

ADVISORY COMMITTEE ON THE MICROBIOLOGICAL SAFETY OF FOOD
DISCUSSION PAPER

Update on response to the ACMSF report on viruses in the food chain

Issue

1. The ACMSF's report "An update on viruses in the food chain" was published in March 2015¹ and contains a significant number of recommendations to the FSA, other Government Departments and Agencies (Annex A-ACM/1179). At the June 2015 meeting the committee was provided with an update on the Agency's progress in addressing some of the Committee's recommendations (ACM/1179). This current paper provides a further update on progress mostly in relation to the research gaps which were identified by the committee. In addition, a summary of the EFSA/FSA workshop on foodborne viruses held in February 2016 is also provided as this is relevant to future research priorities in this area. The full workshop report may also be available. Members are asked to note that the response is still work in progress and a more comprehensive update will be provided at a future meeting.

Detail

Norovirus and Hepatitis A and E research (Recommendations 3.4, 3.5, 3.6, 4.1, 6.2, 7.1)

2. The FSA has commissioned a norovirus attribution study (referred to as NoVAS; FSA FS101040) to assess the contribution that the food chain makes to the burden of UK-acquired norovirus infection. This work includes a work package aiming to develop a capsid integrity assay to measure infectivity of NoV and whether the assay could be applied to the existing European Committee for Standardisation (CEN) detection methods. If successful, this will lead to an improved method for the detection of infectious virus particles in foods (oysters, raspberries and leafy salads). Other work packages in this study will determine prevalence and levels of NoV contamination of oysters, salad leaves (lettuce) and soft berries (both fresh and frozen raspberries) and on retail sale in the UK. The study started in January 2014 and is due to report in May 2017. Further information is available at:
<http://www.food.gov.uk/science/research/foodborneillness/b14programme/b14projlist/fs101040>
3. The FSA has published a critical review of methods for distinguishing infectious and non-infectious NoV (FSA FS101036). The review identified gaps in knowledge regarding the detection of infectious human NoV. For example, the absence of a suitable culture system for infectious human NoV and highlighting that RT-qPCR

¹ <http://acmsf.food.gov.uk/sites/default/files/acmsf-virus-report.pdf>

methods alone cannot currently distinguish infective and non-infective virus. Further information is available at:

<http://www.food.gov.uk/science/research/foodborneillness/b14programme/b14projiist/fs101036>.

4. The FSA has carried out two critical reviews on the survival of viruses in food and food contact surfaces. The first was on the survival and elimination of NoV from food and food contact surfaces (FSA FS101120) whilst the second focused on the effects of heat, pH and water activity on the survival of hepatitis A virus (HAV) and hepatitis E virus (HEV) (FSA FS101074). The reviews investigated the persistence of NoV, HAV and HEV on a variety of food matrices including fresh berries and investigated whether these viruses could be eliminated and/or removed by various physical treatments e.g. heat, washing, freezing, freeze-drying, etc.
5. FS101074 was published in September 2014 and can be found at <http://www.food.gov.uk/science/research/foodborneillness/b14programme/b14projiist/fs101074>. The review concluded that HAV appears to be a highly robust virus which is able to survive on surfaces and foods, and is resistant to mild heat. FS101120 will be published in summer 2015. Further information can be found at: <http://www.food.gov.uk/science/research-reports/fs101120>.
6. The FSA has carried out a systematic review on the survival of NoV in foods and on food contact surfaces (FSA FS241043). Further information is available at : <http://www.food.gov.uk/science/research/foodborneillness/b14programme/b14projiist/fs241043>. The review highlighted that human NoVs are both more persistent and more resistant than surrogate viruses. Therefore the evidence suggests that infectious human NoVs are more likely to persist in foods and on food contact surfaces than currently predicted by most surrogate studies.
7. The FSA has recently published a critical review of approaches to assessing the infectivity of hepatitis E virus (HEV) which is available at <https://www.food.gov.uk/science/research/foodborneillness/b14programme/b14projiist>. The review recommended that a cell culture-based method for assessing HEV infectivity in pork products should be developed. Systems comprising promising cell lines and HEV strains which can grow well in cell culture should be tested to select an assay for effective and reliable measurement of HEV infectivity over a wide range of virus concentrations. The assay should then be harnessed to a procedure which can extract HEV from pork products, to produce a method suitable for further use. Such a method would be essential in any future food surveillance on HEV as it would give us a means of measuring the infectious virus in food samples which will inform risk assessment. It would also help further research to see if heat and other factors such as pH, drying) has an effect of HEV infectivity in foods.

