

ADVISORY COMMITTEE ON THE MICROBIOLOGICAL SAFETY OF FOOD

ACMSF horizon scanning workshop 2022 summary of discussions and outputs.

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Introduction

The Committee held a virtual horizon scanning workshop in June 2022. The workshop followed a similar format to previous workshops with a mixture of breakout groups and plenary sessions. Members were asked to identify emerging issues around a series of specific questions and use more general horizon scanning questions as a prompt. A number of key issues were identified by members both outside the workshop and as part of the breakout groups and the plenary session was used for the Committee to agree a prioritised list of recommendations based on their potential for reducing foodborne illness. This paper summarises the main outputs and discussions from the workshop and actions, where identified, have been highlighted. Where specific actions have not been mentioned but it is obvious that the Committee is suggesting some further work/consideration, this has been indicated. General thoughts/deliberations have also been captured.

At Annex 1 are the comments members provided before the workshop. The secretariat sent the questions to the committee members before the workshop which members provided responses to. This document guided the discussions at the workshop.

Members were asked to consider:

How are the following issues likely to affect the burden of foodborne disease in the UK over the next 10-20 years, in terms of existing and new hazards and likelihood of exposure, including to AMR? What are the key evidence gaps?

Priority emerging issues identified by Members.

Q1 - Challenges associated with the disruption to the supply chain?

In the event of food supply disruption, the following challenges were identified as potentially having direct or indirect impact on the burden of foodborne disease.

Challenge	Possible Actions
<p>1a Increased risk of contamination – Members discussed the effect that less robust supply chains and climate change may have on food safety. Members underlined the potential for climate change to cause increased flooding, contaminating food, or higher temperatures resulting in cold chain being less robust, or for disrupted or reduced water supplies affecting washing/processing of food, leading to increased risk.</p>	<p>Possible Actions for Items a-c</p> <p>To enable consumers to cope better with food supply disruptions combined with squeeze on cost of living, the FSA (in collaboration with industry) may consider research into:</p> <ol style="list-style-type: none"> I. Safety aspects of shelf-life determination for basic/essential foodstuffs, both pre-packaging processes and types of packaging. II. Identifying foods with shorter or more resilient supply chains and promoting them.

Challenge	Possible Actions
	<p>III. Identifying and promoting locally produced foods that would effectively substitute for those with longer supply chains or shorter shelf lives.</p>
<p>1b Increasing risk of fraud – Members noted that supply shortages combined with the increased pressures on cost of living could lead to mislabelling, reduced due diligence, and greater appetite by the consumer to take risks with fraudulent or counterfeit products. The need for effective fraud detection was highlighted, together with having in place measures to monitor unscrupulous operators attracted to the opportunity that disruption of the food supply chain may bring.</p>	
<p>1c Increased pressures on cost of living – Members agreed that increased pressures on cost of living would have food safety risks. There was appreciation that in some communities, sustainability and environmentally friendly sources of food will</p>	

Challenge	Possible Actions
<p>be less important as consumers have to make tough decisions regarding food and budget. Members also felt there was merit for the UK to be more self-reliant in food production and underlined the risks of being heavily reliant on imported food. In addition, members discussion covered possible risk associated with changes in consumers dietary behaviour. It was acknowledged that this could lead to malnourishment and eventually increase the proportion of the population classified as vulnerable in terms of foodborne disease.</p>	
<p>1d Lack of resources in Local Government (LA) to enforce food safety regulations – Members were informed that LAs were presently under resourced in terms of inspecting premises and carrying out food safety checks. It was highlighted that the pandemic has severely affected the systematic approach employed by LAs in the food safety/hygiene inspections they carry out which includes checks in nursing/care homes and public eateries.</p>	<p>Possible Actions for items d-f</p> <p>Local Authorities (and Port Health Authorities) should be encouraged to allocate appropriate funding for food safety law enforcement/food safety inspection. ACMSF has concerns about the current reduced resourcing in relation to food safety that has limited enforcement of food safety regulations.</p>

Challenge	Possible Actions
	Members pointed out that systematic food safety monitoring should be happening in all LAs.
<p>1e There is a risk of less effective food safety controls – Members remarked that this could be due to a number of factors including labour shortages, less skilled workers, cost cutting leading to a reduction in key safety measures (such as to reduce energy costs in production methods), longer delivery times, disrupted/changed supply chains. The consequences of this being increased level of food spoilage and potentially shelf lives being unreasonably extended or shortened.</p>	
<p>1f Members commented that the UK exiting the European Union has resulted in challenges in implementing safety measures for imported food. The need to have a robust system for food safety was underlined. The Committee recognised the risk of increased imported foods coming in with their own safety issues such as new or emerging pathogens, introduction of</p>	

Challenge	Possible Actions
<p>different antimicrobial resistance (AMR) patterns and inadequate safe processing. There was discussion on the need for the FSA to consider profiling countries the UK imports food from to assess risks from the particular foods being imported.</p>	
<p>1g Predict sudden short-term impact of loss of important supplies – Although it is impossible to predict the exact nature of a future threat to the supply chain, members agreed that there is merit of having the ability to identify broad microbiological safety risks that might arise as a result of certain categories of issue when they develop. In practice, this would potentially provide the capability to classify risk based on characteristics such as geopolitical events, climate related issues etc.</p>	<p>Developing a classification scheme (or a defined approach) to describe the likely impact of a possible food chain disruption will put the FSA/ACMSF in a good position to address likely future food chain disruption effectively e.g., a separation of short-term acute issues from long-term developing issues.</p>
<p>1h Emphasis on hand hygiene: The Committee viewed this as important emphasising the significance of a hand hygiene campaign from children (schools) to adults. This could</p>	<p>The FSA should consider running a continuous hand hygiene campaign for all ages.</p>

