacter reduction continues to be an important food safety focus for the FSA as it remains the leading bacterial cause of FBD in the UK.

2. Campylobacter can grow to high levels in the gut of infected chickens and can contaminate the skin and meat of birds during slaughter and processing. Evidence suggests that chicken contaminated with high levels of Campylobacter (exceeding 1000 colony forming units per gram (cfu/g)) presents the greatest risk to consumers. Therefore, the FSA's strategies for protecting public health are aimed at reducing the levels below this level.

3. The UK Campylobacter reduction strategy (2014-2017), a partnership between FSA, FSS and the poultry industry, agreed a voluntary target to reduce the most highly contaminated birds (those with over 1000 cfu/g neck skin) from an estimated 27% in 2008 to below 10% post chill in the slaughterhouse by the end of 2015 and subsequently to <7% at retail. The reduction programme included a suite of interventions targeting producers, processors, retailers, and consumers.

4. The FSA carried our retail level surveys of Campylobacter in UK-produced fresh chicken between 2014 and 2017 and found a steady decline in contamination rates over time. Laboratory-confirmed human case reports for Campylobacter have decreased since 2011/12 and have remained under the threshold levels agreed by the FSA Business Committee in 2018.

5. Following the successes of the programme, work moved into Business as Usual with an agreement that was industry-led. Activities including testing would continue. In addition, further action/investigation would be triggered if the reported levels of product contamination or human cases increased beyond a defined threshold point.

6. Moving forwards, we would like to better understand the interventions currently employed along the food chain by farmers, processors and retailers to reduce Campylobacter contamination. This will enable us to identify priorities for new research, as well as resources and interventions which will help to drive further improvements.

7. We have used various avenues to promote the 4Cs (chilling, cooking, cleaning and avoiding cross-contamination) messaging to consumers to reduce the risk of Campylobacter. These activities encourage consumers to practise good food hygiene in the home, such as not washing raw poultry and cooking poultry thoroughly. The most recent Food and You 2 survey found that 56% of consumers reported they never washed chicken, compared to 26% in 2010. As well as regular content on social media and responding to routine media inquiries, targeted campaigns have included picnic and BBQ guidance.

Annex C – Listeria monocytogenes

1. Listeria monocytogenes infection, known as listeriosis, is rare and in healthy adults and children usually causes few or no symptoms. However, it can cause severe illness (invasive listeriosis) in older people, pregnant women, unborn and new-born babies, and people with impaired immunity. In these groups, listeriosis can present as infection of the bloodstream or brain. Due to the severity of infection and high case fatality rate, listeriosis is an important public health concern.

2. The severity and high mortality rate of cases of listeriosis requires continued action to tackle this pathogen in the food chain. Listeria is widespread in the environment; however, most cases are due to contaminated food. It is an unusual bacterium because it can grow at low temperatures, including refrigeration temperatures below 5°C. It is also capable of surviving within biofilms on equipment, utensils, floors, and drains, leading to cross-contamination risks in final products. For this reason, it is of most concern in chilled ready-to-eat foods that do not require further cooking or reheating.

3. We continue to work closely with NHS England, Welsh Government, Department of Health in Northern Ireland and local authorities and other stakeholders across the three nations to implement recommendations from the NHS Hospital Food Review to ensure that the risk from Listeria monocytogenes is controlled effectively in hospitals and other health and social care settings.

4. The ‘Reducing the risk of vulnerable groups contracting Listeriosis’ guidance was published in 2016 for healthcare and social care organisations to help them protect people within their care. This sets out both the legal requirements and best practice guidance for protecting people.

5. In 2019, an outbreak of listeriosis was linked to pre-packed sandwiches provided in hospitals. This resulted in the independent review of NHS hospital food being commissioned which made a number of recommendations. Food safety recommendations stated that purchasers must have effective mechanisms in place to assure food safety within their supplier base and drive improvements where necessary to ensure all businesses supplying high-risk foods meet the highest standards.

6. Following the 2019 outbreak of listeriosis in hospital patients the FSA commissioned a peer review by independent experts. The peer review concluded the 2016 guidance remains appropriate and, if followed, should manage risks associated with listeriosis in these settings.

7. FSA commissioned a survey to assess how well the guidance is being implemented in hospitals, health and social care settings and how we can improve uptake of the advice. The final report was published on 31 May 2023.

8. A key finding was that 95% of settings surveyed who were aware of the guidance felt that the FSA guidance was effective in reducing the risk of vulnerable groups contracting listeriosis.