Detection methods (Recommendation 5.1)

8. The FSA has commissioned a norovirus attribution study (referred to as NoVAS; FSA FS101040) to assess the contribution that the food chain makes to the burden of UK-acquired norovirus infection. This work includes a work package

aiming to develop a capsid integrity assay to measure infectivity of NoV and whether the assay could be applied to the existing European Committee for Standardisation (CEN) detection methods. If successful, this will lead to an improved method for the detection of infectious virus particles in foods (oysters, raspberries and leafy salads).

9. The FSA is contributing funding towards a NERC research programme on 'Environmental Microbiology and Human Health'. This programme has the overall vision of providing scientific evidence to support fast and efficient identification of pathogenic/allergenic microorganisms and biological material in environmental media which can be used in appropriate tools and models for the protection of public health. The grant provided by FSA will support funding of new approaches for the quantitative detection of human pathogenic viruses within the freshwater-marine continuum, focussing on viruses of strategic importance including NoV, HAV and HEV. The study will aim to use metavirome analysis of viral communities and to develop and apply new techniques to evaluate the proportion of viruses that remain detectable but not capable of human infection. This grant will run for 3 years from April 2015. Details of the NERC research programme are at:
<http://www.nerc.ac.uk/research/funded/programmes/emhh/>
http://gotw.nerc.ac.uk/list_them.asp?them=EM%26HH&cookieConsent=A

Virus monitoring in shellfish (Recommendation 6.1, 6.4)

10. Discussions at EU level to establish statutory NoV limits for oysters have been deferred to allow a harmonised EU baseline survey to be carried out to provide data on which an assessment of impact may be made. This decision acknowledges Member State (MS) concerns over the insufficient evidence base, particularly the lack of a method to detect infectious NoV and the lack of EU-wide prevalence data for NoV in oysters at the point of harvest and following post-harvest treatment. The EU baseline survey will quantify NoV titres in live oysters sampled from classified shellfish production areas and depuration centres. Sampling is planned to run from November 2016 to December 2018. HEV is not included in the EU survey but the option for retrospective testing of samples will be explored.
11. The FSA is currently supporting a NERC grant which aims to develop and use new approaches for the quantitative detection of NoV and other viruses of strategic importance, within the freshwater-marine continuum (see para 9 and 15).

Shellfish depuration (Recommendation 6.2)

12. In October 2014 the FSA commissioned a study to review and evaluate the effectiveness of standard UK depuration practices in reducing NoV in oysters and to explore the potential for novel approaches to significantly improve the effectiveness of this process (FS101068). This study includes a critical review of international literature to evaluate the effectiveness of depuration in removing NoV from oysters, the mechanism by which NoV is specifically bound and retained in oysters, and to identify specific compounds that may destroy these receptors. A series of pilot experiments will also be carried out to trial application of these compounds immediately before depuration to investigate whether this approach

has the potential to reduce norovirus levels in pacific oysters significantly. If these initial studies show efficient reductions in norovirus, further work would be needed to evaluate commercial application. Further information is available at:

<http://www.food.gov.uk/science/research/foodborneillness/p01programme/fs101068>.

Effectiveness of sewage treatment (Recommendation 6.3)

13. A number of different funders have supported research in this area including:

FSA (FS101088). Enhancing knowledge of norovirus behaviour in the marine environment

<https://www.food.gov.uk/science/research/supportingresearch/strategievidenceprogramme/x02projlist/fs101088> (Cefas, 2013-2015) (see para 19)

FSA (FS513404). Review of approaches for establishing exclusion zones for shellfish harvesting around sewage discharge points (see para 16).

<https://www.food.gov.uk/science/research/foodborneillness/p01programme/p01projlist/fs513404>

(Aquatic Water Service, (with Intertek, Exeter University, Aquafish Solutions Ltd, 2013-2015)

14. FSA is contributing top-up funding to a grant award within the NERC Environmental Microbiology & Human Health program. The projects are funded under the theme of “new approaches for the quantitative detection of human pathogenic viruses within the freshwater-marine continuum” The current projects within this theme are scheduled to run for 2015 to 2018 (see para 9). This work also contributes to addressing a number of other recommendations (e.g. 5.1)

http://gotw.nerc.ac.uk/list_full.asp?pcode=NE%2FM010996%2F1 (Bangor University)

http://gotw.nerc.ac.uk/list_full.asp?pcode=NE%2FM010678%2F1 (CEFAS)

http://gotw.nerc.ac.uk/list_full.asp?pcode=NE%2FM011577%2F1 (NERC Centre for Ecology and Hydrology)

http://gotw.nerc.ac.uk/list_full.asp?pcode=NE%2FM011364%2F1 (Cambridge University)

http://gotw.nerc.ac.uk/list_full.asp?pcode=NE%2FM010783%2F1 (Liverpool University)