Challenge	Possible Actions
<p>encompass many areas of food safety but starting with simple hygiene measures. Need to reinforce the message due to the potential of new and emerging pathogens.</p>	
<p>1i New hazards emerging (new strains, AMR, and new pathogens) – Members discussed the possible new hazards, or changes in risk, more intensification in food production and rising sea temperatures (climate change) affecting seafood microbes may introduce. Other areas highlighted include: changing supply chains exposing populations to different pathogens not encountered previously, changing livestock diets e.g., to reduce methane (for sustainability/environmental reasons) that may affect microbes and cause transmission of pathogens to new species or a change in the pathogenicity of organisms and the circular economy where recycled material particularly food/animal waste are used as a substrate to culture microalgae which is then used as animal feed. Microalgae produced through this process could possibly</p>	

Challenge	Possible Actions
<p>become a Transmissible Spongiform Encephalopathy (TSE) agent.</p>	
<p>1j Members flagged the issue of foodborne viruses as important particularly in relation to the increased levels of minimally processed products. In addition, members acknowledged that there were huge differences in the AMR profile of bacteria in foodstuffs depending on where it is produced and agreed that it is vital that threats on a molecular level for imported food should be considered.</p>	
<p>1k Use of prioritisation by ACMSF – Members commented on the benefit of the Committee having access to data from food surveillance and food safety inspection reports to interrogate the evidence from these variety of sources with regard to identifying risks. Discussing the evidence from industry and other sources would help in building up prioritisation in relation to food safety mitigation programmes.</p>	<p>Make food surveillance and food inspection reports accessible to ACMSF for analysis in relation to identification of risks.</p>

Q2 – Changes in methods of food production and new food technologies?

Challenges	Possible Actions
<p>2a Traceability – Value of having more survey data/intelligence on changes of source of food for consumers (legal vs “back-yard” production) – Members discussed the value of collecting data/intelligence on changes of source of food for consumers (where do consumers get their food from, e.g., social media, internet etc). It was felt that recognisable changes in the food system should push the drive to seek relevant data, particularly information relating to legal vs ‘back-yard’ production and using this to assess food safety risk. It was noted that the appearance and disappearance of online unregulated food sources is becoming familiar. New smaller food businesses are increasing and there appears to be no effective control on how they are monitored. Lots of new entrants (FBOs) coming into the market/trading are helped by online distribution.</p>	<p>The FSA in collaboration with LAs should consider how to pull together data on online businesses together with exploring how they can be effectively regulated. Consideration should be given on how to support their needs using new technology and methods.</p>

Challenges	Possible Actions
<p>2b Emerging trend of new protein sources – Members discussed the emerging trend of new protein sources. Plant based alternatives, insect proteins, 3-D meat printing and cell cultured milk were specifically mentioned. The discussion covered the need for detailed information, monitoring (looking at patterns associated with these foods) and how the FSA is regulating these foods. Members noted the risk of contamination due to these new, unfamiliar technologies (3-D printing, vertical farming, plant/insect-based foods, non-thermal processing, novel transmission environments) as new appropriate food safety controls may not have been fully identified or validated.</p>	<p>FSA should consider monitoring and collecting detailed information from the producers of new protein sources looking for patterns associated with these kinds of food.</p>
<p>2c New Technology – As members acknowledged that new technology is being used to change food production in the UK, the issues of scrutiny, assessment, and regulation were flagged. Some of the questions raised include: Is there robust scrutiny as new technology enters the food system? How is it being assessed and regulated? How many of the foods</p>	<p>I. The importance of food microbiological input into the novel food assessment process to be reiterated, it was felt the current approach focuses more on chemical and toxicological issues. ACMSF may consider further developing its interaction with the Novel Foods and Processes Committee.</p>

Challenges	Possible Actions
<p>produced with the new technology should be treated as ‘novel foods’ but aren’t, and are they being appropriately assessed. It was pointed out that new entrants to the market may not have the expertise or technical capability to do proper risk assessment and may need help and support from skilled and appropriately trained Environmental Health Officers (EHOs).</p> <p>It was added that EHOs who enforce food law may be struggling in keeping up with new technologies used in food production and this would impact their ability to properly assess the operations of FBOs.</p>	<p>II. Consideration should be given to support new entrants to the market who may not have the expertise or technical capability to do proper risk assessments.</p>
<p>2d Regulation and Education – There was discussion on challenges EHOs are facing in keeping up with new technology used in food production to be able to competently advise FBOs. It was highlighted that staff shortages and budget cuts have not helped EHOs in fulfilling their role. The added risk of unlicensed, less knowledgeable businesses being able to sell food online was highlighted. Regulation and basic education on</p>	

Challenges	Possible Actions
<p>food hygiene needed for new FBOs was underlined. The need to look at the necessity to licence food businesses and novel food producers to reduce the risks was strongly advocated. It was stated that there would be less risk if the public and FBOs were enlightened on food risks.</p>	
<p>2e Control of risks through procedures and controls – Members noted that large food producers who dominate the wholesale/retail trade have a good track record of providing the general public with food with acceptably managed risks through their tested procedures and controls. However, as there is a shift to smaller independent operators, there is a lack of evidence of appropriate controls in place to mitigate against risk.</p>	<p>FSA/LAs may consider how to monitor the activities of the small food producers/retailers in relation to procedures and controls they employ to reduce risk.</p>
<p>2f Track and trace system (communicating key food safety messages to food business operators) – Members discussed the need to collect data of businesses producing novel foods together with new entrants to the food industry so as to ensure they are up to speed on food hygiene and the</p>	

Challenges	Possible Actions
<p>HACCP process. Communicating food safety process to emerging businesses was underlined as vital. It was felt this could be covered in the licensing process. Food safety courses should be a requirement to obtaining a licence for food production.</p>	
<p>2g Changes to food production/tech outside of UK and how that might affect food safety of imports – Members discussed the effect changes to food production and use of new technology outside of the UK may have on products imported to the UK particularly if the products are novel and have not gone through a robust assessment process. There was concern on how the UK ensures that imported food is safe. The need to adopt the EU system of deploying inspectors to third countries to check food production systems was mentioned.</p>	

Q3 – How are changes in consumer behavior and preferences likely to affect the burden of foodborne disease in the UK.