9. Over the last year, outbreaks associated with the consumption of smoked fish and unpasteurised cheese have highlighted the technical challenges encountered by small to medium sized food producers in controlling listeria. Due to the ability of the pathogen to persist in the food production environment and grow at low temperatures there is a particular need for guidance on shelf-life validation to ensure appropriate durability dates are applied, and the sampling regimes required to verify the effectiveness of cleaning methods in removing listeria from surfaces and equipment. We will therefore work with local authorities and the industry to identify how existing guidance, including our decision support tools can be further developed and extended to a wider range of sectors to support improvements in this area.

Annex D – Continuous improvement

The actions of food business operators

1. Food business operators (FBOs) are responsible for ensuring that the requirements of food law are met within their food businesses, including that food placed on the market is safe and complies with food hygiene requirements. FBOs are required to have suitable procedures and adequate controls in place to ensure that the food they supply is safe. The controls that each business must implement will vary depending on the foods they handle and activities that they undertake. For example, a restaurant will need to ensure that they avoid cross contamination between raw and cooked foods, they may do this by having separate dedicated chopping boards for different raw and ready-to-eat foods.

2. The FSA has produced Safer Food Better Business (SFBB) guides, and the Safe Catering Pack (SCP) in Northern Ireland, to support FBOs operating small businesses to establish their food safety management systems. SFBB is the most frequently downloaded resources from the FSA website (e.g. over 7000 downloads of SFBB for caterers in January 2024. The FSA has also officially recognised 11 national guides to good practice for hygiene and for the application of the hazard analysis critical control point (HACCP) principles, these and the SFBB and SCP can be used by FBOs on a voluntary basis.

The Direct Inspection by Our FSA Operations Teams and Local Authority Officers

3. Meat hygiene inspectors and official veterinarians deliver official controls at approved meat plants (including abattoirs and cutting plants). FSA inspectors (and DAERA inspectors in Northern Ireland) deliver controls in dairy establishments.

4. Local authorities (LAs) or councils are responsible for delivering official controls at the majority of food businesses (such as restaurants, take aways and retailers) to verify FBOs' compliance with relevant food law. These include inspections, audits, surveillance, sampling, and enforcement when required, in most food businesses.

5. Once a business has received an LA or council inspection, they will also provide the business with a food hygiene rating, when applicable. The FSA Food Hygiene Rating Scheme incentivises businesses to increase compliance, allows businesses to demonstrate their good hygiene standards, and supports consumers to make informed decisions about where they purchase and eat foods.

6. The controls extend beyond the domestic food system. The UK has in place stringent import control measures to protect consumers from unsafe imported food, these are implemented through border checks carried out by port health authorities. Specific import requirements are

imposed for all high-risk food and feed products, which includes all products of animal origin and certain high-risk food and feed products of non-animal origin from specific third countries, where a specific hazard has been identified. Where non-compliances are identified, the consignments may be rejected, and border notifications issued. The collective results of the checks help to determine whether additional measures are required.

7. In addition to the import checks undertaken at border control posts, surveillance, both inland and at the border, is used to help monitor and identify potential emerging risks. The intelligence produced feeds into the routine assessment of border controls helping to ensure that import controls remain vigilant and targeted.

FSA Checking the Overall Health of the System

8. When problems do occur in the food chain the FSA will coordinate the response to food and feed incidents and foodborne outbreaks, ensuring that products not in compliance with safety legislation are removed from the UK market. We seek to understand the root causes of incidents, and to identify where practices, guidance or regulations could be improved to enhance the controls in place.

9. FSA Incidents regularly meet with UKHSA to discuss case clusters that pose concern. The agencies jointly assess, monitor, and agree incidents which require a coordinated operational response to bring the situation under control. UKHSA monitor international signals, while the FSA monitor EU and INFOSAN signals for multi-country outbreaks that have an impact on the UK.

10. The FSA supports LAs and district councils by providing relevant advice, training and guidance. The Food Law Code of Practice gives instructions that LAs must consider when enforcing food law. The FSA has a statutory duty to check that the system is working as it should and we do this by monitoring how LAs perform, intervening where necessary.

11. Underpinning all of these controls are the scientific reviews, technical advice, and information and data produced by the FSA and others to inform policy development and approaches. This applies to activities such as assuring compliance, managing incidents and issuing advice to consumers and businesses.