Risk management measures for shellfisheries (Recommendations 6.7, 6.8)

15. The FSA has completed a desk study which reviewed relevant literature relating to approaches that have been used or may be used for establishing exclusion zones for bivalve shellfish harvesting around sewage discharge points (FS513404). The study also assessed technical and practical applicability of the various approaches identified to the UK’s shellfish harvesting waters. Further information is available at:

<http://www.food.gov.uk/science/research/foodborneillness/p01programme/p01projlist/fs513404>.

16. The literature review highlights that NoV has a different risk profile from bacterial Faecal Indicator Organisms (FIOs) used in food hygiene and environmental management controls. It highlighted that seasonal NoV loading in crude wastewater reflects the variation in 'catchment health' of the sewerage connected population, Waste Water Treatment Plants are less effective at removing NoV than FIOs, UV disinfection efficacy and environmental degradation of NoV cannot be demonstrated using current analytical tools and bioaccumulation of NoV from water into shellfish flesh has a very different mechanism from that of FIOs.
17. As no single shellfish risk management measure is likely to be effective for NoV, a 'whole system' approach has been suggested which could include a dynamic 'active management' approach to zoning based on risk scoring. The suitability of such 'enhanced management zones' would need to be assessed on a catchment specific basis.
18. Since August 2013 the FSA and Defra have jointly funded a study to investigate the fate of human NoV in commercial shellfisheries (FS101088). This work involves field and desk-based studies to investigate the relationships between levels of NoV and *E.coli* in shellfish and to identify factors influencing the prevalence and distribution of the virus in the environment. The field data collected will be used to develop possible options for improved risk management for NoV that will inform FSA and Defra policy development. The project is due to be published in Autumn 2016. Further information is available at: <https://www.food.gov.uk/science/research/supportingresearch/strategicevidenceprogramme/x02projlist/fs101088>
19. The FSA and Defra will consider the recommendations from these studies and reflect on the appropriate next steps taking account of other relevant developments, such as the EU baseline survey on norovirus in oysters which will run for 2 years from November 2016.

Enteric viruses in fresh produce and infectivity (Recommendations 7.1, 7.2)

20. The FSA has commissioned a norovirus attribution study (referred to as NoVAS; FSA FS101040) to assess the contribution that the food chain makes to the burden of UK-acquired norovirus infection. This work includes a work package aiming to develop a capsid integrity assay to measure infectivity of NoV and whether the assay could be applied to the existing European Committee for Standardisation (CEN) detection methods. If successful, this will lead to an improved method for the detection of infectious virus particles in foods (oysters, raspberries and leafy salads). Other work packages in this study will determine prevalence and levels of NoV contamination of oysters, salad leaves (lettuce) and soft berries (both fresh and frozen raspberries) and on retail sale in the UK.

The study started in January 2014 and is due to report in May 2017. Further information is available at:

<http://www.food.gov.uk/science/research/foodborneillness/b14programme/b14projlist/fs101040>

21. Further research to identify the most effective means of viral decontamination of fruit and vegetables post-harvest is not a current priority for then FSA. Evidence shows that decontamination of fresh fruits and vegetables that will be eaten raw is inherently difficult and that focusing on actions that will prevent contamination occurring during production and handling of fresh fruits and vegetables is key to reducing risk.

Food preparation and hygiene in the home (Recommendation 11.1)

22. FSA advice to consumers on food preparation and hygiene in the home, including cooking shellfish and washing fruits and vegetables is available to consumers on NHS Choices:

<http://www.nhs.uk/Livewell/Goodfood/Pages/fish-shellfish.aspx#preparings>

<http://www.nhs.uk/Livewell/homehygiene/Pages/How-to-wash-fruit-and-vegetables.aspx>

Public understanding of foodborne viruses (Recommendation 11.4)

23. The ACMSF report made a specific recommendation that SSRC should consider what further research is needed on public understanding of foodborne viruses. A paper was presented to the committee at their April 2016 meeting (SSRC 16/1/4) which outlined proposed work with ACMSF on public perceptions of foodborne viruses. The Committee supported the content and recommendations within the paper; acknowledged that public awareness of foodborne illnesses was likely to be low, depending on recent outbreaks; and discussed how best to improve awareness. There was support for setting up an SSRC working group to explore the issue further and this could include input from the ACMSF.