Challenge	Possible Actions
<p>3a Increasing cost of food and energy – External influences such as the increasing cost of energy and food products and the direct and indirect impact on consumer behaviors were highlighted as an emerging issue to consider in relation to foodborne illness. There are concerns that due to economics and regulations, changes may be imposed on the consumer rather than these changes being up to their own choice. As a result, this may lead to more people needing access to foodbanks, but also struggling to donate to foodbanks. There may also be a decline in sustainability and ethical food consumption. In terms of foodborne disease, consumers could potentially ignore use-by as they struggle to buy enough food. Members felt that consumers may also disregard cooking instructions as means to reduce energy costs. Consumers may also not run refrigerators at the correct temperature as means of energy reduction, leading to an increased risk of pathogen</p>	<p>I. Develop educational guidance on cooking basic foods safely using less energy. For example, teaching consumers how to adapt cooking instructions for use with microwave or air fryer.</p> <p>II. Conduct research on consumer methods of cooking and handling food safely and cheaply. Also, to investigate which food products are more likely to be cooked incorrectly.</p> <p>More research and policy work may need to be carried out, in regard to the labelling of foods, to provide the consumer more ways of how foods can be cooked cheaply e.g., in the microwave.</p>

Challenge	Possible Actions
<p>growth. Members also expressed concerns of the potential of biofilm formation in the home environment on food, especially food that is incorrectly stored, leading to the formation of new or changing pathogen communities.</p>	
<p>3b social media and communication – Members commented that social media has created new ways for consumer to learn food safety information. There are concerns that consumers are receiving poor advice from influencers that is not evidence-based. Members admitted the difficulty in making the FSA stand out as a scientifically led, authoritative body that consumers can trust. Social media “viral challenges” also cause the potential for extreme food behaviours. Vulnerable groups such as those dependent on meals on wheels or in a long-term caring facility may also be at risk of poor food practices adopted from social media if that is where staff are getting their information. Vulnerable groups often have less control over their food choices and therefore it is important for care workers not to adopt poor food hygiene and preparation practices from social media.</p>	<ol style="list-style-type: none"> I. Suggest to the FSA behavior team to look at the extent to which different generations are getting their advice from social media and what makes them trust some sources over others. II. Conduct more social science research into how to use social media to communicate safe food advice and how to effectively use it as an educational resource.

Challenge	Possible Actions

Q4 – How are challenges associated with changes in size of vulnerable groups likely to affect the burden of foodborne disease in the UK.

Challenges	Possible Actions
<p>4a Defining what is a vulnerable group – Members discussed the difficulty in defining what constitutes a vulnerable group as it relates to food safety and the need to be able to provide appropriate advice and risk assessment. For example, older adults who rely on meals on wheels services have lost some independence and therefore may be vulnerable to food safety risks as they depend on others to cook for them. However, people who go on a cruise may also be vulnerable for norovirus if there is a large consumption of seafood such as oysters as well as being in close quarters with a large number of people. Members identified that it is important to consider not</p>	<ol style="list-style-type: none"> <li data-bbox="1153 742 2027 941">I. Use whole genome sequencing meta-data to help inform the decision on defining vulnerable groups. This may not be possible due to data confidentiality, but it may be worth exploring. This meta-data may also be incomplete. <li data-bbox="1153 1013 2027 1276">II. FSA to conduct research to explore what causes vulnerability in terms of health and contextual issues. The aim of this is to help identify if specific advice for subgroups could be created. How often this definition should be revisited is also key.

Challenges	Possible Actions
<p>only physiological circumstances but also contextual circumstances that may result in a vulnerable group such as location and economic status. It is also important to consider that the level of homogeneity in a vulnerable group may be changing. For example, members noted that we have an ageing population. However, many older adults are healthy and live independently but foodborne outbreaks occur more likely in those in care and therefore a differentiation needs to be made, with the focus being on those who provide the care.</p>	
<p>4b Long-COVID patients and the incidence of foodborne disease – Members pointed out that as we are coming out of the COVID-19 pandemic, we may have an increase in vulnerable groups due to those dealing with long-COVID. There are large evidence gaps surrounding long COVID, especially regarding the incidence of foodborne disease. There are also a range of other health burdens that have increased due to COVID-19 along with ongoing COVID-19 infections which would need to be explored regarding its effect on foodborne disease.</p>	<ol style="list-style-type: none"> I. Research into the incidence of foodborne disease in long-COVID patients in an attempt to fill evidence gaps. II. Formation of a potential ACMSF subgroup focused on long-COVID and the results of COVID-19 pandemic in relation to the incidence of foodborne disease. III. Possibly contact those who run the track-and-trace app to assist with information collation.

Challenges	Possible Actions
<p>4c Ageing population and loss of independence – Some members raised concerns that due to medical advances people are living longer with co-morbidities. As people are living longer, members were concerned with a higher percentage of people relying on services such as meals on wheels or other care services. These people lose some of their independence and therefore may be more vulnerable to food borne illness. These people are reliant on care workers and therefore it is up to these care workers to ensure suitable food hygiene practices.</p>	<p>The FSA should consider commissioning research, gathering evidence and assessing risks involving carers of the elderly rather than the elderly themselves to ensure that those who rely on care services are receiving food prepared to a high food-safety standard.</p>

Q5 - Anything else? What are other important issues or challenges that the Committee may face in the next 10-20 years?