12. We recognise the rights of consumers to make their own decisions about the food they eat, so we aim to provide proportionate advice to consumers so that they can make informed choices based on their circumstances.

13. The ‘Always On’ team within FSA Communications develop a series of smaller scale seasonal and themed campaigns throughout the year which aims to continually promote and communicate food hygiene messages to consumers using a variety of digital channels such as social media campaigns. The campaigns team within communications have also identified how a larger communications campaign can help support consumers and businesses to comply with food hygiene requirements and reduce FBD risks.

Annex E – Trigger Levels Toolkit

The toolkit makes it easier to establish clear and timely investigations and actions to be taken when trigger levels are breached or when the number of human cases of illness increase. A significant increase in cases or a breach of the trigger levels set by the FSA Board in 2018 will lead to investigation where appropriate action and/or intervention will then be considered.

1	The 4 key pathogens that are monitored by the FSA: 1. Campylobacter 2. Salmonella 3. E. coli O157 4. Listeria
2	The trigger levels set by the FSA Board in 2018? 1. Campylobacter: Baseline 71,300 lab reports per year in UK 2. Salmonella: Baseline: 8,500-9,500 lab reports per year in UK 3. E. coli O157: Baseline: 800 to 1,500 UK lab reports per year in UK 4. Listeria: Baseline: 150 to 250 UK lab reports per year in UK
3	If trigger levels are not breached but there is a significant increase in any of the four major foodborne disease pathogens (Campylobacter, Salmonella, E. coli O157, Listeria), a review/investigation will be carried out to inform if there is need for further actions to be taken.
4	If no specific action is identified following the review/investigation, the FBD Policy Steering Group* will continue to monitor changes/trends working with the cross-government Epidemiology of Foodborne Infections Group (EFIG) as required.

5	If trigger levels are breached in any of the four key pathogens (Campylobacter, Salmonella, E. coli O157, Listeria) the FBD Policy Steering Group will decide whether to:? 1. Investigate the reasons behind the increase, working in collaboration with Epidemiology of Foodborne Infections Group (EFIG), ACMSF and the FBD Research programme. This will be done by using information from social science outputs (e.g. Food and You) and other commissioned research to monitor consumer behaviour, inform interventions and risk communication. 2. Following investigations, undertake further sampling of products/food associated with specific pathogen. In addition, determine the most appropriate response or action which might include further investigations including assessing likely impact of interventions, research and root cause analysis. 3. Consider if an action plan needs to be developed or reviewed (if there is an existing plan).
6	1. Update Executive Management Team and the FSA Board on the issue and recommend suitable interventions. 2. FBD Policy Steering Group (cross-FSA group) will consider and recommend actions and/or intervention, including possible communications activity. 3. Identify where interventions or control measures could reduce FBD targeting key transmission pathways. 4. Identify which point in the food chain intervention is likely to have the biggest impact. 5. Select and target interventions for clear consumer benefit using rigorous evidence, analysis, and insight. 6. Influence consumer behaviours using tailored food safety messaging which is targeted to the intended population groups based on their particular risk, behavioural and demographic profiles.

1. We have been working to understand the extent of these lesser pathogens and have a paper currently in peer review which might slightly adjust these estimates. Improved testing methodologies may also allow us to further attribute a small proportion of this ‘unknown’ 60%, taking it down to 58%.

2. 95% Credible Intervals are: cases 1.8 million to 3.1 million, GP presentations 150,000 to 320,000, hospital admissions 11,400 to 26,100 and deaths 113 to 359.

3. Foodborne Disease Estimates for the United Kingdom in 2018 (pdf)

4. Estimating deaths from foodborne disease in the UK for 11 key pathogens

5. A Report of the Study of Infectious Intestinal Disease in England (pdf)

6. The second study of infectious intestinal disease in the community (IID2 Study)

7. Extension to the IID2 study: identifying the proportion of foodborne disease in the UK

8. The Burden of Foodborne Disease in the UK 2018

9. Many types of E. coli bacteria carry one or more shigatoxin-producing genes (making them shigatoxin-producing E. coli, or STEC). The commonest type is called O157, but we are increasingly finding disease caused by other types, partly as a result of new more accurate testing. This means that we may have an incomplete estimate if we only look at O157. In IID2 we estimated that half of STEC cases (O157 and non-O157) come from food.

10. Comparing the methodologies used to estimate foodborne disease in the UK to those used in other countries

11. The graphs have been produced to sure how trends in the UK generally compare to other countries rather than to enable specific other countries to be identified.