<https://ssrc.food.gov.uk/sites/default/files/2016-1-4-ssrc-acmsf-joint-working.pdf>

Consumer advice on eating raw shellfish (Recommendation 6.5, 11.5, 11.6)

24. The recommendations do not reflect consumption habits where shellfish such as oysters are traditionally consumed raw. The FSA advice balances the need to protect public health, ensure consumers are informed and can make informed choices. The FSA advice on safe preparation of shellfish and the risk of norovirus infection from eating raw oysters is available to consumers on NHS Choices:

<http://www.nhs.uk/Livewell/Goodfood/Pages/fish-shellfish.aspx#preparings>

<http://www.nhs.uk/news/2011/11November/Pages/winter-vomiting-bug-found-in-most-oysters.aspx>

25. With respect to consumers collecting shellfish for consumption FSA advice also given on NHS Choices. FSA advise members of the public to check with the

relevant local authority before harvesting shellfish from public waters or beaches due to the potential for risks from toxin, bacterial or chemical contamination.

26. The FSA is in the process of developing a risk management framework for dealing with risky foods and shellfish consumed raw is likely to form part of the future considerations in this area. Work arising from the paper considered by the SSRC in April 2016 might contribute to a better understanding of risks in relation to foodborne viruses and help identify ways to improve awareness.

EFSA/FSA workshop on viruses in food February 2016*

27. A joint workshop on viruses in foods was held by the Food Standards Agency and the European Food Safety Authority in February 2016 in order to bring together experts from the scientific, clinical and food processing fields to discuss the current state of understanding with regard to the three foodborne viruses currently of greatest public health concern: Norovirus, Hepatitis A Virus and Hepatitis E Virus.

28. The format of the workshop followed an adaptation of EFSA's Expert Knowledge Elicitation process, which ensured input from all participants and allowed for the opinions of each to be aggregated and ranked. Each breakout session was led by an EFSA facilitator trained in this elicitation method and supported by two rapporteurs. The views of all participants were registered via a system of voting cards, which were tabulated and statistically analysed by the facilitators in order to highlight where there was agreement and disagreement amongst the experts and to identify the areas of consensus.

29. Breakout sessions were held for the following themes:

- Norovirus epidemiology
- Hepatitis A Virus epidemiology
- Hepatitis E Virus epidemiology
- Norovirus and Hepatitis A Virus methodologies
- Hepatitis E Virus methodology
- Norovirus and Hepatitis A control methods
- Hepatitis E control methods

30. Each breakout session examined existing research priorities and determined whether these were still extant or whether there were now new priorities. They were asked to evaluate the resulting list of topics on the basis of the impact on public health in Europe and the feasibility of implementation. They then ranked these in order of priority via the means described above. In the final plenary session, the participants voted for overall research priorities.

31. The overall conclusions of the workshop were that methods for assessing infectivity and public health burden were needed, particularly for Hepatitis E Virus and norovirus. Much more work was needed to progress our understanding of the transmission of Hepatitis E virus in the food chain, including development of standard methods for detection in meat.

32. The following overall priorities for progressing the state of knowledge regarding norovirus, HAV and HEV in foods were identified following the elicitation process:

- **The development and validation of direct and indirect methods for assessment of HEV infectivity**
- **Establishing how the detection of norovirus in foodstuff relates to public health risk**
- **Methods to evaluate norovirus and Hepatitis A infectivity in control measures and food samples**
- **Development of standard methods and ISO methods for detection of HEV in meat and meat products**
- **Establishing the burden of hepatitis E in human populations in Europe**

33. The workshop closed with presentations from FSA and EC DG-Research on potential means of funding the identified priorities. Potential for collaborative working across the research community and industry was highlighted and it is hoped that by working together progress can be made against the highest priority needs.

34. The FSA will continue to work with other Government Departments and Agencies to consider the recommendations in the committee's report and the Secretariat will keep Members informed through updates at future meetings.

Action

35. The Committee is asked to comment on the update.

Secretariat
October 2016

* The Summary Report of Joint Scientific Workshop on Foodborne Viruses was published on 20 October : <http://www.efsa.europa.eu/en/supporting/pub/1103e>

12. Summary of conclusions and recommendations

For ease of reference, this Chapter summarises the conclusions we have reached throughout this report and the recommendations we have made. These are listed by chapter heading.