Challenges	Possible Actions
<p>5a Need to consider complex and potentially antagonistic effects on risk from different hazard groups (micro vs chemical food safety/food waste and sustainability issues)</p> <p>– Members discussed the complexity in some of the issues ACMSF have looked at over the years (and may consider in the future) that revealed conflict in food safety advice. Risk management choices which reduce risk from one category of hazard may increase the risk from others. Reduction in waste and environmental and sustainability issues may also be in competition with assessment of food safety issues. It was agreed that a framework that can express the current situation</p>	<p>FSA/ACMSF to consider developing a framework that can consider net effects on assessed risk via food from microbiological and chemical hazards.</p>

Challenges	Possible Actions
<p>is needed to explore technical approaches to expressing these potential interactions when they occur.</p>	
<p>5b Complexity increasing in Food Business Operators (FBOs) supply chain – There was discussion on the increasing complexity and opacity of the supply chain as it was noted that there has been a huge shift to online trading. The ease in setting up and shutting down of internet food businesses was identified as a concern in relation to food safety. Members felt resources should be targeted towards monitoring the activities of internet FBOs. The use of technology in drawing insights and gathering data that could be used to identify/prioritise food safety risks was highlighted. Members agreed that there was a need to move away from the conventional approach in the way food safety risks are managed for physical and internet FBOs. It was underlined that this shift was needed in managing emerging complexity of the risks that may come from difficult to trace sources.</p>	<p>Appropriate authorities should explore the volume and risks presented by unregulated food sold online and how to support Environmental Health Officers to enforce standards. The use of technology should be considered in drawing insights and gathering data that could be used to identify/prioritise food safety risks.</p>
<p>5c Change in consumer preferences for alternative packaging materials – Consumers preferences to move away</p>	

Challenges	Possible Actions
<p>from plastics and its effects on food safety was discussed. Members felt that the drive to move towards removal of plastics may have knock on effects on food storage, food hygiene and food preservation.</p>	
<p>5d Microplastics – new challenges and new threats – Microplastics was flagged as having the potential to bring new challenges and novel threats to the food chain. The main threats highlighted were the introduction of physical kind of particles in food together with these microplastics being vehicles for transmission of pathogens.</p>	
<p>5f Viruses: lack of information on how food processing/matrix affects viruses – Members commented on the challenge food safety assessors face in knowing what food processing does to viruses, particularly thermal processing. Members discussed the challenge of how to use data from thermal inactivation experiments which can be poor and hard to extrapolate. Members agreed that there was dearth of information on food processing in relation to viruses. Although it was acknowledged that the committee published a</p>	<ol style="list-style-type: none"> I. FSA/ACMSF to consider how to address the dearth of information on food processing in relation to viruses. II. ACMSF to consider revisiting the comprehensive report it produced on virus in food chain.

Challenges	Possible Actions
<p>comprehensive report on virus in food chain in 2015, there was no objection to the suggestion of the need to revisit the report.</p>	
<p>5g Lack of knowledge about food safety risks and management, and the food supply chain in the general population. There appears to be very little information on food safety or nutrition included in school syllabuses.</p>	<p>Ensure food knowledge in the population from a young age to enable informed decisions re food and safety, possibly by seeking to have it included in relevant sections of the school curriculum, so as to empower people to be aware of and manage their own food safety risks.</p>
<p>5h EU sunseting Bill - Government's bill that proposes sunseting more than 2,400 pieces of retained EU legislation on 31 December 2023 was highlighted as among the challenges associated with the disruption to the supply chain. The Committee is concerned how the review of several food safety rules within 12 months will be done effectively without compromising food safety. This proposal has the potential to harm food safety leading to increased risks to the food chain.</p>	

December 2022

Secretariat

ANNEX 1

ACMSF HORIZON SCANNING 2022 (collated responses to horizon scanning questions from Members)

How are the following issues likely to affect the burden of foodborne disease in the UK over the next 10-20 years, in terms of existing and new hazards and likelihood of exposure, including AMR? What are the key evidence gaps?

- **Challenges associated with disruption to food supply chains**

Potential examples to consider: disease outbreaks, climate and environmental change, geopolitical issues including EU Exit, shortages of materials or resources.

Member A

1. Ingredient supply shortages resulting in increased risk or contamination / fraud, increased likelihood of procurement from less robust supply chains.
2. Worker shortage and / or increased cost of employment leading to recruitment of less skilled labour.
3. Production cost increases due to energy resulting in cost cutting of key food safety controls e.g., cleaning, protective clothing, etc.
4. Climate change resulting in increased rainfall resulting in greater risk of pathogen contamination of field grown crops or increased temperatures resulting in poorer temperature control in production, distribution, retail, and consumer.

Member B

5. More intensification in broiler chicken and pig production (to tackle food shortages and price increase) may lead to the emergence of new hazards or new strains of existing hazards, which may pose different level of risks to the consumer. This also may be linked to increase in AMR.

Member C

6. The conflict in Ukraine is already affecting the food supply chain, adverse weather conditions (more floods, droughts etc.) may affect the supply of certain ingredients and lead to an increase in food fraud, which could pose microbiological hazards. The food sector in the UK is suffering from a labour shortage of skilled workers which may lead to unqualified workers making mistakes along with training quality diminishing due to time constraints. The port health checks have been delayed again for imported food.

Member D

7. Disrupted supply chains (whatever the cause) mean longer delivery times, so increasing the risk of spoilage and consequent foodborne disease. It would be good to fund research into:
 - a. extending the shelf life of the major /basic foodstuffs that could be affected in this way – both research into pre-packaging cleanliness/treatment, and types of packaging.
 - b. Identifying and promoting foods with shorter supply chains

- c. Identifying and promoting domestically/locally produced foods that would substitute effectively for those with longer supply chains or shorter shelf life.

Member E

- 8. Food security and UK self-sufficiency in light of shortage of cereals, sunflower etc from Ukraine and also minerals from Russia, particularly for fertiliser.
- 9. The cost of energy (gas in particular) impacting production and cost of fertiliser, also CO2 (e.g., CF Fertiliser Ince plant closed), hence agricultural product yields.
- 10. Cost of energy (electricity and gas) impacting food production (potential for corners to be cut to reduce energy consumption) and food costs.
- 11. Food poverty including risks from more perishable foods through foodbanks etc.
- 12. Potential for increased food imports of possibly poorer quality from the above

Member F

- 13. We have seen recent disruptions to supply chains caused by war, COVID-19, changes in the just-in-time philosophy of manufacture. Disruption for legitimate businesses leads to changes in supplier and supply chain. Probably fast than normal and with reduced due diligence. This exposes businesses to potentially lower microbial quality/safety ingredients which may overwhelm a food safety

management system. There is also the issue of changing country of supply leading to new strains of pathogens entering the UK food supply. If supply countries have lax controls on antibiotics these bacteria may also pose an increased AMR threat. Supply chain disruption also presents opportunities for fraud and placing of unsafe food on the market which may also lead to foodborne illness.

Member G

14. The impact of climate change on mycotoxin prevalence in horticulture/crops is an ongoing concern. This has importance when considering global supplies and may alter dynamics to different extents in different geographical jurisdictions. As such, this needs to be considered for all import supply chains, in each case.

15. The impact of Brexit on food supply chains (e.g., new supply sources) needs to consider associated food safety standards and risks. Not just confined to pathogen prevalence, issues such as AMR are important to consider, since evidence demonstrates the associated AMR risks are significantly different in different geographical jurisdictions.

Member H

16. Food chain disruptions (changes?) occur continually and have many causes or drivers. It is unlikely that a prospective 'ranked' list of disruptions, organised by the significance with respect to microbiology safety, can be robust and would always be 'reordered' in the face of newly identified events (strictly the list is 'fragile'). However, there could be merit in consideration of a scheme for clustering or classification of challenges as they arise based on a set of features e.g., disruptions that are long term, gradual might be classified

differently from those that are short term or sudden (the current shortage of sunflower oil might be considered a different kind of disruption from the inevitable introduction of low meat diets). A classification scheme for food chain disruption could help FSA/ACMSF address issues with greater effectiveness.

17. Climate change is likely to be a dominant issue with respect to food, and microbiological food safety, for the foreseeable future but corresponds with many distinct and non-immediate disruptive drivers. Although it is very difficult to predict and prioritise the potential food safety consequences and issues that correspond with climate change disruptions it may be possible to separate some for immediate considerations and, in particular, the effect on water supplies used within food production and manufacture may have particular significance for food safety.

Member I

18. Disruptions to the food supply chain has been at times unpredictable/unprecedented (as was the case with the recent and ongoing Covid-19 pandemic), however there are challenges that are looming and becoming more present.

- Climate change will continue to disrupt in direct and indirect ways
 - o Microbial threat: Raising temperature of sea waters will have microbial and greater environmental impacts for industries surrounding aquaculture and fishing.
 - o AMR threat: AMR will continue to raise with an increase in disease due to higher temperatures and changing climate/environment and use of antimicrobials to battle aquaculture production-associated diseases.

- Geopolitical issues and supply chain disruption will challenge food safety and spoilage of foods due to delays.
 - o The potential to increase shelf time to compensate for transport time may arise for some products creating a food safety concern.
- Shortages of material may be a short-term challenge but may also be a longer-term innovation opportunity to switch materials (e.g., cooking oil sources – sunflower, rapeseed). Challenge of this is to not default to unsustainable or environmentally impactful alternatives (e.g., palm oil).
 - o Microbial threat: Switching supply chains of products may have an impact on foods carrying AMR containing microbes or increase in a pathogen (e.g., *Salmonella* in frozen chicken products – different source had different *Salmonella* load risk).

Member J

19. Climate change

- a) droughts reducing water for irrigation and washing/processing food
- b) floods causing faecal contamination of growing food
- c) reduce methane production e.g., seaweed in cow's diet – microbiological impact?

20. Wars disrupting food production and supply chains.

21. Risk of AMR increase linked to metal resistance genes on plasmids due to feeding animals with supplements e.g., Zn or Cu in pig feed as a growth promoter and the waste recycled to land to enter the food chain.

Member K

22. Considering EU exit, shortages of grain and commodities such as cooking oil and climate change, there is likely to be more dependence on ambient stable products that are more resilient to food chain perturbances. EU Brexit may result in shorter shelf-life of some products exported to EU due to additional documentation required. Most of these are not likely to impact on food safety, but some may impact on food quality, with reduction in shelf-life for a number of products. One area of safety potentially affected may be products that have limited shelf-life set for pathogens such as listeria – if shelf-lives are shortened, consumers may be unaware of these and continue using products with previously set use-by dates.

Member L

23. Food fraud, mislabelling due to shortages.

24. Microbial and chemical contamination.

25. Potential for sporadic outbreaks of foodborne viruses due to imported ingredients/goods.

26. Potential for parasites?

27. Risk that new and incorrectly documented allergens are introduced if ingredients have to change.

28. Increased costs which filters down to consumer behaviour and purchasing.

• **Changes in methods of food production and new food technologies**

Potential examples to consider: new food packaging, sustainable food practices, food reformulation trends.

Member A

1. Plant based foods including modified atmosphere packaged, extended shelf life, chilled, ready to eat foods.
2. 3D printed meat analogues.
3. Synthetic cell culture milk and milk products.
4. Vertical farming.

Member B

5. Diverging from EU legislation and possible trade agreements with USA may lead to different approach towards food safety interventions, particularly the ones for which regulatory approval is required at present (e.g., chemical interventions). This will require a proper risk assessment for associated microbiological and chemical hazards. This may also lead to an increase in AMR.