We have endeavoured to prioritise the recommendations by separating these into recommendations that we consider will **inform risk assessments** and those that will **impact on risk assessments**. For those recommendations that inform on risk assessments we have undertaken to identify the lead Department that should take these forward.

Foodborne viral disease

Conclusions

We conclude that:

The public health significance of viral contamination as indicated by PCR results is an important issue for the food producing sector that requires:

- Effective, quantitative tools for detecting viruses in the foodstuffs are now available. These methods are based on the direct detection of viral nucleic acid by PCR and viral nucleic acid does not necessarily equate to infectious virus, for example virus may be inactivated. However preliminary evidence suggests a dose-response relationship between viral RNA and subsequent illness at least in oysters.
- Validated quantitative methods are available for noroviruses and hepatitis A virus in molluscs. Methods have been described for other viruses such as hepatitis E virus and for other food matrices as part of research studies, but are not formally standardised so these are not yet suitable for control purposes.
- A major change since the last review by ACMSF is the ability to detect viruses in food matrices and the existence of standardised methods suitable for use in a risk management context.

Recommendations

| | Recommendations that Inform Risk Assessments* | Lead Department/s |
|-------------|--|------------------------------|
| R3.1 | Wider use of food and environmental testing should be employed to support outbreak investigations. This will need to include methodological refinements targeting characteristics indicative of infectious virus eg. intactness of genome or protein coat. | PHE and devolved equivalents |

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| R3.2 | Molecular diagnostics, typing and quantification should all be used more systematically to understand the burden of virus contamination in foodstuffs on the UK market to help identify the potential control points; this might include validation of potential virus indicator organisms. | PHE and devolved equivalents |
| R3.3 | Further work is undertaken on the correlation between infective dose and genome titre (as measured by PCR) in order to help develop risk management criteria that will adequately protect public health without imposing disproportionate burdens on the food industry. This might include food consumption studies focussing on infection outcomes related to virus titre. | PHE lead with FSA support |
| R3.4. | Further research is undertaken on the development of methods for assessment of norovirus and hepatitis E virus infectivity in food samples to inform surveys and that could potentially be applied to routine monitoring. | FSA |
| R3.5 | Further research is undertaken on appropriate surrogates in other food matrices to help identify suitable control treatments. | FSA |
| R3.6 | Research is undertaken on processing methods that are effective for virus decontamination and appropriate for the food product. | FSA |

Burden of illness

Conclusions

- Although the IID2 Study provided valuable information on the overall burden of norovirus, the proportion of norovirus transmitted by food is still uncertain.
- Pork products have been implicated in foodborne hepatitis E infection in the UK and abroad. However, the burden of HEV transmitted by food, including pork and pork products, is still uncertain, although likely to be significant.

Recommendations

| | Recommendations that Inform Risk Assessments* | Lead department/s |
|--------------|--|---|
| R4.1. | Further epidemiological research is undertaken to estimate the contribution of foodborne transmission to the burden of enteric virus disease and to identify the most important foods. | FSA, PHE and equivalents in devolved administrations |
| R4.2. | Further epidemiological studies are undertaken to identify sources, and risk factors for HEV infection and the role of the food chain in transmission. | PHE and equivalents in devolved administrations, Defra, FSA |

Routine surveillance and investigation of foodborne viruses

Conclusions

- Currently the burden of foodborne illness associated with norovirus and HEV is likely to be an under-estimate. The impact of foodborne transmission in health and social care settings, in particular, may be higher than is currently recognised because the possibility of foodborne transmission in these settings is likely to be under-investigated. Variation in the extent to which potential foodborne outbreaks are investigated also militates against a good understanding of the scale of foodborne transmission.
- New technologies such as whole genome sequencing (WGS) and metagenomics for viruses may provide further insight into burden of foodborne infection and environmental routes of contamination.
- Multiple agencies at local, regional and national level across the UK are responsible for public health surveillance but other organisations also hold relevant data and this information needs to be coordinated.
- Current legislation appears not to be applied by all food business operators e.g. in relation to notifying suspected foodborne enteric virus outbreaks immediately to allow the relevant statutory authorities to perform a thorough public health investigation.
- Failure by any food business operator to report immediately to the competent authority “when it has reason to believe that a food it has placed on the market is injurious to human health” constitutes a criminal offence².
- In almost all incidents where a viral aetiology is suspected proper investigation is not performed.

² See <http://food.gov.uk/enforcement/regulation/foodlaw/> and Regulation 4 of the General Food Regulations 2004, SI 2004 No.3279.

Recommendations

| | Recommendations that Inform Risk Assessments* | Lead Department/s |
|--------------|---|--------------------------|
| R5.1 | Reliable methods for norovirus WGS should be established to track transmission of norovirus, attribute potential food vehicle/sources in outbreaks and identify the source of HEV introduction into the UK. The value of WGS to link foodstuff, infected cases, food handlers for norovirus, hepatitis A, and hepatitis E should be defined. | PHE with FSA support |
| R5.2 | Public health agencies need to work together and with other relevant organisations to develop a single, integrated outbreak reporting scheme, (this was previously recommended in the 1998 FVI report) involving all aspects of enteric virus transmission through the food chain. In the meantime we reiterate recommendation R3.1 from the 1998 Report that all relevant authorities who maintain outbreak records (PHE and equivalents in devolved administrations, FSA, local authorities, other Government laboratories and agencies) should contribute to an annual reconciliation and consolidation of outbreak records. PHE, and equivalent authorities in devolved administrations, should take the lead on this activity. In the absence of a reconciled system the impact of food related viral illness and outbreaks will continue to be under-estimated. | PHE, with Defra and FSA |
| R5.3. | Studies are required to investigate the best way(s) of gathering and analysing information from sporadic cases of suspect food poisoning to ensure public health benefit without wasting scarce resources. For example, the FSA should consider funding a local or regional pilot study to elicit the costs and benefits of developing a sentinel surveillance system for investigating foodborne enteric viruses. | PHE with FSA |
| R5.4. | Viral foodborne outbreaks should be reviewed periodically (e.g. annually) to evaluate lessons learned, to identify any reoccurring problems or issues, and to review the effectiveness of control measures and potential improvements. | PHE with Defra and FSA |
| R5.5. | National surveillance of foodborne viruses should include the foodborne component of hepatitis A and hepatitis E. | PHE |

| | Recommendations that Impact on Risk Assessments* |
|-------------|--|
| R5.6 | <i>The FSA reviews its guidance to local authorities and all food business operators, including caterers, to clarify their legal obligations to notify immediately “when it has reason to believe that a food it has placed on the</i> |

| | |
|-------------|---|
| | <i>market is injurious to human health”.</i> |
| R5.7 | <i>All food business operators, including caterers, need to be reminded of their duty to inform competent authorities immediately (Local Authorities and, when appropriate, the FSA) they suspect a foodborne virus outbreak so that appropriate public health investigations are not hampered by destruction of evidence before EHOs have been alerted to a problem.</i> |
| R5.8 | <i>The FSA’s 2008 Guidance on the management of foodborne illness³ should be updated and the latest information on norovirus incorporated. These Guidelines need to ensure that investigations of suspected foodborne outbreaks are consistent. They should incorporate advice on the use of new virological tools to detect viruses in the environment and in food matrices. The Guidelines need to define when it is appropriate to investigate a potential foodborne virus outbreak and, if investigation is performed, the minimum dataset of evidence required for recording a foodborne outbreak in national surveillance systems.</i> |

Contamination of food

Conclusions

- Many bivalve mollusc production areas in the UK are subject to significant human faecal contamination as evidenced by the low percentage of the highest quality (class A) areas and the high percentage of samples found to be contaminated with norovirus during surveillance studies.
- Consuming raw bivalves (e.g. oysters) is generally accepted as an important foodborne risk for enteric virus infection. The direct impact at population level is likely to be small, given that the people who eat raw bivalves are probably relatively limited in number. Assessing exposure is hampered by lack of consumption data. However, the contribution of raw bivalves to the overall burden of norovirus through seeding of the community, introduction of new strains through trade, opportunities for recombination events within multiple infected cases, secondary and tertiary cases, might be important.
- Whilst cooking provides effective health protection, the available post-harvest treatment processes for bivalves sold live (particularly depuration) have limited effectiveness for control of norovirus.
- Norovirus testing of bivalves is now available, which can contribute significantly to risk assessment and risk management for producers and for Government.
- Limited data suggests contamination of bivalves with HEV RNA and a possible link between HEV and shellfish consumption. The recent pig at slaughter study has also identified that pigs are a likely source of human infection. Further research on both these areas would assist risk assessment.