Member C

6. Food that has been reformulated to reduce salt and/or sugar (where their inclusion may have a preservative effect) must also have the storage conditions and best-before date checked to ensure that it is adequate for the new recipe. The same for food that have artificial preservatives or additives removed to provide a 'fresh' product to the consumer. Will either of these changes lead to a reduction in shelf life and potentially an increase in food waste? Will the removal of plastic packaging reduce shelf life for some products, or will it expose the food to an increased contamination risk? Some food is packaged to protect it (delicate fruit) and if the packaging is changed, the food may get

damaged and not chosen by the consumer so it will be wasted. The current debate on use-by dates is interesting and it may affect food safety if the removal of use-by dates is extended to more products.

Member D

7. Reduced use of plastic packaging may increase cross contamination and shorten shelf life.

Member E

8. Insect protein farmed for use in animal feed – potential for operators not to be regulated plus contamination of the insects from waste food substrates – including mammalian protein (TSE) and salmonella etc (as ACMSF subgroup)
9. Risks of imported meat having been fed the ‘wrong’ mammalian protein (TSE, as ACMSF subgroup)
10. Greater risk of food fraud due to food poverty

Member F

11. The Farm to Fork strategy in EU will affect UK as well. It is unlikely that a move to more sustainable food systems in the EU will not result in similar political pressure in UK. The shift from plastic packaging, for a microbiological perspective, could affect shelf life of products if FBOs do not introduce them with valid studies. Food reformulation, if not done correctly, could affect preservation and shelf life as well, leading to an increase in food safety incidents. Technologies involved with the production of meat substitutes are likely to bring with them microbiological challenges that may introduce new food safety threats.

Member G

12. The use of food loss/waste remains a growing sector in food production and food additive/bioactive compound purification/production. This has potential to introduce new risks from known pathogens, but also has the potential to lead to the emergence of novel pathogen threats. This needs to be considered as these biomaterials, technologies and approaches see wider adoption in food production. This also ties in with the potential applications of food loss/waste biomaterial as new novel food packaging technologies, and the potential impact to food safety.

13. Non-thermal technologies (e.g., UV, cold plasma, high pressure/high pressure thermal processing, microwave) need to be continuously evaluated as they are applied to new novel food applications.

Member H

14. Many aspects of food chain safety and organization have been developed on the basis of volume i.e., economies of scale for production have in many cases also manifested as economies of scale for food safety assurance e.g., tracking and tracing, pasteurization controls. Any move towards smaller scale production, e.g., driven by a rise of nation state self-sufficiency (anti-globalization) or by the residual societal impact of a global pandemic, could have an impact on food safety if, on smaller scales, new methods/technologies are actually old methods/technologies with weaker safety criteria.

15. Current trends indicate that food production and manufacture will shift to the use of renewable energy sources and lower usage of energy over a relatively short timescale. The effect of changes in energy use, and potentially compensatory changes in chemical use etc., are complex but may require consideration in many risk assessment activities that are relevant for the ACMSF.

Member I

16. The move towards meat and protein alternatives continues with a growing market of non-animal and alternative protein (e.g., insect) as well as production methods to improve shelf-life of food products.

- Microbial threat: Methods to decrease spoilage of foods by way of understanding what causes spoilage and interventions at the microbial community growth level that is in part responsible for spoilage. There is a resilience in microbial communities in biofilms. New intervention strategies and methods are required and will need to be reviewed/assessed.
- Sustainable food practices and innovative vertical agriculture as a sustainable and affordable practice for foods (fresh and processed).
- Microbial threat: Changes in methods may introduce novel environments for pathogen transmission (e.g., previously unknown sources of pathogen - e.g., *Campylobacter*) or persistence of known pathogens (e.g., *Listeria*, *Salmonella*).

Member J

17. Potential for shift in consumption away from conventional livestock production and towards the consumption of protein from insect or plant-based sources.

18. Political, social and economic pressures to reduce energy use and switch to renewable sources ("Low Carbon Society") may make it more challenging to heat/disinfect/sterilise foods during processing and in the home without increasing carbon emissions.

Member K

19. Reformulation trends will continue due to product development needs.

The greater risk is likely to be for SMEs that have fewer in-house skills and expertise to develop new products that have a robust preservation/processing regime.

Member L

20. Sustainability of packaging and costs.

21. Allergens due to increased consumption of plant proteins by cohorts.

Changes in consumer behaviour and preferences

Potential examples to consider food poverty and inequality, changes in food storage/preparation practices, changes in consumer diets influenced by health or sustainability issues.

Member A

1. Food poverty due to household cost pressures resulting in reduced food safety compliance e.g., exceeding use by dates, cooking efficacy, use of leftovers, etc.
2. Reuse of containers and consequent increased risk of cross contamination of filling stations or storage containers.
3. Increased poverty resulting in poorer diets and poorer health / immunity.

Member B

4. Not overly related to direct foodborne route, but novel trends in pets raw feeding is leading to increased exposure to main hazards from raw meat: STEC, Campylobacter, Salmonella, AMR, etc. Pet owners and particularly their immunocompromised household members (children)

are more often at risk of acquiring infections when in direct contact with raw pet food.

Member C

5. The increase in people choosing a plant-based diet may increase the amount of land given over to crop cultivation and may encourage clearing of forests in certain countries. Insect protein may become a larger part of our diet, and this will need to be regulated to be done safely. People may keep food too long at home as they cannot afford to throw it away once the use by date expires. People may start to eat more ready to eat food as they cannot afford the fuel bills to cook food, and this may lead to an increase in listeriosis particularly.