³ Management of outbreaks of foodborne illness in England and Wales. FSA 2008.
<http://www.food.gov.uk/multimedia/pdfs/outbreakmanagement.pdf>

Recommendations

| | Recommendations that Inform Risk Assessments* | Lead Department/s |
|-------------|--|--------------------------|
| R6.1 | The potential value of routine norovirus monitoring for better risk management during primary production should be evaluated by the FSA. | FSA |
| R6.2 | There is a need for further research into the effectiveness of depuration and relaying in reducing the viral content of shellfish species commercially harvested in the UK to try and establish ways of improving the performance of this commercial process for removal of norovirus. | Defra |
| R6.3 | There is a need for further research into the effectiveness of sewage treatment processes in reducing the norovirus concentrations in sewage and the effectiveness against norovirus of disinfection treatments. | Defra |
| R6.4 | The possible association between shellfish consumption and HEV infection should be further investigated to inform risk management, particularly with regard to the potential hazards associated with pig farm effluents impacting shellfish production areas. | FSA |

| | Recommendations that Impact on Risk Assessments* |
|-------------|--|
| R6.5 | <i>The FSA should reinforce its advice on the risk of consuming raw oysters and that cooking of shellfish reduces the risk of exposure to human enteric viruses as stated in the 1998 Report.</i> |
| R6.6 | <p><i>The environmental controls protecting shellfish waters should be reviewed by Defra and its equivalents in the devolved administrations in the light of emerging evidence on norovirus contamination:-</i></p> <ul style="list-style-type: none"> <i>○ As a priority future sewerage infrastructure investment should be particularly targeted at controlling norovirus risk from permanent sewer discharges and storm overflows impacting oyster areas.</i> <i>○ Consideration should be given to relocating permanent sewer discharges away from oyster production areas and planning should ensure sufficient sewage dilution between the discharge point and the shellfish beds.</i> <i>○ Other permanent discharges impacting designated shellfish beds should receive at least tertiary treatment – which need to be shown to be effective against norovirus.</i> <i>○ New CSOs should not be permitted to discharge into designated shellfish waters.</i> <i>○ The compliance of existing CSOs with Government policy on maximum number of spills permitted should be reviewed and action taken to improve those found to be non-compliant.</i> <i>○ All existing and future CSOs potentially impacting designated</i> |

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| | <i>shellfish waters should be monitored and spills reported such that prompt risk management action (e.g. area closure) can be taken.</i> |
| R6.7 | <i>The FSA should review risk management measures for shellfisheries (particularly oyster fisheries) in regard to point source human faecal discharges:-</i> <ul style="list-style-type: none"> ○ <i>Prevention of harvesting in areas in close proximity to sewer discharges, or regularly impacted by CSO discharges, is a sensible preventative measure and should be introduced.</i> ○ <i>Policy should be formulated regarding preventative measures (e.g. bed closure periods, virus monitoring policy) following a known spill event or outbreak.</i> |
| R6.8 | <i>Given the range of risk management options set out above, Defra and the FSA should work together to develop a unified strategy for managing the risk from raw bivalves.</i> |
| R6.9 | <i>Prohibition of overboard disposal of sewage from boats should be mandatory under local byelaws in all water bodies and coastal areas with designated shellfish waters. Inshore Fisheries and Conservation Authorities (IFCAs) and the Marine Management Organisation (MMO) should take the lead on this.</i> |
| R6.10 | <i>The FSA should review traceability and enforcement of sanitary controls for bivalve molluscs, particularly following outbreaks, to ensure that all regulatory requirements are being complied with at the local level.</i> |

Berry fruit and leafy green vegetables

Conclusions

- The contribution of contaminated fruit and vegetables to foodborne norovirus and HAV is uncertain but the impact at population level could be significant given the consumption levels.
- Protection of the consumer relies on adoption of and compliance with non-statutory hygiene schemes.

Recommendations

| | Recommendations that Inform Risk Assessments* | Lead Department/s |
|-------------|--|--------------------------|
| R7.1 | There needs to be systematic surveys to estimate the prevalence of enteric viruses in fruit and vegetables particularly those grown outside the retail Field to Fork schemes. This should include imports, wholesale, markets, food service and smaller farm shops "Pick your Own". Ideally these studies should address the issue of infectivity (see section 3.4). | FSA |
| R7.2 | Further research is needed to identify the most effective | FSA |

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|--|--|--|
| | means of viral decontamination of fruit and vegetables post-harvest. | |
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| Recommendations that Impact on Risk Assessments* | |
|---|---|
| R7.3 | <i>The FSA assess the level of take up of voluntary (non-statutory) 3rd party assurance schemes that contain relevant food safety criteria, across all scales of production, to determine sector coverage and whether or not this provides adequate protection for the consumer.</i> |

Pigs and Pork products

Conclusions

- Available evidence suggests that HEV is able to withstand the current minimum standard pasteurisation process of 70°C for 2mins in pork products contaminated experimentally. However, we note that typical industry pasteurisation practice for various pork products is variable but exceeds 70°C for 2mins.
- Cooking pig's liver medium or rare may not inactivate HEV.