Member D

6. High energy costs are likely to lead to less or different cooking so it would be good for FSA to research how to cook typical basic foodstuffs cheaply but effectively (to remove foodborne microbes) and educate the public in this; e.g. microwaving is much cheaper than oven cooking so research to establish cooking power and times for widely consumed foods typically cooked in the oven that could then be shared by labelling and other means would be good.
7. Increased food bank use may impact on nutrition of users as fresh fruit and veg are hard to include this may lead to users becoming a vulnerable group for foodborne disease, and their poverty makes them less likely to cook appropriately. Research to enable fresh produce to be included at food banks safely would be useful.

Member E

8. Increased food poverty and use of food beyond 'use before' dates.

9. Vegetarianism.

Member F

10. Consumer health preferences will drive reformulation and introduction of plant based and vegan foods. Reformulation done badly could affect shelf life and pose microbiological threats. Plant based foods pose challenges with some bacteria like *B. cereus* being a potential threat. Another concern would be the number of small start-up FBOs in this area where technical knowledge and experience could be lacking leading to problems with food safety management systems. The growth in consumption of fresh fruit and RTE salads couples with the convenience factors of pre-preparation may cause a rise in foodborne illness especially from viruses but also parasites like Cyclospora and Cryptosporidium. This may be exacerbated by changes in weather patterns and pressures on water supplies in some UK regions leading to irrigation with unsafe water.

Member G

11. The impact of outbreaks such as COVID leads to changes in behaviour by both businesses and consumers in how they mitigate against the outbreak pathogen. We know co-selection has caused notable shifts and selection pressures that change the landscape of foodborne pathogens, selecting for specific resistant populations (e.g., triclosan co-selection of antibiotic resistance).

12. The increased use of biocides to target outbreak organisms may influence exposure of consumers to resistant strains and may predispose foods to carry higher burdens of antibiotic resistance markers/AMR organisms. This needs to be considered and evaluated to clarify potential downstream issues.

Member H

13. Ongoing changes in the prevalent information sources for consumers, which include unchallenged authority, targeted network sources and paid influencers are rapidly affecting the connections between reliable food safety advice and food users. Strategies to strengthen science-based truths, and to dispel alternative truths, in relation to food safety information should be a priority of food safety assurance over the next decade (or less).
14. With respect to food the appearance of more opportunities for choice, more and deeper societal inequalities and more diverse lifestyles means that food consumers, and their behaviours, are disaggregating rapidly and it will become essential that risk assessments relating to food safety reflect the disaggregation in order to remain relevant to the many 'publics'.

Member I

15. Cost of living and access to affordable foods will further change consumer behaviour to optimise and maximise the groceries purchased for a household.
- Home storage of perishable items may be stored longer if unused.
 - o Biofilm formations in the home environment, foodborne pathogens surviving in biofilm communities create a new microbial threat.
 - Purchasing of near/past expired products and keeping them longer at home
 - Changing behaviour to longer lasting foods (i.e., not fresh foods) will influence diets, vulnerabilities to other illnesses.

Member J

16. Turning off refrigerators to save electricity, increasing food contamination risk; eating out of date food; undercooking food to save electricity.

Member K

17. With cost-of-living increases, cheaper products are likely to become more popular, but this is not likely to impact directly on safety unless less robust preservation/processing is applied – no evidence that this is the case at the moment.

Member L

18. It was clear from the reports at the last AGM that there were significant issues with consumers understanding the use of hygiene, cooking right through to defrosting etc., this needs to be followed up on with clearer education as the current information does not seem to be disseminating.

Challenges associated with changes in the sizes of vulnerable groups.

Potential examples to consider ageing population.

Member A

1. A significant increase in the proportion of elderly adults in the population has the potential to lead to an increase in age-related diseases and greater vulnerability to certain foodborne pathogens.

Member B

2. Increase in the size of ageing population will lead to increase in the incidence of the food related incidents involving foodborne pathogens that are affecting predominantly immunocompromised individuals (e.g., *Listeria*, *Toxoplasma*, nosocomial infections, etc).

Member C

3. Older persons are at higher risk for Listeria poisoning and cases may increase with an ageing population. Older people may rely more often than others on ready to eat foods due to several factors. They may lack the motor skills (due to arthritis etc.) to chop and prepare food and may have trouble standing for long periods. They are more likely to live alone and therefore not 'bother' to cook a full meal for one, they are more likely to be in fuel poverty and cannot afford to pay fuel bills as they are on a fixed income so cold food is more likely to be consumed. They are more likely to choose to purchase their sliced, cooked meats from the delicatessen counter rather than prepacked and studies have shown that sliced, cooked meats from the delicatessen counter have higher incidents of Listeria contamination. They may choose this way to buy sliced, cooked meats as this is what they are used to from their younger days before supermarkets, they may wish to talk to the person behind the counter for human interaction and they can choose a smaller number of slices rather than the 7+ slices in a pre-packed packet. In addition, older persons are in a vulnerable group as their immune system is weakened over the years and they are more susceptible to infections generally.

Member D

4. Widespread problems with long COVID, medical waiting lists and increasing autoimmune disease will increase these vulnerable groups, we may get to the point where most people are in one or other

vulnerable group and so there will be little point in using this to determine who needs advice and support – everyone may need it.

Member E

5. Weakened immune systems from COVID (especially elderly / vulnerable).
6. Increased infection levels due to less face mask wearing.

Member F

7. Clearly aging populations are more vulnerable and as that group grows in UK there will be more microbiological illness and Listeriosis will have to be a particular focus but not the only one. Medical progress will lead to a bigger group of people living with chronic conditions that may suppress their immune system for periods which will leave them vulnerable to foodborne infection. This group are probably less aware they are vulnerable which increases the challenge.

Member G

8. The aging population presents new challenges for food safety risks in terms of disease severity. For example, risk of severe illness and/or mortality can be greater in the elderly population demographic for a range of pathogens, such as *Listeria monocytogenes*.
9. Supply chains and infrastructure associated with any potential future changes (growth) in raw/less cooked food consumption, (e.g., raw milk, undercooked beef consumption as was the case in the US), needs to be considered. This could, for example, increase the risk of vulnerable populations (e.g., children) to high-risk pathogens such as *E. coli*

O157/high risk serotypes, as could be the case with other pathogens.
Raw food for domestic animal feeds is also an emerging risk area.