Recommendations

| | Recommendations that Inform Risk Assessments* | Lead Department/s |
|-------------|--|--------------------------|
| R8.1 | Further work is undertaken on heat inactivation of HEV in naturally contaminated raw, rare and ready-to-eat pork products and these studies should relate to industry practice. Infectivity should be 'measured'. | FSA |
| R8.2 | Further work is undertaken on the effect of curing and/or fermentation of pork products (e.g. salamis and dry cured meats) on HEV infectivity. | FSA |
| R8.3 | Work towards development of an ISO standard method for detection of HEV in foodstuffs (including pork products) should be encouraged. | FSA |
| R8.4 | A structured survey of HEV contamination in pork products across the retail sector is conducted. | FSA |
| R8.5 | Comparative HEV phylogenies in human and pig populations in those countries supplying meat to the UK should be examined in order to more fully define the sources and routes of the infections which have been reported in the UK. | |

Contamination of the environment

Conclusions

- Our current understanding is that symptomatic infected food handlers constitute the single most common source of foodborne norovirus. However, the public health relevance of asymptomatic carriage is not well understood.
- General guidance on food and personal hygiene is widely available but translating it into reliable control measures within small scale outlets especially those with a transient workforce, has not been accomplished.
- Alcohol wipes/gels are not effective against enteric viruses.

Recommendations

| | Recommendations that Inform Risk Assessments* | Lead Department/s |
|-------------|---|--------------------------|
| R9.1 | Further studies to understand the role of environmental contamination in transmission of enteric viruses would be valuable. | FSA with PHE |

| | <i>Recommendations that Impact on Risk Assessments*</i> |
|-------------|--|
| R9.2 | <i>The FSA should ensure that the industry guide to good hygienic practice in catering is completed and published. This should include definitive advice on appropriate cleaning regimes and clear advice on how to deal with projectile vomiting.</i> |
| R9.3 | <i>The FSA should work with training providers to highlight and promote good practice to assist improved understanding and compliance.</i> |
| R9.4 | <i>There needs to be better engagement with the smaller catering establishments to ensure adequate awareness of enteric viruses and their control.</i> |
| R9.5 | <i>Hand hygiene needs to be highlighted better as a critical control measure. EHOs should consider investigating the effectiveness of a targeted campaign to tackle hand washing with soap and warm running water, and drying, as a norovirus control method. Alcoholic wipes are not effective against enteric viruses.</i> |

Consumer awareness

Conclusions

- Authoritative information on risks associated with different foodstuffs and definitive cooking instructions is hard to find on Government websites.
- There is a lack of information about the public understanding of risk as applied to foodborne viruses, particularly for specific groups at higher risk such as the immunocompromised.
- There is a lack of clear and consistent advice on recommended food preparation and cooking advice to reduce risk.

Recommendations

| | <i>Recommendations that Impact on Risk Assessments*</i> |
|--------------|--|
| R11.1 | <i>There should be clear, consistent and coordinated Government advice on viruses for all consumers in relation to food preparation and hygiene in the home. For instance, there should be advice on cooking shellfish and pork products as well as information on washing leafy green vegetables and soft fruit.</i> |
| R11.2 | <i>The Government should identify the lead organisation responsible for developing and delivering clear and consistent advice on viruses for all consumers.</i> |
| R11.3 | <i>There should be specific advice produced by Government for groups at high risk such as the immunocompromised.</i> |
| R11.4 | <i>The Social Sciences' Research Committee should consider what further research is needed on public understanding of foodborne viruses. This might involve specific questions in the next FSA biannual public attitudes tracker.</i> |
| R11.5 | <i>The Group reiterates Recommendation 6.1 from the 1998 FVI report that the Government should remind members of the public of the risks from eating raw oysters, of the potential dangers from collecting molluscan shellfish from beaches, and of the need to cook molluscan shellfish thoroughly. This should include the fact that the risk of norovirus, associated with eating raw bivalves from seawater, is higher during the winter months.</i> |
| R11.6 | <i>Advice should be available at the point of consumption of the hazards of eating raw oysters.</i> |