Member H

10. Challenges with vulnerable groups: Although the population of food consumers is changing rapidly, including aging, it is unlikely that these changes are reflected homogeneously in terms of food safety. Rapid advances in the science relating to the human immune system, and in relation to the human gut microbiome, may indicate that an established view in terms of a small number of exclusive vulnerable groups should be replaced by a more systematic description in terms of the variability of human immune responses, i.e., a statistical acknowledgement of healthy aging, in assessments of food safety.

Member I

11. Aging population, post-covid populations and changing life circumstances have contributed to a changing demographic of vulnerable groups. Cost of living challenges have also impacted this. The psychogastrology (gut-brain axis) has been an increasing will be a further challenge in the coming years. The influence of the gut and gut microbiome onto the brain and vice versa is in increasing area of importance.

- Vulnerable individuals may comprise of aging population, stressed individual due to life circumstances, post-illness or chronic sequelae individuals.
 - o Vulnerable populations may be at a higher risk of foodborne disease or complications due to foodborne illness.

Member J

12. Immunosuppressed groups e.g., increasing diabetes susceptibility to infection. Long COVID patient susceptibility?

Member K

13. An increase in the aging population will increase potential for some individuals to misread or overlook storage and cooking instructions. Highest risk will be products where shelf-life and cooking target pathogens.

Member L

14. Allergens due to increased consumption of plant proteins by cohorts.

15. Ageing population more vulnerable to foodborne infections – need for vigilance.

16. Toxin exposure.

Anything else?

What are other important issues or challenges that the Committee may face in the next 10-20 years?

Member A

1. Reduced enforcement and inspection resource for official controls.

2. Reduced industry resource on food safety controls.

3. Reduced capability and capacity to deal with major incidents.

Member B

4. Nil.

Member C

5. One current hazard is the lack of knowledge about the food supply chain in the general population. Food science/safety/nutrition can be included in almost every school subject, but it doesn't seem to be. Empowering the population from a young age with food knowledge is a very important part of any future plans to help the public to protect themselves with knowledge and understanding.
6. The volume of unregulated food sold online is astonishing. People are selling food through Facebook/Instagram etc. with no checks or inspections as to how safe this food is. If the above suggestion were implemented and we educated people on the dangers of this type of food, they wouldn't buy it. Something needs to be done to either make sure that these businesses are supplying safe food or to close them down to protect the public.

Member D

7. The Committee should revisit the definition of 'vulnerable groups' before addressing their challenges (as per the last question above) so as to be sure of identifying and protecting them appropriately, possibly including seeking to categorise different groups according to their different food borne risks.
8. The changing climate is likely to increase flooding and surface water, including in fields with crops to be harvested. This will increase both

the risk of contamination of those crops with foodborne pathogens and their contamination with environmental organisms that may carry AMR genes/markers, which will subsequently enter the food chain and the human population.

Member E

9. Anti-Microbial Resistance.

10. Salmonella levels in raw pet food

Member F

11. Although COVID-19 wasn't foodborne the next epidemic/pandemic virus maybe, at least in part, we need to build up more expertise in viruses as a committee and also parasites given the global trade in food and treats from fresh produce.

12. We will also need to maintain access of the committee to members with good expertise in statistics and quantitative risk assessment.

Member G

13. COVID has emphasised the capacity for new emerging threats to become a reality for global communities. The efficacy of cleaning and sanitising, food packaging, and other interventions used in the food industry, on inactivation of such biological agent are important considerations. In addition, the potential of foodborne transmission of such agents must always been at the fore for consideration of food as a disease transmission vector.

Member H

14. Other ACMSF challenges.

- Recently it has become apparent that the interface between the ACMSF and relevant data supplies is complex, e.g., the representation of EFIG data, and it may be appropriate to address the issue (optimization) on a wider scale as the sources and types of quantitative information increases.
- The issues addressed by the ACMSF are becoming increasingly complex and often involve competitive forces/drivers e.g., Food safety and Food Waste, Food Safety and Environmental Issues. It may be appropriate for the ACMSF to develop a framework that allows a clear expression of conflicts that are relevant to decision making that involves food safety.
- The number of issues that are within the remit of the ACMSF is increasing rapidly because of the ability of many scientific techniques, such as WGS, to disaggregate risks. It may be appropriate for the ACMSF to consider how this inevitable trend will be reflected in the work programme and whether some specific considerations to arrest (or capture) the disaggregation are necessary.

Member I

15. Microplastics/nanoplastics are only starting to be recognised as a threat to food as a direct contaminant, however these particles may also be vehicles of transmission of known and novel pathogens as microbial communities build biofilms on the particles and are passed through the food chain unchecked.

16. Long term (post covid) effects on the human body (Immune responses, infection vulnerabilities will continue to be a field that needs to be monitored in the coming years

17. Climate changes changing agricultural practices and conditions (e.g., seas, soils, arable lands etc)

18. Metagenomic approaches to monitoring threats in the food chain.

- Laboratory methods to use innovative strategies and develop reliable results are required as there continue to be changes to testing and an increased stress on resources (personnel, time, cost etc) that impact decision making of what to test and when.

Member J

19. UK divergence from EU food standards – implications for imported and exported food.

20. Migratory birds bringing viruses and AMR pathogens to the UK, contaminating growing crops and infecting animals.

Member K

21. Pressure to develop standards, practices, and risk assessments independently from the EU.

Member L

22. Time/costs to put relevant infrastructure in place.

23. AMR and food safety appear to be viewed as two different things – ensure opportunities for joint working are identified and followed through.